MONITORING THE EFFECTS OF FIRE MANAGEMENT ON NATURE CONSERVATION VALUES

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SUMMARY

The effects of managers on nature conservation values, through either the alteration of fire regimes or as a result of the methods used to manage fire, can be substantial. Monitoring is necessary to identify the environmental effects, ascertain whether the objectives of management are being achieved, and decide what adjustments by managers might be necessary to achieve the objectives. It may lead to changing the management strategies and, in some cases, the objectives of management, should these prove to be unrealistic.

Successful monitoring requires clear objectives, cost effective methods, adequate resources and motivation. Some approaches towards practical and meaningful ways of monitoring are outlined for vegetation, wildlife, soils nutrition and hydrological and wilderness values.

INTRODUCTION

To monitor is to "observe critically" (Oxford Dictionary). Here it is taken to mean the systematic recording and evaluation of changes over time to provide guidelines for management.

Monitoring is necessary to assess what effects land managers have on the environment, whether the objectives of management are being achieved and what adjustments by managers might be necessary to help achieve the objectives. The adjustments would normally involve changing the management strategies, but if the objectives were shown to be unrealistic then these also would need to be changed.

Management of fire is undertaken in most conservation reserves, although the emphasis has been more on suppression of fire than its use for ecological purposes. Changes to the fire regime are a consequence of management, leading to fire exclusion in some areas and, at the other extreme, to frequently repeated or unseasonal burning in other areas. This directly affects flora and fauna, favourably or unfavourably, depending on the fire regime imposed and the species or community involved (Gill *et al* 1981). Altering fire frequency, for example, can alter vegetation composition and structure and wildlife distribution, and decrease soil fertility (particularly nitrogen). The effects may be critical in small or fragmented reserves where there is limited resilience to major distrubance or change, and limited scope for recolonisation of species from other areas.

The methods and associated facilities used to control or manage fires can also significantly affect nature conservation values. These include:

(a) site disturbance by machinery affecting soil, vegetation recovery, spread of weeds and soil borne diseases and wildlife survival;

(b) increased access degrading wilderness values, increasing visitor activity and impact, and creating habitat fragmentation and barriers to some fauna;

(c) constructed water storages supporting animals foreign to the area, including pest species; and

(d) fire retardants and polutants from machinery altering soil nutrient levels and affecting vegetation.

The effect of managers, through either the alteration of fire regimes or as a result of the methods used to manage fire, can be substantial and therefore require monitoring. There has been relatively little such monitoring in Australia, and the challenge is to develop practical and meaningful ways of doing this.

Successful monitoring relies on having a clear understanding of management objectives, cost effective monitoring methods and motivated people (Campbell 1987).

Management Objectives and Strategies for Fire Management to be Considered in a Monitoring Program

For conservation reserves, the objectives are generally the protection and maintenance of natural ecosystems, life processes and flora and fauna. There may be more specific objectives such as the promotion of particular plant or animal species or the maintenance of wilderness values. Another common objective is the protection from damage by fire of human life and property, either in the conservation reserve itself or in adjoining areas.

Strategies developed to achieve these objectives may include:

(a) burning for ecological purposes, such as habitat manipulation to promote a range of seral stages or favour specific species, and to regenerate or rehabilitate particular plant communities;

(b) fuel reduction by burning, grazing or mechanical means; and

(c) wildfire suppression to restrict uncontrolled spread, ranging from attempted total exclusion of fire to permitting wildfires to burn in remote or wilderness areas where human life or property is not threatened.

Cost Effective Monitoring Methods

Effective monitoring relies on selecting the critical aspects and parameters to be monitored, developing practical and meaningful ways to monitor (which others could undertake and are likely to continue in your absence) and evaluating the

results to provide feed-back so that managers may if necessary adjust their programs.

The aspects that may be monitored are numerous and will vary according to the situation or project under consideration. These in broad terms include fire history or the fire regime itself; effects of wildfires, fuel reduction or prescribed burning for ecological purposes; and effects of fire management works and facilities.

Techniques for Monitoring

Techniques may be qualitative or quantitative, using direct records made on site or remote sensing techniques such as multispectral imagery. Although a quantitative approach will provide more detail and precision, it is generally more costly and time consuming and may not be warranted if a suitable qualitative approach is available, such as photographic plots to record general vegetation changes. Multispectral satellite or airborne imagery and computerised programs for image analysis (eg MICROBRIAN) are undergoing rapid technological development and offer increasing potential for monitoring fire events and vegetation changes, particularly on the broad scale.

Some Approaches to Monitoring

In the case of *prescribed burning*, a monitoring program (whether basic to assess the successful conduct of the operation, or more specific to determine responses of particular species or communities to the fire) should entail making records both before and after the event. Before and after event data for a given site are much more meaningful than the comparison of matched events on different sites. For wildfires, unless studies already happened to be in progress, pre-fire data are generally not available. To improve the availability of pre-fire data, all research or inventory plots should as far as possible be accurately marked both on the ground and on maps. This may entail relatively little effort and could be a bonus later for monitoring.

Following any fire there should be an initial assessment or monitoring program, which may lead to monitoring over a longer term. The basic short term approach recommended is to:

(a) Map the extent of the fire and any major unburnt islands which may be important refuges. Aerial photography or satellite imagery can be useful to achieve this for large fires.

(b) Identify specific areas of unusual fire frequency (eg burnt by successive fires in a short period) or not burnt for a very long period which have value for close study and protection.

(c) Assess monitoring requirements to assist management (eg sites of biological significance to be monitored for recovery; grazing animals inhibiting vegetation regeneration, such as rabbits grazing *Callitris preissii* (Cheal 1982); rehabilitation of earthworks and vegetation clearance resulting from fire suppression work).

Some vital considerations or guidelines concerning the aspects and parameters to be monitored are as follows:

Vegetation changes

- record of species composition and vegetation structure changes are basic to understanding fire ecology and management priorities, ie what is the desired fire regime.

- if possible select indicator species for study, representing different strategies of regeneration, sensitivity to disturbance, health and vigour of vegetation.

- assess whether variety is being promoted, whether selected species are being favoured and weeds invading.

- be aware of what is being measured, eg interaction between drought, frost and fire; between fire and grazing or carnivorous animals; or between fire and man-made disturbance.

- evaluate effects of different firebreak construction methods and soil rehabilitation methods, or effects of chemical fire retardants on vegetation recovery.

- assess effect of earthmoving equipment as an agent for the introduction and spread of soil borne plant pathogens (eg *Phytophthora*) and weeds.

Wildlife

- similar principles to monitoring vegetation apply to wildlife.

- species presence is relevant, but ability to feed and breed in the area are the critical determinants for survival.

- long lived species or species with selective breeding requirements (eg parrots (Burbidge 1985), Malleefowl (Benshemesh 1986)) are of highest monitoring priority because lack of recruitment may not be apparent until too late unless it is monitored.

- loss of tree hollow habitat due to fires is an incremental process and may not be evident unless it is monitored. Fires may also help create hollows.

- artificial water supplies in arid areas can affect species distribution of birds and attract pest animals (Williams 1986) and extend the distribution of feral bees; these aspects warrant monitoring.

Soils, Nutrition and Hydrology

- soil movement and sedimentation measurements can indicate losses in site fertility, sedimentation of streams and changes in stream substrate affecting microfauna.

- soil nitrogen levels generally are most limiting to plant growth (Tartowski 1986); large potential nitrogen losses occur after fire which can be monitored in terms of little biomass burnt, and the recovery will be dependent on re-establishment of nitrogen fixing legumes, lichens, algae and soil microfauna (Hopmans 1987).

- monitoring may be needed to assess increased run-off and stream flow patterns, and changes to watercourses, swamps or bogs due to burning of peat or high organic accumulations.

Wilderness Values and Site Amenity

- the effect of increased access (constructed for fire management) on wilderness values, as well as on changing visitor activity and their impact on site, and the fragmentation of habitat is an important aspect for monitoring.

Some general guidelines apply to all aspects of monitoring. A standardised format for recording like data is advocated as this aids later analysis and provides compatability with data collected from other areas, thereby enabling the pooling of data and its wider use.

A successful monitoring program requires a scheduling system to ensure measurements continue to be made at the prescribed times and a definite end point. It is also essential that data are analysed progressively and conclusions are drawn and heeded.

Movitated People to Undertake the Monitoring

If there is clear understanding and acceptance of the management objectives and monitoring goals, and if the monitoring program is cost effective (readily carried out and useful) then it is likely that motivation for monitoring will be correspondingly high. However, unless Departmental priorities for monitoring are high the resources available for monitoring will limit achievements regardless of the calibre of the program and motivation.

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