Fire and Biodiversity Management in Victoria – Integrating the Science, Planning and Implementation Processes

G.R. Friend[1], M. Leonard[1], S. Troy[2], K.G. Tolhurst[3] and M. Wouters[2]

[1] Department of Sustainability and Environment, Melbourne, VIC, Australia

[1] Parks Victoria, Melbourne, VIC, Australia

[2] Forest Science Centre, University of Melbourne, Creswick, VIC, Australia

Abstract

In Victoria, the State Government agencies responsible for the management of fire on public land (the Department of Sustainability and Environment DSE and Parks Victoria) have long recognised the need for a holistic and scientifically-based approach to the management of fire, both for the protection of human life and property through reduction of wildfire hazard, and as a tool for managing ecosystems to maintain biodiversity. This reflects the fact that fire is inextricably linked to the structure, function and sustainability of Victoria's (and Australia's) ecosystems and if used inappropriately, will lead to their irreversible change or collapse.

In 1998 DSE's Parks Flora and Fauna Division, Forests Service and Fire Management combined with Parks Victoria to develop a unique cross-business/cross tenure approach to the management of fire for the conservation of biodiversity on public land. This was achieved through the formation of cross-business/agency committees at three levels - a Fire Ecology Steering Committee, a Fire Ecology Working Group and five Regional Fire Ecology Reference Groups.

A major feature of the approach is that of using the life history characteristics (vital attributes) of constituent flora and fauna species to determine appropriate, ecologically-based fire regimes for an area. This provides an objective, scientific basis on which to set clear and relatively simple ecological objectives and to develop ecologically sound fire regimes which can be monitored for their achievements of the desired outcomes. The process has been documented in the *Interim Guidelines and Procedures for Ecological Burning on Public Land in Victoria* and its implementation facilitated through:

- the running of a number of Statewide workshops in 1998 and 2000 and the publishing of two sets of Workshop Proceedings;
- initiation of pilot ecological burning case studies in key ecosystems;
- developing a structured and practical framework for gathering the information required for planning and implementing ecological burning;
- improving the availability of and access to biodiversity support tools and databases in FireWeb;
- appointing dedicated Regional Fire Ecology Project Officers in Forests Management and Parks Victoria to ensure consistency in the development of ecological burn plans and to provide technical support for Regional staff involved in ecological burning.

In early 2002, this work culminated in the publishing of a study which analysed disturbance by fire across public land in Victoria. This work used the *Interim Guidelines* approach to identify and prioritise areas across the state where fire needs to be either introduced or

excluded in order to achieve ecological sustainability or desired ecological outcomes. Results from this analysis indicated that the threat which fire frequency poses to species composition and community conservation in Victoria is in fact from *under-exposure* to fire; ie. fire frequency is too low across the landscape. The work pointed to the need to promote and target the active use of fire as a tool for ecological management on public land in Victoria, so as to achieve the diversity of fire regimes (of varying intensities, scales, seasons and fire intervals) needed to maintain the biodiversity of Victoria's unique ecosystems.

Introduction

Fire has been an integral part of the Australian environment for millions of years, largely shaping the richness, composition and distribution of the plants, animals and ecosystems we see today. In concert with soils, topography and climate, fire has influenced the biota over geological time-scales to develop a myriad of adaptations to disturbance, and has thus become inextricably linked to the structure, function and sustainability of Australia's ecosystems. A substantial proportion of Australia's unique biota has indeed become largely dependent on fire and the attendant variety of fire regimes for its continued existence and development.

Since the arrival of Europeans and their creation of cities, towns, farms and other infrastructure, fire, when uncontrolled, has taken on a more sinister role as a destroyer of life and property. Victoria, with its relatively high population and flammable tall forests, woodlands and shrublands, has been at the centre of this phenomenon, experiencing one of the most severe fire climates on earth. Indeed, over the past 100 years Victoria has accounted for over two-thirds of all bushfire related deaths and over half of all significant bushfire associated property losses in Australia.

Understandably, this predicament led to a concentration on protecting human lives and assets from wildfire threat through the development of wildfire suppression and prescribed burning technologies. Techniques for controlling fire have become quite sophisticated and effective, but until very recently, this has occurred at the expense of an adequate understanding and recognition of the vital role fire plays in managing ecosystems to maintain biodiversity. In many ecosystems, fire suppression has become so effective that the incidence of fire has declined dramatically, to the extent that fire-dependent species are under threat, while fire sensitive ones proliferate (eg, *Pittosporum undulatum* in the foothill forests near Melbourne).

A New Approach

Recognising the complex and ironic duality of fire, the managers of the State's national parks, State forests and other public land, together with those responsible for biodiversity policy, set about developing a holistic and scientifically-based approach to its management, so as to achieve both wildfire protection and ecological management aims. This change in direction reflected the increasing realisation that fire protection and biodiversity conservation are *not* mutually exclusive processes. All fires (and indeed absence of fires) have an ecological dimension, while many "ecological burns" may also provide some asset protection. Both approaches also rely on prescribed burning, where fire is applied under specified environmental conditions to a predetermined area and at the time, intensity of heat and rate of spread required to attain planned resource management objectives.

In 1998 the new cross-business/cross tenure approach to the management of fire for the conservation of biodiversity on public land was formalised. This new approach was based on a number of key principles/messages:

- Fire is a natural part of the (Victorian) environment
- Parts of the (Victorian) environment need fire to regenerate – many native species are dependent on fire to germinate or to flower and set seed, or are dependent on successional habitat conditions created as a result of fire
- Fire needs to be managed to protect life, property and environmental values
- Fire management involves the prevention, suppression and introduction of fire where appropriate
- Fire prevention and suppression, and the deliberate use of fire for biodiversity protection and regeneration, are not mutually exclusive but are all tools for effective fire management
- Fire management needs a long-term, collaborative approach across all land tenures including public and private land
- Fire management needs careful planning.

Most importantly, the approach recognised the need to bring together the science on which ecological burning could be based, with the planning and implementation processes which would allow this science to be 'operationalised'.

The Science

Developing ecologically-based fire regimes relies on combining two sets of information:

(a) the life history characteristics (or vital attributes, Noble and Slatyer, 1980) of the key fire response species of plants to determine the maximum and minimum time between fires (the fire interval or interfire period) needed to maintain all species in one or more vegetation communities, and
(b) the analysis of the age-class and spatial distribution of these communities in the landscape to identify areas which need to either be protected from fire or exposed to fire.

The vital attributes of a plant species are the characteristics of that plant which affect: 1) the method of persistence on a site after fire, 2) the environmental conditions required for re-establishment, and 3) the longevity of the juvenile, mature and dormant propagule store if present following disturbance (Noble and Slatyer 1981). The vital attributes of the individual species within a particular community can be used to deduce the past (fire) disturbance regime of the area, since the composition of the current plant community on a site reflects the sum of the past biological and physical factors affecting it. If a species requires a particular disturbance regime to maintain its presence, then it is argued that such a regime must have existed in the past for it to be present in the community today.

Key fire response species are those whose vital attributes indicate that they are most likely to be affected (eliminated) by very frequent and very infrequent fires and will determine the maximum and minimum tolerable fire intervals (TFI) and the fire cycle for a community. The *shortest* tolerable fire interval is set by the species which takes the *longest* time to reach maturity. The *longest* tolerable fire interval is set by the species with the *shortest* time to local extinction. The key fire response species form the basis for developing management strategies and for on-going monitoring.

The fire cycle is the period of time over which an area equivalent to the total area of a community is burnt and is calculated as the point approximately mid-way between the maximum and minimum tolerable fire interval. It is *not* the period of time each segment of the community will be burnt. This concept allows some communities (or segments of communities) to remain unburnt for very long periods of time, while others may be burnt several times in the same period, but the community composition overall will be maintained and structural diversity will be maximised.

The approach works by using fire history records to determine the known age-class distribution of a particular vegetation type in an area, generally using Geographical Information Systems (GIS). This distribution is then compared to an 'idealised' age class distribution, developed from a determination of tolerable fire intervals and a fire cycle using the vital attributes information of the key fire response species occurring in the area or landscape unit of concern. Age classes which are *over-represented* compared with the ideal are thus highlighted and may be targeted for prescribed burning and considered when developing fire suppression strategies. Similarly, age classes which are *under-represented* compared with the ideal are highlighted and may be considered for exclusion from prescribed burning and consideration given to protection when developing fire suppression strategies (Fig. 1).

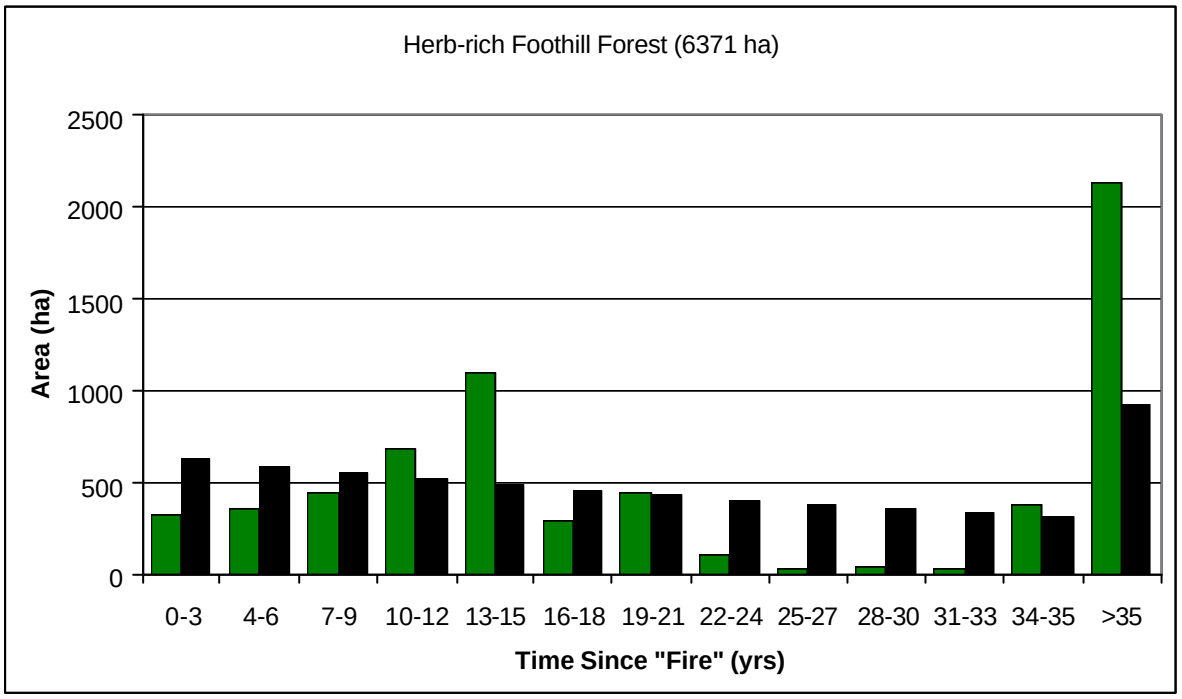

Figure 1. Actual (coloured) and idealised (black) age class distribution of the Herb-rich Foothill Forest EVC found in the Mt Cole proposed burn area (from NRE/PV 2002a).

Development of an 'idealised' age class distribution for a particular area/vegetation type within a landscape unit is based on the fact that if fires are spread across that vegetation type in approximately random fashion, then the resultant distribution of age-segments within the community will take the form of a negative exponential function. This negative exponential function is the basic model of the idealised age-class distribution. Although it is not likely to

ever be found in nature, natural systems do tend to converge toward the negative exponential function where fires have been allowed to occur 'naturally' across a landscape. The idealised fire age-class distribution is thus useful as a management **guide**, and provided there is broad agreement between the actual and idealised age classes, the land manager can be reasonably confident that viable populations of all species will be maintained across that vegetation type or landscape unit.

Together, vital attributes and age-class distribution information respectively determine **how often** and **where** to burn within ecological limits. This approach can be used for any area of land, at any scale, for which it is possible or meaningful to determine fire requirements. This process provides an objective, scientific basis on which to set clear and relatively simple ecological objectives and to develop ecologically sound fire regimes which can be monitored for their achievements of the desired outcomes. Further details of the vital attributes and age-class distribution approach are provided in Tolhurst and Friend (2001).

Planning and Implementation

In establishing the new approach to managing fire for biodiversity outcomes in Victoria, land managers, scientists and policy makers recognised the need to formalise a structured and integrated approach to decision-making and planning and the transmission of this to on-ground operations. To achieve this, cross business/agency committees were formed at three levels:

1. A Fire Ecology Steering Committee which provides a high-level forum for land managers to agree on the overall strategic direction and co-ordination for the work. This committee comprises senior managers from the main businesses within the Department (*viz*. Fire Management, Forest Management, Parks Flora and Fauna) and from Parks Victoria which deal with fire management on public land.
2. A Fire Ecology Working Group whose role is to co-ordinate and implement recommendations and decisions arising from the Steering Committee and provide feedback and advice on relevant issues. The Working Group comprises one member from each of the above Departmental businesses and from Parks Victoria and its convenor also sits on the Steering Committee as the Executive Officer.
3. Five Regional Fire Ecology Reference Groups, each of which again comprises representatives from the relevant Departmental businesses and from Parks Victoria. The Regional Reference Groups provide regional co-ordination between the various businesses and provide direct links to the relevant public land manager who has responsibility for the local on-ground planning and implementation of ecological burning.

These three tiers of decision-making and planning provide integration both vertically (from the strategic level to the on-ground implementation level) and horizontally (across the various public land and fire management businesses), which is essential if the fire ecology framework is to be properly developed and implemented. This management structure has proved a useful model for integrated natural resource management and is being adopted in other areas of DSE and Parks Victoria.

Achievements

Using the scientific framework above for determining how often and where to burn for ecological management purposes, DSE and Parks Victoria developed the *Interim Guidelines and Procedures for Ecological Burning on Public Land in Victoria* (NRE/PV 1999a). This document sets out the legislation, policies and key principles relevant to ecological burning and provides a framework outlining the information, standards, planning procedures and responsibilities involved in conducting such burns. The *Guidelines and Procedures* form the backbone of policy and planning for the fire and biodiversity framework and, having been trialled for four years, are currently being revised and finalised for publication.

The implementation of the fire and biodiversity framework has been facilitated through the development of a number of initiatives including:

- The running of a number of Statewide workshops in 1998 and 2000 and the publishing of two sets of Workshop Proceedings (NRE/PV 1999b, NRE/PV 2002a). These workshops enabled a common understanding of the main principles underpinning the use of fire for ecological management to be gained, identified knowledge gaps and impediments to progress and provided some of the tools and the momentum to implement the framework;
- Initiation of three pilot ecological burning case studies in Foothill Forests, Heathlands and Mallee Shrublands (McCarthy 2000, Tolhurst 2000, Wouters 2000). These were co-ordinated by the Regional Fire Ecology Reference Groups to help staff better understand the steps in the process and apply them in a local situation;
- Developing a structured and practical framework for gathering the information required for planning and implementing ecological burning. This has necessitated the integration of ecological burning and protection burning into a single fire management planning process, supported by a state-of-the-art computer platform, the *Integrated Fire Information System* (IFIS). IFIS is the backbone of DSE's *FireWeb*, which provides an integrated system for the planning, tracking and recording of all burns and fire protection works on public land in Victoria;
- Improving the range of and access to biodiversity and other support tools and databases in *FireWeb*. This has involved the development of specific tools to capture and analyse flora and fauna vital attribute data, fire history data, idealised age class distributions and spatial data to map vegetation types, threatened species and other disturbances and show planned burn areas in considerable detail;
- Appointing three fixed-term Regional Fire Ecology Officers in DSE Forests Management and Parks Victoria. Their tasks are to ensure there is a consistent and correct approach applied to the development of ecological burn plans, to facititate the collection of relevant vital attribute and fire history data and to provide technical support and training opportunities for Regional staff involved in ecological burning. These Officers have now completed fourteen 'Ecological Fire Strategies' across the State for a broad range of habitat types, providing the basis for on-ground planning and implementation of ecologically-based fire regimes. Where relevant, these plans have also taken into account the consequences of the recent large-scale fires in the North-east and East of the State;
- Publishing a 'Practitioner's Manual' (DSE/PV 2003a) aimed at local fire management planners, which provides a step-by-step guide to developing an Ecological Fire Strategy and which should be used in conjunction with the *Guidelines and Procedures* and other specific guidelines (see below).

- Developing a number of *Fire Ecology Guidelines* covering specific topics for use by local fire management planners. Topics include 'Defining a Land Management Unit', 'Setting Specific Ecological Burning Objectives' and 'Establishing a Monitoring Framework for the Ecological Use of Fire on Public Land.'
- Publishing a brochure – 'Fire and Biodiversity in Our Parks and Forests' – aimed at informing the general public about fire and the environment and the approach being adopted in Victoria (DSE/PV 2003b).

New Insights for Setting Fire Management Priorities

In early 2002, the fire ecology work culminated in the publishing of a landmark study which analysed disturbance by fire across public land in Victoria (NRE/PV 2002b). The study arose from the recognition that strategic priorities needed to be set for ecological burning across public land in Victoria. It used the *Interim Guidelines* approach to compare 'idealised' age-class distributions with known age-class distributions (derived from fire history data) for major vegetation types throughout Victoria and thus determine those areas which are most at variance and in need of active management.

The study analyses the pattern of fire disturbance across the landscape at two scales:

- the statewide scale (ie. Victoria-wide) using Ecological Vegetation Class (EVC) or groups of like EVCs (EVCGroup) data which was subdivided according to public land tenure as either Protected Area Estate, State Forest or Other Public Land
- the bioregional scale using Victorian Bioregions described in the *Victorian Biodiversity Strategy* (NRE 1997a and b).

The study also compiled critical information on vital attributes of plant species across EVCs, lists of key fire response species, spatial information on time-since-fire from EVC and fire history data, and developed spreadsheets for calculating actual and "ideal" age class distribution graphs.

In order to examine priorities the study set a benchmark for the degree of acceptable variance from the idealised age class distribution for vegetation types across EVCs and bioregions as: *at least half of the existing age classes are within 50% of the 'ideal' for that EVC/EVCGroup in the area or bioregion of interest*. This benchmark was a relatively coarse one, designed to identify those vegetation types that are most divergent from their 'ideal' state.

Results from this analysis indicated that at a statewide scale, only one EVCGroup satisfied the benchmark. Analysis by land tenure showed that there is also only one EVCGroup which satisfied the benchmark across Protected Areas, and none across State Forest and other public land. At a bioregional scale, no bioregion satisfied the benchmark for all vegetation types and only four bioregions (East Gippsland Lowlands, Glenelg Plain and Greater Grampians and Northern Inland Slopes) out of the total of 22 analysed contained individual EVCGroups which satisfied the benchmark.

This work has enabled Victoria's land managers to identify and prioritise areas across the state where fire needs to be either introduced or excluded in order to achieve ecological sustainability or desired ecological outcomes. Results from this analysis indicated that over-burning is not occurring at either a Statewide or at any bioregional scale. The threat which fire frequency poses to species composition and community conservation in Victoria is in fact

from *under-exposure* to fire; ie. fire frequency is too low across the landscape. The work pointed to the need for a philosophical shift in management to promote and target the active use of fire as a tool for ecological management on public land in Victoria, so as to achieve the diversity of fire regimes (of varying intensities, scales, seasons and fire intervals) needed to maintain the biodiversity of Victoria's ecosystems.

The Future

The development of an objective and scientific basis to the planning and implementation of burning to achieve ecological outcomes and its integration into wildfire protection planning, has enabled a major hurdle to be overcome in the management of Victoria's unique landscapes and natural resources. Although only in its infancy, this new approach offers considerable opportunities for more consistent and holistic park and forest management. Much remains to be done, however, in terms of developing more accessible data bases, in improving our understanding of the 'vital attributes' and related characteristics of Victoria's flora and fauna, and in maintaining sufficient levels of expertise within Victoria's park and forest management agencies to safeguard biodiversity conservation well into the future.

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