Australian Plants Society NORTH SHORE GROUP
Ku-ring-gai Wildflower Garden

Fire and the Australian Flora

Did you know that?

- Fire has been part of the landscape in Australia for thousands of years.
- Plant species have mechanisms to ensure their survival as a result of fire.
- Some plants are killed by fire, whereas others, not killed, have evolved special strategies to survive fire.
- The frequency of fire influences which species survive.

History of fire in Australia

Fire has been part of the Landscape in Australia for thousands of years. Initially, fire was the consequence of lightning. It would presumably have accelerated the drying out process that had been occurring for millions of years. With the arrival of our first known residents, the Aboriginal people, some 50,000 years ago, the events of fire would have increased. Cook and Banks in 1770 made frequent reference to the fires of the Aboriginal people, which they presumed were camp and cooking fires. For thousands of years Aborigines used 'fire-stick farming ', burning the bush in patterns to maintain their food supply. Burning produced rich new growth, which in turn brought game for hunters. It was also used to drive animals into a position where they could be easily killed. Care was taken to avoid burning those parts of plants which yielded edible fruits. Unburnt areas remained as refuges for animals and birds. Since the arrival of the European settlement in 1788, fire has intensified. Besides wildfires, planned fires are also used, mainly to control wildfires, but also for environmental purposes.

Excluding Antarctica, Australia is the driest of the continents with 2/3 of its area classified as arid or semi-arid. The indirect consequence of this dryness can be seen in the prevalent occurrence of fire and the adaptations of plants species in relation to it.

Types of fires

'Good' fires are those which encourage plant and animal populations to thrive but have no impact on life or property.
There are several types of fire. They are:

- **Ground fire,** where the fire burns below the surface, generally slowly smouldering in deep layers of organic material, such as peat.
- **Surface fire,** which burns in low vegetation, such as grass.
- **Crown fire,** which consumes the crown of trees.
- **Spot fire,** resulting from small pieces of bark or other burning material blown ahead of the fire.

Fire regime

Fires will only burn when there is fuel available. The fire regime consists of **intensity, frequency** and **season**.

- **Intensity: -** the rate fire releases energy.

The two main types of fire are those with low and high intensities. Burning is often done to reduce fuel (hazard reduction), but there may be problems for the bush in such a fire. It generally does not burn to the mineral soil, which favours germination of small seed such as eucalypts. Neither does it heat the soil sufficiently to germinate seed with a hard seed coat, such as wattles and peas.

- **Frequency: -** The average number of years between fires.

This varies considerably from area to area. If fires are too frequent, then plants that take longer to set seed will be wiped out. For most plant communities, fire frequency should be longer than 3-8 years. Variety of intensity, season and frequency will ensure that plants and animals will at some time all be favoured or disadvantaged and diversity should continue. Depending on its community, there are different recommended times.

- In Heath, if the fire is of low intensity, 8-10 years.
- In Open forest, low intensity fire, times may be 8-10years, but with a high intensity perhaps 30-40 years. If there is no fire for many years, reversion to rainforest can occur.
- In Tall-Open forest, too frequent fires can change Forest to Scrub and no fire for a long period can create rainforest. On the other hand, fire can change rainforest to dry forest.
- In the Northern woodlands of the Northern Territory nearly all of the region was burnt every 1-2 years but some revision of this schedule has taken place and the frequency has changed to follow the previous Aboriginal fire pattern and it is suggested that no area should be burnt more than about once in every 4 years.
- In the semi–arid woodlands of Queensland and New South Wales, several factors influence decisions about frequency including heavy grazing pressure, soil compaction, ring-barking, scrub clearing and wildfires.
- In sub-alpine woodland also, a variety of factors influence decisions and suggested times vary between every 4 to greater than 40 years.

- **Season:** - the time that forests ignite.

The season is important. It may affect the breeding of some animals. The Brown Antechinus breed over a very short period. Many birds nest at regular times of the year. An autumn burn could be followed by cool/cold conditions which may be too severe for successful seedling establishment.

Effect of fire on the soil and nutrient cycles

Aspects of soil ecosystem that may be changed are **erosion**, **soil structure**, **micro-organisms, invertebrates** and **nutrient cycling.**

Erosion: - Sheets of rock may flake off due to extreme heating. Heavy rain after bushfires also causes severe soil erosion. On the other hand, moderate rain after an intense summer fire initiates plant growth which starts to protect the soil.

Micro-organisms and invertebrates: -It is unlikely that fungi, bacteria, algae etc are ever all eliminated by fire, but the abundance of different organisms may be greatly changed. The effect on invertebrates is unclear, but small animals

such as spiders, centipedes, ants and millipedes can find shelter under rocks and logs. The time or season of fire is important. In winter, a large component of the invertebrates is in an arrested stage or shows low mobility, so that animals are unable to avoid the fire. On the other hand in spring animals are in the stage of greatest activity so that they can avoid the fire.


Ash-bed effect

Nutrient cycling: - The effect of fire on nutrient distribution may be divided into two sections: -

- The ash-bed effect
- Nutrient loss in run-off and smoke.

The ash-bed effect refers to the post-fire soil conditions, which result in very rapid growth of surviving plants and germinating seedlings. Soil phosphates in the top few millimetres become more available to plants when soils are subjected to high temperatures during intense fires. The amount of Nitrogen in the form of ammonia also increases. Another result is the release of nutrients from mineral ash, where substantively higher concentrations of Calcium, Magnesium and Phosphorus are found in the ash left after fire. This comes from the plants originally present. Nutrients can be lost in smoke and run-off from the soil caused by heavy rain.

Micro-organisms and chemicals: -After an intense fire the top few centimetres of the soil are sterilised. All micro-organisms are killed. Bacteria can rapidly recolonise and fungi do so more slowly. These early Bacteria and Fungi include many types not detected in unheated soil. This distinctive microflora reverts to that of the untreated soil in approximately one year. Some plants will grow more successfully because toxins present in normal forest soils have been destroyed by heat.

Fire management

Fire is used by authorities for various reasons.

- **Hazard reduction** (Proscribed Burns). Bush near property is regularly burnt to reduce fuel to lower the risk to houses and other property.
- **Back burns**. When a fire is advancing toward property, part of the area in front of the flames is burnt to reduce the fuel load and stop the fire's advance.
- **Environmental burns**. Fire and the smoke arising are used to promote germination of the seed bank and thereby increase diversity. Generally, the plant population left without fire for some time no longer contains many species that were previously found.

Reaction of plant species to fire

Some plants are killed by fire, whereas others have evolved mechanisms to survive fire. They can be divided into sprouters and non-sprouters. The non-sprouters rely on seed to reproduce and are sometimes called obligate seeders.

Epicormic growth

Xanthorrhoea regrowth after fire

- **Sprouters**: These are plants that **resprout** after all leaves have been scorched. They have either:-
  1) Underground buds
     i) Root suckers, horizontal rhizomes
     ii) Basal stem (lignotuber) sprouts, vertical rhizomes
  2) Aerial regenerative buds
     i) Epicormic buds grow out
     ii) Continued outgrowth of active pre-fire buds

- **Non-sprouters**: Plants **die** if all leaves scorched**.** They have one of:-
  1) Seed stored on the plant that is released
  2) Seed stored in the soil
  3) No seed storage in the burnt area

Banksia spinulosa lignotuber

Sprouters

As an example of the 'Sprouters', Eucalypts may be the most obvious of the survivors. Most eucalypts have lignotubers, a woody swelling at the base of the stem which contains buds and food reserves. Lignotubers are usually accompanied by epicormic buds within the bark, hence the familiar sight of red tips springing from a black trunk. These eucalypts also have the additional survival mechanism of seed stored on the tree. Waratahs and Mountain devils with resprouting lignotubers were noted to flower well about two years after fire. There are however some fire sensitive eucalypts, for example in the Blue Mountains, *E. oreades* and *E. deanei.*
Many plants have been observed to flower prolifically a year or two after fire. The grass tree (*Xanthorrhoea* sp) is one and while their grass-like leaf crowns burn readily, their tightly packed leaf bases will not.
The other survival mechanism is by the regrowth of underground root suckers or horizontal rhizomes. Many grasses and ferns have these underground rhizomes,

so it is common for plants like Bracken or Blady Grass to be amongst the first appearing after fire.

Non-sprouters: Plants killed by fire rely on seed to germinate and produce new plants. Seed may be stored on the plant or in the soil. Examples of seed stored on the plant include Banksias, Hakeas and Allocasuarinas and stored in the soil, Peas, Wattles and Boronias. Seed may exist in the soil for many years before germination, which may be promoted by the heat and /or smoke of the fire. Some Banksias survive fire well. This is the case when the species has a lignotuber. However, *B. ericifolia* doesn't have a lignotuber, is killed by fire and recovery of the species is dependent on seed released from the burnt plant. The emergence of seedlings is affected by season and fire intensity. Seeds are released more quickly from cones exposed to high temperatures. If the fire is followed by periods of good rainfall, a large proportion of seed will germinate. New plants mature and produce seed again after 5-6 years. A second fire within 5 years would therefore result in the species being lost to the area. (See also Table 1.)

Hakea – Post fire seed release

Lobelia germinated by fire

The following species were found to occur after a fire in the Blue Mountains and would almost certainly would also at KWG: - *Actinotus helianthi, Thysanotus sp*, *Hybanthus sp, Sowerbaea juncea, Dampiera purpurea* and *Lobelia sp* (said to flower only after fire).
Several ground orchids (especially *Diuris sp)* flower well after fire. They have underground tubers, which provide valuable protection, as during fires the heat rises and only a small proportion penetrates the soil. It is thought that the increased light benefits them after fire has passed through. These orchids probably should be classified as sprouters.

Growth of post-fire buds

Non-Sprouter *Acacia*

Examples of Survival after fire			
(high intensity at 100% scorch)			
Sprouter	**Survival**	**Non-sprouter**	**Survival**
(Survives fire)	**Mechanism**	(Killed by Fire)	**Mechanism**
	L Lignotuber		
	E Epicormic buds		
	U Underground rhizome		
	G Growth pre-fire buds	*Acacia suaveolens*	Soil seedbank
Actinotus minor	G	*Actinotus helianthi*	Soil seedbank
Banksia oblongifolia	L E	*Allocasuarina littoralis*	Seed on plant
Banksia serrata	L E	*Banksia ericifolia*	Seed on plant
Callicoma serratifolia	L E	*Boronia ledifolia*	Soil seedbank
Eucalyptus (most)	L E	*Boronia serrulata*	Soil seedbank
Gahnia spp.	G	*Dillwynia retorta*	Soil seedbank
Hakea laevipes subsp. *laevipes*	L E	*Epacris pulchella*	Soil seedbank
Imperata cylindrica	U	*Eriostemon australasius*	Soil seedbank
Pteridium esculentum	U	*Grevillea sericea*	Soil seedbank
Xanthorrhoea spp.	G	*Hakea dactyloides*	Seed on plant
		Hakea teretifolia	Seed on plant
		Petrophile pulchella	Seed on plant?
		Pimelea linifolia	Soil seedbank
		Woollsia pungens	Soil seedbank

Role of smoke
Smoke has been recognised as important in some species for germination. Smoke water, available commercially is used by propagators to aid germination.

Use of fire by Bush Regenerators
The woody stems of weeds removed by bush regenerators frequently are placed in a pile which may be burnt. Burning effectively reduces the mass of weeds, but perhaps more importantly, it will bring about germination of the seed in the soil. Often in this process plant species no longer growing will reappear and so restore diversity on the site. (The other aspect of such a pile is that it forms good habitat for wildlife.)

Bush Regeneration Pile Burn

Effect of fire on weeds
Lantana, Small-leaf privet, Trad, Pampas grass, Morning glory and many other weeds have fire survival mechanisms. Most weeds are not killed by fire!

Fire at Ku-ring-gai Wildflower Garden

The area under the power lines, along Smiths Track, was burnt in 1991. Most of the remainder of the garden was burnt in the 1994 extensive fires in Sydney. In the many years since, a sequence of communities has occurred. Immediately after the 1991 fire along the Smiths Track, it was common to find large numbers of *Dillwynia retorta* and *Boronia ledifolia.* Recently, before the burn in 2012, they were uncommon. Shortly after this burn *Actinotus helianthi* and in recent times many more species were regenerating. After the 1994 fire, in the area known as Donnelly's Swamp, *Blandfordia*, *Sprengelia*, *Drosera* were present shortly afterwards. Some years later (? 10) a large area of *Viminaria* was located. Before the recent burn there, these species were hard to find. *Banksia ericifolia* was a dominant remnant species in this area. It was unknown which species existed as an underground seed bank. The recent new fire has stimulated germination of many of these species.

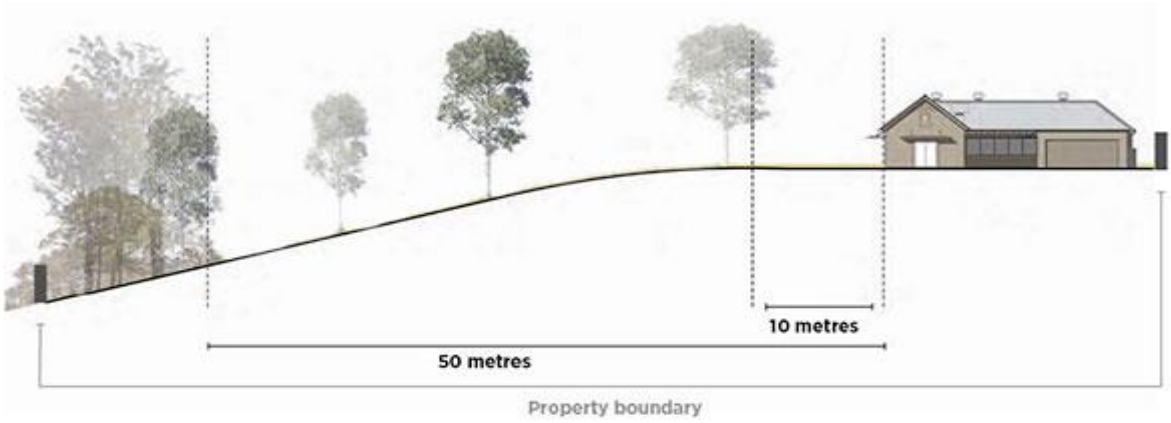
Microtis rara

It seems that fire has stimulated the appearance of previously unrecorded species or species that have not been recorded for some years. After a controlled burn approximately some years ago at the Western end of the Mueller Track, *Prasophyllum brevilabre* was recorded for the first time. As well, after a burn in the Senses Track, *Prasophyllum elatum* was found for the first time for some 15 years. *Genoplesium ruppii* and *Genoplesium fimbriatum* were recorded for possibly the first time. *Pultenaea polifolia* was also recorded on the Senses Track following fire, after also not having been observed for some years. Also many plants of the terrestrial orchid *Microtis rara* have been observed for the first time after a Senses Track burn. Most terrestrial orchids have adapted to fire to the extent that fire is an integral part of their lifecycle.

10/50 vegetation clearing - NSW RURAL FIRE SERVICE

10/50 Scheme

A recent development, some would say controversial, scheme established by the NSW Rural Fire Service (NSW RFS) is the 10/50 vegetation clearing scheme. NSW RFS says "if you live in an area close to the bush, you need to prepare your home. This scheme gives people living near the bush an additional way of being better prepared for bush fires".



The scheme allows people in a designated area to

- Clear trees on their property within 10 metres of a home without seeking approval; and
- Clear underlying vegetation such as shrubs (but not trees) on their property within 50 metres of a home, without seeking approval

References

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