Nature Conservation Council of NSW

PRIMER ON FIRE ECOLOGY

FIRE A NATURAL COMPONENT OF MANY OF AUSTRALIA'S ECOSYSTEMS

Australia is the most fire-prone continent in the world (Pyne 1992). Fire has played a critical role in the evolution of Australia's flora and fauna for millions of years and continues to be a key driver of many of its ecosystems (Bradstock et al. 2002). Lightning is a natural source of fire that has impacted on Australia's landscapes even before the arrival of Aboriginal people.

CURRENT USE OF FIRE

Bush fire is now largely perceived as a disturbance to be feared, as increasing numbers of people move to bushland settings (in rural and peri-urban areas), and life and property are at times catastrophically impacted. Land managers currently use prescribed burning primarily for broad-scale wildfire management and human asset protection through reducing fuel loads (Penman et al. 2011), otherwise known as hazard reduction burning.

Wildfire. Photo: G. Walker

Fire (both its occurrence and absence) can also threaten biodiversity. Although over 400 flora and fauna species are threatened by 'inappropriate' fire regimes in NSW (Threatened Species Conservation Act 1995), the listing of high fire frequencies as a key threatening process under the Threatened Species Conservation Act 1995 may give the impression that too much fire is more detrimental than insufficient frequency. From an ecological perspective fire is neither good nor bad per se, it is about implementing 'appropriate' fire regimes. The term 'fire regime' describes the intensity, season, extent (total area burnt) and patchiness (proportion burnt within the total area burnt) of each fire and the frequency at which they re-occur (Gill 1981). A species may decline and eventually be lost from an area, if the fire regimes that occur there are adverse or 'inappropriate' for their biology or life history traits (Noble and Slayter 1980; Kenny et al. 2004).

Sun Orchid.

Fire managers not only implement hazard reduction burns to mitigate the risk of bushfire, they actively suppress wildfires when they occur, for the protection of life and property. This has resulted in the need to re-establish fire in ecosystems that are fire responsive and require fire for their regeneration and ecological function. Without fire, many plant communities will eventually decline, along with their associated wildlife.

ECOLOGICAL BURNING

Ecological burns are prescribed burns that are used to promote or enhance ecological assets (such as flora and fauna species and ecological communities), or by protecting ecological assets from potential wildfire (Penman et al. 2011). Ecological burns can also have hazard reduction benefits, but this is not their primary purpose. There are a number of current applications including:

1. **Stimulating the germination or flowering of particular plant species.** For example some threatened orchid species.

2. **Modifying the habitat of individual wildlife species.** For example the northern bettong requires intense fire every 20 – 30 years to regenerate shrub thickets which are a critical habitat requirement.

3. **Promoting overall ecosystem resilience through regeneration of particular vegetation formations.** In NSW, twelve broad vegetation formations have been identified, with their ecological resilience measured through the use of state-wide fire frequency guidelines. These suggest appropriate upper and lower fire frequency thresholds for each of the vegetation formations (Kenny et al. 2004). This is based on flora vital attributes and the principle that plant species have limits of tolerance to different components of the fire regime and these can be identified and managed for (Hammill and Tasker 2010). The goal is to keep most of the vegetation community within the lower and upper thresholds and to vary the time between fires in an area to maximise diversity.

4. **Regeneration of fragmented landscapes where there is an absence of fire** such as peri-urban grasslands. Grasslands in western Victoria (of which only 0.5 % are left) are being regenerated using fire. The combination of fire exclusion and fragmentation leads to local extinctions within these remnants (Barlow and Ross 2001; Williams et al. 2006).

5. **Weed control**. Some species including the African olive are increasingly being treated with integrated weed control including fire (Richter et al. 2005; Watson 2005).

6. **Treatment of key threatening processes**. For example Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners (otherwise known as Bell Miner Associated Dieback) which is being treated with integrated weed control including fire.

7. **Mitigating the risk of wildfire burning fire sensitive ecological assets.** For example in the south-western Fleurieu Peninsula in South Australia, fuel is reduced in strategic areas to provide landscape protection for the reserve i.e. to reduce the possibility of an entire block or reserve burning in one fire event. This reserve supports populations of the Nationally Endangered Mount Lofty Ranges southern emu wren (Department for Environment and Heritage 2009).

CLIMATE CHANGE, FIRE AND ECOSYSTEM RESILIENCE

Climate change is predicted to alter fire regimes. This will in turn, affect the composition and structure of flora and fauna species assemblages and their associated ecological communities (Williams et al. 2009). Climate change will have direct impacts on biodiversity by causing shifts in species distributions. Climate-induced changes to biodiversity will drive fire regimes by changing the amount of and composition of fuels. In addition, other agents of change such as invasions of exotic species are also likely to affect fuel loads. Hence climate change, fire regimes and biodiversity have complex feedback interactions (positive and negative) with different potential outcomes for different ecosystems (Williams et al. 2009).

Resilience is the capacity of an ecosystem to withstand external pressures and eventually return, to its pre-

disturbance state. Resilient ecosystems are able to maintain their taxonomic composition, structure and ecological function. Maintaining and restoring biodiversity in ecosystems through appropriate fire management promotes their resilience to human-induced pressures such as climate change.

Traditionally management of areas for biodiversity conservation (particularly in protected areas) has been to manage species assemblages as they are. However, with the onset of climate change, the environment will be in an increased state of change. The current conservation goal of minimising the risk of extinction of species from an area will need to consider how persistence of species within specific areas – and migrations of species into and from neighbouring regions – will be affected by climate change and by potential changes to fire regimes (Williams et al. 2009). Appropriate fire management can increase ecosystem resilience, decrease large-scale fragmentation as well as increase the diversity of fauna habitat and species assemblages in the landscape. This is normally achieved through mosaic burns applied across the landscape. Conversely, the loss of a species from a landscape may occur when adverse fire regimes predominate across the bulk of its habitat in that landscape. In this sense, adverse fire regimes may act as a dynamic fragmentation process (Kenny et al. 2004).

Bullio

Mosaic burning is the process of creation of a spatial pattern of burned and unburned patches from a single or multiple ignition prescribed burn (Gill 2008). The concept of mosaics is that a diversity of patches at different times since fire lead to an increase in species diversity in the long-term (Gill 2008). They typically lead to the creation an array of patches of bushland, creating different intensities of fires and unburnt refuges for fauna during fire as well as places for fauna and flora to recolonise post fire.

CONSERVING BIODIVERSITY UNDER CLIMATE CHANGE

A number of recommendations have been made for increasing the resilience of biodiversity under climate change using fire management.

1. Ensure that a substantial proportion of each vegetation formation is well above the recommended minimum fire threshold. Keeping vegetation well within thresholds at the high frequency fire end of the scale is likely to be more critical, because fire frequency is predicted to increase under climate change (Hammill and Tasker 2010).

2. Maintain a diversity of fire regimes. Even if the fire interval is above the minimum needed by most fire-interval species, repeating the same interval repeatedly has been shown to result in biodiversity decline. By implementing variable frequencies within the specified thresholds and maintaining a small proportion of ecosystems outside the specified fire frequency thresholds, the floristic, faunal and structural diversity of these systems will be enhanced, providing greater latitude to respond to change (Hammil and Tasker 2010).

3. Management is carried out as an adaptive process (including monitoring) in which a succession of procedures is continually revisited and revised so that management is evolutionary (Gill 2009).

CHALLENGES TO PERFORMING ECOLOGICAL BURNS IN NSW

The use of fire for managing the environment and ecological assets and at a small scale is not a novel approach. Aboriginal people have applied fire to promote food resources, improve hunting, and enhance access through land (reviewed in Penman et al. 2011). Applying fire management specifically for ecological benefits can be undertaken using similar methods and by incorporating traditional Aboriginal knowledge.

One of the challenges to accomplishing ecological burning is that most fire management in NSW is focused on underaking burning to enhance protection of life and property, with consideration given to environmental factors. Since 2003 the Bush Fire Environmental Assessment Code has provided a streamlined environmental assessment process for fire management activities undertaken for hazard reduction purposes. However, it is not possible to assess ecological burns under the Bushfire Environmental Assessment Code (2006) unless a proposed burn can be shown to have a hazard reduction benefit. It can therefore be challenging to assess and implement ecological burns. As a result, fire is often not recognized as an integral component in maintaining healthy ecosystems and in promoting landscape resilience, and in practice ecological burns become a low priority.

GLOSSARY

Ecological burn: A form of prescribed burning. Treatment with fire of vegetation in nominated areas to achieve specified ecological objectives.

Fire regime: the intensity, season and type of each fire and the frequency at which fires re-occur (Gill 1981).

Flora vital attributes: Information on the life history traits of plants including their mode of reproduction and regeneration and how they respond to fire. Plant species fall under two main categories: 'resprouters' and 'obligate seeders'.

'Resprouters' regrow from shoots after a fire. These shoots come from woody underground lignotubers or from buds protected underneath their bark. Examples include many eucalypt and species.

Obligate Seeder.

Resprouter. Photo: Penny Watson

'Obligate seeders' are plants that die when their leaves area scorched in a fire and therefore rely on regeneration from seed. They generally produce more seed and a greater number of seedlings than resprouters and seedling growth rates tend to be quite rapid. Examples include many banksia and pea species (reviewed in Tierney and Watson 2009).

The fire frequency thresholds are based on an analysis of life history and fire response traits of plant species that normally occur in each of the vegetation formations, and particularly groups of plants that are most sensitive to very short or long fire intervals (Hammill and Tasker 2010). The lower fire frequency threshold for a particular vegetation formation is based on the number of years to first flowering of plant species most sensitive to frequent fire. This group of plants is particularly vulnerable to being burnt before they have had time to flower and set seed. While the upper fire frequency threshold for a particular vegetation formation is based in estimates of the life-span of those

plant species most sensitive to long periods of time without fire. These are species which are essentially dependent on fire to set seed and have long-lived seedbanks (Hammill and Tasker 2010).

Hazard reduction burn: The planned application of fire to reduce hazardous fuel quantities; undertaken in prescribed environmental conditions within defined boundaries.

Prescribed burn: The controlled application of fire under specified environmental conditions to a predetermined area and at the time, intensity, and rate of spread required to attain planned resource management objectives. It is undertaken in specified environmental conditions.

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