

# Adaptive management

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To effectively manage and conserve biodiversity, we need a clear understanding of those threats that directly or indirectly lead to an increased risk of decline in species, populations, ecological communities or ecosystem functions. At a minimum this includes an understanding of how and where each threat operates, the nature of any interactions between different threats, and how each threat may be changing. An understanding and identification of cause and effect is crucial to the effective management of threatening processes (Caughley 1994). At the same time, our understanding of the ecological processes that control species composition and persistence is incomplete. As a consequence, many possible management actions are limited by uncertainty.

## Adaptive Management Concept

The concept of adaptive management (Walters and Holling 1990) seeks to improve our knowledge through clearly designed alternative management options, where the results of these options can then be used to further modify management actions. Such adaptive strategies promote experimentation to spread and reduce risk of failure across alternative actions (Lindenmeyer & Burgman 2005). It is also essential to ensure that any management actions are monitored (using clear and appropriate designs) to inform adjustment and development of threat amelioration measures accordingly over time. All this must be done

in the context of limited resources, necessitating priority setting of actions or target species, while minimising the impact of threats across local and landscape scales.

Under a changing climate we must also consider how the goals of adaptive management may change in response to changes in a species' ability to persist in its current environment or to move across the landscape to new areas. This may entail re-thinking and re-defining current management objectives over time.

Adaptive management has been used as a framework to guide the conservation of biodiversity, for example in the management of Kruger National Park, South Africa. The work at Kruger has highlighted that, to successfully implement an adaptive management program, a number of problems have to be overcome, including the incorporation of science into management and policy, maintaining collaboration and the ongoing resourcing of monitoring (Walters 1997; Rogers 1998). These issues should be considered when applying adaptive management to the Australian context.

## Adaptive Management – Landscape Scale

An example that highlights the above issues is the beginning of an adaptive management strategy across the landscape in eastern Australia. This involves the development and application of minimum fire return intervals for species and ecological communities. In this case, there has been a clear identification of a direct threat to the maintenance of biodiversity where fires occur too frequently in a landscape (e.g. NSW Scientific Committee 2000; listing under the *Flora and Fauna Guarantee Act 1988* in Victoria).

Considerable uncertainty remains concerning the capacity of individual species to cope with frequent fire, the interaction of frequent fire with other components of the fire regime, and how the probability of frequent fire may change under a changing climate. In NSW, to address this, minimum fire-free intervals have been developed for those species most at risk of extinction (threatened species) as well as for broad-scale vegetation classes (NSW Rural Fire Service 2006). These thresholds are based on detailed data for some taxa and extrapolation for many comparable taxa.



*Sampling the fire response of plant species after an ecological burn for restoration. Photo: David Wilks*



A register for plant responses proposed by Gill and Bradstock (1992) has been developed in NSW. Monitoring of the fire response of species, along with the time taken to first flowering and development of a seed bank, can then be used to further inform or modify the thresholds and to build up our knowledge of a range of species and ecological community responses to fire.

Landscape scale mapping of fires, both prescribed burns and wildfire, can be used to identify potential areas at risk of being burnt too frequently. This may then lead to direct protection actions for these areas. With time, some of the uncertainty in species' responses will be reduced, while modelling will inform risk assessment under climate change (e.g. Carey *et al.* 2006).

This scheme is still in its infancy and requires ongoing collaboration between researchers, fire managers and those policy makers that determine the legislative context of the scheme.

### Adaptive Management – Local Scale

At the local scale, there are examples of conservation management which favour an adaptive management approach. The restoration of remnant habitat areas impacted by weeds is an ever growing area of management focus. In such cases, the key threat is the invasion of exotics, but other issues may also be important, such as nutrification, habitat disturbance, fragmentation, urbanisation and changes to disturbance regimes such as fire.

Determining the best amelioration strategies may be straightforward (e.g. removal of weeds) or complex (e.g. experimental weed control treatments combined with treatments, such as fire or smoke, that promote natural regeneration from a soil seed bank). In the latter case, we need to learn both how effective different control treatments may be, as well as the capacity of the habitat to respond to treatments aimed at trying to mimic natural disturbance regimes.

Alternative strategies may also carry a risk element for biodiversity, within the context of the local area, that may be quantified in the treatment application and subsequent monitoring. For herbicide application this would include impact on non target species. For smoke application, smoke may promote germination from a soil seed bank without a concurrent reduction in fuel levels, and there may be a risk that fire will eliminate this recruitment in the near future. Hence monitoring schemes need to be sufficiently robust to cover a range of possible impacts.

### Key Points

A key message for those seeking to apply an adaptive management framework is to identify threats and design sound ameliorative measures and monitoring schemes that will increase our knowledge of the response of the flora to the range of possible amelioration measures. Where considerable uncertainty exists, alternative strategies should be trialed. It is critical to have sound objectives. Too often we fail to ask the right questions or to undertake monitoring that will provide us with relevant answers to our questions. At the same time, we need to consider how to integrate such schemes into land management programs and legislation to ensure their long-term uptake.

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