

## 27. Applying Adaptive Management Principles to Malleefowl conservation

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### **Abstract**

The Malleefowl Recovery Plan highlights numerous potential threats to Malleefowl persistence and recommends adaptive management as an approach to integrate monitoring and management activities across the birds' range. In a series of papers, the Malleefowl adaptive management research team outlines the structure for such a program. We use community knowledge, the existing National Malleefowl Monitoring Database and supplementary data to inform our approach. Network ecosystem models will capture and prioritise the range of threats and actions potentially affecting Malleefowl persistence. High-priority and high-uncertainty issues, such as the efficacy of fox baiting to improve Malleefowl persistence, can be researched as scientific experiments. In addition to Malleefowl mound activity, supplementary data may be collected to support such experiments. All evidence built and lessons learned from these detailed experiments can inform future iterations of the network ecosystem model and allow new priorities to emerge over time. While these models can develop scientific evidence and provide guidance for management, successful Malleefowl conservation will continue to depend on the co-ordinated efforts and enthusiasm of policy-makers, environmental managers and community groups across the Malleefowl's range.

### **Introduction**

In a context of myriad environmental threats, limited management budgets and poorly understood ecosystem behaviours, adaptive management is a popular planning approach. Adaptive management is a philosophy and set of scientific methods that allow for evidence-based action in the face of uncertainty (Walters 1986). It creates space for learning from the actions that are undertaken, and is thus often known as 'learning by doing'. However, it is much more than simply trial-and-error or learning from mistakes. Adaptive management is a strategic approach that balances learning opportunities against ecosystem responses to maximise overall environmental benefits (Runge 2011).

Ecosystem monitoring is a crucial component of adaptive management. While initial actions may be based on scant evidence and careful risk assessment, monitoring the ecosystem's response to actions allows managers to accumulate more evidence, adapt their thinking when needed and 'learn by doing'. In order to document this learning experience scientifically, uncertainties must be clearly articulated from the outset. This means carefully eliciting expert knowledge and regularly analysing monitoring data, converting these into meaningful evidence, tracking reductions in uncertainty as time progresses and adapting management plans to reflect the current balance of evidence.

Adaptive management is centred on management and not research. Learning and research activities are embarked upon only insofar as they are expected to directly increase environmental benefits (Runge 2011). In order to focus on management benefits, adaptive management requires that the objectives of a project be specified in a clear and measurable way.

Malleefowl conservation is a current candidate for adaptive management (Benshemesh & Bode 2011). The National Malleefowl Recovery Plan highlights the many potential threats to Malleefowl persistence, and adaptive management offers a method for prioritising activities to combat these threats. This prioritisation can occur even in the presence of uncertainty regarding the intensity of threat and the effectiveness of the candidate conservation actions. Furthermore, historical Malleefowl monitoring data and community knowledge provide a foundation of evidence to form initial models and predictions.

Here we provide an overview of the adaptive management research project for Malleefowl; some project components will be presented in more detail elsewhere in the Proceedings (Bode *et al.* 2014, Lahoz-Monfort & Hauser 2014, van Hespen *et al.* 2014).

## **Project Structure**

The scope of Malleefowl conservation is vast given their extensive distribution, the range of threats to their persistence, and the network of government agencies, land holders and community groups involved in the management of their habitat. In this project we address Malleefowl management at multiple scales. At the broadest level, we use expert workshops and network ecosystem models to coarsely capture this conservation challenge as a whole. Then we develop a more detailed experimental design for a single threat and explore supplementary data to support this experiment. Finally we outline the process of learning and updating that will make best use of Malleefowl data and knowledge.

### *1. Expert workshop*

In October 2012 the research team gathered experts at the University of Melbourne to develop Malleefowl conservation objectives (Figure 1), and then construct models linking threats, drivers and potential actions for a whole-ecosystem view. The group agreed that the fundamental objective of adaptive management should be:

*The long-term persistence of a self-sustaining Malleefowl population over an unspecified range.*

Means objectives were identified as a measurable path to achieving this fundamental objective. These included adult abundance, juvenile abundance and occupancy/range.

In an effort to capture diversity of thought and potential uncertainties in ecosystem behaviour, the expert team was divided into three groups. These groups developed independent models of threats to Malleefowl persistence, environmental drivers and potential conservation actions (Figure 2). Grazing, fire, rainfall and predation emerged as key issues. Potential conservation actions included:

- reducing grazing pressure
- controlling other species, e.g. predators (including introduced ones like foxes and cats)
- fire management
- Malleefowl translocation
- road signs
- influencing land use change and protection
- revegetation
- supplementary feeding.

A full record of the workshop and its findings are available on request.

### *2. Network ecosystem models*

The traditional mathematical modelling techniques adopted for adaptive management, such as stochastic dynamic programming (Walters 1986), are suitable for addressing a modest set of uncertainties and ecosystem responses. However the expert workshop revealed that Malleefowl are placed within a complex ecosystem with many uncertain interactions. Bode *et al.* (2014) are investigating new approaches in network modelling, which translate the workshop models into millions of possible numerical interactions. Some of these models and interaction rules have been presented at a second expert workshop, held in conjunction with this National Forum, to identify and remove unrealistic scenarios. The refined set of models will offer some insight into key threats and uncertainties affecting the persistence of Malleefowl.

### 3. Experimental design for a single threat

Network ecosystem models will provide a coarse, overarching view of Malleefowl persistence. However they may not be suitable for directing specific management actions to individual Malleefowl sites. For this purpose, we additionally focus on a single threat-action candidate and develop a more detailed management plan based on methods of experimental design and statistics (Lahoz-Monfort & Hauser 2014).

We propose fox predation and baiting as a suitable threat-action pair. While foxes have undoubtedly been documented preying on Malleefowl eggs, chicks, and captive-reared birds, their cumulative effect on Malleefowl persistence is uncertain (Bode & Brennan 2011). Furthermore, the efficacy of fox baiting to reduce fox densities and interactions with Malleefowl warrants further investigation (Walsh *et al.* 2012).

Lahoz-Monfort & Hauser (2014) seek to monitor Malleefowl sites across Australia, with some sites baited for foxes and some not baited, and all sites monitored for Malleefowl activity. The authors show generic preliminary models that calculate the quantity of data needed to detect a fox-predation-response in amongst the natural year-to-year and site-to-site variations in Malleefowl activity.

### 4. Supplementary data to support an experiment

Monitoring data in the National Malleefowl Monitoring Database will provide the important ecosystem response information for adaptive management. However it may be augmented with other data streams, particularly in the case of a focused management experiment.

As we evaluate the potential for fox baiting to reduce predation on Malleefowl, fox population density forms a crucial link between fox baiting and Malleefowl survival. Estimating fox density will allow us to distinguish the effect of fox baiting on foxes from the effect of foxes on Malleefowl.

Benshemesh (2014) has completed a pilot study on the use of camera traps in Malleefowl habitat and has secured funding for an expanded program. Van Hespden *et al.* (2014) will develop statistical designs that maximise the quality of information gathered by cameras, to help develop new evidence regarding fox response to baiting.



**Figure 1.** Brendan Wintle elicits knowledge from Malleefowl ecosystem experts at the 2012 workshop.

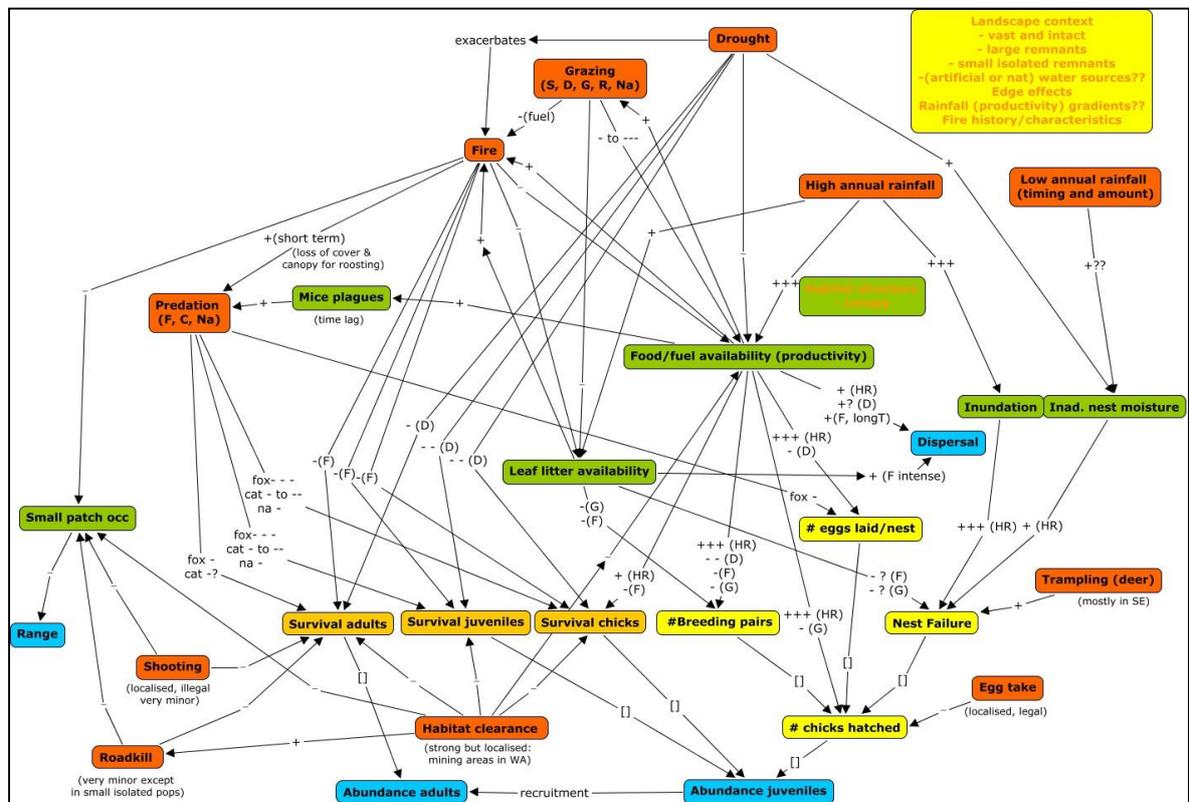
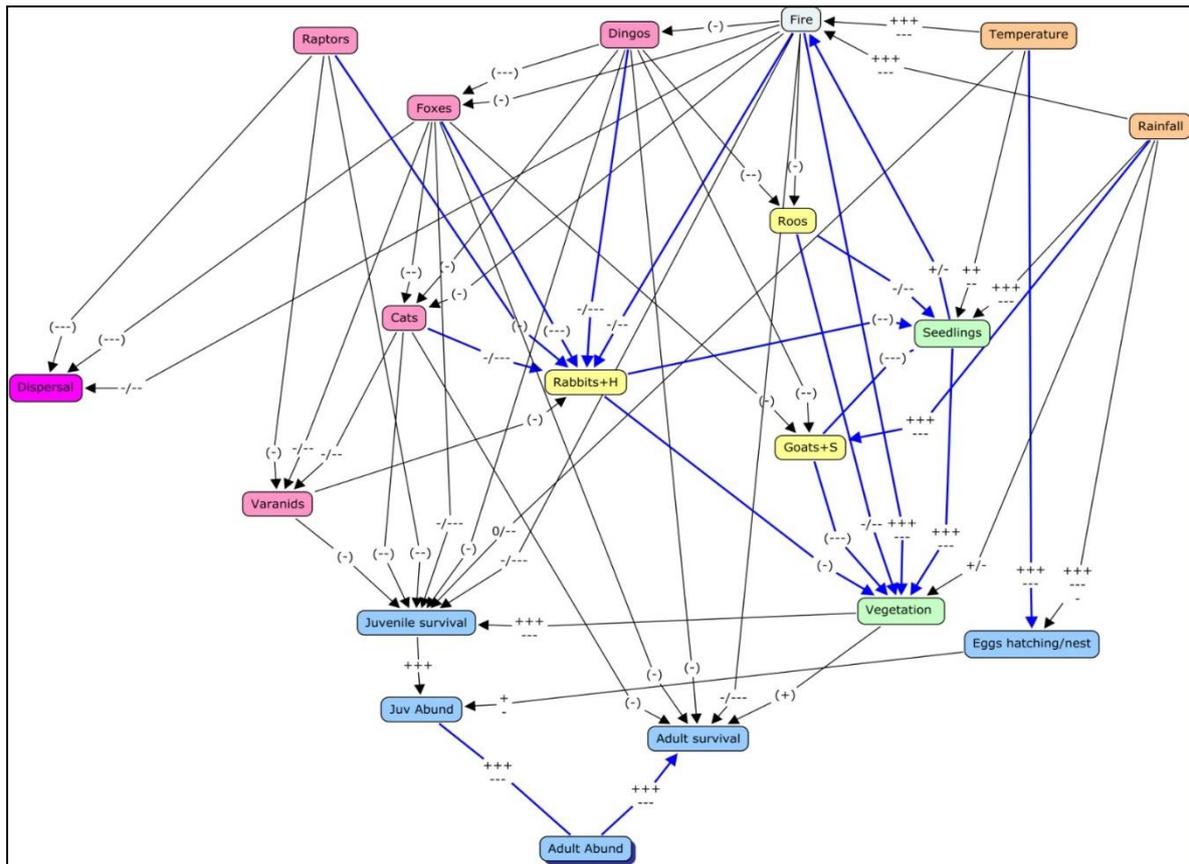


Figure 2. Two of the three independently-elicited ecosystem models for Malleefowl conservation and persistence developed at the 2012 workshop.

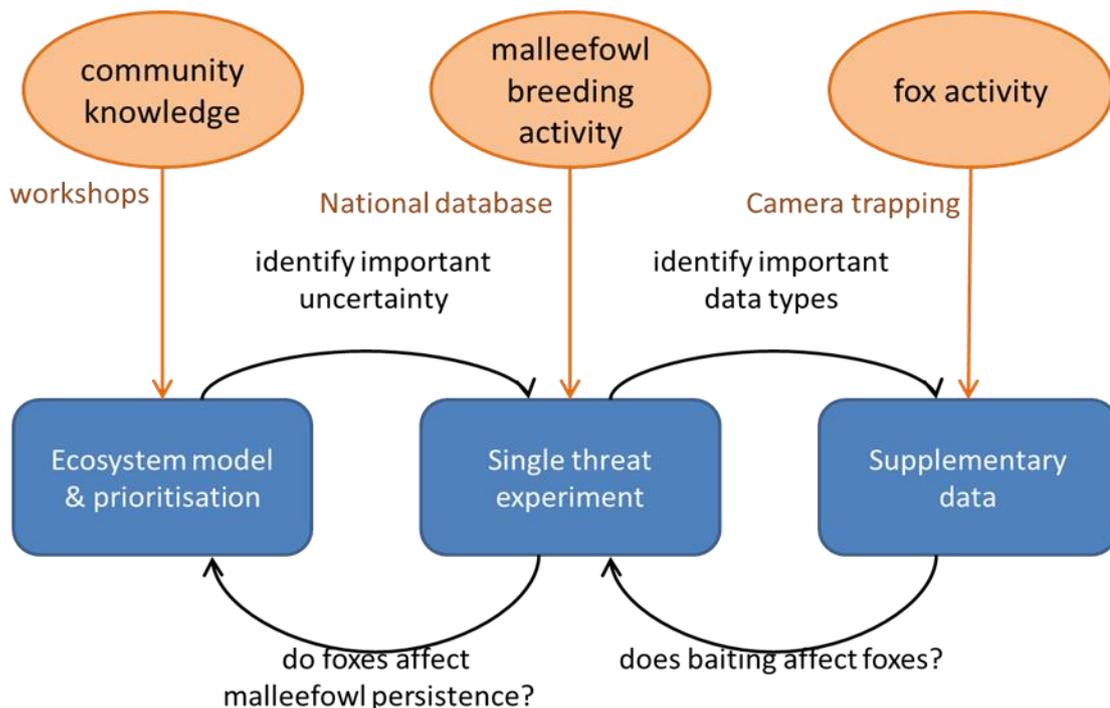
## 5. Learning and updating

The ecosystem network model, single threat experiment and supplementary data design described above can be considered a nested set of research projects operating at different scales and all serving an overarching adaptive management purpose (Figure 3).

We have drawn from community knowledge through elicitation workshops. This has provided structure to the *ecosystem network model*, which will allow us to prioritise promising threats and actions. When an action or threat is shown to carry influential uncertainty, a *single threat experiment* can be designed to learn more and resolve uncertainty. Malleefowl breeding activity drawn from the National Database will be an important resource, and the experimental design might also reveal other *supplementary data* (such as camera trapping to monitor fox activity) that will support the experimental design.

Supplementary data can then be used to update the findings of the single threat experiment. For example, fox camera trapping may help determine whether baiting affects fox density. Single threat experiment findings can be used to update the ecosystem network model, for example by establishing whether fox baiting influences Malleefowl persistence. Thus threats and actions can be reprioritised using updated knowledge and any remaining influential uncertainties become candidates for future single-threat experiments.

While experiments need not be restricted to one threat at a time, this formulation provides a simple template that demonstrates the range of issues and data that must be considered to build evidence and new understanding.



**Figure 3.** The adaptive management project structure. Research is divided into three components (blue boxes), each relying on knowledge and data (orange ovals). Progressing from left to right, projects become more narrow and detailed in scope. Narrow, detailed projects provide learning that can be used to update and influence projects with broader scope.

## **Conclusion**

Malleefowl conservation is challenging, with numerous potential threats to their persistence via varying ecological processes. Their range covers vast areas and varied land tenures.

Adaptive management is a scientific approach that allows conservation objectives to drive the research questions. Coarse whole-ecosystem modelling is a means of structuring and prioritising these threats so that resources can be effectively allocated and bring Malleefowl the best chance of persistence. Experimental design and statistics will guide quality data collection. Data expands our evidence base and allows us to adapt. Nevertheless, it will require a co-ordinated and co-operative effort from many organisations and communities over decades to reap these benefits.

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