Will curiosity kill the cat?

Research examining fox and cat interactions in the northern jarrah forest is adopting some new technologies to try to untangle the complicated interactions between introduced and native predators.

by Paul de Tores and Oliver Berry

In Western Australia, research aimed at improving control of introduced predators, specifically the fox and feral cat, is taking on new dimensions. The Department of Environment and Conservation (DEC, formerly CALM) has been at the forefront of introduced predator control. DEC has demonstrated many native species increase in abundance when fox numbers are reduced and has shown the importance of controlling foxes before initiating native wildlife translocation programs.

A spectacular example is the response to fox control by the black-footed rock-wallaby (*Petrogale lateralis*) at Nangeen Hill and Mount Caroline in the Wheatbelt. Baiting for fox control at these reserves—both small granite outcrops with remnant vegetation in a sea of agricultural land—began in the 1980s and resulted in dramatic and sustained increases in rock-wallaby numbers. A similar response has been shown by tammar wallabies (*Macropus eugenii*), at Tutanning Nature Reserve, east of Pingelly, where the number of tammar wallabies increased to nuisance levels—an unusual problem for a conservation management agency.

These examples are convincing and show the benefits of fox control. However, disturbing patterns have recently emerged. At some sites where foxes have been controlled for several years, the initial pattern of native species recovery has not been sustained. For example, by the late 1990s at Leschenault Peninsula Conservation Park north of Bunbury, translocation of western ringtail possums (*Pseudocheirus occidentalis*) seemed to have been successful. However, follow-up research in 2002 and from 2004 to 2006 revealed the population had significantly declined, despite reduced numbers of foxes. Intensive monitoring of radio collared ringtails since 2004 showed the fox was no longer a problem at Leschenault. However, the feral cat (*Felis catus*) and the native south-west carpet python (*Morelia spilota imbricata*) seemed to have taken over the role of the fox. These predators accounted for more than 95 per cent of predation of radio collared western ringtail possums since 2004.

A similar pattern emerged from *Operation Foxglove*, the large-scale fox control program in the northern jarrah forest from 1994 to 2000. The data strongly suggested predation by feral cats increased when fox density was reduced. Cat predation on translocated populations of woylies (*Bettongia penicillata*) increased in two of the three areas where fox control had been carried out. This pattern has also occurred at other sites where woylies have been translocated.

Mesopredator release—what is it?

The pattern of an increase in one or more subordinate predators (such as feral cats) after the removal or reduction in numbers of a dominant predator (such as the fox) is known as 'mesopredator release'. It can be caused by changes to simple or complex interactions between these predators. Removing or reducing numbers of the dominant predator clearly advantages subordinate predators. They are no longer preyed upon directly by the dominant predator, and no longer have to compete with it for resources. When the dominant predator is removed, or reduced in number, the absence of its territorial defence mechanisms (such as physical aggression or strategic

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Main Jarrah forest.
Photo – Chris Garnett/DEC
Inset Feral cat from Leschenault Peninsula Conservation Park.
Photo – Paul de Tores/DEC and Suzanne Rosier

Above left Tammar wallaby.

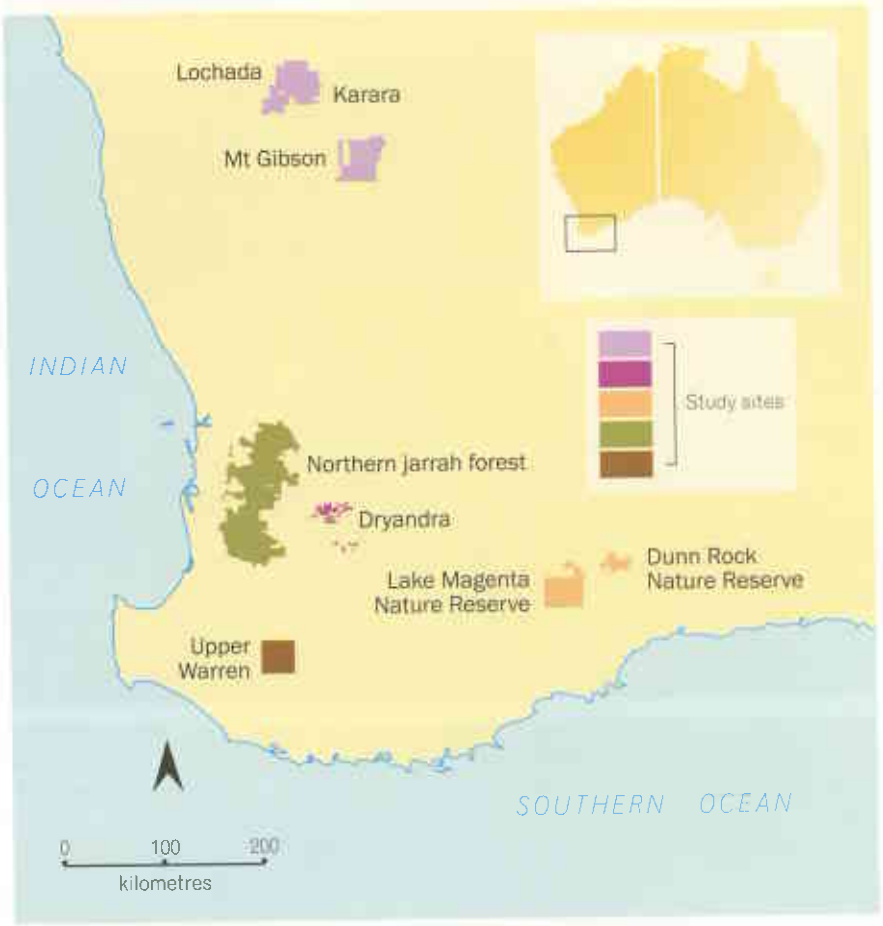
Left Black-footed rock-wallaby at Mount Caroline.
Photos – Jiri Lochman

Right Western ringtail possums.
Photo – Geoff Taylor/Lochman Transparencies

placement of faeces and scent markers) also frees up the environment for the previously subordinate predators.

These interactions are difficult to predict, so there is considerable debate in the scientific community about the benefits of reducing numbers of, removing, or adding predator species. Some believe the phenomenon of mesopredator release is an argument for reintroducing the dingo (*Canis lupus dingo*) to parts of mainland Australia where it is no longer present. Some anecdotal evidence suggests fox numbers remain low in the presence of dingos. However, the dingo is thought to have arrived in Australia as recently as 3500 to 4000 years ago and it has no affiliation with Australia's Gondwanan heritage. Reintroducing it may not be appropriate if the intent is to restore Australia's native fauna. Proposals to reintroduce the dingo certainly receive a mixture of responses, often heated, from conservationists, ecologists, pastoralists, graziers and politicians.

Mesopredator release may also be an argument for reintroducing the Tasmanian devil (*Sarcophilus harrisii*) to mainland Australia, where it was present until relatively recent times (ironically, the dingo has been implicated in its demise). Reintroducing Tasmanian devils to areas from which dingos are absent, along with effective fox control, may be one strategy to restore the diversity of natural predator species. However, the complex interactions between these native predators and introduced foxes and cats are poorly understood.



Understanding predator interactions

DEC recently embarked on an ambitious collaborative program with the Invasive Animals Cooperative Research Centre (IA CRC), the Australian Wildlife Conservancy (AWC), Alcoa of Australia and Worsley Alumina Pty Ltd. The program is examining interactions between native and introduced predators at five sites in WA (see map above). Each site has a slightly different focus, but all are examining fox and cat interactions.

The northern jarrah forest research is perhaps the most ambitious of these projects. The research will examine and test several hypotheses. Firstly, we need to determine whether, in the presence of fox control, cats increase in abundance. That is, do cats show a 'mesopredator release' response when fox density is reduced?

It is notoriously difficult to monitor foxes and cats and derive reliable and meaningful estimates of density. No two scientists are likely to agree on the best method. The four scientists in the northern jarrah forest research team report to an independent review panel of three additional scientists. Debate runs high, but we have agreed on the fundamental principles and research

has begun. The study area within the northern jarrah forest has been zoned into two large areas of 172,000 and 121,000 hectares, which are both aerially baited with baits containing 1080, a naturally occurring poison, six times a year. A control zone of about 63,000 hectares will be left unbaited.

We also need to determine whether subordinate native predators also show a 'mesopredator release' response. Hence, the chuditch (*Dasyurus geoffroii*), south-west carpet python and two large goanna species (*Varanus gouldii* and *V. rosenbergi*) are being closely examined. Mesopredator release may manifest itself through behavioural changes and changes in the density of these species.

Complicating this, the flow-on effect from mesopredator release can also manifest itself through changes exhibited by prey species. We are monitoring the brushtail possum (*Trichosurus vulpecula*) and hopefully also the quenda (*Isoodon obesulus*) to determine if there is a flow-on effect (or 'trophic cascade', as it is referred to in scientific literature). Monitoring will enable us to determine if levels of predation on these two indicator species increase or decrease. We will also be able to determine if the rate of juveniles reaching adulthood is being limited by fox predation, by cat predation, or both. Ultimately, this recruitment determines whether the population is increasing.

The research will also examine whether these prey species behave differently once predation pressure is lifted. For example, brushtail possums may spend more time foraging on the ground and less time avoiding predators by switching dens. However, such behaviour may not occur if we are simply replacing predation pressure from foxes with predation pressure

Top left A red fox.
Photo – Dennis Sarson/Lochman Transparencies

Centre left Dingo.

Left Tasmanian devil.
Photos – Jiri Lochman

Right Gould's monitor.
Photo – Jiri Lochman

from cats. We may not see these changes until we can effectively reduce both fox and cat density.

Estimating fox and cat density

Estimating fox and cat density is central to the research program in the northern jarrah forest. The technique most widely used to estimate the density of foxes and cats involves using 'passive' or 'active' sandplots. In either case, a passing fox or cat will leave its tracks in these smoothed sandy patches. Passive plots have no lure to attract the fox or cat to the sandplot and no reward. The number of tracks left in the sand is then used to estimate the density of foxes or cats in the area. Active sandplots incorporate a lure or attractant and may have a reward.

Both techniques confound activity with density and it is impossible to know if we are seeing the activity of one fox or cat, or many. Consequently, the techniques may, but equally well may not, accurately reflect the density of each species. Both passive and active techniques are imperfect and need to be validated in the environment in which they are being used to give any confidence in the derived estimate of density. Active sandplots were previously used in the northern jarrah forest as part of *Operation Foxglove*. This technique was validated and we believed we had a reliable estimate of density, at least for foxes. However, it provided very little data on cats. Importantly, relying on sandplot data alone does not enable us to identify individuals.

DNA-based monitoring

It seems the time has come to use more sophisticated techniques that will provide more accurate estimates of fox and cat density.

Each fox or cat has a unique DNA fingerprint or 'genotype', and will leave its identity card in the environment when it defecates or sheds hair. By collecting scats (faeces) or hair samples and identifying the individuals to which they belong, we can estimate the number of foxes or cats present in the landscape and map their movements. This exciting research brings together our ecological expertise in mark–recapture analyses (conventionally applied to capture, mark, release and recapture of trapped animals) with newly developed DNA-based techniques.

The challenge for the northern jarrah forest research team is to find ways to collect this DNA. Scats are particularly useful for monitoring foxes because they are often deposited in prominent locations such as track junctions. Foxes also tend to deposit scats on novel features, such as sandplots. Scat collection and analysis is not glamorous nor for the faint-hearted, but the information provided makes the smelly job worthwhile.

Unfortunately, cats don't defecate in prominent locations, so we also target hair samples. Hair is more pleasant to work with, but to collect it we have had to develop special snares which capture hairs plus the all-important DNA-containing follicles. Captive trials at DEC's Dwellingup Research Centre have shown fox hair yielding usable DNA can be collected on strategically positioned sticky wafers and barbed wire.

Luring cats to hair collection points has proven more difficult. Captive animal trials and field trials involving a range of attractants and snares are underway. Among the attractants being trialled is an audible lure known as a 'Felid Attracting Phonic' developed

by Dave Algar, from DEC's Science Division. Alone or combined with a visual or olfactory attractant, it appeals to the curiosity of the cat. The desired outcome of our testing will be a lure which works equally well for foxes and cats and enables us to collect hair from both species at a single point.

Wildlife forensics

With trace DNA samples there is usually only a very small amount of DNA present and it may be highly degraded. This makes analysis difficult, requiring intensive work on each sample. As there is a high chance of sample contamination from extraneous DNA, we use strict sample handling protocols like those typically used in human forensics. All laboratory work is conducted in a dedicated wildlife forensics laboratory at The University of Western Australia (UWA).

Identifying individual foxes and cats enables us to answer some major questions with immediate implications for conservation management. For example, DEC's current baiting programs rely on repeated baitings and we accept some foxes will survive each baiting event. However, we are unsure if it is the same individuals surviving each baiting session. By identifying the individuals present within an area after each baiting event we will be able to determine whether the same individuals continue to survive repeated baiting sessions. If this is the case, we may be facilitating the 'natural selection' of foxes which avoid baits or develop a tolerance to the 1080 toxin. If so, alternative control strategies would need to be employed in conjunction with the standard 1080 baiting programs.

Use of the landscape by predators

The research needs to determine if, and how, use of the northern jarrah forest by feral cats changes when fox density is reduced. To test the hypothesis that cats will become more conspicuous and less restricted in their movements with reduced fox density, we are fitting satellite radio collars to cats and foxes to monitor their use of the landscape in baited and unbaited areas. The satellite radio collars have also been fitted with proximity circuitry and data loggers so we can tell whether foxes and cats are regularly coming into contact, or if they are avoiding each other.

This will also enable us to shed light on an issue which has long vexed biologists involved in radio-telemetry studies—determining the predator responsible for individual predation events. This requires fitting radio collars with proximity circuitry and data loggers to the prey species: brushtail possums and quendas. The data loggers will record when a radio collared fox or cat comes in contact or close proximity with a radio collared brushtail possum or quenda. The brushtail possum research is being undertaken by a PhD student, Jennyffer Cruz, supported by an IA CRC scholarship.

The collaboration with, and financial support from, IA CRC has also enabled DEC to employ two post-

Above left A collection of fox hair strands.

Left DNA sampling of fox scats.
Photos – Oliver Berry/UWA

Above Dryandra woodland.
Photo – Alex Bond

Right Chuditch.
Photo – Jiri Lochman

doctoral research scientists, Al Glen and Duncan Sutherland, who are working on chuditch and goannas respectively. This work will assess whether these species show a mesopredator release response and whether the diversity of predators changes as a result of fox control.

The python research is examining the role of this ambush predator from a mesopredator release context and the role of python predation in translocation outcomes. Predicted changes in python behaviour as a result of mesopredator release include longer periods of time in foraging, and ambush positions, longer periods of time in exposed basking positions and a less limited choice of clutch brooding sites by females. This research is being undertaken by Gillian Bryant, a PhD student supported by DEC and Murdoch University.

Monitoring the range of prey species

An equally important component of the research is aimed at determining whether the dominant and subordinate predators are selecting prey items on the basis of their availability. To determine this, we will assess the prey species present and their respective abundance and then examine the proportion of prey being eaten by each predator species. This is achieved by conventional trapping programs followed by more scat analysis.

The ultimate objectives of the research are to reduce fox density and ensure we are not simply replacing foxes with cats. If this is the case, control strategies to reduce cat density will also need to be implemented. Once foxes and cats are reduced in number, we anticipate native predators will become more abundant and change their behaviour. We need to be able to demonstrate the flow-on effects from these changes improve biodiversity conservation, including sustained native predator diversity and increases in the abundance of native prey species.

How you can be involved

The research team based at Dwellingup needs volunteers to assist with seasonal trapping sessions and monitoring of brushtail possums, ringtail possums and pythons. Please contact Paul de Tores if you would like to be involved in the northern jarrah forest research through DEC's volunteer program.

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