Development and implementation of monitoring protocols to evaluate the effectiveness of weed management programs

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Summary  Land managers spend considerable resources on managing weeds; however, the effectiveness of weed control is not always well understood in non-agricultural areas. To redress this, Parks Victoria has developed monitoring protocols for evaluating the outcomes of weed management. The protocols have been written up as a user-friendly instruction handbook for field staff.

Successful implementation of the protocols relies on recognition that monitoring is an important component of sound environmental management. It also requires wider understanding of the benefits of monitoring and adequate training and technical support for field staff who will implement them.

Keywords  Monitoring, evaluation, performance measures.

INTRODUCTION
Public land managers invest considerable resources in weed management. Despite this, the direct outcomes of weed management are not always formally evaluated. However, without monitoring, how can land managers know that their efforts are effective, or whether management objectives are being met? In today’s climate of competing priorities for funding, greater certainty in the outcomes of weed management is being demanded.

Parks Victoria uses an Environmental Management Framework (EMF) to manage natural values (ecosystems, communities and species) within the network of parks and reserves across Victoria. The framework is based on risk-management principles and identifies natural values, the processes that threaten them and the strategies implemented to reduce the level of threat and thereby improve the condition of the natural values. Monitoring at all levels is a key component of the EMF. Parks Victoria has identified three performance indicators:

1. Efficiency indicators are quantitative measures of management activity, such as the number of hectares treated. These indicators may be routinely monitored.

2. Effectiveness indicators are quantitative measures of the outcomes of threat management, such as the density of a weed following control. These indicators may need to be monitored over several years.

3. Environmental indicators are measures of the outcome of threat management strategies on natural values, such as the cover of native species following weed control. Detecting changes in the condition of natural values may require many years of monitoring.

Currently, reporting of weed and other pest management programs is based largely on efficiency indicators. To enable reporting on effectiveness indicators in a consistent, comparable and scientifically robust manner, Parks Victoria developed threat-monitoring protocols to be used by ranger staff. To date, protocols have been developed for pest animals (deer, cats, foxes and rabbits) as well as for the mapping and monitoring of weeds.

PROTOCOL DEVELOPMENT
Parks Victoria’s Pest Plant Mapping and Monitoring Protocols have been developed over several years. External consultants were used for the initial development of the protocols with input from Parks Victoria staff. The result was a detailed review of vegetation mapping and monitoring techniques. Mapping was included as information on the distribution of weeds is essential for planning control programs. However, the mapping techniques were not considered robust enough to measure the effectiveness of weed control. Three parameters were identified as suitable for monitoring effectiveness:

- Frequency (measured using quadrats),
- Density (measured using quadrats), and
- Cover (measured using either line or point intercepts).

Visual estimation of percentage cover was not included as a recommended technique, as estimates can vary widely between observers, making it difficult to draw strong conclusions from results.

A decision key was included to help select the most appropriate technique given the life-form/habit and abundance of the weed of interest. Instructions were provided for implementing the techniques and designing a monitoring program.

The initial protocols were very technical and detailed. Field staff found them complex and difficult to use. Field trials using the initial protocols required a very high level of assistance from technical
staff and while initial monitoring was undertaken at a small number of sites, no follow-up sampling was undertaken.

Throughout the field trials it was recognised that the protocols needed to be simplified if they were to be used widely. As a result, Parks Victoria undertook an extensive revision of the document. The revised protocols were limited to information necessary for on-ground implementation of the recommended techniques. A procedural format was adopted; the same format has now been applied to all threat monitoring protocols. As much as possible, plain language was used and where technical terms were required, definitions were included.

The revised weed monitoring protocol has three components:
- Introduction and decision keys (flow charts) for selecting the most appropriate monitoring technique,
- Recommended parameters and techniques for their measurement, and
- Field sheets and associated material.

For each technique included in the protocols, an electronic Excel file has been created that contains worksheets for project information, field data sheets and data input and storage. Where possible, the files have automated functions for undertaking any required calculations (for example, determining means and standard deviations). Worked examples with sample data, summary statistics and graphs are also included.

**IMPLEMENTATION**

The revised protocols were made readily available through the Parks Victoria intranet and promoted through internal newsletters, however there has been limited implementation by field staff. Some reasons for this are:
- Traditionally, field staff have not been involved in monitoring effectiveness. Hence, staff may not have the skills or confidence required to undertake weed monitoring without technical support.
- Current understanding of the benefits of monitoring is varied. Efforts in communicating these benefits may not have reached all staff effectively.
- Monitoring is seen by some staff as additional to weed control, rather than an important component of well-designed management programs. That is, ‘doing the control work is more important than monitoring’. Allocating time to monitoring needs to be incorporated into the planning stage of weed management programs.

Other management agencies have also reported similar difficulties in achieving widespread adoption of weed monitoring (Popay 2004).

To help overcome these barriers, a two-day monitoring workshop has been planned for each of Parks Victoria’s 15 districts. The workshops are targeted at Environmental Team Leaders, who will plan monitoring programs, as well as staff who may implement the protocols in the field. This will enable the development of local monitoring networks and facilitate the sharing of skills across parks.

The workshops include both a theoretical and a practical component. They provide a basic understanding of what monitoring is and the importance of doing it, some basic principles of monitoring (identifying objectives, sampling, standardisation, representation and replication), basic sampling approaches and how to combine these aspects in the planning and design of a monitoring program. Each recommended technique is explained in detail prior to an indoor simulation (using tape measures and coloured paper). Field exercises are then undertaken in a local park where workshop participants use the techniques described in the protocols.

**Lessons learnt** Some of the lessons learnt so far in the development and roll-out of the protocols are:
- Technical information should be presented as simply as possible. Feedback from staff indicates that the revised version of the protocol is much easier to understand and more user-friendly.
- Having a dedicated staff member to provide technical support is essential. Field staff are interested in taking up the challenge of learning new techniques and are able to implement them provided they receive adequate training, encouragement and access to advice.
- The processes involved in planning and designing a monitoring program are generally difficult for staff to comprehend. In particular, articulating the objectives of weed management and identifying the questions to be addressed through monitoring can be challenging for staff that don’t have a scientific background.
- Some staff still view monitoring the effectiveness of weed control as an additional task, rather than part of good weed management. Further work is needed to demonstrate the benefits of well-designed programs that include monitoring as an integral component.

**NEXT STEPS**

The protocols will continue to be disseminated via district workshops in the near future. Feedback will be sought from participants to assess the accessibility and usefulness of the workshops and changes will be made to the workshop format as necessary. Initial
comments have been positive, with staff indicating that they ‘learnt something useful’. Additional communication products are also being developed. These include an instructional DVD with commentary on each of the techniques.

As the monitoring protocols focus on field-based procedural information for implementing monitoring programs, a Monitoring Guide is being developed as a supplement to the protocols. The guide will contain technical information not provided in the protocols. This includes basic principles of monitoring, sampling strategies and experimental design and analysis and presentation of monitoring results. It also provides a framework for planning and designing a monitoring program, which includes identifying management objectives and questions to be answered through monitoring.

As the monitoring protocols are ‘living documents’ they will be revised as required to incorporate improvements suggested by users. The protocols may also be expanded to included new techniques as demand arises (e.g. monitoring using remote sensing techniques).

Currently, analysis of monitoring data is undertaken by technical staff. As the protocols become more widely implemented, field staff will require basic skills to analyse the data that they have collected. This will require documentation of basic statistical analyses, such as t-tests, as well as additional training and technical support.

An important challenge in achieving wider implementation of the protocols will be to set meaningful guidelines for when and where to monitor. Given the resources required, it is neither feasible nor warranted to monitor all weed control programs. As a minimum, monitoring will be directed towards larger programs at high-value sites.

Although the focus of the protocols has been on their use to assess changes in weed populations, the same techniques can be adapted to determine the environmental outcomes of weed management. An example of this is monitoring the response of native species following the management of English broom (*Cytisus scoparius* L.) (Allan et al. 2006). It is anticipated that monitoring environmental outcomes of weed management will be undertaken at more sites in the future. With increasing awareness and understanding by park managers (at all levels) that monitoring is an essential component of good environmental management, it is hoped that monitoring effectiveness will be incorporated into future weed control programs.

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**REFERENCES**

