A new threat posed by foxes

The introduced red fox is an efficient killer that has inflicted untold damage on much of Australia's marsupial fauna. Recent research on rock wallabies has shown that the mere presence of foxes can be equally as damaging as the act of predation itself. But solutions are at hand.

by Natasha Moore, Craig Pentland and Jack Kinnear

For more than 30 years, the wheatbelt black-flanked rock wallaby (*Petrogale lateralis lateralis*) has been the focus of a long-term ecological experiment. The originators of the conservation project (see 'A controversial experiment begins' below) have passed research to a new generation of scientists, but lessons continue to be learnt. For the most part, the project has been a spectacular success story, but it has also been the subject of controversy and scepticism, such as during times when the introduced red fox (*Vulpes vulpes*) was not yet accepted as a major wildlife conservation problem.

Through the early years of the project, and because of the resulting fox control through the then Department of Conservation and Land Management's *Western Shield* program, some rock wallaby population numbers irrupted. Indeed, some very small rock wallaby colonies, officially acknowledged as threatened with extinction, achieved pest status. Furthermore, these sites

became net exporters of wallabies in an effort to reduce their numbers, with batches periodically shipped off to fox-controlled sites where the species occurred before the arrival of the fox—a bonus for conservation efforts.

This was the scene for many years, but then the once too-good-to-be-true conservation story fell to Earth with a resounding crash. Some sites began showing signs of overgrazing. This had been predicted, but the severity of the consequent weed invasion was nevertheless alarming. No immediate remedial action was taken and in retrospect this was fortuitous, as the outcomes produced some new ecological insights.

Bad tidings

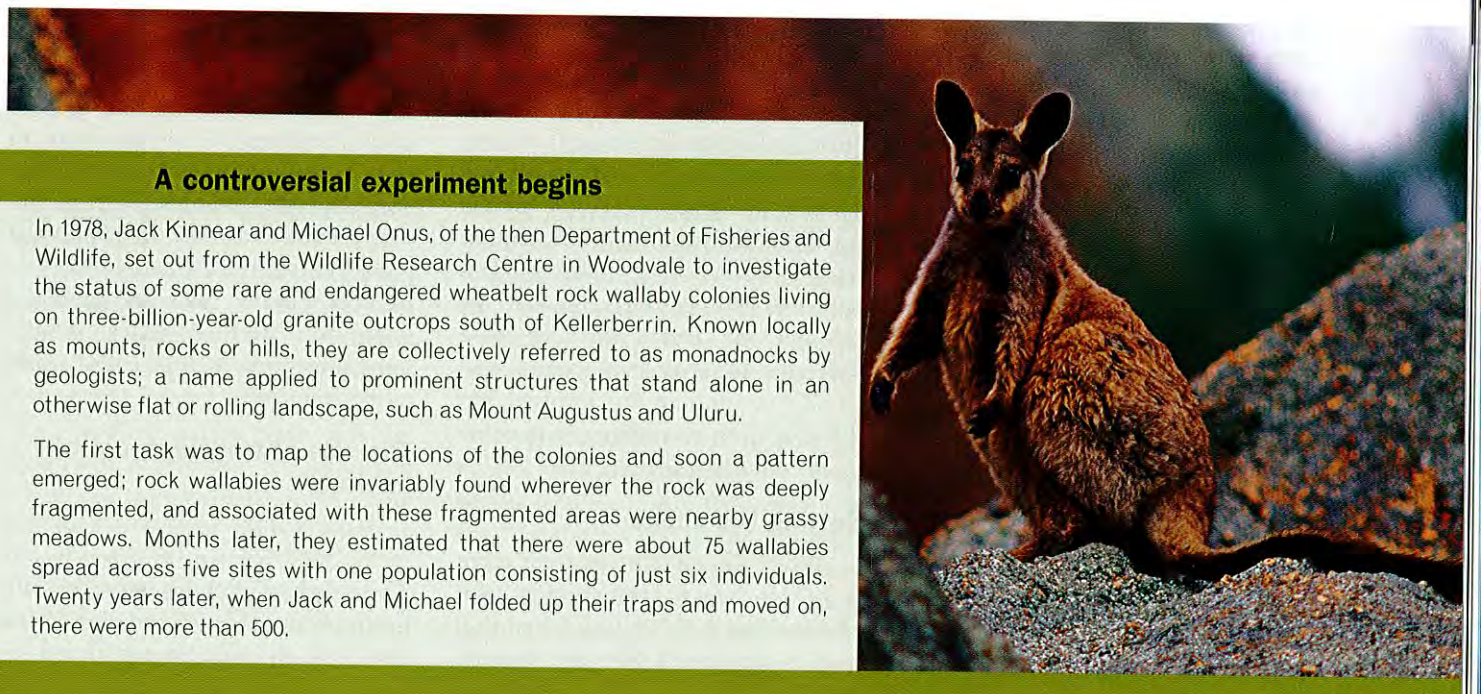
Signs of the recent rock wallaby population crash were first confirmed during site monitoring by the Department of Environment and Conservation (DEC) in 2010. Only a handful of animals was trapped on Nangeen Hill, a 160-hectare nature reserve in the wheatbelt. The trap success rate was extraordinarily low, sending a strong signal that something was wrong.

In response to this disturbing finding, further intensive trapping was organised, but, incredibly, only 14 wallabies were caught, compared with more than 100 wallabies trapped on the site during 2007, a figure comparable to the previous four census years (1986, 1990, 1994 and 1998). Moreover, statistical analysis suggested that the 2010 trapping had caught all the rock wallabies. Next, the outcrop at Mount Caroline Nature Reserve (351 hectares) was set with traps and again the results were jarring; the numbers had declined by 80 per cent from more than 300 to about 70 wallabies, and many were in poor condition. Both sites were heavily overgrazed. In terms of population, it was like 1978 all over again.

This posed the question: could the crash have been prevented? The provision of food supplements might have helped, but such an action would have resulted only in never-ending palliative measures. Moreover, such an intervention would have detracted attention from the fundamental issues that caused the crashes and, more importantly, any understanding of how to prevent them.

Opposite page
A female black-flanked rock wallaby warming itself in the early morning sunshine in the wheatbelt.
Photo – Hayden Cannon/DEC

Below A rock wallaby in its habitat.
Photo – Jiri Lochman



A controversial experiment begins

In 1978, Jack Kinnear and Michael Onus, of the then Department of Fisheries and Wildlife, set out from the Wildlife Research Centre in Woodvale to investigate the status of some rare and endangered wheatbelt rock wallaby colonies living on three-billion-year-old granite outcrops south of Kellerberrin. Known locally as mounts, rocks or hills, they are collectively referred to as monadnocks by geologists; a name applied to prominent structures that stand alone in an otherwise flat or rolling landscape, such as Mount Augustus and Uluru.

The first task was to map the locations of the colonies and soon a pattern emerged; rock wallabies were invariably found wherever the rock was deeply fragmented, and associated with these fragmented areas were nearby grassy meadows. Months later, they estimated that there were about 75 wallabies spread across five sites with one population consisting of just six individuals. Twenty years later, when Jack and Michael folded up their traps and moved on, there were more than 500.

Left A good result for one rock wallaby population—Craig Pentland and DEC volunteer Sharon Lewis release a young male rock wallaby trapped during a population monitoring field trip in the wheatbelt.
Photo – Phil Lewis

Below left An adult rock wallaby ready for release after being measured and tagged during a population monitoring field trip.
Photo – Hayden Cannon/DEC

The instability problem

The fundamental problem that characterises the plight faced by the rock wallaby colonies is that they are inherently unstable, due to circumstances imposed on them by agriculture and predation by the introduced fox. When rock wallaby numbers are low, the fox, and probably the feral cat (*Felis catus*), pose an ongoing threat to their survival. Indeed, two local extinctions—in the absence of fox control—were recorded. Not only do unstable populations run a greater risk of extinction, they also lose genetic variability during a crash, which promotes inbreeding and increases the extinction risk even further.

All of these problems were supposed to disappear as the populations increased under fox control, and this was the case for about 25 years. But, as the years passed, other conditions transpired that created instabilities and set the colonies on a course heading for an inevitable crash. In other words, what seemed to be a simple win-win situation (that is, fox control) became a no-win situation. When small, the colonies are unstable because of the fox threat, and so the obvious remedy was to increase their numbers. This occurred with great success, but the colonies still ended up unstable—welcome to ecological complexity! Clearly, overgrazing was involved, but this was only a symptom; something more complex was going on.

Setting the scene

When the initial steps were taken in 1978 to assess the conservation status of wheatbelt rock wallabies, historical records revealed that the species was once widespread and abundant throughout the region. Development and agriculture took their toll on the habitat of many native marsupial species that once flourished in the wheatbelt, and for any species that managed to hang on, the coming of the fox sealed their fate. However, since no one has yet managed to grow crops on granite monadnocks, the habitat of rock wallabies survived to some extent.

The six-fold population increases—75 to 500—evident by 1998 were due to fox control achieved by monthly distribution of 1080 poison baits through *Western Shield*. Before the experiment began, between 1979 and 1982, numerous trials were conducted to assess the effectiveness of baiting, with the optimistic objective of making the reserves absolutely fox free. This turned out to be an unrealistic goal, in particular during the period when young foxes leave their birthplace seeking to establish their own territories, from November to May.

Fortunately, invading foxes do not always represent a direct threat to a rock wallaby population, as they normally take poisoned baits before they cause any damage. In addition, as populations increase, some depredations can be tolerated without causing a population decline—hence, despite some shortcomings, fox control works in the wheatbelt.

The role of fragmented rocky habitats

Rock wallabies live on fragmented rocky sites, known as 'breakaways'. These habitat features serve as safe havens from predators and also enable the species to avoid lengthy periods of

Above left Typical rock wallaby habitat among the tumbled and fractured rocks found within some wheatbelt nature reserves.
Photo - Hayden Cannon/DEC

Above The fox is a major threat to rock wallaby populations.
Photo - Jiri Lochman

Left Craig releases a tagged adult rock wallaby during a monitoring field trip.
Photo - Hayden Cannon/DEC

extreme heat and cold. Whenever the weather becomes extreme, the animals simply retreat into caves and crevices which serve as passive 'air-conditioned' niches or thermal refuges. By doing so, they do not need to drink—the moisture in the vegetation they eat suffices—and they also conserve energy through being insulated from extreme heat and cold.

The importance of these habitats—particularly when foxes are not controlled—cannot be overstated. Rock wallabies can only survive on deeply fragmented rocky sites and food must be nearby. Such sites are recognised as predation refuges or safe havens, and they were the places where the rock wallabies were invariably found during the first surveys made in 1978. No predator-proof safe havens, no rock wallabies; this rule explains why so many outcrops in the wheatbelt and elsewhere failed to sustain colonies.

Accordingly, logic suggests that when foxes are controlled, wallabies will occupy the less secure sections of an outcrop. And this is exactly what happened—with baiting, and therefore fewer foxes, the rock wallabies eventually spread out to occupy previously 'no-go' areas of the outcrops. In this way, fox control led to more wallabies because it reset the carrying capacity of all sites to a higher level. By 1998, the rock wallabies had responded accordingly—500 and climbing.

Applying further logic, suppose fox control was not working for some reason, and that was the reason for the decline: what would happen? Logic would predict that the declining population would contract to refuge sites. However, the trapping data showed that rock wallabies were caught at both refuge and at non-refuge sites (although the numbers were reduced)—this meant researchers could rule out fox predation as the cause of the decline.

A useful analogy is to liken the rocky sites to hotels with a fixed number of rooms, with this capacity setting a limit to the number of rock wallabies a site can support. One can also grade them accordingly: a 'five-star' refuge site is one which provides maximum security in the form of deeply fragmented breakaways, thus providing a safe haven from the four-footed marauding terrorist, the fox. Under fox control, the need for 'five-star' accommodation can be relaxed and more 'rooms' become available. When the 'hotel' becomes full, however, any rock wallabies that fail to secure a safe place to stay become homeless and either die or disperse. It's nature's way of limiting the population and preventing overgrazing, but currently it no longer works.

Above The impacts of overgrazing at Nangeen Hill Nature Reserve.
Photo – Hayden Cannon/DEC

Right A rock wallaby trapped for monitoring purposes.
Photo – Jiri Lochman

Marauding terrorists

Foxes not only kill rock wallabies, they also terrorise them. Researcher Craig Pentland has spent countless hours while collecting data for his PhD observing rock wallabies using night vision equipment. From time to time, a fox would appear and any wallabies foraging on the meadow would flee to the rock en masse—a mad scramble to safety. On one occasion, a fox was witnessed killing a wallaby. Gradually, it became evident that within the rock wallaby population, the mere presence of prowling foxes generates a fear of being killed, a phenomenon well documented in the predation literature. Indeed, it has been noted that the mere presence of predators can make prey so fearful that they elect to starve to death rather than risk predation.

In the case of the wheatbelt rock wallabies, the 'fear effect' only came into play as the numbers increased. Harking back to 1982 when fox control began, the populations were small, food was nearby and fear of predation was of little concern because they could safely graze close to their predator-proof five-star shelter—indeed, entirely on the rock itself. However, as the numbers increased, they exhausted the nearby food supply and therefore were obliged to venture away from shelter to graze and, as a consequence, the fear factor kicked in.

It is this fear factor that accounts for the inherent instability affecting the once-thriving Nangeen Hill Nature Reserve population: fear of prowling foxes has restricted the population's foraging range, a behavioural response that over the years has caused the outcrop and some surrounds (for example, the adjacent meadow) to become overgrazed and infested with weeds. What is particularly frustrating about this effect is that on the rock itself, the rock wallabies were limited to eating bark and ice plant (species of introduced annual herb which leach salt into the soil), and at 30 to 40 metres from the outcrop on the meadow the ground is bare or weed infested, but at 50 metres and beyond, perfectly good forage remains untouched.

In summary, Nangeen Hill Nature Reserve has enough food to support a population at carrying capacity, but the wallabies are just too scared to access it—all because it is not possible to totally exclude foxes by baiting. This outcome is somewhat paradoxical, because to control foxes in a wheatbelt setting we have to allow them to invade in order to expose them to bait, and hence they make their presence felt to the wallabies with fatal consequences—a near 'catch-22' situation. So, is there a solution? Prevent foxes from entering by erecting a predator-proof fence and rehabilitate the site. Importantly, the latter is already underway, organised by DEC district staff.

Mount Caroline

The situation at Mount Caroline Nature Reserve is similar in some ways. While larger than Nangeen, it has fewer 'five-star' sites: before fox control it supported less than 20 rock wallabies. By 1998 researchers were nearly overwhelmed as the population burst past the 300 mark, filling every available 'room' on the rock. This did not deter some of the homeless, who were observed happily occupying some 'one-star' sites around a nearby homestead, living under brush piles and abandoned buildings, enjoying scheme water and succulent food, while at night raiding the homestead's hanging baskets.

Will we bait forever?

Are conservation agencies obliged to control the fox by baiting forever? A good question, and one that we cannot answer definitively for now, except to say that science and technology do not stand still. At this moment, a paradigm shift is occurring; researchers are applying genetic engineering to control pests in ways that were previously unimaginable.

So the answer is this: baiting is a holding action, not an endless one. In the meantime, baiting needs to be seen as an essential action required to keep vulnerable species alive and well, pending the day when a more sustainable solution inevitably arrives.

Above Fencing of Mount Caroline Nature Reserve to protect crops from grazing.
Photo - Craig Pentland/DEC

Below Rock wallaby.
Photo - Jiri Lochman

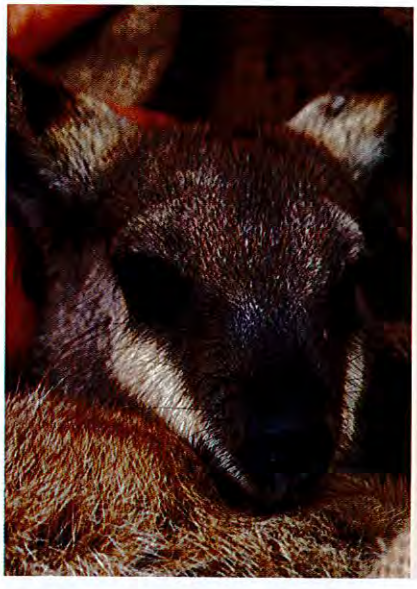
Meanwhile, away from the homestead, the pillaging took on a more serious note: rock wallabies were leaving the reserve to forage as they had done for countless generations, but now the forage was a valuable crop. Not fussed about this exotic food, they fed on these cereal crops regularly, causing serious economic losses to farmers. DEC managers responded in the only way they could: a fence was erected which confined wallabies to the reserve, but this had unforeseen consequences—severe overgrazing within the reserve, making a population crash inevitable sooner rather than later.

While the Mount Caroline instability scenario appears to mimic the Nangeen situation due to overgrazing, the solution to the problem requires a different action. Nangeen Hill Nature Reserve has enough food to support a population at carrying capacity, while Mount Caroline does not. The solution to the overgrazing problem at Mount Caroline, brought on by extensive clearing of the surrounding landscape, is to buy some land back, in particular the land adjacent to the exclusion fence, and bait it for foxes.

The future

Does the rock wallaby have a future in its wheatbelt setting? Indeed it does—it is an adaptable, resilient species and, were it not for foxes, DEC would be faced with a pest species rather than a threatened one. Fundamentally, to conserve rock wallabies, all one needs to do is control foxes (see 'Will we bait forever?' above) and provide the colonies with sufficient food and, most importantly, enable them to access this food.

This lack of access to food is the root cause of the instabilities and the cause of the recent crashes. The remedies differ: at Nangeen Hill a predator-proof fence needs to be erected, at Mount Caroline some land needs to be added to the reserve.



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Jack Kinnear was employed by the Department of Fisheries and Wildlife and then the Department of Conservation and Land Management, two of DEC's predecessor departments, from 1978 to 2001. He can be contacted on (08) 9245 3896 or by email (jakinn2@bigpond.com).

A project of this nature and longevity would not have been possible without the goodwill and cooperation of the rural community throughout the district and, in particular, the farming families whose properties contained or abutted the rock wallaby sites. And while there is much to be done, the collective skills of DEC, universities, local governments, World Wildlife Fund Australia, the Australian Wildlife Conservancy, regional natural resource management groups and individuals are being mobilised to restore the colonies to a more resilient and sustainable state.

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