# Science
## for saving species

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## Booderee's conservation success stories

## Global extinction crisis calls for transformative change

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Threatened Species Recovery Hub

National Environmental Science Programme

IMAGE: NICK SHORE

Editorial...

# A million species at risk of extinction

One million species threatened with extinction worldwide. That was the attention-grabbing headline that recently (and, sadly, briefly) captured the world's attention, when the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystems Services (IPBES) released its first global assessment of how the planet's biodiversity is faring – and what that means for people. Hub deputy director **Professor Martine Maron** talks about the global challenge we are facing.

For so many of the Earth's species to be threatened with extinction is unspeakably sad in itself, but it is also a sign that something is very seriously wrong with the ecosystems we rely upon. As threatened species researchers, we are working in the emergency ward of biodiversity protection. The IPBES assessment found that 25% of all species are in our waiting room. Our hub's own work is confirming these trends in Australia, with the Threatened Bird Index showing Australian threatened bird populations have dropped by half in 30 years on average. We need to be worried – not only for them, but for us.

The real message of the IPBES report was that we are unpicking the tapestry of life on this planet, pulling out threads one at a time. With each thread we reduce the integrity of the ecosystem upon which we rely. Biodiversity provides myriad benefits that we often take for granted, many of which are partly or wholly irreplaceable. As it disappears, our food production systems, the health of our waterways, the quality of our air and the stability of our climate are all compromised.

Looking past the shocking headline figure, what struck me the most was the sheer scale and reach of humanity's impact on the globe. Seventy-five percent of the planet's land surface is severely altered by people. We allow so little for all of the rest of the species with which we share this planet and upon which we depend. Last year, a paper in PNAS calculated that wild species contributed only 4% of the global biomass of mammals – all the rest was humans and their livestock. That's one hell of an appropriation of life on the planet.


ABOVE: To halt the extinction crisis, biodiversity needs to become a serious factor in decision-making by government and in every industry.

As we tend to see too often these days, the buzz over the report and its warnings disappeared from the headlines after a few days, with exciting things like royal babies and embattled footballers taking over again. That's not surprising, but also not a good sign that we will truly see what the report is calling for – transformative change.

Our society is much more comfortable with incremental change – although people can still struggle even with small changes, like a ban on single-use plastic bags at the supermarket or the idea we might have more electric cars. We see optimistic examples everywhere – Qantas recently announced its first 'rubbish-free' flight, and the reintroduction of species to areas where they have been absent for a century (such as the return of eastern quolls and southern brown bandicoots to Booderee National Park). But the IPBES report shows that the pace of change is not nearly fast enough. In all the scenarios they examined, only those that involved seismic shifts led to a moderation of the current trajectory by 2050.

## Inside the Autumn 2019 issue of *Science for Saving Species*



Threatened Species Recovery Hub
National Environmental Science Programme

RIGHT: Forums to share hub research findings and seek feedback from stakeholders are an important activity for the hub.

What would transformative change look like? We need to account for biodiversity impacts from industry, from individuals, and from legacy threats like invasive species. We need to track products we consume through their production and waste cycles to understand the full impact of our actions on biodiversity, and identify alternatives that are better.

Next, biodiversity needs to become a serious factor in all decision-making, by every government and by every industry. Not just a consideration; not just a number to be reported upon – something that drives the decisions that are made. And those decisions must be science-based: consistent with a vision of not only minimising impacts, but maintaining and improving the health of the natural environment.

Humanity has to learn to share. And we have to learn to set limits and respect them. All of these are things that we struggle with. And even for concerned individuals it isn't easy to see, let alone weigh up, the complexity involved in making more environmentally sensitive decisions about everything they do and consume. Our governments must lead. We need sound and biodiversity-friendly incentives, rules and regulation just as much as we need individual action and awareness-raising.

Science can and does help save species, and the Threatened Species Recovery Hub and our incredibly dedicated partners and colleagues will keep providing the evidence base for better decisions and action. For example, we have identified the top 20 Australian birds, 20 mammals and 100 plants at greatest risk of extinction, to alert managers to their plight and allow action to occur before these species are lost. But ultimately, science can only help achieve transformative change if society seriously commits to it.

The next 12 months will reveal something of the extent of the world's commitment to change, as new global biodiversity targets are due to be decided by next year's Conference of Parties to the Convention on Biological Diversity. But whether nations act to achieve those targets is another matter entirely – with the deadline for achievement of the current set of 20 Aichi targets up next year, good progress has been made on only four.

Most of Australia's species are found nowhere else on the planet – they are our unique responsibility. We are a wealthy, politically stable nation. I personally hope we seize this opportunity to respond to the IPBES report with leadership for transformative change. We punch well above our weight in biodiversity science – now let's do the same in putting it to work.

Professor Martine Maron
Deputy Director, TSR Hub
m.maron@uq.edu.au

IMAGE: JAANA DIELENBERG

# Making research partnerships **work**

**Rachel Morgain** is the Threatened Species Recovery Hub's Knowledge Broker. She believes stakeholder engagement in vitally important to achieving hub aims.

The central purpose of the Threatened Species Recovery Hub is delivering research that is relevant for and useable by decision-makers, land managers and others responsible for recovering threatened species. Working with partners is vital if we're to achieve this.

Over our four years of operation, our hub has worked with over 200 agencies across the breadth of the country. Our partners include Commonwealth, state and territory policy agencies, conservation and land managers, environmental NGOs, Indigenous groups, local government, community groups and businesses.

Many of these organisations are direct partners on our projects. Others have contributed knowledge, expertise, skills or data. Still others are end-users, who seek to apply the findings of our research to inform their own contexts and challenges.

## Strategic engagement

Guiding engagement at a strategic level is the hub's Stakeholder Reference Group (SRG), which includes representatives from Commonwealth, state and territory governments, NGOs, natural resource management organisations and the hub's Indigenous Reference Group, Leadership Group and engagement team. The SRG have a vital role in providing strategic input into our research activities and guidance into our hub's engagement strategies.

The size and scale of the hub means that our research is relevant to much wider networks than can be involved day-to-day in our project-level collaborations. In partnership with state governments, our hub is holding roadshows in capital cities, with plans for regional areas. These provide an opportunity for audience members to hear findings from a breadth of hub research in one place and provide feedback into how project findings and knowledge from the research can be shared. They have been a drawcard for many from government, natural resource management, ecological consulting, community landcare groups and industry, many of them learning about our hub's research for the first time.

## Showcasing collaboration

Many of our major projects are made possible through the involvement of dozens of partners and collaborators across the country. Celebrating these major achievements through product launches is a way to showcase the work and applaud these contributions. In 2018, our hub launched two books on threatened species recovery, guidelines for plant translocation developed through the Australian Network for Plant Conservation, and Australia's first *Threatened Species Index* for Australian birds (tsx.org.au).

These big events have the profile, but they are in reality just the end-point of much fuller processes of engagement, driven by a simple core principle of research co-production. The day-to-day activities of our hub's projects are guided by the awareness that research designed, implemented and delivered with stakeholder input is almost certain to be better directed and more readily implemented than research undertaken in isolation.

***For further information***

Dr Rachel Morgain
rachel.morgain@anu.edu.au

IMAGE: JENNY PIERSON

# To cull or not to cull?
## Quieting the noisy miner

The noisy miner is possibly Australia's most successful native bird species. It is also one of the most hated, as its success has been at the expense of many other species of woodland birds, including several threatened species. For these reasons many people call for the bird to be culled – but does it work? That is exactly what **Richard Beggs** from the Australian National University is going to figure out as part of a PhD project. Here he explains how this aggressive and territorial bird is causing so much trouble and discusses the challenges of controlling it.

ABOVE: Research team member Mason Crane carries out a cull of noisy miners. Unfortunately, there are so many miners in the landscape that new individuals poured into the cleared area in a matter of days.

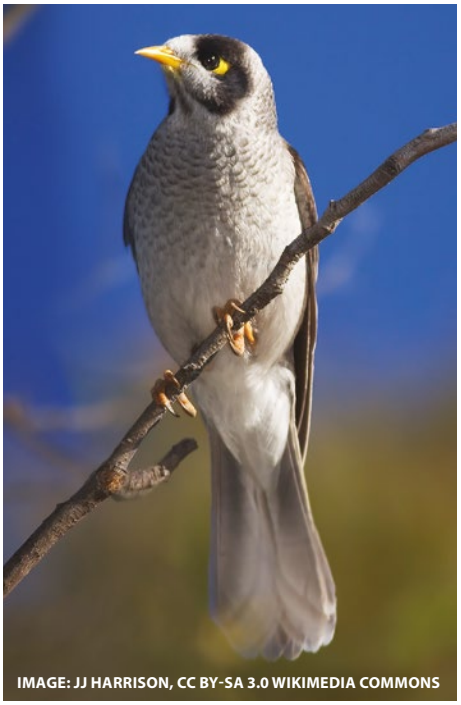

IMAGE: JJ HARRISON, CC BY-SA 3.0 WIKIMEDIA COMMONS

ABOVE: The noisy miner, possibly Australia's most successful native bird species. Unfortunately, its success is at the expense of many other woodland species.

In recent decades, noisy miner populations have expanded in fragmented landscapes across most of eastern Australia. They are a striking example of the unforeseen consequences of habitat modification. In two centuries, Australia has achieved levels of deforestation that took two millennia to achieve in Europe. This has had severe negative impacts on small woodland birds as well as encouraging noisy miners to become overabundant.

### Noisy miners: A few fast facts

As aggressive, communal birds of considerable size (around 70 g), noisy miners manage to frighten away many other species of woodland bird from their patch, several of which are in steep decline.

Noisy miners favour small (under 300 ha) patches of eucalypt woodland with minimal understorey and a grass ground layer. This is the type of habitat created when native woodland is used for grazing. Consequently, the agricultural landscapes of eastern Australia provide perfect habitat for this aggressive native species, and their numbers have exploded.

So concerning are the impacts on declining woodland bird species that, in 2014, the aggressive exclusion of woodland birds from potential habitat by noisy miners was formally declared to be a Key Threatening Process under Australian environmental legislation (the EPBC Act).

### Solution: Habitat restoration?

It is believed that habitat restoration (i.e., re-establishing the understorey layers) is the best way to reverse the dominance of the noisy miner in these landscapes, but this is easier said than done. It takes time and money, there is considerable uncertainty about how to achieve enduring restoration cost-effectively, and such restoration on farmland can reduce the economic potential of the land. For all these reasons it seems unlikely that restoration will happen quickly enough or at a sufficiently large spatial scale to save many species of woodland bird that are currently in decline.

### Solution: Culling?

Some ecologists and conservation managers have therefore suggested that culling noisy

RIGHT: The crested shrike-tit is one of many woodland bird species that is aggressively driven away from open woodland habitat by groups of noisy miners.


IMAGE: JJ HARRISON CC BY SA 4.0 WIKIMEDIA COMMONS

miners is the only practical way to prevent extinctions of some of the most threatened small woodland birds affected by noisy miners.

The impact of such a cull on the success, in particular the breeding success, of small woodland birds is largely unknown. Three studies in the 1990s involved the experimental removal of noisy miners. They showed an improvement following this removal in species richness of insect- and nectar-feeding birds in small woodland fragments. However, these experiments used only a few replicates, one had no control, they only measured detection rates, and included large woodland insectivores and nectarivore species such as white-winged choughs and red wattlebirds. While these two species are sometimes attacked by noisy miners, they are larger birds that can manage to coexist with them.

Which is where my research comes in. My PhD project aims to measure the impacts of an experimental cull of noisy miners on ecosystem function. We culled noisy miners from eight small, degraded patches of remnant box gum grassy woodland in the highly fragmented South West Slopes region of New South Wales, and compared those sites to eight matched control sites. At the experimental and control sites, we measured the size of the noisy miner population, the size of other bird populations, foraging rates of small woodland birds, harassment rates (by noisy miners) of other species, and artificial nest predation rates.

During the winter of 2016, we removed all noisy miners from treatment patches until there was no vocal response to a 45-minute playback of their call. This is a good indicator that no other noisy miners are in hearing range.

Unfortunately, as soon as the operation was over, the vacant sites were quickly recolonised by noisy miners from the surrounding area. We attempted to remove noisy miners again within three weeks of the first cull – but the same thing happened. Similar results have been noted in a number of culls of different scales across Victoria, New South Wales and Queensland in the past few years, most recently in a study by Davitt et al (2018).

## In conclusion: Looking ahead

So, what has been the impact of removing noisy miners? It hasn't significantly reduced their numbers. Noisy miners quickly recolonised sites from surrounding areas, so densities in treatment sites remained higher than the 0.8 birds per ha threshold above which they impact small woodland birds.

While the number of noisy miners remains high, there is likely to be a change in the behaviour of the new birds, and this may be beneficial to other birds. This is because noisy miners have a very complex social structure. When a site is colonised by birds who do not yet have an established community structure they are likely to behave quite differently – and this may be enough to change ecological outcomes, at least for a time. We are now working on determining what the effect is.

In treatment compared to control sites, we have so far seen a small increase in total harassment rates, a small increase in foraging rates of small woodland birds, but no change in artificial nest predation rates. Through further modelling of responses we aim to discover whether culling of noisy miners has any benefits for small woodland birds in this kind of landscape.

*Thanks to all the landholder partners in the region who allowed the experiment to be carried out on their properties.*

***For further information***
Richard Beggs
richard.beggs@anu.edu.au

RIGHT: Richard Beggs surveys one of his woodland treatment sites for noisy miners.


IMAGE: JENNY PIERSON

## Key messages

Human modification of woodlands has led to an explosion in the number of aggressive noisy miners, a native honeyeater

Culling noisy miners has been proposed to prevent them from driving several other species of woodland bird to extinction

Efforts to cull noisy miners have proven difficult as sites are quickly recolonised from surrounding areas.

# The kowari: Saving a central Australian micro-predator

IMAGE: NATHAN BEERKENS

ABOVE: A kowari on a gibber plain in the Sturts Stony Desert in South Australia, one of the last strongholds of the tiny predator.

The roles that medium- and micro-predators play in ecosystems were first noted by Darwin. He observed that field mice prey upon "humble" bee nests, and that the abundance of cats in a district, through suppression of mice, may increase the flowering success of certain plants, such as clover. Here, **Aaron Greenville, Katherine Tuft, Rob Brandle and Chris Dickman** discuss how the Australian arid zone is an ideal place to examine Darwin's observation and its implications as they undertake research to help secure the future of the kowari.

## The rise of micro-predators

Micro-predators are defined as weighing less than 300 g. They are present on most of the Earth's land surface and play an important role, through their predation, in food webs. Interactions within groups of micro-predators can be subtle, yet pervasive. One example, from cool temperate forests in Asia, is a decrease in spider numbers in the presence of the long-clawed shrew (*Sorex unguiculatus*), which leads to an increase in the spider's prey, tiny springtails. An example from closer to home is that of the insectivorous marsupials (dasyurids). The presence of the larger brush-tailed mulgara (*Dasycercus blythi*) increases the diversity and number of these smaller desert dasyurid marsupials, such as the wongai ningaui (*Ningaui ridei*), through the suppression of dunnart species (*Sminthopsis* spp.).

The loss of top predators from regions around the world is leaving micro-predators as the dominant predators in many ecosystems. The need to understand and conserve these species and their ecological functions is therefore more vital than ever.

## The biology of the kowari

The kowari is a small nocturnal dasyurid predator whose diet consists of invertebrates and rodents. During the day, this species shelters in burrows that it digs into sand mounds. Such mounds occur infrequently across stony gibber environments in arid Australia, where temperatures often exceed 40°C in summer and fall below 5°C in winter.

Adult kowaris weigh up to 175 g (males) or 140 g (females), which highlights the vulnerability of the species: it lies within the critical weight range (35–5500 g) of mammals most prone to extinction in Australia.

Kowari populations have declined across the central Australian deserts, and the species currently has only a very limited distribution. The few populations that remain are located

BELOW LEFT: Checking a pregnant kowari pouch.

IMAGE:TALI MOYLE

BELOW RIGHT: William La Marca inspecting a kowari.

IMAGE: TALI MOYLE

in arid South Australia and western Queensland. In these central desert regions, drought–wet cycles are driven principally by the El Niño Southern Oscillation, and are particularly intense.

With the decline or extinction of larger native arid zone predators, such as the western quoll, the possibility exists of the kowari now rising as an influential micro-predator in these desert regions. It is a similar size to the brush-tailed mulgara discussed above, and has the potential to hold a similarly important role in structuring and promoting biodiversity in arid Australia. Securing the kowari's populations could then be critically important not just for its own sake, but also to maintain diversity in these regions.

## Extinction risk for the kowari

Recent research by our team drawn from The University of Sydney and the South Australian Government found that the kowari populations in South Australia declined over the period 2000–2015. This finding was in spite of relatively favourable climate conditions over the period and some evidence that both the body condition of kowaris and their rate of reproduction increased after rain. Further, the region where we surveyed kowaris featured favourable habitat. This leads us to suggest that the two studied populations are under stress from pressures that are external rather than threats arising from within the species itself.

The two populations of kowaris showed highly similar trajectories. This is not good news, because when two adjacent populations are both declining it reduces the opportunity for them to recolonise each other, and points to an increased risk of extinction. In fact, the results from the population viability analysis suggest that, if similar trends occur elsewhere in other populations, the species would be eligible for listing on the IUCN Red List as Endangered, due to a 20% chance of extinction within the next 20 years.

IMAGE: AARON GREENVILLE

## What we are doing now

Given these alarming results, we are recommending that the kowari be considered for listing as Endangered. Working with stakeholders, such as pastoralists, the Traditional Owners of land now managed as national parks through co-management boards, and Arid Recovery (on a property that has excluded introduced predators and is dedicated to research), we hope to return the kowari to its former strongholds and a predator-free reserve to learn about how to manage its conservation effectively.

A PhD project by William La Marca is also investigating the major threats to the survival of the kowari – currently thought to be predation by feral cats, a medium-sized predator, and habitat disturbance due to cattle grazing – and how to mitigate them. The roles that Darwin first noted medium- and micro-predators to play in the ecosystem, and their implications for biodiversity, are thus being enacted – and investigated – on the stony gibber plains of South Australia.

*This Threatened Species Recovery Hub project is a collaboration between The University of Sydney, Arid Recovery, the South Australian Department for Environment and Water and the Foundation for Australia's Most Endangered Species (FAME). We thank Jim Phillipson for his recent support of this project.*

ABOVE: Brush-tailed mulgara in the Simpson Desert.

***For further information***

Aaron Greenville and Chris Dickman,
The University of Sydney, New South Wales
– aaron.greenville@sydney.edu.au
– chris.dickman@sydney.edu.au

Katherine Tuft, Arid Recovery, South Australia
– Katherine.Tuft@aridrecovery.org.au

Rob Brandle, Department for Environment and Water, South Australia
– Robert.Brandle@sa.gov.au

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*"Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of [bumble] bees, the frequency of certain flowers in the district."*

Darwin, C. (1859), *On the Origin of Species by Means of Natural Selection*. London: John Murray, p. 74.

BELOW: Many regions are suffering declines in top predators like dingoes, leaving micro-predators as the dominant predator in the ecosystem.

IMAGE: WILLIAM LA MARCA

# Reasons to be cheerful: Conservation success stories from Booderee National Park


RIGHT: Clare Crane from the Australian National University radio tracking southern brown bandicoots at Booderee National Park.

The Threatened Species Recovery Hub is celebrating great conservation outcomes from projects taking place in Booderee National Park for two Endangered species: the eastern bristlebird and the southern brown bandicoot (eastern subspecies). The Australian National University's **David Lindenmayer** and **Chris MacGregor** give us the scoop on the bristlebird and **Natasha Robinson** shares the good news about the southern brown bandicoot.

## Locating the **eastern bristlebird**

The eastern bristlebird has been lost from the vast majority of its former habitat along coastal eastern Australia, but is persisting in Booderee National Park. Surveys for all bird species at more than 130 long-term sites throughout Booderee have found that while the eastern bristlebird is largely absent from wet forests and rainforests, it is widely distributed in many other vegetation types found there. These include heathland, shrubland, sedgeland and woodland, especially where the ground cover and shrub layer are well-developed.

Booderee National Park is located in the Jervis Bay Territory of Australia, approximately 200 km south of Sydney on the southern coast of New South Wales. Co-managed by Parks Australia and the Wreck Bay Aboriginal Community, it encompasses 6379 ha of wild, unfenced, predator-managed environment. The hub has multiple research collaborations underway with the park, including general fauna monitoring, and targeted monitoring of three reintroduced species: the southern brown bandicoot, long-nosed potoroo and the eastern quoll (see our story about the latter in Issue 8).

### Good news for the bristlebird

Our monitoring is showing that not only are populations of the eastern bristlebird widespread throughout Booderee National Park but they appear to be slowly increasing. Further analysis of our data over the coming year will quantify changes in the number of sites the bird is occupying and the number of individuals at each site. The most likely reason for this positive outcome is outstanding attention to intensive fox control by park managers. The eastern bristlebird is a poor flyer and spends almost all of its time on the ground, where it can be vulnerable to predation, especially by foxes and feral cats. Feral predator control is therefore key to its effective conservation.

Our long-term surveys have spanned several major fires, and shown that the species has survived in burned areas, especially where there are unburned refuges. Indeed, the presence of these refuges is one of the factors promoting the speed of recovery of the eastern bristlebird in regenerating vegetation following fire. Fox control after fires is particularly critical, as burning can remove vegetation cover, facilitating hunting. The presence of refuges from fire coupled with effective fox baiting are thought to be critical factors supporting the persistence of the bird in Booderee.


ABOVE: Eastern bristlebird.

The eastern bristlebird also responds positively to control of highly invasive plant species such as bitou bush. Experimental studies have shown the removal of this noxious weed and revegetation with native vegetation cover has had positive effects on the bird's occurrence. This also highlights how weed control can be as positive for birds as it is for plant communities.

### What's next?

The persistence of healthy populations of the eastern bristlebird at Booderee National Park is good news for the species now, and critical for its future. Booderee populations have become a source of animals translocated to Beecroft Weapons Range on the other side of Jervis Bay, where the eastern bristlebird is now well-established at almost all of the long-term sites we have located there.

The potential for birds to contribute to the captive breeding program for Queensland eastern bristlebirds is also being explored.

## Return of a **marsupial**

We have also recently collaborated with Booderee National Park on the reintroduction of 27 southern brown bandicoots (eastern subspecies) that were sourced from the nearest wild population, located in state forests near Eden, New South Wales. We transported them to Booderee by car, releasing them the same day they were trapped. The releases started in 2016, with 11 animals (5 male, 6 female), then continued in 2017 with 12 individuals (8 male, 4 female) and the final release in 2018 of 5 more (4 male, 1 female).

Southern brown bandicoots are a nationally threatened marsupial. Once very common across their historical range, the coastal fringe from northern New South Wales to Victoria and South Australia, they have since declined to small, isolated populations and were last recorded in the Jervis Bay region in 1919. The bandicoot has suffered a combination of threats, including predation by feral cats and foxes, habitat loss and fragmentation, and altered fire regimes.


ABOVE: Releasing a southern brown bandicoot at Booderee National Park.

### Good news for the bandicoot

Over the past three years, we have used radio tracking, trapping and genetic analysis to monitor the survival, movements, habitat preferences, breeding and genetic diversity of the reintroduced population. Many volunteers have assisted with this monitoring. Our tracking data has revealed that the bandicoots have a preference for habitats like heath and woodland over forest, and that males and females have a similar home range.

The reintroduced bandicoots have successfully bred, with evidence of pouch young in the first year. The first adult bandicoot born at Booderee was caught the following year (2017). The bandicoots had a minor setback soon after, with a September 2017 wildfire in the location of the population. However, we trapped just after that and found several individuals, including some with pouch young, persisting in small unburnt refuges within the burnt landscape.

In addition, we found that the bandicoots continued to use the burnt landscape, adapting the location and structure of their nest sites to within dense regenerating vegetation.

We are also studying the genetic diversity of the reintroduced population, to avoid inbreeding and genetic drift. The diversity of the founder population is high, and comparable to other populations across the subspecies' range.

### What's next?

The genetic study will help managers to make informed decisions to maximise the long-term persistence and genetic diversity of the reintroduced southern brown bandicoot population at Booderee. This reintroduction is considered a success based on short-term criteria, such as stable population and breeding, and ongoing monitoring will evaluate longer-term criteria, such as population growth and persistence.

*These Threatened Species Recovery Hub projects are collaborations between Parks Australia, Booderee National Park, the Australian National University, Taronga Conservation Society Australia and Wreck Bay Aboriginal Community Council. The NSW Forestry Commission provided the bandicoots for reintroduction.*

***For further information***

David Lindenmayer
david.lindenmayer@anu.edu.au

Natasha Robinson
natasha.robinson@anu.edu.au

BELOW LEFT: Chris MacGregor (left) with volunteers catching and releasing southern brown bandicoots.

BELOW RIGHT: Volunteer Hannah Kapelj, radio tracking bandicoots.


# Tracking cats to help the night parrot

IMAGE: RACHEL MURPHY

ABOVE: Dr Steve Murphy has extensive experience researching the impact of feral cats on night parrots in Australia.

Know thy enemy is a famous quote from Sun Tzu's *The Art of War*. It is also a brilliant strategy when trying to saving an endangered species from a relentless threat. We talked to **Dr Steve Murphy** from The University of Queensland about new research which will GPS-track feral cats at Pullen Pullen Reserve.

Pullen Pullen Reserve was established by Bush Heritage Australia in 2016 to protect what was, at the time, the only known population of night parrots. It is still the best-known stronghold for this wonderful bird. Feral cats are believed to be the major threat to this extremely rare and Endangered nocturnal parrot, with cat control a major focus of conservation effort by Bush Heritage at the reserve. But finding and culling cats over 20,000 hectares of core night parrot habitat is not easy.

Researchers at The University of Queensland have been working closely with Bush Heritage on research that will inform night parrot conservation. The latest collaboration will help the reserve managers better understand feral cats' patterns and distribution at Pullen Pullen, with the aim of more targeted and cost-effective cat control. And this means potentially more young night parrots surviving to adulthood.

Dr Steve Murphy has spent hundreds of nights in the field at Pullen Pullen over six years to learn more about the mysterious night parrot and its habitat. We asked him about the new project and why understanding cats is so important to saving night parrots.

## Why do we need to do this work?

Cats are notoriously difficult to catch, trap and even shoot. Currently most control is happening in core parrot areas, which is great, but we need to know if we could further reduce the cat threat by taking the fight into adjacent habitats that are currently receiving less management attention.

Bush Heritage has removed about 35 cats over the past 18 months, but we keep seeing (and shooting) new cats in the parrot areas. Due to its vast size (56,000 ha) it is not possible to remove cats right across Pullen-Pullen Reserve. Instead, we have to be much more strategic about where and when to control cats to reduce the threat to night parrots and other wildlife.

## What do you already know about cats at Pullen Pullen?

We know from previous work on neighbouring Diamantina National Park, including extensive camera trapping by Dr Alex Kutt, Bush Heritage Senior Ecologist, and Stephen Kearney, a PhD student at The University of Queensland, that cats are more likely to be detected along creeks and rivers, and only intermittently visit Mitchell Grass Downs, where bilbies live. At Pullen Pullen, the same thing might

IMAGE: NICOLAS RAKOTOPARE

ABOVE: Techniques for tracking feral cats have been developed and refined by Dr Hugh McGregor in arid South Australia.

be happening, but could involve other source habitats like sandhills and escarpments, in addition to rivers. In some areas near core parrot areas, cats are rarely detected twice. We need to know where the source areas are for cats on Pullen Pullen so we can remove them there before they reach the parrot areas. Controlling cats at the source and within the corridors will reduce the likelihood that cats will get close to the parrots.

IMAGE: NICK LESEBERG

RIGHT: A night parrot at Bush Heritage Australia's Pullen Pullen Reserve in outback Queensland.

## Tell us about the cat tracking research

We'll trap feral cats from a variety of habitats on Pullen Pullen Reserve that are not near the core night parrot areas. We have Animal Ethics and Biosecurity Queensland approval for 40, but we'll be happy with 10. We'll fit them with GPS collars then track them for one to two months. The project will last two years, enough time to build up a good picture of the parts of the landscape they are using as well as document any seasonal variation in movements. And, importantly, we'll also know if and when cats from other parts of the reserve are travelling into the core night parrot areas, from where, and the corridors they use. This information will be invaluable to planning future cat control strategies, like where and when to deploy Felixers (grooming traps) or undertake shooting.

## Why can't we learn this another way?

We've learned as much as we can from camera traps and other monitoring techniques. The information has been invaluable, and helped us to plan the next research stage. Those methods can also have limitations and be open to interpretation, for example, a greater number of cat tracks in a certain habitat could be from lots of cats or from one cat walking back and forth.

But GPS tracking is the only way we will be able to get detailed spatial information about exactly where cats are going and when. It will tell us things like how far cats are travelling each day, if there are any key areas or habitats that cats use more often, and if there are key times of day or even seasons for these places.

## How will you minimise risks to the parrots?

First, we have assembled a team with extensive experience with both night parrots and feral cats, including Dr Hugh McGregor, who has trapped and tracked about 200 cats over the past few years, often near populations of other threatened species. Second, parrot nesting and feeding areas were defined in previous detailed tracking and acoustic studies, and we have set up a safety zone around them with a 3 km buffer. We are using highly reliable satellite GPS units, which will give us real-time updates if any cat enters this zone. This will allow us to remove any cat within the 3 km zone, thereby reducing risks to night parrots. By the end of the study, we will have used the GPS collars to relocate and humanely destroy all of the collared cats. And all aspects of the project are being overseen by the Night Parrot Recovery team, who are providing invaluable technical advice.

## Will other species also benefit?

Yes! A large number of species, including Endangered plains wanderers and bilbies, occupy similar open habitats to night parrots in Pullen Pullen and are also threatened species impacted by cats. Hopping mice, dunnarts, small reptiles and many birds will also be happier about fewer cats on the reserve.

## Are you hopeful for the future of the night parrot?

At Pullen Pullen, we think that cats are the last major threat to reduce before night parrots can flourish.

After Bush Heritage removed cattle from the reserve the amount of seed available to parrots in their main feeding areas skyrocketed. Nick Leseberg from The University of Queensland showed that night parrots bred for an extended period soon after this grazing pressure was removed. The counter-balance was that night parrot nestlings get really noisy in the nest close to fledging, which can attract cats. One cat was observed honing in on a nest that Nick was monitoring, and it was promptly dispatched by Bush Heritage staff.

So it seems that the parrots are quite happy to breed when conditions are good, but we remain highly concerned that cats are out there ready to kill young, naïve night parrots soon after they leave the nest. If this research helps us get smarter about reducing the cat threat, we expect the number of night parrots on the reserve to increase.

*This Threatened Species Recovery Hub project is a collaboration between Bush Heritage Australia and The University of Queensland.*

***For further information***

Dr Steve Murphy - stephen.murphy@uq.edu.au
Dr Alex Kutt - alex.kutt@bushheritage.org.au

Pullen Pullen Reserve is a stronghold of the Endangered night parrot.

IMAGE: BUSH HERITAGE AUSTRALIA

Jabin Watson beside the flume.

# Why do tiny frogs persist or perish on a tiny scale?

IMAGE: EMILY HOFFMANN

The white-bellied frog in south-western Western Australia is experiencing population extinctions throughout its small range. The driver of recent declines is a mystery, but **Emily Hoffmann** of the University of Western Australia is on the case. She presents some of the pieces of the puzzle here and asks some of the questions that may produce the clues we need to solve it.

ABOVE: A juvenile white-bellied frog. Fully grown, these tiny frogs are only about 2 cm long.

## Meet *Geocrinia alba* – the white-bellied frog

The white-bellied frog is probably not what you think of as a 'normal' frog. They are pretty teeny – only weighing around a gram or so as an adult – and they are entirely terrestrial, living all of their life stages on land (yes, including the tadpoles!). Females lay a small number of eggs in a shallow depression in moist soil made by a male frog and they form a jelly-like pool. The eggs develop into tadpoles entirely within that little jelly-filled burrow, and emerge as miniature frogs a couple of months later. They will then take potentially two or three years to mature into adults.

White-bellied frogs are unique to south-western Western Australia and are only found in a small number of isolated patches near headwater streams in the Margaret River region. It is estimated that the total area they occupy is less than 2 $km^2$ – so you could think of them as a 'micro' endemic. And they really like it in these swampy patches. These frogs show incredibly high site fidelity, with males found to move less than five metres in a year on average. So even though some populations are not physically far away from each other, genetics work has shown them to be isolated, with almost no movement between populations.

So in essence, these frogs are rather fussy, sedentary and are slow to mature (not that dissimilar to myself now that I write it ...).

## Declining populations

Since their relatively recent discovery in the 1980s, over half the known populations of white-bellied frogs have become locally extinct. In the past, habitat clearance and land use change were clearly responsible for their decline, but more recently a dedicated team of conservation managers noticed populations being lost in areas that seem 'untouched'. These declines are more of a mystery and are continuing to occur throughout the species' range.

BELOW: Developing embryos (left and middle), and a tadpole nearing metamorphosis (right).

IMAGE: EMILY HOFFMANN

IMAGE: EMILY HOFFMANN

IMAGE: EMILY HOFFMANN

BELOW: (L-R) White-bellied frog project team members Matt Hipsey, Kim Williams, Nicki Mitchell and Emily Hoffmann in the field.


IMAGE: CHRISTINE TAYLOR

Why are we losing populations from conservation areas that should be protected from known threats? And why do some populations seem to persist, while nearby neighbouring populations seem to be dropping off the perch?

In eastern Australia and other parts of the world, enigmatic frog declines have been linked with the notorious chytrid fungus, which causes the infectious disease Chytridiomycosis, but in Western Australia it does not seem as likely. While it has been detected in the area, infection levels were low and not thought to be linked to the decline of white-bellied frogs.

Conversely, we do know that there are climatic changes happening on a regional scale in south-western Western Australia. Rainfall in the south-west has reduced by around 15% over the past 40 years. Furthermore, there is evidence of increased air temperatures, declining groundwater and reduced summer flows in catchments in the area. These factors could be altering the moist and cool patches on which this species solely depends. So, are white-bellied frog declines and population extinctions linked with changes to the microclimates within their unique habitats? That is what we (a group of scientists from the University of Western Australia and conservation managers from Western Australia's Department of Biodiversity, Conservation and Attractions) have set out to try and answer.

## Finding the key to persistence

Over the past year, I have been getting up close and personal with the dense and rather spiky swamps where these frogs solely occur. We have been looking at sites where the frogs are present and comparing the habitat characteristics with adjoining areas that look 'good' but where the frogs are absent, or areas where they used to be but are now locally extinct. This could tell us what is driving the recent population declines and what particular habitat qualities are associated with a 'good' frog site.

The results so far support our micro-climate hypothesis – nearby sites where the frogs don't occur or have become extinct were drier and experienced more extreme temperatures over the summer months. We are now looking at frog eco-physiology to try and ask how white-bellied frogs may respond to environmental changes, particularly, how hot is too hot, and how dry is too dry for these frogs?

We hope we can use this fine-scale understanding of their habitat requirements to predict where they stand the best chance of survival and aid with selecting translocation sites that are most likely to support viable populations into the future.

## Why do we care about (these) frogs?

Frogs in general are not doing well in the current global extinction crisis. More than one in three are threatened with extinction around the globe. Research into frog declines has emphasised that each case is unique, and thus we need to investigate and understand the drivers of decline on the scale of individual species.

White-bellied frog populations are continuing to decline and without research will likely continue toward the extinction path, without us knowing why. These specialist species are sensitive to environmental changes, and their declines could be indicating changes we are currently unaware of. For a species restricted to such a small area of specialised micro-habitat, and one that has little capacity to move, it also raises the important question about the future of species in a changing climate.

There's still so much we don't know about the natural world. Why do species occur where they do? How do they all interact and are they unique and important? It would be hard to ask these questions when they are no longer there, so we must ask and learn from them now.

*This Threatened Species Recovery Hub Project is a collaboration between the University of Western Australia, the Western Australian Department of Biodiversity, Conservation and Attractions, Parks and Wildlife Service and Perth Zoo.*

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***For further information***

Emily Hoffmann
emily.hoffmann@research.uwa.edu.au

*This article was first published in the Naked Scientists (www.thenakedscientists.com).*


IMAGE: BRUNO BUZATTO

ABOVE: Emily Hoffmann deploying frog 'models' to estimate water loss in the field.

BELOW: Emily Hoffmann inspecting a white-bellied frog nest.


IMAGE: CHRISTINE TAYLOR

# Kakadu collaboration for the **yellow chat**

The Alligator Rivers yellow chat is a small, bright yellow insectivorous bird of the Kakadu floodplains. This Endangered species is imperilled by habitat changes caused by altered fire regimes, buffalo and feral pigs, rising sea levels and the spread of weeds like prickly mimosa and introduced grasses. What has been happening to degrade these floodplains has been equally of concern to Traditional Owners as to yellow chat researchers. Charles Darwin University PhD candidate **Robin Leppitt** is celebrating the completion of field work, and has news to share.


IMAGE: KEITH LIGHTBODY

ABOVE: A male Alligator Rivers yellow chat.

## Survey sites and sacred places

I first obtained permission from the Traditional Owners, including Victor Cooper and Sean Nadji, to work on the Country. People had concerns about the invasive animals and weeds that were not only threatening the yellow chat but also damaging sacred places on the floodplains and making it harder to hunt for bush foods. Many of the survey sites are also important hunting and collecting sites. In response to their interest I collected additional data on these threats across the floodplains.

Roy and Harold are Traditional Owners from other parts of the Top End, but their wives are Alligator Rivers Traditional Owners. Working with them was really valuable to the project as it helped me access areas of the floodplain and also better understand local views about how the floodplains were used and how they should be managed.

## Our findings

In addition to identifying the whereabouts and abundance of yellow chats, we were interested in discovering more about the chat's preferred habitat, investigating their favourite types of vegetation and how they are affected by different fire regimes and feral animals.

Our preliminary results indicate that yellow chats like channels and depressions in unburnt areas of the floodplain that have old, deteriorating sesbania bushes. Sesbania is an annual, low-growing flowering shrub native to the Kakadu region. Unfortunately, these channels and depressions also attract feral pigs, which dig in the mud, often destroying the vegetation that the yellow chats forage among.

Our work also involved trapping and banding individuals, not only to help determine numbers but also to take some feathers for genetic analysis so we can compare the DNA of the Alligator Rivers yellow chat with its two sister subspecies. This will allow us to determine how much genetic variation exists within the Alligator Rivers population and also give an indication of how genetically distinct the three subspecies are from one another.

The floodplains which the Alligator Rivers yellow chat lives upon are all coastal and all just a few meters above sea level. Perhaps most alarmingly, any significant rise in sea level will have vast impacts upon not only yellow chats but the entire ecosystem. How the floodplains respond to sea level rise will be key in determining the future of this tiny yellow bird.

***For further information***

Robin Leppitt
robin.leppitt@cdu.edu.au

BELOW: Harold Goodman, Laura Dreyfus and Robin Leppitt in an all-terrain vehicle en route to a survey site on the South Alligator River floodplain in Kakadu in October 2018.


IMAGE: ROBIN LEPPITT


IMAGE: ROBIN LEPPITT

ABOVE: Donna Belder and Harold Goodman setting up a mist-net to catch chats for leg banding.

# **Norfolk Island's** threatened flora


ABOVE: Lydia Guja from the Australian National Botanic Gardens and Leah Dann setting up exclosure plots.

The native forest on Norfolk Island provides vital habitat for the island's threatened plant and bird species, many of which are found nowhere else on the planet (also called endemic). When the British colonised Norfolk Island in 1788, they cleared much of the original vegetation. Remaining forest is now protected in the national park and reserves, but plant recruitment is poor and invasive non-native plant species would likely overtake the forest without the on-going efforts of park managers. To preserve remaining forest, it is important to determine the main causes of declines and the most effective actions that managers can take to address these threats and restore native vegetation. Project Leader **Salit Kark** and PhD student **Leah Dann** of The University of Queensland discuss this collaborative project working to protect the island's endemic and threatened species.

Norfolk Island's native forest faces threats that are common to the flora of many islands, including invasive non-native plant and animal species. Norfolk Island's pest species include strawberry guava, black rats, house mice and feral fowl. These invasive species may be playing an important role in preventing native forest plants from recruiting and establishing: the guava by outcompeting native plants for space, light, water and nutrients; the rodents by eating native plant seeds; and the feral fowl by constantly disturbing the soil and litter while they forage and build nests, which we believe decreases seedling survival.

## Measuring threats

To measure the effects of rodents and birds on seed and seedling survival, we are comparing seedling establishment and seed take within various types of exclosures that protect seeds and seedlings from both rodents and birds, birds only or from no vertebrates at all. We are also comparing areas where the invasive guava has not been removed and areas where it has been managed at different time points during the past 20 years. This will allow us to determine the influence of guava and its removal on native plant recruitment, forest health and forest composition (which species are present and their relative abundance). Collectively this research will provide valuable information about how invasive plant and animal species are impacting native plant recruitment.

Norfolk Island currently has 41 threatened endemic plant species, and little data is available about their biology and ecology. This project will help fill these knowledge gaps by compiling information about the seed viability and longevity of these threatened plant species, as well as gathering information about plant–animal interactions. We will also analyse patterns of native and invasive vegetation cover over time and space. This will serve to further investigate the drivers of forest change.

Gaining an understanding of the impacts of key threats and management actions will be vital to creating an effective strategy for monitoring, managing, and restoring native forest to prevent the extinction of endemic plant and bird species.

## Collaboration is critical for successful conservation

This Threatened Species Recovery Hub project is a collaboration between The University of Queensland, Parks Australia, Norfolk Island National Park and the Australian National Botanic Gardens, who have been working tirelessly to save threatened species not only on Norfolk Island, but across Australia. Local people on Norfolk Island have a great deal of knowledge about the flora and fauna present on the island and passion to conserve this highly endemic and unique system. They have provided immense contributions to our understanding of the ecosystem.

Ecosystem conservation is a difficult task. By integrating scientific research and community engagement, and implementing practical management and restoration strategies we will be in the best position to successfully conserve the unique species of Norfolk Island.

***For further information***

Leah Dann
l.dann@uq.edu.au

BELOW: Leah Dann from The University of Queensland pulling up seed bags for viability testing.

TSR Hub Researcher Profile

# Rosemary Hohnen

As a kid I spent a lot of time after school down the river with my blue heeler Blossom. We'd roam river edges looking for bunny holes, duck nests and new swimming spots and come home muddy and happy. While my old friend and those days are long gone, sometimes I find myself checking a pitfall trap in the rain with my face in the dirt and feeling like not much has changed.


ABOVE: Rosemary firefighting in the Kimberley in 2016.


ABOVE: Rosemary Hohnen (left) and Laura O'Connor measuring animals caught during surveys on Kangaroo Island.

At uni I liked zoology because we got to go outside. I did honours in reptile physiology, and while I loved the lizards and found learning about their physiology oddly satisfying (like solving a puzzle), I discovered that lab work and I weren't meant to be. I also really wanted to work on projects I felt contributed as directly as possible to the conservation of threatened species.

After graduating I interned with the Australian Wildlife Conservancy (AWC) in the Kimberley region. I worked in a team trapping small mammals, reptiles and frogs as part of AWC's annual biodiversity survey on their sanctuaries over north-western Australia. I met some creative, funny and driven ecologists like Sarah Legge and Katherine Tuft, and I began to hope for such a future for myself.

Sarah helped me secure a PhD project on one of AWC's north Kimberley sanctuaries called the Artesian Range. The range is home to many species of small mammal that have disappeared from other parts of northern Australia, and for my PhD I set about trying to understand why they'd persisted there.

It's a remote and beautiful part of the world, with big rugged escarpments and gorges surrounding dense pockets of rainforest. We lived under a tarp through two wet seasons trapping scaly-tailed possums and golden-backed tree rats and looking at their habitat preferences and resource requirements. We found that many arboreal mammals rely on fruiting trees and rainforest pockets – and both resources are unfortunately susceptible to intense fires that in the past 30 years have been increasingly frequent in the region. The rugged landscape of the Artesian Range has helped protect these resources from fire, and may have thus helped some small mammals persist there.

For the past two years I have been working on a project investigating how the Endangered Kangaroo Island dunnart might respond to broadscale feral cat control. Studying this small carnivorous marsupial has been a lesson in the reality of working with threatened species. When researching such species that are found in low numbers over a restricted area, you have to be stubborn and resourceful, and work hard for a small amount of data. Every bit collected has helped us better understand the dunnart's current distribution, how to best monitor it, what the main threats are, and what we can do about them. Feral cats appear at high densities in some areas where the dunnart persists, so monitoring the dunnart population, and controlling cats may help the species persist in the long term.

I've loved the opportunity to work with a close-knit and caring island community. It has also been great to learn more about island conservation, which seems a powerful tool for pushing back against small mammal extinctions in Australia.

***For further information***

Rosemary Hohnen
rosemary.hohnen@cdu.edu.au

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Editor: Jaana Dielenberg
j.dielenberg@uq.edu.au

Science Communication Officer: Kate Donnelly

Graphic Designer: Mary Cryan

www.nespthreatenedspecies.edu.au

COVER IMAGE: NATASHA ROBINSON RELEASING A BANDICOOT INTO BOODEREE NATIONAL PARK. (SEE PAGE 9 FOR THE FULL STORY). IMAGE: NICK SHORE

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