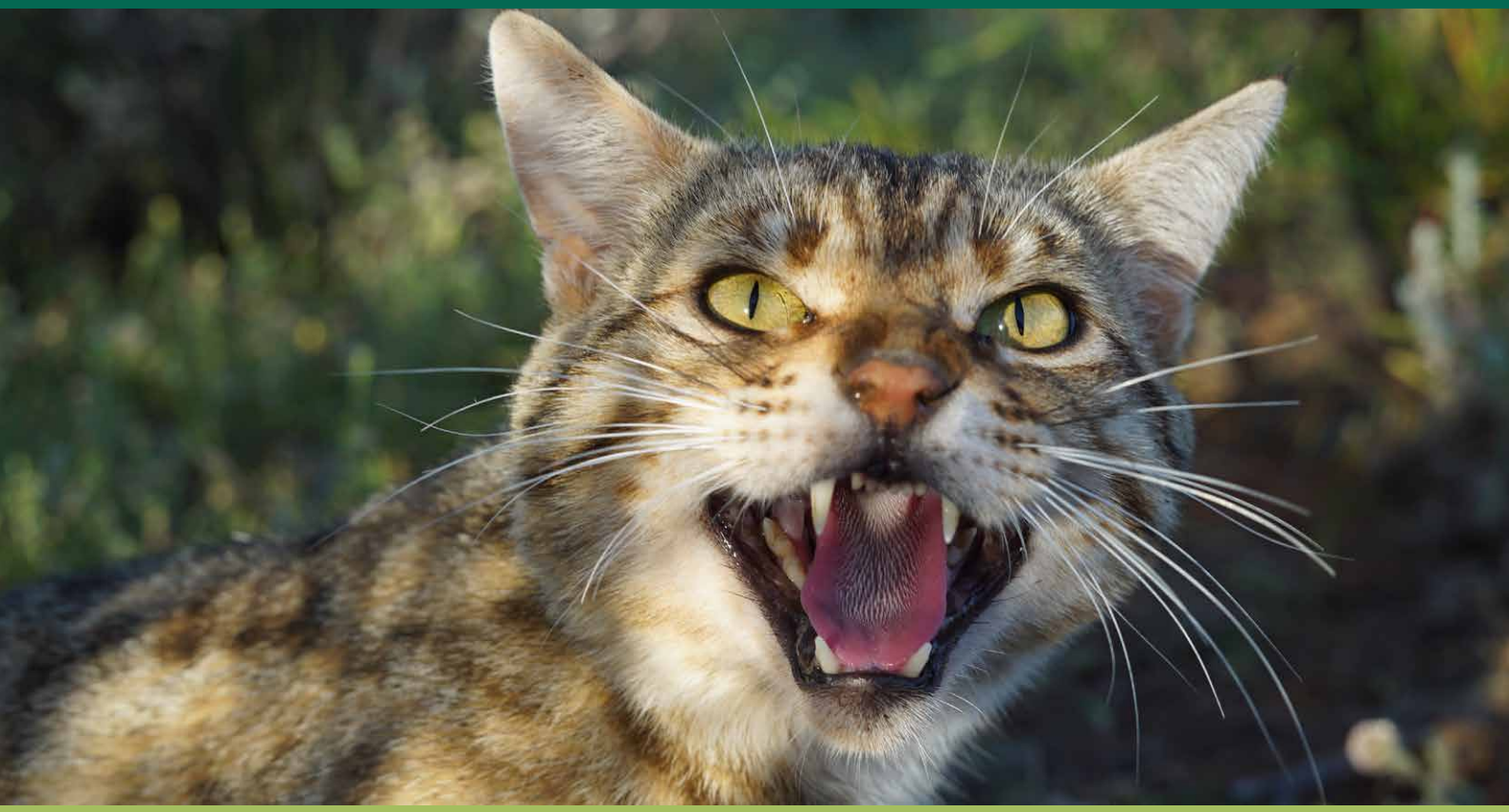
Threatened Species Recovery Hub

National Environmental Science Programme



Integrated management of feral herbivores and feral predators

Final Report

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Cover image: Feral Cat (Felis catus)*. Image: Dennis Church, Flickr, CC BY-NC-ND 2.0*

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Executive summary

This project aimed to understand how feral predator control programs can be affected by additional food sources from introduced prey species. These includes populations of European rabbits, and anthropogenic food provided in dumps and towns. We looked at how rabbit control might affect cat survival and population dynamics, how conservation reserves might attract feral cats *Felis catus*, and how supplementary food sources at townships might support feral cat populations during drought.

Introduction

Invasive predators like feral cats and foxes *Vulpes vulpes* are a major threat to native animals across Australia. Their impacts can be amplified by novel prey sources, that could increase the volume and reliability of feral predator calorie intake, thus increasing the predator population density. The outcome could be elevated predation rates on native prey. This would increase the level of threat to many of Australia's imperiled species.

Such an effect may be operating in southern Australia, where abundant rabbit populations support high densities of feral cats and foxes. When populations of rabbits are reduced, the abundance of cats and foxes could be expected to also decline, thereby alleviating predation pressure on native wildlife. However, before cat numbers stabilize to a new equilibrium to match lower rabbit densities, there could be a period where cats respond to the loss of rabbits by temporarily increasing predation on native species.

The most well-known case of a major reduction of rabbits was the release of the bio-control agent Rabbit Haemorrhagic Disease Virus (RHDV, or calicivirus) in the mid-1990s. Before this, plagues of rabbits caused substantial damage to vegetation, and provided a prey base that supported some of the highest known densities of feral cats outside of islands and townships. Rabbits are also implicated in a number of extinctions of threatened species from mainland Australia. After RHDV, cat numbers across Australia plummeted in parts of arid Australia and have not rebounded since. At least four species of threatened mammals have increased in range as a result.

However, there is also evidence of prey-switching by cats when rabbit populations decline. Numerous studies have reported an increase in the proportion of native animals in cat scats when rabbit numbers drop. It is possible that native animals are particularly vulnerable for a short period when rabbit density is low but cat density is still high. In this study we asked three critical questions to which we need answers to properly assess the impacts of rabbit management on threatened species:

- Does the evidence of increased proportions of native prey in cat diets after rabbit declines represent an increase in kill rate of native animals?
- Are cats just eating more carrion?
- Is the short-term prey switching by cats onto native prey offset by an overall reduction in cat numbers?

In addition to rabbits, there can be many other novel sources of food available to feral cats. Human settlements provide rubbish and other food sources in abundance that are easy for cats to acquire. Feral cats in Australia are adept at surviving in anthropogenic landscapes. The implication is that townships could provide cats with an abundant and easily accessed food source not subject to the same climatically driven limitations as other Australian ecosystems. In particular, it would provide a food source not impacted by drought.

Understanding how the availability of surplus food affects the success of feral animal control operations will improve our ability to design and implement successful programs. While the importance of such food sources in boosting feral animal populations has been established, there has as yet been no direct research on how actual control operations are affected by the availability of artificial food subsidies. In this research we aimed to develop knowledge to support cat and fox control programs being implemented for conservation purposes in central South Australia.

Context

In Australia, feral cats and red foxes threaten many species of native wildlife, especially native mammals weighing between 35g and 5,500g (Burbidge and Manly 2002; Woinarski et al. 2015). The regions with the greatest loss of mammals have been the arid and semi-arid zones of southern Australia (Smith and Quin 1996), coinciding with the regions where densities of the invasive European rabbit *Oryctolagus cuniculus* have historically been highest. This suggests that at least part of the explanation for the large impact of invasive predators on native prey in these regions could be the effect of rabbits in sustaining high population densities of feral cats and foxes. Therefore, managing populations of invasive herbivores that are important prey of cats and foxes, such as rabbits, may provide a tool for indirect control of invasive predator populations (Pech et al. 1992; Pedler et al. 2016).

Methodology

Feral cats and rabbits

Our first major study was an experimental investigation into how feral cats respond to a sudden reduction of rabbit populations (McGregor et al. 2019). This was conducted in a large fenced paddock at the Arid Recovery reserve in central South Australia. To understand the processes by which cats respond to a reduction in rabbit numbers, we followed the lives of individual feral cats before and after rabbit control. We carried out a rabbit control operation equivalent to a major knock-down that reduced the rabbit population in a 37 km^2 experimental enclosure by ~ 80% (2,215 rabbits removed from an estimated population of ~2,800), while monitoring an adjacent unmanipulated area as a control. We caught 36 cats and fitted them with wildlife tracking collars of various kinds. Cats were caught by leg-hold and cage trapping. All cats were fitted with VHF collars, which were used to measure cat movements and survival. Cat hunger was measured by providing sausages and recording uptake by passing cats. We also recorded cat diet by collecting scat samples inside the paddock where rabbit control was conducted and where rabbits remained stable. However, using this method, we could not tell whether cats were hunting their prey or just scavenging. Understanding this distinction was critical to our research so we used animal-borne video collars to monitor cat behaviour. The cameras were built by Hugh McGregor and deployed on multiple cats before and after rabbits were reduced.

Figure 1. *Map of the study area, where Arid Recovery is located.*

Feral cats and fenced reserves

Further research projects were conducted to enhance our understanding of how feral predators might benefit from novel food sources (McGregor et al. 2020). One study investigated how feral-proof fenced reserves might inadvertently provide food for feral cats, by supporting large populations of native rodents that pass through the fence. This study was also conducted at the Arid Recovery reserve. Here, we investigated whether feral cats were increasingly likely to be detected closer to a fenced reserve than further away using track transects. We also considered whether native rodents were more likely to be found in the stomachs of cats caught close to the reserve edge. Finally, we tested whether individual cats selectively hunted on the reserve fence compared to two other similar fences, based on GPS movement data from 10 cats.

Feral cats and townships during droughts

Another study aimed to understand how cats fared during the recent megadrought of 2018-2019, and whether townships and mine sites provide feral cats with refuge from drought conditions. We assessed cat carcasses collected as part of control operations both at a town/mine sites and around nearby conservation reserves and on indigenous land (Moseby et al. 2021). We measured cat weight, body condition and breeding rates, and tracked this at both sites over time before, during and after the drought.

Findings

Feral cats and rabbits

In our first study (McGregor et al. 2019), which experimentally investigated how cats respond to rabbit control, we found evidence of major impacts on cat populations. The effects of the rabbit removal on feral cats were very sudden. Cat activity and survival of VHF-collared cats decreased by 40% in the month after reduction of the rabbit population. Surviving cats lost weight, and evinced hunger by increased their intake of experimentally-supplied sausages. No change in cat survival, body condition or activity was observed in the nearby area with no rabbit removal.

Cats also changed their diets substantially after rabbits were removed. Cats were more likely to eat novel food sources like carrion, reptiles and insects after rabbit control. Data obtained from video collars also showed that after the rabbit reduction, cats were more likely to eat dead rabbits and invertebrates. In contrast, they did not increase their per capita consumption of small mammals like plains mice or hopping mice. The activity of small mammals declined in the experimental area, but it also declined to a lesser extent in the area with no rabbit control, so other factors such as drought might have been operating.

Figure 2. *Images from video-collars deployed on cats, of a cat investigating but not eating a bearded dragon (a), eating a* Nephurus *spp. (b), consuming the intestines of a rabbit (c), and catching a spinifex hopping mouse (d).*

Feral cats and fenced reserves

Other research conducted under this project has focused on how a fenced conservation reserve can also inadvertently provide food for feral cats (McGregor et al. 2020). We found that spinifex hopping mice and plains mice occurred at very high density within the Arid Recovery fenced area and would emigrate outside (Moseby et al. 2019). Cats appeared to respond to this, and cat activity was substantially higher adjacent to the fence. Native rodents were far more likely to be found in the stomach of cats collected at the reserve edge than in the stomachs of cats far from the reserve edge. Also, out of the 10 radio-collared cats we captured and obtained GPS movement data from, eight demonstrated strong selection for hunting along this fence (Figure 3).

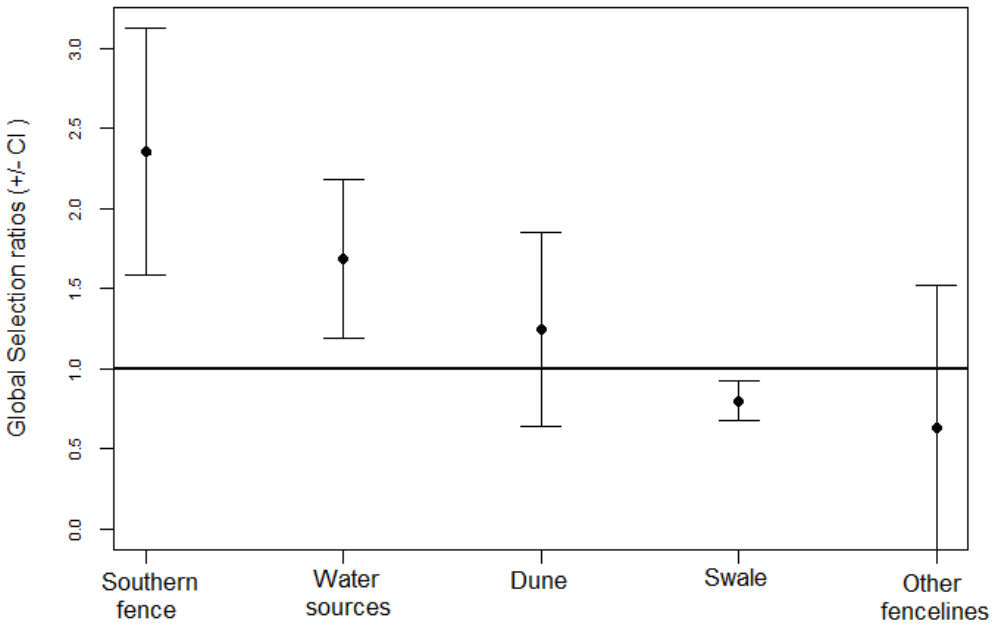

Figure 3. Selection ratios of GPS collared feral cats for different habitats inside a large fenced paddock, where the 'Southern fence' was the only fence connected to the conservation fenced reserve where small mammals would pass through.

Feral cats and townships during droughts

To understand how feral cats might benefit from townships and mines during periods of resource shortage (like in the 2018-2019 megadrought), we analysed the carcases of 550 cats removed from control operations around the Roxby Downs township, the Arid Recovery reserve, and nearby Indigenous land. We found cats from townships were twice as likely to be breeding than cats outside such areas, whilst condition scores were consistently higher for cats around townships even during the drought.

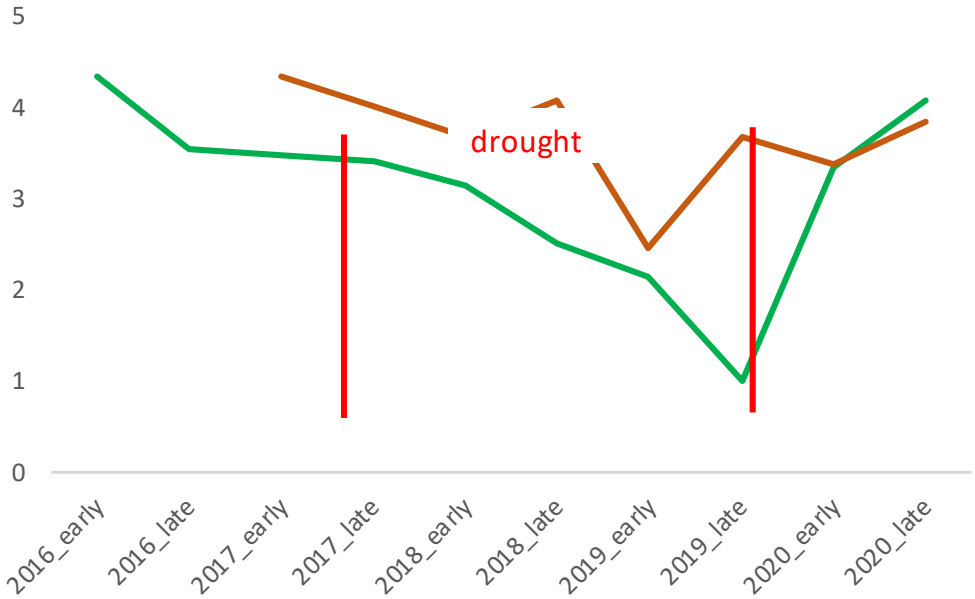

Figure 4. Feral cat average condition score (0-5 scale where 0 is terrible and 5 is excellent condition) from those found in conservation reserves and in a nearby township and mine in central South Australia. Samples were taken before, during and after the drought (red) from 2018 to 2019.

Discussion

Overall, the various research projects we conducted reveal a pattern of cats benefiting from supplementary food sources. We found that: populations of rabbits promote high densities of feral cats; successful conservation reserves can inadvertently assist feral cats by providing a supply of native wildlife; and townships can act as drought refuges for feral cats. Our study indicates that different management approaches are needed near to towns and conservation reserves, versus further away. Away from towns, rabbits can be controlled by bio-control agents, direct shooting, or warren ripping, which in turn should reduce local cat populations and impacts in those areas. Near conservation reserve edges and townships or mine sites to which cats are attracted, control operations should target cats directly.

Application of research

Our research has implications for policy or management of native wildlife. We show that prey-switching by cats may occur after rabbit populations are reduced. Reduction of rabbit populations, using biocontrol (e.g. RDHV, calicivirus) or warren-ripping, would create prey-switching by feral cats, so the risks of this for native species need to be considered. However, it also creates an opportunity for land managers to achieve widespread reductions in feral cat numbers. Prey switching after rabbit removal can greatly increase the likelihood of cats eating novel food sources, hence making them more susceptible to control techniques that benefit from cat hunger. Coupling rabbit control with cat control, for example using poison baits, would be extremely effective.

We also show that overall, rabbit control is likely to deliver substantial benefits to the conservation of native wildlife, beyond the direct benefits it provides for vegetation condition. By removing a major food source for cats, managers can prevent cats from living at high densities.

Another implication arising from our research is that successful conservation efforts can attract feral cats. We show cats are aware and can take advantage of local increases in prey availability like native rodents. Increasing predator control around conservation reserves may be critical for offsetting elevated numbers of predators that concentrate in such areas. Such unintended consequences should be considered when planning such fenced reserves.

Impact of the research

This research has contributed to how numerous organisations manage feral animals regionally across central South Australia. Arid Recovery now has integrated cat and rabbit control, and will proactively conduct baiting programs when rabbit populations are found to decrease. The local mine-site environmental team (BHP) have increased their efforts on local cat control, and utilising some of the control and monitoring methods we have trialled. The Arabana Cultural Rangers are conducting cat control and monitoring in conjunction with us based on findings from our research (i.e. targeting cat control around homesteads during droughts). Numerous other organisations in the region are applying rabbit control and citing our research in their applications.

Broader implications – for other places or species

Overall, rabbit control is likely to deliver substantial benefits to the conservation of native wildlife. By removing a major food source for cats, managers can prevent cats from living at high densities. These findings are likely relevant to other sites and habitats across Australia, wherever rabbit populations lead to greater densities of feral predators. Feral cats are very difficult to control in open landscapes; targeting their food sources is a lot more achievable in many circumstances.

Across Australia, there would be many other conditions in which people invariably create food sources that feral cats can take advantage of. This might be in the form of introducing rats to offshore islands, free-feeding in cities, or land-management changes that promote rabbits. We suggest all such instances that the impacts on feral predators be considered.

Future research priorities

Whilst our research was focused exclusively on feral cats, it is likely that similar patterns and threats are operating with the other major feral predator, the red fox. In other landscapes where foxes dominate, they would also likely be impacted by rabbit control, and use townships as drought refuges. We suggest that future research focus on whether this species has similar impacts.

Recommendations

- Integrate cat and rabbit management programs wherever possible
- Extra feral animal control should be conducted around conservation reserves, to protect from potential influxes of cats
- Control of cats around townships is important during droughts, as they act as refuges.

Conclusion

Integrated management of the food supplies of cats, as well as direct management of cats themselves, can greatly increase the effectiveness of management aimed at protecting native wildlife vulnerable to predation by feral cats.

Acknowledgements

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Ethics statement:

All methods were approved by University of Tasmania Animal Ethics Committee (A0015720).

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Further information:
http://www.nespthreatenedspecies.edu.au

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