Science for Policy

Research findings in brief

Project 4.4

Threatened Species Recovery Hub

National Environmental Science Programme

The northern quoll in the Pilbara

In brief

The northern quoll is a short-lived omnivorous marsupial whose range has contracted greatly since the arrival of Europeans. This study set out to understand what is behind the population distribution and density of the northern quoll so that we can act effectively to protect it.

Once distributed in a wide variety of habitat types, rocky outcrops seem to offer highest habitat quality, and high-quality vertebrate prey, although quolls will also venture into surrounding spinifex grasslands to supplement their diets. It is in these more open areas that quolls are most vulnerable to cats. Thus, rocky outcrops offer refuge against introduced predators, especially from feral cats that have been identified as important factors diminishing quoll populations. However, quoll populations are also influenced by long-term weather cycles, for example, droughts can diminish quoll populations.

Understanding more about quoll refuges, their denning preferences, and how best to manage introduced predators and the high-intensity fires common in the Pilbara that create favourable conditions for feral cats will be key to conserving this Endangered species.

The northern quoll in the Pilbara

The northern quoll (*Dasyurus hallucatus*) is a marsupial that is cousin to the Tasmanian devil and the extinct thylacine, and is listed as Endangered under Australian environmental law. It has an omnivorous diet with opportunistic habits, relying heavily on insects but also consuming small mammals, reptiles, amphibians and birds, and it will eat fruits when they are available. The quoll has a short lifespan. Most males die soon after their first reproductive season, but second-year females are common and some female quolls survive to three years of age.

The northern quoll was once found across the northern third of Australia from Southern Queensland to the Pilbara.

However, it has disappeared from most of its former range, especially from open, lowland habitats like savannas and grasslands, and is now restricted to a few populations in mainly rocky areas.

The main threat to the species is the cane toad. Its secretions are so poisonous that they can kill a quoll, even if the quoll mouths the toad but does not consume it. Fortunately, there are not yet any cane toads in the Pilbara, making quoll conservation in this region a very high priority. The region offers an opportunity for examining other threats to this imperilled marsupial, which include predation by feral cats, foxes, and dingos, and habitat alteration by changes in fire regimes.

Northern quoll. Photo: Nicolas Rakotopare

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CONACYT Consejo Nacional de Ciencia y Tecnología

ANZ TRUSTEES

Australian Government Australian Research Council

Research aims and methods

The aim of this study was to assess the ecology of the northern quoll in the Pilbara so that we might better understand the drivers of its density and distribution, and use this knowledge to inform and enhance conservation efforts towards the species. In the Pilbara, the largest mammalian predators are the dingo and feral cat, and the northern quoll is the largest native marsupial carnivore.

The Pilbara is a semi-arid to arid area subject to cyclones between December and March. I selected two sites, Millstream Chichester National Park (2381 km^2) and Indee Station (1623 km^2). These areas are dominated by spinifex (hummock) grasslands, with rugged outcrops, shrublands, riverbank areas, and some soft (tussock) grasslands. They are also subject to frequent seasonal fires, which have created a mosaic of recently burnt and longer unburnt areas. I chose these two Pilbara sites that feature a variety of habitat types because I wanted to understand the reasons why northern quolls are doing better in rocky than other habitat types.

I collected field data on six one-month trips over two years, through live-trapping, camera-trapping (quolls, predators, prey, insects), and surveys of vegetation, habitat structure, and den availability. I explored spatial and temporal associations between introduced predators and quolls, and associations of both with habitats, to assess the impact of introduced predators on quolls. I also assessed spatial and temporal associations among dasyurids to understand the current role of northern quolls within that guild (grouping of similar species).

Northern quolls have a synchronised annual reproductive cycle in which births are timed to enhance offspring survival by coinciding with seasonal resource pulses. The Pilbara is now the most arid and southern part of the quoll's patchy range. I analysed the northern quoll's demography and population dynamics to compare quolls from this range extreme with other populations across the whole range of the species.

I also assessed factors contributing to habitat quality for northern quolls to understand whether and how "bottom-up processes" regulate their apparent preference for rocky habitats. For this, I looked at den availability, vegetation cover, and diversity, and the availability and diversity of potential vertebrate and invertebrate prey.

The Pilbara.
Photo: Lorna Hernandez-Santin

Key findings

Predators and quolls

Dingos, cats, and quolls take large, medium, and small prey, respectively, with almost no overlap. However, I found evidence that dingo control programs prevent dingos from fulfilling their ecological role as top predators, which is leading to feral cats taking their place, in a process known as mesopredator release. Feral cats are associated with open habitats (spinifex grasslands and recently burnt areas), and quolls are associated with rocky habitats, which suggests that quolls avoid cats. But while quolls perceive cats as a significant risk, they venture into spinifex grasslands to forage. The larger size of cats, their widespread distribution in open habitats, and the temporal avoidance of cats by northern quolls together suggest that cats regulate the distribution of the quoll in a "top-down process".

Dasyurid guild

Looking at the dasyurid guild, I found that the range contraction of northern quolls into rocky habitats is preventing them from fulfilling their role as top native predators across the landscape. This is potentially leading to mesopredator release of kalutas (*Dasykaluta rosamondae*). Kalutas are associated with spinifex grasslands and may be controlling densities and distribution of smaller dasyurids such as stripe-faced dunnarts (*Sminthopsis macroura*), which more often inhabited recently burnt areas.

Northern quoll caught on camera trap. Photo: Lorna Hernandez-Santin

Key findings (continued)

Reproductive cycle

I found that the reproductive timing of northern quolls in the Pilbara differs from other, previously studied, populations in less arid and lower latitude regions. The finding is consistent with the hypothesis that dasyurids respond to differences in food availability by timing reproduction to coincide with peak resources. I found that females carry pouch young when the availability of prey is highest for vertebrates (the highest quality of prey), as this is when their demands for energy are greatest – the availability of prey was strongly seasonal. Specifically, the quolls in my two Pilbara sites ate more vegetation during the pre-mating season (June), ate more vertebrate prey when females carry pouch young and had high energy demands (September), and ate more invertebrates during the recruitment season (April).

Habitat quality

The supply of dens can limit the density and survival of denning species like the northern quoll. I found that except for a few dens in riverside areas, rocky habitats were the only areas with dens available. Rocky habitats had consistently more shelter, despite the better vegetation cover at the ground level that is provided by spinifex grasslands and shrublands. Spinifex grasslands had the highest combined numbers and diversity of vertebrates and invertebrates; rocky habitats, on the other hand, while having the highest abundance of vertebrate prey ranked only fifth among habitat types for abundance of invertebrates. Soft grasslands held few potential prey. This finding suggests that, although rocky areas provide high-energy vertebrate prey, they may not completely supply the year-round energetic needs of northern quolls, and they may consequently need to supplement their diet in surrounding spinifex grasslands.

Quolls may retract to refuges during droughts, and I found that Indee may be such a refuge. The population densities there are similar to those on offshore islands of the Northern Territory, such as Groote Eylante, which are free or nearly free of introduced predators and have intact understorey shelter as a result of infrequent burning.

Overall, I found evidence that top-down regulation by predators, particularly feral cats, affects the distribution of the northern quoll across the landscape in the Pilbara, while bottom-up regulation from seasonal cycles and prey availability may alter the density of quolls there. However, severe droughts may alter both the density and distribution of northern quolls by lowering survival and forcing individuals to move to pockets of higher productivity within rocky habitats.

Recommendations

Maintaining connectivity

My results suggest that rocky habitats currently represent the highest quality habitat for northern quolls. Management plans should therefore include ways to preserve rocky habitats and the features that provide natural connectivity between them. For example, waterways can connect rock outcrops. Such connectivity is important to maintaining genetic diversity and re-establishing quoll populations following periods of severe drought.

Droughts can be more important than top-down regulation by predators only when they are so severe that northern quolls are forced to retreat into resource refuges within their predator-refuges until conditions become favourable again.

Creek-lines in my study areas are in close proximity to rocky habitats, and water is often associated with more productive habitat. Therefore, overexploitation and disruption of naturally available water should be avoided, especially in creeks with low levels of water, because this has the potential to diminish resource availability that may be crucial to the quoll during droughts.

Managing fire and vegetative cover

Although feral cats pose a predation risk to northern quolls, I found evidence that quolls still feed in adjacent habitats like spinifex grassland where cats may be present. Cats are more active in more open and recently burnt areas, as this openness increases their hunting efficiency.

In grassland areas that surround rocky habitat, quolls will benefit from patches of denser, older (long-unburnt) vegetation, as this lowers the risk of predation by cats by offering more vegetative cover, and also improves prey availability for quolls. This is especially important for isolated or relatively isolated outcrops.

Before the arrival of Europeans, Indigenous people managed fire to avoid high-intensity burning. This promoted the presence and diversity of mammals through a matrix of vegetation patches of different ages. Fire management that results in less intense fires and increased landscape patchiness would favour native wildlife.

Recommendations (continued)

Research in other areas of northern Australia has also found that grazing by livestock (both managed and feral cattle, donkeys, goats, and camels) can also simplify vegetative ground cover to the advantage of feral cats. As such, stocking rates should also be considered in pastoral areas.

Managing human impacts

The Pilbara is a region of important economic value due to mining, and most of its mining activities take place in the rocky habitats so crucial for quolls. Considering that introduced predators restrict the distribution of quolls to rocky habitats, human activity that removes these habitats, such as mining, can push northern quolls in the Pilbara beyond the threshold of population resilience. It will be vital to restrict mining in areas important for the quoll until we know the thresholds of population resilience to this activity.

Managing introduced predators

Given that total exclusion of introduced predators is near-impossible, there are two ways to manage the impacts of introduced predators. One is through improving vegetative cover through fire and stock management, which reduces the hunting efficiency of cats and other predators, and the other is through control of feral cats. Unfortunately, current lethal control measures are more likely to succeed on dingos, which has led to mesopredator release of feral cats. However, new delivery mechanisms and bait preparations such as Eradicat® are being tested in the Pilbara, with promising results. Restoring dingo populations may help control invasive predators like feral cats and foxes by preventing the adverse effect of mesopredator release.

Further research

An important area of future research will be to understand differences in quality between different rocky habitats, including those subject to mining. This research should include analysis of the microhabitat characteristics of dens, and how quoll population density might be associated with them. Determining the importance of predation on quolls by native predators would also help us to understand the quoll's perceptions of den quality.

Cited material

Hernandez-Santin, L. (2017). Ecology and predator associations of the northern quoll (*Dasyurus hallucatus*) in the Pilbara. PhD Thesis, School of Biological Sciences, The University of Queensland. https://doi.org/10.14264/uql.2017.661

Further Information

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Releasing a northern quoll. Photo: Nicolas Rakotopare

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This project is supported through funding from the Australian Government's National Environmental Science Program.