DEVELOPING ECOLOGICAL FIRE MANAGMENT GUIDELINES FOR SA

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Abstract
Fire is a natural component of the South Australian environment and ecosystems conserved in the reserve system. The maintenance of biodiversity and ecosystem processes in reserves is dependent on appropriate fire regimes.

The South Australian Department for Environment and Heritage (DEH) prepares Fire Management Plans for reserves which set *Ecological Fire Management Guidelines* for Conservation Zones (C-zone). These *Ecological Fire Management Guidelines* are based on the ecological fire management requirements of species, populations, habitats, wilderness areas or cultural heritage in the plan area and the ecological risks to those values.

Ecological Fire Management Guidelines are developed from the life histories or vital attributes of the constituent flora and fauna species. This includes information, where known, on the impacts likely given a particular frequency, interval, intensity, season or spatial parameters. The process for developing *Ecological Fire Management Guidelines* is outlined and an example provided.

Introduction

Fire is a natural component of the South Australian environment and ecosystems. The South Australian Department for Environment and Heritage (DEH) is charged with the management of the species, populations, habitats, wilderness and cultural heritage values conserved in the South Australian reserve system. The maintenance of biodiversity values and ecosystem processes in these reserves is dependent on maintaining appropriate fire regimes.

Fire Management in South Australian Reserves

The DEH Fire Management Policy (DEH 2005) states that fire will be managed in the State's reserve system to protect life, property and environmental assets and enhance the conservation of natural and cultural heritage. South Australian Government Agencies involved in prescribed burning operate under the *Code of Practice for Prescribed Burning* (GAFLC 2004) which sets out the legislative framework, principles, and practices for planning and conducting prescribed burning operations. The Code requires Agencies to ensure that:

- Fire is managed in a way that protects and enhances biodiversity values as well as offering protection to life and property
- A range of intensities, frequencies, seasons and scales of burning are incorporated into ecologically-based fire regimes that optimise the conservation of biodiversity.
- Ecologically based fire regimes for an area are developed from knowledge of the life histories or vital attributes of the constituent flora and fauna species.
- Fire management in reserves is based on an adaptive management approach supported by contemporary research.

Ecological Fire Management Guidelines

DEH uses *Ecological Fire Management Guidelines* to guide and set minimum standards for managing fire to conserving biodiversity. Fire Management Plans will set *Ecological Fire Management Guidelines* for Conservation Zones (C-zone). These *Ecological Fire Management Guidelines* will be based on the ecological risks and ecological fire management requirements of species, populations, habitats, wilderness areas or cultural heritage in the plan area. This will include information, where known, on the likely impacts given a particular fire regime (fire frequency, interval, intensity, season or spatial parameters). *Ecological Fire Management Guideline*s for C-zones will be developed from the life histories or vital attributes of the constituent flora and fauna species of the area.

Determining Ecological Fire Management Guidelines

The steps used to determine *Ecological Fire Management Guidelines are:*

1. Identify the Management objectives for area
2. Compile species list (flora and fauna) for community/habitat(s) in the area, highlighting significant species (flora and fauna) and community(s)
3. Identify species of flora and fauna vulnerable to changes in fire regime *(Key Fire Response Species)* for the community/habitat(s)
4. Specify *Ecological Fire Management Guidelines* for community(s) using minimum/maximum fire interval, range of season, minimum/maximum intensity and extent of most vulnerable Key Fire Response species.
5. Review *Ecological Fire Management Guideline(s)* regularly, to include additional information as it becomes available.

Rated (legislatively listed rare or threatened) species (SA National Parks & Wildlife Act and Commonwealth Environment Protection & Biodiversity Conservation Act) have extra legal protection and need to be specifically identified in any analysis. Significant species can also include significant habitat species, keystone species and weed/pest species which are significantly affected by fire.

The species most susceptible to decline due to inappropriate fire regimes need to be identified. These species and their needs in relation to the components of fire regime provide a guide to the acceptable thresholds of the fire regime components for the community (e.g. the upper and lower Tolerable Fire Intervals, intensities required to stimulate regeneration and appropriate season) for the area. Knowledge of these ecological thresholds, in particular for Tolerable Fire Intervals, enables fire management to be planned to avoid fire regimes which may lead to the decline and loss of species. For flora, the Vital Attributes scheme of Noble and Slatyer (1980, 1981) is being used to identify *Key Fire Response Species*, that is those species most vulnerable to a change or extreme of fire regime.

Fire Interval
Certain functional groups (of Noble and Slatyer) are more vulnerable to disturbance. The species with the shortest extinction period (i.e. time to when regeneration from seed or reproduction is no longer possible) will be the *Key Fire Response Species*.

Season and Intensity
This 'Key Fire Response Species' approach is also used to determine the *window* (min. & max.) of fire intensity and season appropriate to a vegetation type (i.e. either low or very high intensity fire, fire in a particular season).

Extent
For biodiversity conservation, the chief concern is the amount of the landscape that is subject to adverse fire regimes (i.e. outside the acceptable fire interval window). Landscape ecology and its application to fire in particular suggests that the effects of extreme inter-fire intervals (too short or long) on a community will be related to the area affected (e.g. effects could be considered to be unimportant if the area affected is relatively small). Decline or extinction of species due to extreme intervals in patches within vegetation may be offset, through recolonization from other neighbouring patches, subject to more favourable fire intervals. Provided that the relative abundance of patches of both favourable and unfavourable fire intervals remains at a balanced level, recolonization will outweighs losses and no overall decline of affected species will result. Loss of species will result if losses from patches outweigh recolonization. A basic conservative approach is, if more than 50 % of any particular vegetation formation is subject to intervals beyond the appropriate fire regime 'window', then the decline or possible losses of species from the entire landscape may be expected. "Patchy" fires are not automatically beneficial to biodiversity. A range of variation of fire extent is desirable.

Fauna
A key issue is the need for any approach to developing *Ecological Fire Management Guidelines* to include critical elements of habitat for fauna as well as flora. Currently there is no widely accepted 'vital attributes' scheme for fauna. Friend (1993), Keith *et al*. (2002) and Whelan *et al*. (2002) have identified some of the ecological and life-history attributes that are important in determining the response of vertebrates to fire: shelter type, foraging patterns (activity substrate), mobility and breadth of diet are key characteristics. These life history attributes are included as primary variables in DEH's proposed Fauna Fire Response Database.

In contrast to many plants, the functional equivalents of dormant seeds or ability to resprout are lacking in higher vertebrates: if a species is eliminated from a patch or area by any particular fire, recovery will be dependent on dispersal from elsewhere. In this sense many animal species may be characterised as 'D' species under the vital attributes system. D type species persist in landscapes by avoiding fire in refugia and by avoiding unsuitable post-fire conditions (Kenny et al 2003). Additionally, however, a high degree of mobility in animals (e.g. the ability to move daily or seasonally) may allow many species to use burnt areas provided these are adjacent to refuges (such as rock outcrops) that provide critical resource/s. Characterisation of the ability (or dependence) of an individual to regularly use different habitat elements remains a central issue in the development of a functional classification of animal responses to fire.

In the interim, an approach developing fire regime thresholds using flora, and then testing these against known faunal needs, and particularly threatened species (Figure 1) is advocated. This approach (for fauna) is currently in development. In the interim, Fire Management Plans will set *Ecological Fire Management Guidelines* for Conservation Zones based on the best available fauna information and expert opinion.

Dealing with Missing Data

Not all Vital Attribute data will be known for all species; some species will also show multiple or conflicting data. Ecological Fire Regimes can still be determined, using the following the rules from Bradstock & Kenny 2003 and Kenny et al 2004 for dealing with the missing or conflicting data.

Where local data is not available, data for the same species from other South Australian sites can be used with caution. Other non-SA data can be used where no other is available. Acquiring local data is a priority for fire management monitoring programs. Data using the classification of Gill (1981), including earlier SA data, can be utilised by converting this data using the rules set out in Noble and Gitay (1996).

Conclusions

Ecological Fire Management Guidelines to guide and set minimum standards for managing fire to conserving biodiversity are being developed as part of the Fire Management Planning process for SA Reserves. *Ecological Fire Management Guidelines* are based on the ecological risks and ecological fire management requirements of species, populations, habitats, wilderness areas or cultural heritage in the plan area and are derived from the life histories or vital attributes of the constituent flora and fauna species of the area. Where known, information on the impacts likely given a particular fire regime (fire frequency, interval, intensity, season or spatial parameters) on fauna and significant species are incorporated into *Ecological Fire Management Guideline*s.

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Example of *Ecological Fire Management Guidelines* for a Fire Management Plan

SA_VEGID	**SA_VEGID**	**Significant impact likely if…**	**Ecological Fire Management Guidelines**
SM0201	Eucalyptus baxteri (mixed) forest over tall shrubs and low shrubs	Inter-fire Interval < 15 years Inter-fire Interval > 60 years Successive low intensity fires	1 Inter-fire interval greater than 15 years & less than 60 years across greater than 50% of area of this vegetation type in Plan area 2 Some intervals greater than 60 years are desirable 3 Avoid 2 or more successive fires less than 15 years apart 4 Avoid 3 or more successive fires of low intensity 5 Some medium – high intensity fire needed to regenerate some species
SM2601	Eucalyptus cosmophylla woodland over and low shrubs	Inter-fire Interval < 10 years Inter-fire Interval > 70 years Successive low intensity fires	1 Inter-fire interval greater than 10 years & less than 70 years across greater than 50% of area of this vegetation type in Plan area 2 Some intervals greater than 70 years are desirable 3 Avoid 2 or more successive fires less than 10 years apart 4 Avoid 3 or more successive fires of low intensity 5 Some medium – high intensity fire needed to regenerate some species
SM3901	Leptospermum continentale (mixed) shrubland >1m	Inter-fire Interval < 10 years Inter-fire Interval > 40 years	1 Inter-fire interval greater than 10 years & less than 40 years across greater than 50% of area of this vegetation type in Plan area 2 Some intervals greater than 40 years are desirable 3 Avoid 2 or more successive fires less than 10 years apart
SM4401	Olearia ramulosa shrubland >1m over low shrubs	Inter-fire Interval < 7 years	1 Inter-fire interval greater than 10 years across greater than 50% of area of this vegetation type in Plan area 2 Avoid 2 or more successive fires less than 10 years apart

Figure 1 Approach for Determining Ecological Fire Management Guidelines (including fauna)