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MONITORING VEGETATION FOR FIRE EFFECTS

RESEARCH REPORT No. 34

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SUMMARY

Monitoring of fire effects is important for identifying, and if necessary correcting, any undesirable impacts that planned and unplanned fire regimes, including those of fire exclusion, may be having on natural ecosystems.

In this report the techniques and philosophy of monitoring fire effects are briefly reviewed and a photo-plot technique that has been applied operationally in the Grampians is described. The technique has been successful in monitoring some of the specific and general effects of fuel reduction burning. It has also been used in determining the regeneration responses of selected species. It can be applied elsewhere in Victoria, to fire effects and other activities that may cause vegetation changes.

A strategic approach to monitoring, which focuses on indicator species including woody perennials, obligate seed regenerators, serotinous species, species with short-term seed viability and limited fertility is also reviewed. This monitoring will provide the Department of Conservation and Natural Resources with a process with which it can review its fire management practices and answer public concerns about the effects of planned and unplanned fire.

INTRODUCTION

"Without monitoring, management is like a ship without a rudder"
(Gill 1986)

Monitoring is the assessment and evaluation of management in achieving its objectives. It is a feedback mechanism which helps to assess the efficacy of management techniques, and which provides the basis for developing improvements or alternatives to those management techniques. It should be noted that monitoring is **not** scientific research or flora/fauna survey, and does not replace the need for these activities. It is a tool for applying good science in the operational practice of land management and meant to complement formal research and survey.

In Victorian ecosystems, one of the greatest management influences, and hence greatest source of need for monitoring, is the application, exclusion and general management of fire and fire regimes. The general public increasingly expresses concerns about the effects of planned and unplanned fire. At the same time, field staff in the Department of Conservation and Natural Resources (CNR) are increasingly seeking assistance with, and advice on, appropriate monitoring techniques, particularly about fire effects.

A workshop (Hamilton 1987) in 1987 provided guidelines and advice for establishing monitoring projects. Some projects have been subsequently established, but in general the operational monitoring of fire effects by CNR has shown little progress. A consistent approach and commitment to fire effects monitoring by CNR is still needed.

A fire research project was established in the Grampians in 1989, with the aim of developing operational techniques and selecting target species, for monitoring the fire effects of CNR's program of fuel reduction burning. The purpose of this report is to outline the monitoring rationale and methods being used in the Grampians, and to present a technique for the monitoring of fire and other effects.

THE AIMS AND PURPOSE OF MONITORING FIRE EFFECTS

The CNR "Policy on Fuel Reduction Burning" (CFL 1986) states that the purpose of monitoring fire effects is to identify (and hence avoid) undesirable effects, to identify research needs and to refine burning strategies.

Monitoring should be a process that is structured so that it targets specific management needs and evaluates and reviews management objectives and techniques. It should not be an aimless process of gathering information. Specific management needs are those which relate to a particular burning program in a particular area (e.g. where a particular site contains a plant species that may be sensitive to fire). These specific issues are usually easily identified during the planning of a burning program and can readily become the focus for monitoring.

A monitoring program should also provide some long term information that is required to improve and develop fire management (Wilson *et al* 1984). A key aim of the monitoring conducted in the Grampians is to provide basic information about the regeneration responses of various plant species to fire (i.e. seed regeneration vs resprouting, etc). This information will be used to develop fire regimes with an ecological basis that is appropriate for the vegetation types in which these plants occur, and will contribute to a better understanding of the effects of different fire regimes on these ecosystems.

Monitoring, in association with prescribed burning operations, should be an important part of any fire management program. It should also be carried out following wildfires, slashing, break construction and other fire management activities. Monitoring should be an integral part of all fire management.

WHICH SPECIES TO MONITOR?

The most common question associated with monitoring is "what to monitor?" Monitoring will not be done if it is time consuming - most staff have only limited time available. For any monitoring of vegetation communities to be efficient and effective but not time consuming, it should focus on one or more representative or target species.

According to Tolhurst & Gullan (1987) the important features of change in vegetation communities which should be monitored are:

- loss (or gain) of large structural plants,
- loss (or gain) of species of a particular type,
- changes in species composition, and
- invasion by weeds.

The actual choice of species will depend on the objectives of the monitoring. For fire effects the aim of monitoring should be to detect changes in the plant community (especially the loss, gain or changes in abundance of particular species) following a fire event. The main target for monitoring effort should be those species (of the community or habitat) that are the most sensitive to change by fire (i.e. "fire sensitive" species).

Fire sensitive flora comprise those species whose populations can be reduced or eliminated by inappropriate fire management regimes. These species may have low ecological tolerances (Austin & Belbin 1982) or regenerative characteristics that are dependent on particular fire regimes (Gill 1981). For example, *Banksia ornata* produces seed between 6-7 years and 50+ years following fire, after which time the plants decline (Gill & McMahon 1986). A fire, of sufficient intensity to open seed cones, at a frequency of less than 6 years or much greater than 50 years, may not produce adequate regeneration from seed and may eliminate the species from a site. An example from eastern Victoria is *B. serrata,* which often holds its seed capsules in the upper part of the plant. To ensure adequate regeneration following fire, flame heights need to be high enough to heat capsules and induce opening. As well, the fire frequency needs to be in the correct range. The group of plants that is regarded as being the most sensitive to fire comprises the "obligate seed regenerators", which are those species that regenerate only from seed.

The presence, absence and status of fauna are largely influenced by habitat requirements. Fauna habitat is made up of three components - food, shelter, and breeding sites. Living vegetation provides for most of these components. The effects of fire on particular species of fauna can therefore be substantially monitored by monitoring the key components of vegetation that make up their habitat.

Additional factors that may need to be monitored include (K. Tolhurst pers. comm.[1]):

- the area and diversity of each vegetation community

[1]Kevin Tolhurst, Fire Effects Research Officer, CNR Forest Research, Creswick

- the age distribution of the vegetation community
- the quantity, location and nature of fallen timber (eg. in relation to hollows) and of surface rock, open areas and water,
- potential threats (such as predators, competitors).

Fire sensitive fauna include those species which depend on particular habitat components that can be eliminated or diminished by disturbance, or which depend on particular successional stages of vegetation that are triggered by disturbance. For example, the Heath Mouse *(Psuedomys shortridgei)* requires the wide variety of food plants that develop in heathlands at about 6 to 9 years following fire, particularly plants that flower or fruit in late winter and early in spring (Cockburn 1978). These plants not only provide food during the critical over-wintering period, but some of them are necessary as dietary requirements before the mouse can breed (Watts & Braithwaite 1978). Fire sensitive fauna tend to have low population densities, be specialists of patchily distributed habitat or successional stages of vegetation, or have low dispersal ability. Wardell-Johnson *et al* (1989) describe critical plant species in relation to fauna habitat as being species that fruit, flower or seed outside community peaks in production or that provide other specific habitat requirements. Any monitoring program should consider any plant species that, if adversely affected by the fire regime, may precipitate losses or significant population reductions of fauna species.

Ridsdill-Smith (1987) has summarised the principles of monitoring by suggesting a set of characteristics for selecting a plant species which would be reasonably vulnerable to disturbance. Plant species with some or all of these characteristics should make good indicators of changes in the health of a community. These characteristics include:

- woody perennial,
- obligate seed regenerator,
- serotinous (late flowering and seed maturing, generally woody seeded) species,
- short-term seed viability, and
- limited seed fertility.

Some suggested fire sensitive species for the Grampians are:

- *Astroloma* spp. (*A. conostephioides, pinifoloium, humifusum*)
- *Banksia* spp. (*B. ornata, saxicola, marginata*)
- *Callitris rhomboidea*
- *Epacris impressa*
- *Hakea* spp. (*H. ulicina, muellerana, sericea*)
- all rare, threatened or endangered species (from Gullan *et al* 1990).

As additional information on the fire responses of plant species becomes available this list can continually be updated. A similar list of species could be put together for any other area using the above characteristics as a guide.

FIRE EFFECTS MONITORING IN THE GRAMPIANS

The program of fire effects monitoring that has been implemented in the Grampians involves three levels of monitoring:

To assess specific assets effects

- Specific monitoring of particular "assets" (e.g. such as rare species and historic sites) at a particular site.

To assess general effects or unforseen effects

- Monitoring of vegetation recovery following prescribed burning at a particular site.

To obtain strategic management information about particular species

- Monitoring of whether regeneration occurs from seed or from resprouting and the type of seeding or resprouting regeneration (as per Gill 1981),
- monitoring of the number of years between the fire event and the production of adequate seed supply to ensure future regeneration for species for which this information is not already known,
- monitoring of the number of years between the fire event and the decline and disappearance of the species from the site.

EXAMPLES OF MONITORING

Three examples of monitoring conducted in the Grampians are described below. They illustrate the range of monitoring levels and techniques that are possible, from a very simple series of photo-plots through to a large multi-species program.

Specific Effects: Rare Species at a Particular Site

In 1986 an area near Crute Tk in the northern part of the Grampians was proposed for fuel reduction burning. The area was found to contain a small population of Tiny Spyridium (*Spyridium cinereum*). This species is classed as vulnerable in Victoria (Gullan *et al.* 1990) and was thought to be a fire sensitive obligate seeder. The burn proposal was amended to ensure that a large proportion of the population of Tiny Spyridium was not burnt, and a monitoring project was established to monitor the effects of burning on that part of the population that was to be burnt.

The monitoring method consisted of a series of photo-plots within the burnt area. These photo-plots were simply photographs taken from a marked point in a particular direction. While some of the photo-plots were of the general vegetation, most were focused on the *Spyridium* plants.

The area was burnt in April 1987. The fire intensity was between 1 000 and 2 000 kW/m and flame heights varied between one and two metres. The photographs (together with field observations of regeneration) showed that *Spyridium cinereum* was indeed a seed regenerator, although the source of this seed is still uncertain. The regeneration of *Spyridium* plants after the burn was prolific; and, several years after the burn, the amount of *Spyridium* identifiable in the photographs had exceeded the amount in the pre-burn photographs. *Spyridium* was confirmed as being an obligate seeder with a favourable response to a single autumn fire event in the intensity range mentioned.

In this case, simple photo-plots proved to be a simple, yet effective, means of monitoring the effects of a fire or burn on a particular plant or asset.

General Effects or Unforeseen Effects: Fuel Reduction Burning at Particular Sites

A program of vegetation monitoring in areas proposed for fuel reduction burning in the Grampians commenced during the 1990/91 fire and burning season. The major emphasis of this program is the Grampians area, although the program may be implemented in other areas as monitoring needs are identified.

Monitoring sites were established in some of the large fuel reduction burns conducted during the 1990/91 season. Sites were located to ensure representation of the main vegetation types being burnt across the Grampians. At each site, plots were set up in groups of three to provide some limited replication.

The method comprises a photo-plot with supporting measurements to quantify the vegetation in the photographs. This type of method has been successfully used by several other programs, chiefly in Western Australia, to monitor the effects of grazing and fire in rangelands (Holm *et al.* 1987, Hopkins *et al.* 1987 and Hopkins 1988).

The monitoring procedure and the recording forms being used are reproduced in Attachments 1 and 2. The codes that are used for vegetation cover (from Tolhurst & Gullan 1987) are expressed in layman's terms to enable use by staff who may not be familiar with the use of formal survey techniques. These codes, which are shown below, correspond approximately to the following Braun-Blanquet cover values as commonly used by botanists:

- Prolific (P)
- Common (C)
- Common in Patches (CP)
- Scattered (S)
- Uncommon (U)

The "indicator species" section is provided to allow the recording, in a little more detail, of occurrences of species of particular interest such as rare species and key habitat species, fire sensitive species. These species should preferably be determined beforehand. In the Grampians the species that are used are those which are listed earlier in this report, together with any species that are known to be rare or of restricted distribution. These species lists can be changed later in the program to intensify records of any particular species.

"Weed species" are included to obtain records of any weeds (ie non-indigenous species) that may be invading after a burn.

Strategic Management Information about Particular Species: Plant Fire Responses

Monitoring is being conducted to obtain further information about the responses to fire of the Grampians flora (i.e. whether particular species regenerate by seed or resprouting, etc as discussed by Gill 1981). The aim of this work is to provide a sound basis for developing fire regimes that are ecologically appropriate for the vegetation types in which these plants occur, and contribute to a better understanding of the effects of different fire regimes on these ecosystems.

Using known locations of particular species from an earlier survey, a minimum number of sites (and species at each site) that are needed to monitor all species that are fire sensitive (i.e. seed regenerators), or which have unknown fire responses, has been determined. The responses of these species to fire will be monitored when these sites are next burnt. This is an example of a long term strategy for obtaining information with a minimum of survey effort. The information will aid the determination of appropriate fire regimes for the conservation of these species and the prediction of the effects of burning programs on the flora and fauna values of the Grampians .

Monitoring at all three of these levels should form an important part of any monitoring program.

INTERPRETATION OF RESULTS

The photoplot methods outlined in this paper are useful for providing long-term records of the status of vegetation and plant communities. However, care needs to be exercised in the interpretation of the results obtained. These repeated measurements show changes that may be attributed both to management actions (e.g. fire regime) and to other factors such as climate. The differences that are attributable to non-management factors need to be determined by comparing measurements of monitoring sites with those of reference sites (similar sites which have not been subject to the management actions).

The methods assume that the changes in the plant communities are visible (either to the observer or in the photo). It needs to be remembered that the results obtained are qualitative, and are not definitive scientific results.

These limitations should be recognised in conducting any monitoring or using data from monitoring. To obtain more detailed information, other methods, such as line transects for floristic changes and plant counts for individual species monitoring, are needed.

REVIEW AND EVALUATION OF MONITORING

The monitoring program and methods outlined in this paper are not static and will be adjusted and developed as results are reviewed. The objectives of the monitoring are also expected to change as priorities change and new research results become available. This process of review and evaluation will be essential if monitoring is to remain practical and continue to be relevant to the manager.

Further evaluation may be assisted by comparing results from monitoring in similar areas elsewhere in the State. To achieve this, fire effects monitoring projects should be registered with the Fire Research Section of CNR's Fire Management Branch (as proposed in Hamilton 1987) so that information is not lost or replicated unnecessarily and is available for use by other fire managers in other Regions. This Register is scheduled to be incorporated into the F.I.R.E.S.[2] computer system in 1993. This module will be used to record a summary of all fire effects monitoring work being conducted across the State, and allow users to be aware of similar monitoring work is being done in other places.

CONCLUSION

The fire effects monitoring program being developed and trialed in the Grampians uses three levels of monitoring, including photo-plots with supporting measurements that quantify the vegetation in the photographs, and observations of the regenerative response of particular plant species. This monitoring will assist fire management staff by allowing them to assess and evaluate the impacts of their management operations, the changes that are occurring without active management, and the level of success they are achieving in their management objectives. It is also an important means by which the knowledge base of fire effects and management will be improved. The program should provide the base information on which appropriate ecological fire regimes for the various vegetation types can be developed.

The monitoring program and methods outlined in this report can be applied elsewhere in Victoria, in relation to both fire and other effects. This monitoring will be developed as the program is further implemented and results are reviewed. The monitoring program outlined will provide a feedback mechanism for helping managers to learn from their successes and failures and hence improve their achievement of desired results in their management.

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[2]F.I.R.E.S. (Fire Information, Resources and Equipment System) is the computerised system used to plan and record all CNR Fire Management activities.

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ATTACHMENT 1: VEGETATION MONITORING PROCEDURE

(This method can be varied depending on monitoring objectives)

Plot Size: 10 metres x 4 metres

1. Establish plots with a star picket/post at each end of the plot (10 metres apart) and extend the plot two metres either side of a line joining the two posts (i.e. so that the plot is four metres wide).

2. Label one post with the plot number and use this as the first/start post.

3. Record plot location on a sketch map and include distance and compass bearing to a clearly identifiable & permanent point.

4. Fill in plot details in plot field book (plot no., film no. & photo no. to identify photos later).

5. Take two photos[1] of plot (i.e. one from each end post).

- site camera on one end post.
- place range/height pole at other end post.
- ensure that other end post (with range/height pole in camera's view) is in centre of camera view.
- take photo.
- repeat procedure from other end post.

6. Working along one side of plot and then the other, assess and record the Cover, Lifeform and Height of the Dominant Species for each Layer (Tree, Shrub & Herb) record Cover, Lifeform & Height for any Indicator and Weed Species which occur on the plot; and list all other species (and their lifeform) that are encountered on the plot.

7. Record any observations which may be affecting the vegetation at the plot site (e.g. signs of *Phytophthora*, insect/animal damage to plants, drought effects, animal sightings, etc.)

NOTE: Recording the fire observations on the day of the burn is a vital part of the monitoring procedure. The planning and conduct of all burns should follow the standard CNR process (Fire Protection Instruction No. 2), the forms for which can be obtained from any Regional Fire Management Officer.

Particular attention should be paid to measuring and recording the fuel conditions prior to the burn/fire (especially fuel load, age, arrangement and drought index) and to the fire conditions on the day of the burn/fire (especially fire intensity, flame height and rates of spread). The RECORD section from the F.I.R.E.S. Prescribed Burn planning module[2] should be used as a guide to recording these details.

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[1]The use of 2 cameras, one with print film and the other with slide film, may be useful in providing slides as well as prints for later use.

[2]F.I.R.E.S. (Fire Information, Resources and Equipment System) is the computerised system used to plan and record Fire Management activities. The Prescribed Burn planing module of this system should be used to plan and record the results of all burning operations.

ATTACHMENT 2A: MONITORING RECORD SHEETS

VEGETATION MONITORING RECORD

ASSESSOR: ______________ DATE: __________

GRIDREF: ______________ ELEVATION: __________m

PLOT LOCATION: ____________________________________

PLOT NUMBER: ______________ PLOT DIRECTION ________°

ASPECT: ______________ SLOPE: __________°

LAST FIRE: ______________ Wildfire / Prescribed burn

VEGETATION TYPE: ____________________________________

SOIL TYPE: ______________ ANN. RAIN: __________mm

OTHER COMMENTS: ____________________________________

____

REMEMBER TO COMPLETE THE SKETCH MAP BELOW

PLOT LOCATION

ATTACHMENT 2B: MONITORING RECORD SHEETS
COMMUNITY STRUCTURE, WEEDS & INDICATORS:

PLOT NO: ________________ **DATE:** __________

	DOMINANT SPECIES	COVER#	LIFE@	HEIGHT*
TREE LAYER				
SHRUB LAYER				
GROUND LAYER				
WEEDS				
INDICATOR SPECIES				

 # Cover Codes Overleaf, @ Life Stages Overleaf, * Average Plant Height in cm

ATTACHMENT 2C: MONITORING RECORD SHEETS

VEGETATION OBSERVATIONS

RECORD DOMINANT SPECIES, WEEDS & INDICATORS ON OTHER SIDE

PLOT NO: ____________ **DATE:** ____________

SPECIES	SPECIES	SPECIES

COVER CODES:

P = Prolific - almost continuous cover
C = Common - can be seen from any point, widespread
CP = Common in Patches - occurs in isolated patches where it is common
SC = Scattered - widespread, but infrequent
U = Uncommon - difficult to find, occasional specimens

LIFE STAGES:

SE = Seedling, R = Resprout, A = Adult (flowers or seed evident), D = Dead

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