Counting the cost: fire and reptiles

Are prescribed burning targets appropriate for reptile conservation?

By Annabel Smith (Australian National University)

Be careful when playing with fire. It's a message politicians know too well and after recent catastrophic wildfires in different parts of Australia they want to be seen as actively responding to the threat. One of the common responses is to raise the level of prescribed burning but what are the benefits and costs of this strategy?

Following the 'Black Saturday' wildfires in 2009 the Victorian Government introduced a 5% annual prescribed burning target to the entire public estate in Victoria. They are currently on track to delivering this target (see: http://www.dse.vic.gov.au/fire-and-other-emergencies/planned-burning-an-introduction/fire-operations-plans-approved). The South Australian Government has followed suit, also adopting a 5% prescribed burning target for high risk public land (see: http://www.environment.sa.gov.au/firemanagement/Fire_Planning).

At the same time that these policies are being implemented there is growing scientific evidence that such policies are unlikely to protect lives, built assets or to conserve biodiversity. Consider the study by Phil Gibbons and colleagues, for example, who found that prescribed burning was not the most effective way to protect houses in severe bushfires. (See *Decision Point #56*)

Let's discuss one group of animals where it has been assumed prescribed burning has advantages. Prescribed burning is often assumed to be beneficial for reptiles because fire opens up the habitat, creating areas where reptiles can bask. However, this is not always true, and our research over the past nine years has started to reveal how reptiles may respond to changes in fire management, including increases in prescribed burning. This research is revealing how complex ecosystems and responses to fires can be; it's also demonstrating the value of long term research studies are to unraveling this complexity.

Fire in the mallee

We conducted a study in the mallee vegetation of South Australia to determine 1) how reptiles respond to fire in their habitat, 2) if we can develop a predictive model of their responses based on ecological traits of species and 3) whether commonly used short-term survey data (eg, collected in two year studies) are appropriate for making recommendations for fire management in areas of high reptile diversity.

The field effort involved in our study was enormous. We surveyed reptiles every summer for six years in two reserves on the Eyre Peninsula. Over 100 volunteers were involved in the field work, resulting in 100 unique experiences of pitfall trapping in the remote mallee wilderness. Our data set for this study included 4,796 individual reptiles collected during 32,246 trap nights.

Most common reptile species that we studied were 'successional specialists', meaning they were most abundant at a particular time after fire. For example, many 'early successional' species were common in the first year or two after fire, while a number of 'late successional species' were most common in habitats that had not been burnt for more than 40 years.

Some species persisted in low numbers in their sub-optimal habitat. For example, the effect of time since fire on the southern shovel-nosed snake (*Brachyurophis semifasciatus*) was small. This species was most common 30 years after fire but it occurred in small numbers in all post-fire stages from one to 50 years after fire.

Other species were virtually absent from sub-optimal habitat. For example, the abundance of the early successional knob-tailed gecko (*Nephrurus stellatus*) declined to almost zero after 30 years since fire. The late successional skink *Ctenotus schomburgkii* was almost absent from habitats that had been burnt in the last five years. Species with this kind of ecological response to fire will be most at risk of extinction under inappropriate fire regimes (eg, widespread prescribed fire or complete fire suppression).

Some ecological traits of the reptile species we studied were related to their fire response. Species that shelter in leaf litter were generally late successional, while species that use burrows for shelter were generally early successional. Understanding the shelter requirements of different species may therefore provide a way of predicting how a reptile assemblage will be affected by different fire regimes. However, our ability to predict fire responses from ecological traits was limited by the scarcity of biological information (eg, movement, dispersal and reproduction) on most reptile species. We are still a long way from having a mechanistic understanding of how reptile communities will respond to changing fire regimes.

> "These species may become threatened if the amount of fire in the landscape increases, for example by implementing high prescribed burning targets such as 5% per annum."

A volunteer with a pit-fall trap to catch reptiles wandering through the mallee. The data set for this study included 4,796 individual reptiles collected during 32,246 trap nights. Volunteers were vital to the data collection. (Photo by Jana Bradley)

Different surveys, different findings

A key discovery from our study was that many of the ecological responses to fire in reptiles were not found in previous studies that used smaller, although substantial, subsets of the same data. Two previous two-year studies at the same locations concluded that most common reptile species were not affected by post-fire succession. Our six-year data set suggested that this conclusion was premature and that many reptile responses to fire may not be detected using short-term data sets.

Importantly, a higher rate of late successional responses to fire went undetected in previous studies, while early successional responses appear easier to detect. We noticed a trend for sample size to be related to the point in the succession where a species peaks in abundance. This does not mean that early successional species are more abundant than late successional species, but that it is more difficult to accumulate samples to study late successional species.

The implication of these results is that we are probably unaware of the extent to which many reptile species that specialise on old vegetation (eg, over 40 years old). It has previously been suggested that fire is beneficial for reptiles because they rely on basking to regulate their body temperature and fire increases habitat in which they can bask. Our study suggests that there may be a large suite of reptile species that need long unburnt vegetation for habitat. These species may become threatened if the amount of fire in the landscape increases, for example by implementing high prescribed burning targets such as 5% per annum.

Managing fire for reptile diversity

Management that is likely to be of greatest benefit to reptiles in mallee ecosystems would aim to protect long-unburnt habitat (eg, 40–50 years old, and potentially older) from fire because these post-fire habitat stages are uncommon. Actions to help achieve this include promoting small, patchy fires to prevent widespread wildfire and minimising the application of back-burning in long-unburnt habitat while fire-fighting. Implementing spatially targeted burns to reduce the risk that long-unburnt habitat will be burnt in a single fire is likely to be an important strategy but this needs to be implemented as an experiment because its efficacy is poorly understood.

Our study highlighted a risk that fire management decisions based on insufficient data may not accommodate the complex range of responses by animal communities to fire. Although long-term, intensive studies are not always possible, it is important that results from time- or sample-limited fire studies of reptiles are interpreted with the knowledge that many ecological responses may not have been detected.

While avoiding widespread frequent burning or complete fire suppression, it is important that responses to alternative fire regimes are monitored across a range of taxa, so that management practices can be updated in light of new information.

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Reference

Smith AL, Bull CM, Driscoll DA (2013) Successional specialization in a reptile community cautions against widespread planned burning and complete fire suppression. *Journal of Applied Ecology* DOI: 10.1111/1365-2664.12119.

Reptiles in the mallee: a. Volunteer Catherine Whitehead holds a juvenile goanna (Varanus gouldii); b. the mallee skink (Ctenotus atlas) lives in spinifex grasses that take around 30 years after fire to reach their peak density; c. the spiny-tailed gecko (Strophurus assimilis) can be found in mallee of the northern Eyre Peninsula; d. the knob-tailed gecko (Nephrurus stellatus) thrives in open habitats created by fire. (Photos byAnnabel Smith)