Mallee Emu-wren.
PHOTO: CHRIS TZAROS

Fire mosses, and fire fungi such as *Giopyxis carbonaria*, illustrated here, can sometimes blanket large areas immediately after a fire. But the fire responses of most fungi are unknown
PHOTO: DAVID CATCHSIDE.

FIRE AND BIODIVERSITY
Some notes from the symposium

VNPA Park Protection Officer Phil Ingamells *reports on this symposium, organised jointly by the VNPA and the Royal Society of Victoria and held on 24-25 October.*

Presentations will be summarised in a larger report. Peer reviewed papers will be published as Proceedings of the Royal Society of Victoria.

VICTORIA IS CURRENTLY PERFORMING THE largest ecological experiment ever carried out in the state.

Over the last decade, more than three million hectares of Victoria have been burnt in bushfires, most notably in the severe fires of 2003, 2006 and 2009. And climate change is predicted to bring us ever more frequent episodes of severe fire.

To protect the public from fire, the State Government has embarked on an extensive program of management burns: 5% (around 390,000 hectares) of public land are to be burnt each year, regardless of the area already consumed by bushfires.

The impact of this amount of fire (both wild and planned) on our already fragmented and otherwise compromised natural areas is largely unknown.

To help us understand this predicament, the VNPA, together with the Royal Society of Victoria, held a Fire and Biodiversity symposium on 24 and 25 October. Attended by 120 scientists, land mangers and other interested people, the symposium looked for answers to three questions:

- What do we know about fire and biodiversity in Victoria?
- How should we go about management burn targets and prescriptions for biodiversity?
- How should we design research and monitoring programs to improve management of fire and biodiversity?

The symposium was held as a tribute to Jenny and John Barnett, Leigh and Charmian Ahern, and Richard and Eileen Zann, three couples who contributed greatly to our understanding of biodiversity in Victoria before falling victim to the fires of Black Saturday.

The following is an excerpt from a statement by Dale and Chloe, son and daughter of the Aherns, which was read at the opening of the symposium.

> *As early as our parents' memorial service in February 2009, one of our father's colleagues was already observing the gravity of the task set before the scientific community in the wake of Black Saturday – that of speaking up for measured and informed environmental policy against a tide of reactionary public opinion and government decision-making.*
>
> *An extreme approach to fire management, with an emphasis on the environment as something dangerous, is not what our parents would have wanted. They both knew about our ecosystem's wonderful subtleties and intricacies...*
>
> *Our parents also knew how fragile our environment is, and how much is yet to be learned about it.*

Some of the findings of the symposium appear in the following pages. A more comprehensive summary will be developed for the VNPA website, and peer-reviewed papers will be published next year as Proceedings of the Royal Society of Victoria.

What do we know about fire and biodiversity in Victoria?

We know quite a lot about the way our vascular plants (trees, shrubs, smaller herbs and grasses) respond to fire. But we know much less about the way vertebrate (backboned) animals are affected, very little about the responses of most cryptogams (mosses, liverworts and fungi) and most invertebrates (spiders, insects and worms), and almost nothing of the world of countless microbes and bacteria and their relationship with fire.

That means we are ignorant of how more than 95% (around 100,000) of our native species behave in response to fire.

We know our natural systems have evolved to live with fire, and in many cases depend on it, but we don't know how they will handle increased fire frequency, or unseasonal fire.

As a best fit, our land managers have been using vegetation responses as a surrogate for all species. The assumption is that if our vascular plants can handle a certain fire regime, then everything else will manage to tag along. But that assumption is largely untested.

Fire tolerances for vegetation types

A team in DSE, led by ecologist David Cheal, has developed a relatively comprehensive report: *Growth stages and tolerable fire intervals for Victoria's native vegetation data sets.*

The complexity of this task should not be underestimated.

The flowers of a young Desert Banksia (*Banksia ornata*), for example, will not produce seed pods—most seeds are produced when the plant is decades old. And many plants need hundreds, even thousands, of seeds to guarantee replacement after fire.

Some plants store seed in the canopy, others in the ground. Other plants are resprouters and not dependent on seed accumulation. Few species in a complex community actually prefer the same time interval between fire, or fire at the same time or severity.

The report groups Victoria's vegetation types into 32 Ecological Vegetation Divisions (EVDs), and establishes up to eight growth stages for each, ranging from 'renewal', through 'adolescence' to 'waning'. It also establishes, for each EVD, a minimum tolerable fire interval (TFI) for high severity fires, another for low severity fires, and a maximum TFI.

While this is a very useful tool for fire managers, there are many issues around the way it should be used.

The 'minimum' tolerable fire interval for a given EVD is not the point at which fire *can* be applied; it is the point at which a manager can *consider* burning. That consideration must take into account the existing range of fire age classes for that EVD, degrees of fragmentation of the community, the needs of fauna, invertebrates, etc. and, importantly, things that affect condition, such as drought.

This means that people actually planning and implementing management burns must have a good understanding of the ecology of the areas they are responsible for, and a growing understanding of fire ecology generally.

Importantly, while a vegetation community that was burnt three years ago can be replaced in another three years, it is extremely difficult to replace a community that has not been burnt for 50 years or more, once it is lost. And it's almost impossible to guarantee the eventual replacement of a 150-year-old Mountain Ash forest (see p. 12).

In the situation we are faced with in Victoria—very few long-unburnt areas remaining, and predictions for increased fire activity – we have to plan management actions very carefully.

Fungi and fire

There are many tens of thousands of species of native fungi: macrofungi (mushrooms and the like), microfungi (leafspots and other things important to ecological systems), truffles and lichens.

And their responses to fire are highly varied. Some love fire, others don't, and some have complex fire relationships.

Things get even more complex when you realise that most fungi have established relationships with other plants, and also with a range of insects. In many ways, fungi are the lynchpins of ecological systems. We ignore them at our peril, yet no public land management agency in the state employs a mycologist (fungi expert).

Stone fungi, like *Neolentinus dactyloides* above, can have remarkably complex fire associations. A similar stone fungus is known to grow in the decaying logs of long-unburnt eucalypt forests. However, though it needs a long fire-free period to grow, it does need fire to stimulate its fruiting body.

PHOTO: RICHARD ROBINSON

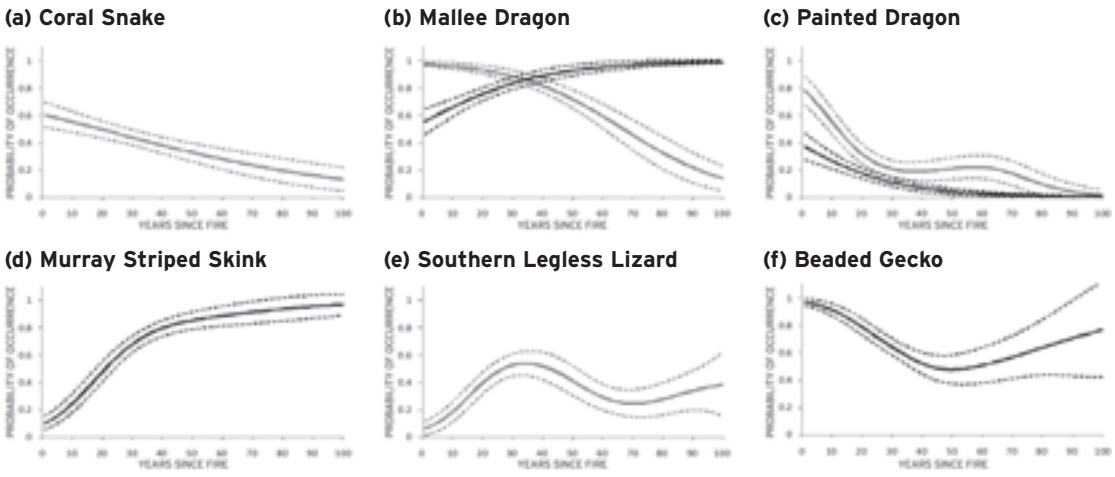
The Mallee Fire Project

This project, led by ecologists Mike Clark from La Trobe University and Andrew Bennett from Deakin, is the most extensive fire ecology project ever conducted in the state, and it's a model for future studies.

Supported by 12 agencies, involving around 38 collective years of full-time work by PhD students and supported by 100 volunteers, the project studied 840 sites across reserves of treed mallee in Victoria, SA and NSW covering an area 'three times the size of Belgium'.

It mapped the fire history of the area, looked at the diversity of age classes, habitat structure (including hollow formation), and measured the abundance of a considerable range of vascular plants, vertebrates and invertebrates.

The figure below, for example, outlines the probability of occurrence of six reptile species in *Triodia* (Porcupine Grass) mallee vegetation in the years following fire. The black lines indicate occurrence of species north of the Murray, and the grey lines species south of the Murray. Several species showed differing responses to time since fire in different regions.



from Nimmo et al, *Global Ecology and Biogeography*, in press

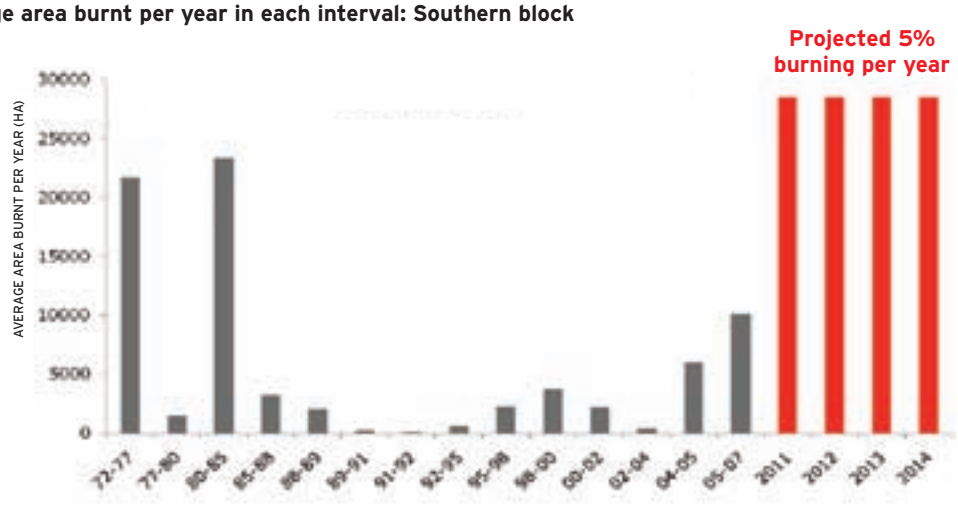
Analysis of the results from this complex program is continuing, but some results are already evident. Most telling is the conclusion that simply maintaining floristic diversity in a fire regime will not guarantee a diversity of animals.

Another clear conclusion is that we have to be very site-specific when planning burn programs. Simplistic application of an inappropriate statewide target has the potential to do irreversible ecological harm.

The grey bars in the figure below show that the combination of wildfire and planned burning since the 1970s has burnt on average 1.7% of the mallee per year. The red bars depict the area that would be burnt by planned burning alone if the 5% annual target were met (ignoring any wildfire that might be additional to this target).

The researchers believe that a fire regime dictated by such a target would lead to serious concerns for the many species which prefer, or depend on, long unburnt country (40-100 years since fire). Such areas of mallee are now scarce.

Average area burnt per year in each interval: Southern block



What about invertebrates?

The relationship of invertebrates to fire is often difficult to study, partly because tens of thousands of species are not even described, but also because the appearance of invertebrates is often seasonal, or even less predictable. And insects go through complex life cycles, with differing life-forms having different fire responses.

Nevertheless, understanding invertebrate responses to fire is important, and not just because many, such as the Mallee moths, have a role in reducing fuels by breaking down accumulated leaf litter. Invertebrates perform a great variety of functions in healthy ecosystems.

Indigenous burning

Two symposium presentations explored the extent of pre-European Indigenous burning, by quite different means.

Scott Mooney (University of NSW) outlined his collaborative project which looked at charcoal records across Australia over the last 70,000 years. The study showed that the chief agent of increased fire was climate, and that apart from that, there was a significant increase in the charcoal deposit record *after* European occupation. Importantly, grass fires do not contribute greatly to the charcoal record.

Monash University's Beth Gott has consulted widely with Victoria's Aboriginal communities, and also explored the historical record. Then, as a botanist, she studied the fire attributes of Indigenous food plants and their locations across the state, to see where pre-European burning would have been most advantageous for Aboriginal people. Generally, this was likely to have been in the grasslands and grassy woodlands.

Fire mapping

It's not just the length of time since the most recent fire that is important for managing ecological systems.

Long-term fire history is particularly useful, and ideally that would include an understanding of the severity, season and degree of patchiness for each burn.

Accurate mapping of fires has rarely happened in the past, but it is important to correct that for the benefit of future managers. In some regions, DSE is now using a range of tools (including aerial and satellite imaging) to track fire. In the meantime, we can also backdate fire maps using what records we have, and a growing understanding of the fire responses of individual species.

The role of science

Melbourne University's Ary Hoffmann opened the symposium with a call for respect for science.

Science has taken a bit of a bashing over recent years, most particularly over the climate change 'debate' where scientists are expected to justify their studies to uninformed commentators. It is important to recognise science for what it is: a search for the truth through evidence-based studies, which in turn are reviewed by other experts in the field.

The role of fire in the management of ecological systems is inevitably becoming the province of science. There are many opinions and theories, some well-informed, some based on decades of prejudice. In either case, it's high time to test these through rigorously designed and executed studies. And it's important to respect that process.

Ecologists Ralph MacNally, Michael Clark, Dick Williams and Andrew Bennett in an informal moment at the Fire and Biodiversity in Victoria symposium held by the VNPA in conjunction with the Royal Society of Victoria.

PHOTO: KAREN ALEXANDER

Our thanks to the many scientists, land managers and others who contributed to the symposium. We also acknowledge the support of the VNPA Jenny Barnett Tribute Campaign, the Poola Foundation (Tom Kantor Fund), and individual donors to the VNPA Poola Foundation challenge grant.