Department of
Sustainability and
Environment

The effects of fire on Victorian bushland environments

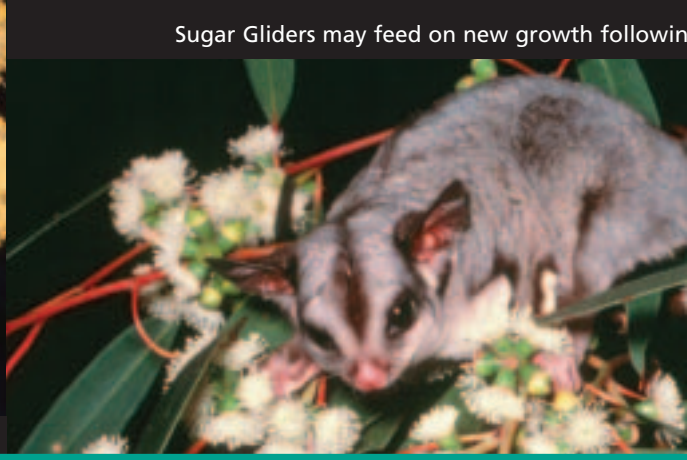
Fire has been present on the Australian continent for millions of years. Many of our plants and animals have evolved to survive fire events and subsequently most Australian ecosystems have developed very specialised relationships with fire.

Most forests and woodlands in Victoria have a similar structure, featuring a number of strata or layers. The overstorey, or top layer, is generally composed of large eucalypt species. The understorey generally has a multi-layered structure comprising acacias, other small trees and tree ferns, shrubs, ferns and tussock grasses. The ground cover often includes various grasses, ground ferns and herbs. Species within the various forest ecosystems vary across Victoria.

The long-term effect of fire on a landscape varies according to sequences of fire events, rather than to a single fire event. Sequences of fire events are known as 'fire regimes'. Fire regimes are determined by three factors: intensity (how severe fires are), frequency (how often fires occur) and season (the time of the year fires occur).

Victoria
The Place To Be

Wattle may survive due to root growth from specialised root structure or suckers



Sugar Gliders may feed on new growth followin

The effects of fire on Victorian bushland environments ...some

Observing the after-effects of fire

The ongoing changes in bushland after fire will be largely determined by the composition of plant species before the fire and the adaptation mechanisms of these species to fire.

Fire frequency

The frequency of fire affects the growth cycle of plants. Plant communities vary in their response to the period of time between fires, as do individual species and plants.

Some species, such as Mountain Ash *(Eucalyptus regnans)*, may not survive if fires are too frequent, as the plants are unable to reach maturity and produce sufficient seed before the next fire episode. In this case, Mountain Ash will be replaced by another species that has adapted to frequent fires, such as Messmate *(Eucalyptus obliqua)*. Infrequent fires may displace plants that require fire to assist with their regeneration, such as most heath species.

Fire intensity and season

The intensity of a bushfire is measured by the rate of heat (energy) released at the fire front, per unit of length of fire front. Intensity depends on the amount of fuel (i.e. vegetation) available and how fast the fire travels.

Fires that occur during mid-summer and autumn are generally the most intense as vegetation is dry; growth from the previous spring is high, rainfall is low, and higher temperatures are more likely to occur. The intensity of fires that start in these conditions can be extreme when combined with a dry, hot northerly wind.

A high intensity fire, although very destructive, also heats the soil and canopy, encouraging seed drop and germination and subsequent dense seedling regrowth. In general, the higher the fire intensity the greater the effect it has on the environment.

Immediate change

The most obvious result of a fire is the loss of vegetation cover. Variations in the fire's intensity may produce variations in the effects on the vegetation. Severe fires for example, may remove all vegetation.

Each species has its own survival features, which assists it in recovery.

Treeferns and some species of eucalypts, such as Messmate and Narrow Leaf Peppermint *(Eucalyptus radiata)*, are protected by thick bark. The bark also protects the eucalypts' epicormic buds, which sprout new growth when activated by the loss of foliage, damage or the intense heat.

Other species such as Silver Wattle *(Acacia dealbata)* and Blackwood Wattle *(A. melanoxylon)* may survive due to regrowth from root suckers, and/or soil stored seed.

Regrowth from root suckers can occur up to several metres away from the trunk of the parent tree and is the main mechanism of regeneration for the Blackwood Wattle.

A fire may create many open spaces and a seedbed of fine material, which is high in nutrients. Plants such as Grass Trees *(Xanthorrhoea spp.)* produce flowers and seeds after a fire and take advantage of the increased nutrient and light availability. Mountain Ash, which is often killed by relatively low intensity fires, may also release massive amounts of seed after a fire (up to 14 million seeds/hectare).

What happens to the animals?

Most species suffer reductions in populations during or immediately after a fire. Many individual animals may be killed through burning or suffocation. Others may survive the fire, but die shortly afterwards due to predation by other species and/or through shortages of food. However, some animals survive and, like plants, use varying survival techniques in their response to fire.

Mobile animals such as birds, kangaroos and wallabies may be able to move out of burning areas to safer refuges. However, these animals can suffer in high intensity fires, as spot fires (which develop ahead of the main fire) may trap them as they try to move away.

Wombats and echidnas may survive fire by seeking shelter in burrows or logs while fire passes through an area. Reptiles and amphibians also take refuge underground. Possums and other arboreal mammals move from tree to tree ahead of low intensity fires, or seek safety in the high crowns and hollows of trees. However, very severe fires will burn into the crown and hollows of trees and the intense heat may reach underground. Animals unable to move from these sites may be killed.

Many insects and spiders are also killed, especially in a high intensity fire that destroys the bark and litter layer in which they live. Flying insects have a higher chance of survival, as they can move away from the fire and then back again after it has passed.

g fire

Echidnas may survive fire by seeking shelter in burrows or logs

Epicormic buds sprout new growth after a fire

animals, like plants, use varying survival techniques in their response to fire.

Soils

Bushfires can have biological, chemical and physical effects on soils. The occurrence and/or extent of these effects are dependent on the fire's intensity and the resulting temperature of the soil. Generally, only the top few centimetres are affected as they are subjected to the highest temperatures.

Low intensity fires cause biological effects such as sterilisation (or death of living tissue) within the soil. Higher soil temperatures (greater than 100°C) may alter soil chemical structure, changing the amounts and availability of nutrients such as nitrogen, phosphorus and ammonia. These soil changes, combined with ash from the fire, may cause an 'ash-bed effect', increasing the fertility of the soil. However, these nutrients are relatively soluble, and may be rapidly washed from the site by rain.

Fire may cause changes in the permeability of the soil (or its ability to absorb moisture) and so may also alter soil structure. The removal of vegetation during a fire exposes the soil to wind and water. These two factors make soils very susceptible to erosion, and consequently, heavy rainfall immediately after a fire may cause massive erosion or mudslides.

Water

Fire can affect streamwater quality and may also influence the amount of water produced by a forest (that is, the levels of streamwater). Erosion may cause soil, ash and nutrients to be transported into streams. This increases the sediment load and the turbidity of the water.

The quantity of water produced by an area that has been burnt may initially increase, as there is little vegetation, and subsequently little water usage or entrapment. Sometime later, however, high water use by regenerating vegetation can reduce water yield from a catchment.

Short term changes

Within three to four weeks of a fire many trees, such as Messmates and Mountain Grey Gums, begin to show signs of life. The loss of foliage stimulates new growth from the epicormic buds located under the bark along trunks and branches. Damage-stimulated growth can also occur from lignotubers – nodules bearing underground dormant buds. These are often the first sign of recovery.

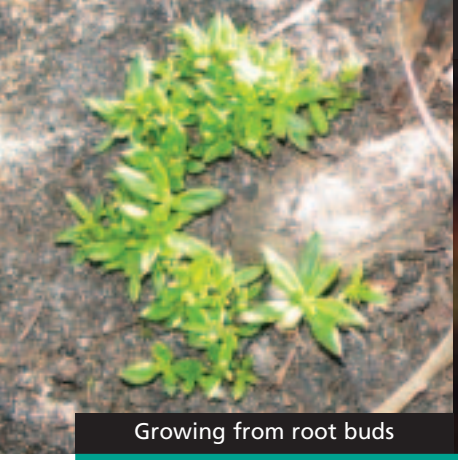
Wattle and pea species continue to appear, mainly from growth occurring from root suckers (i.e. new shoots from the roots of the parent plant) as well as seeds cracked open by the intensity of the fire. New shoots of Silver Banksia *(Banksia marginata)* also appear from root suckers.

Grass trees produce flowers and seeds after a fire

Species such as hakeas, banksias, some acacias and many eucalypts regenerate from seed. The heat of the fire facilitates the release of seed.The set of circumstances created by fire is ideal for some types of plants. The open canopy allows more light to reach the ground, and the 'ash-bed effect' provides many nutrients for initial germination.

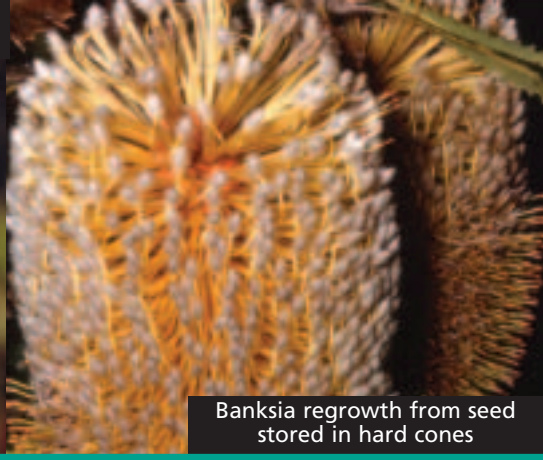
Treeferns regrow from the charred trunks; shrubs regenerate by sprouting new growth from branches; grasses regenerate by rapid regrowth from the base of the plant.

Some environments, unburnt for many years, may appear to not contain some species. However, through fire allowing more light to reach the forest floor, prolific germination of plants not recorded for many years may appear from seed stored in the soil. Some orchids, for example, regenerate from seed, but don't do well until fires promote their growth.



Growing from root buds

Some species require fire to promote their growth



Banksia regrowth from seed stored in hard cones

Medium term – between one to five years

Species richness (that is, number of different species) is often greatest in the early stage of recolonisation following fire, and generally decreases with time. The eventual changes in vegetation occurring in an area of burnt bushland will depend significantly on what was present before the fire event.

Acacia seedlings sprout from soil-stored seeds and shoot up, taking advantage of the increased light and soil nutrients. Eucalypt seedlings are initially slower growing than acacias, but will grow to eventually dominate the upper canopy.

The rate at which individual faunal species respond and return to the regenerating bushland is determined by their unique requirements for food and cover, and by their reproductive capacity and the size of the burnt area. Insect populations recover in stages. Populations of insects dwelling in the litter (leaf and organic matter) and soil usually recover after two to three years. But other insects, such as mites, may take four to five years before populations return to pre-fire levels.

A regenerating forest often uses much more water than a mature forest, due to the many new plants and their rapid growth. This reduction in groundwater and run-off may decrease the amount of water in streams.

As the bushland continues to re-establish, food sources for animals also improve. Mobile animals begin to forage in the regenerating bushland, although they may still utilise nearby unburnt areas for habitat and more reliable food sources. For example, browsers, such as wallabies and wombats, may forage on young shoots and seedlings. Possums may feed on new flowers and fruit, but will only return permanently when hollows or nest sites become available.

Food sources for some animals, such as owls, magpies and crows, may increase after fires, as the lack of vegetation cover exposes native mice and lizards.

Birds often reappear in the first few years, attracted by the flowering wattles and insects feeding on the lush new growth.

The middle layer of vegetation develops dense regrowth in the first few years following the fire. Ferns regrow from buds covered by protective plant tissue. Peas, grasses and herbs, such as lilies and some orchids, may also appear. Native fireweeds, such as Senecios, grow quickly and are often very abundant. These plants play an important role, trapping nutrients before they are washed away. They are short-lived and decompose slowly, releasing nutrients back into the soil.

This thick regrowth offers more protection for ground dwelling animals, such as the antechinus and echidnas, reducing predatory impacts on these species.

In the longer term

As plants mature, they consume more light, nutrients and water. Insufficient quantities of these elements mean that some plants will be displaced and plant density will be reduced.

The eucalypts generally grow to become the dominant species, reducing the light reaching the forest floor. Species richness will gradually decline, and the types of understorey plants will change, with shade tolerant plants becoming more abundant. As these changes occur, the conditions will suit some animals better than others, bringing about further ecosystem changes.

The extent of further change in vegetation composition depends on many factors, including future fires (their patterns, frequency and intensity), events like drought, and the impact of insects and fungi.

Further information

Department of Natural Resources and Environment, and Country Fire Authority, 1999, *Fire in the Australian Landscape*.

Department of Environment and Sports and Territories 1996, *Fire and Biodiversity: Effects and Effectiveness of Fire Management*
www.deh.gov.au/biodiversity

Gill,A M, Groves, R H, Noble, I.R. 1981, *Fire and the Australian Biota*

Stanbury, P 1981, *Bushfires: their effect on Australian Life and Landscape*

In 1984, a multidisciplinary study was established in the Wombat State Forest, 80 km north-east of Melbourne, to investigate the effects of repeated low-intensity prescribed burning in mixed eucalypt forest in Victoria. The study, which continues, includes the impacts on various aspects of flora, fauna, soils, tree growth, fuel management and fire behaviour. Relevant research reports can be found on DSE's website.

For more information contact

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www.dse.vic.gov.au/fires

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