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# 20 Years of Ecosystem Restoration at Arid Recovery: successes challenges and the future

Katherine Tuft, Katherine Moseby, John Read

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## The problem

- Australia has the dubious record of having the worst extinction rate of mammals anywhere in the world (Woinarski *et al.* 2012). Up 30 Australian mammals, both marsupial and placental, have gone extinct within the last 200 years, accounting for a third of Australia's mammalian fauna.
- While mammals have been lost from most parts of the country, the worst concentration of extinctions has occurred in the arid and semi-arid zones – regions that account for 70% of the entire country. Most of the extinctions of arid zone mammals went largely unnoticed in the vast and sparsely populated outback. With the exception of some perceptive early observers (Finlayson 1961), the role of feral cats and foxes as the major drivers of extinction were also largely overlooked as these predators penetrated the interior, often in advance of white settlers.
- Some species disappeared before European scientists could describe living specimens. Others were observed thriving before they completely disappeared from the mainland. Still others shrank back from the large areas they once occupied, to persist in small, scattered refuges. None of these animals evolved with cats and foxes, so that, coupled with competition for resources with introduced herbivores, they rapidly declined due to predation.

## A first solution

- Arid Recovery is a conservation charity based near Roxby Downs in northern South Australia. We work in partnership with BHP, the SA government and Adelaide University.
- Near Roxby Downs in northern South Australia, 60% of the original mammal fauna has been lost. Fortunately, some of those species survived on offshore islands in SA and WA where introduced species never intruded.
- In the mid-1990s, the release of the first calicivirus caused local rabbit populations to plummet by up to 90% (Bowen and Read 1998), inspiring Arid Recovery's founders to fence an area and exclude rabbits completely. With funding from Olympic Dam operators (originally Western Mining Corporation, now BHP) and the state government, and with support from the community, a 14 km<sup>2</sup> exclusion fence was built in 1997. The initial goal of excluding rabbits to protect vegetation expanded to include exclusion of feral cats and foxes, and reintroduction of locally extinct species.

## Achievements

- Fence design tested and improved (Moseby and Read 2006), now serves as a model for many other predator enclosures in Australia and overseas.
- Twenty years on, the Arid Recovery Reserve has grown to 123 km<sup>2</sup>, the largest predator-proof reserve in Australia. We support self-sustaining populations of four reintroduced threatened mammal species: the Greater Stick-nest Rat (*Leporillus conditor*), the Burrowing Bettong (*Bettonia lesueur lesueur*), the Greater Bilby (*Macrotis lagotis*) and the Western

Barred Bandicoot (*Perameles bougainville*), as well as one self-reintroduced threatened species: the Plains Mouse (*Pseudomys australis*).

- The ecosystem within the Reserve has been transformed by removal of rabbits and introduced predators, and the reintroduction of native mammals. Excluding rabbits, cattle and sheep resulted in increased germination of sensitive long-lived trees such as mulga *Acacia aneura* (Munro *et al.* 2009).
- The digging activities of bilbies, bettongs and bandicoots turned over the soil, pocked the landscape with pits, increasing soil carbon and facilitating additional germination of native plants (James *et al.* 2009). Bettong and bilby warrens provided refuge for many native vertebrates and invertebrates (Read *et al.* 2008).
- Exclusion of feral cats and foxes enabled some *in situ* species to thrive within the Reserve. Spinifex Hopping Mice (*Notomys alexis*) were present in small numbers before, but now boom within the Reserve, at more than 15 times greater abundance compared to outside (Moseby *et al.* 2009). Similarly, after Plains Mice spread southwards and appeared within the Reserve after the release of calicivirus (Pedler *et al.* 2016), they are also now booming within the Reserve.

### Learnings

- The Arid Recovery Reserve is intentionally broken into six discrete paddocks to which different experimental treatments can be applied. This enables us to use the Reserve as a landscape-scale laboratory. For example, one compartment originally contained no rabbits, feral cats or foxes, but also excluded reintroduced native mammals. This acted as a control and enabled us to tease out the impacts of feral animal exclusion from the impacts of reintroduced mammals (Moseby *et al.* 2011).
- Learning from mistakes is critical. Where restoration works have failed, we have reported on them too so that lessons can be made public for others to learn from. For example, two species were released into the Reserve in trial translocations in 2004 (woma pythons) and 2006 (numbats). In both cases the animals failed to establish, largely due to predation by native predators (Read *et al.* 2011; Bester and Rusten 2009).
- Removal of mammalian predators from a large but contained area has resulted in high population growth of burrowing bettongs, to the extent that the species is now having deleterious effects on vegetation condition within the Reserve (Linley *et al.* 2016).

### Towards future solutions

#### Restoration within fenced reserves

- We are continuing to build on long-term monitoring datasets tracking the status of fauna and flora within the Reserve, usually in comparison to reference sites outside the Reserve.
- A strategic adaptive management framework is in development to manage some of the opportunities and challenges that have arisen, in particular, developing solutions to address overabundance of the bettong population.
- Reintroductions of native predators such as Western Quolls and Woma Pythons are planned for the near future.

#### Restoration in open landscapes

- Looking beyond the fence, we are now focusing attention on developing techniques for restoring wider landscapes and reintroducing threatened species without the use of conservation fencing.
- We are working in two complementary areas:

- *Giving native animals more of an edge* to improve their chances of survival in coexistence with introduced predators.
  - We are working with the University of NSW to overcome the problem of prey naivety (where prey animals fail to recognise predators and behave appropriately) via *in situ* predator training (Moseby *et al.* 2015). Populations of bettongs and bilbies are exposed to feral cats within a large area in a controlled way. Results after three years show that bettongs are changing their behaviour to be more wary of feral cats (West *et al.* 2017). We are currently testing whether those behavioural changes equate to improved survival in the presence of introduced predators.
- *Smarter feral animal control* – developing more effective, more efficient and more targeted control for feral cats and foxes, integrating old techniques (Moseby and Hill 2011) with emerging technologies (Read *et al.* 2015).
- Restoration in open landscapes is vastly more challenging. Attempts to establish bilbies and bettongs outside of the Reserve have so far failed (Moseby *et al.* 2011; Bannister *et al.* 2016). However, robust science means that we can learn from every attempt, and ultimately work towards solutions that can work across whole landscapes where the opportunities for conservation are also immense.

### Concluding remarks

- Arid Recovery was one of the first predator-proof fenced reserves to have been constructed in Australia and marks 20 years in 2017. There are now 30 predator-proof fenced reserves of 30 ha or more across Australia protecting 31 threatened mammal species (Threatened Species Recovery Hub, unpublished data). These are managed by 17 different organisations, including NGOs such as the Australian Wildlife Conservancy, as well as state governments.
- In the context of this growing network of reserves, Arid Recovery aims to continue to add to the body of knowledge for managing ecosystems within fences, and to develop the science for open landscape reintroductions, for the benefit of the whole conservation community.

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