# 2024 University Research Grant Winners

The Australian Wildlife Society's University Research Grants are offered to honours or postgraduate students at Australian universities conducting research that contributes to the conservation of Australian wildlife (flora or fauna). Ten grants are awarded each year: one $5,000 scholarship and nine $3,000 grants.

The Dr Clive Williams OAM Memorial Wildlife Conservation Scholarship is awarded to the highest-ranked applicant of all our University Research Grants in honour of former Director Dr Clive Williams.

Grants may be used to purchase equipment and consumables, travel expenses related to field research, or attend a conference where the student presents their research.

## The Australian Wildlife Society is delighted to announce the winners for 2024:

### George Lester

(Dr Clive Williams OAM Memorial Wildlife Conservation Scholarship Recipient)

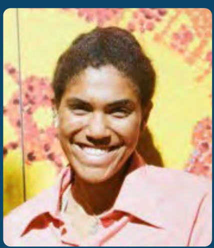
**School of BioSciences, The University of Melbourne.**

**Project Title:** Pollination Networks in East-Arnhem Land: Analysing Effects of Climate Change on Stingless Bees through DNA Metabarcoding of Foraged Pollen.

### Rose Lownds

**School of Science, Western Sydney University.**

**Project Title:** Determining the Distribution and Migratory Flyways of Bogong Moths (*Agrotis infusa*) Using Genetic and Stable Isotope Analyses.



### Alexandra Ikpe

**School of Science, Technology and Engineering, The University of the Sunshine Coast.**

**Project Title:** Tracking an Elusive Predator, Mature Male Tiger Sharks, Along Eastern Australia.

### Jasmine Towle

**School of Biological Sciences, The University of Adelaide.**

**Project Title:** Climate Change Impacts on Marine Invertebrates in Temperate Australia.

### Alice Howie

**School of Natural Sciences, Macquarie University.**

**Project Title:** Sound as an Emerging Technology to Monitor Biodiversity Across Seascapes.

### Matthew Rose

**Institute for Marine and Antarctic Studies, University of Tasmania.**

**Project Title:** Collapsed Habitat Threatens Australian Marine Wildlife.

### Emmeline Norris

**Centre for Tropical Environmental and Sustainability Science, James Cook University.**

**Project Title:** Utilising Drone-Based Thermal Imagery to Accurately Estimate the Abundance of the Endangered Spectacled Flying-Fox (*Pteropus conspicillatus*) and Model Population Trajectories.

### Natalie Grassi

**School of Environmental and Conservation Sciences, Murdoch University.**

**Project Title:** Does Fragmentation Alter Predator Diets?

### Luke Florence

**Department of Environment and Genetics, La Trobe University.**

**Project Title:** Mycorrhizal Diversity in Australian Temperate Forests in the Context of Drought and Nitrogen Deposition.

### Rebecca Quah

**School of Science, Edith Cowan University.**

**Project Title:** Is There Mush-Room for Bettongs? Resource Use and Availability for Bettong Reintroductions to Dirk Hartog Island.

# From Pollen to Preservation:

## Establishing baseline data for conservation of native bees in Northeast Arnhem Land

**George (Clancy) Lester**
School of Biosciences,
University of Melbourne

Dr Clive Williams OAM Memorial Wildlife Conservation Scholarship Recipient

**Australia is home to around 1,650 species of native bees, but the actual number is likely closer to 2,000 as many species have yet to be described. Data on bee populations is extremely limited, particularly in remote regions like the Northern Territory, where only 200 species have been officially recorded. My research team and I were invited to support a collaborative investigation into the status of native bee populations in Barrkira, a small First Nation homeland of Northeast Arnhem Land.**

The pristine environment of Northeast Arnhem Land is dominated by a mosaic of Darwin stringybark (*Eucalyptus tetrodonta*) woodlands and open savannah tropical grasslands. It is not as exposed to the threats that native bees typically face worldwide, such as land clearing, pesticide use, and intensification of agriculture and urbanisation. Yet, Yolŋu elders have reported changes in bee activity and flowering patterns in recent years, as well as less predictable and diminished honey harvests. We aimed to address these concerns by investigating native bee populations, the plants they forage on, and the flowering patterns of food plants at Barrkira.

A *Megachile remeata* specimen collected from Barrkira, Northern Territory, is currently only known to exist in New South Wales, Western Australia, and South Australia. Image: Clancy Lester.

### Investigating Bee Populations

Together with Yolŋu rangers, we conducted surveys of local bee and plant populations, focusing on areas known for Guku production. We used sweep nets to capture foraging bees from flowering shrubs and herbs. We surveyed three sites across Barrkira each month for three months during the 2023 dry season when native bees were more likely to be observed. These surveys have continued into 2024 and are contributing to a long-term monitoring project.

The surveys resulted in collecting specimens from at least twenty-three different bee species from four of the five bee families in Australia. Bees from the family Megachilidae, particularly the genus *Megachile*, were the most common. Many captured species, such as the *Megachile remeata* and *Leioproctus sp.*, have never been reported this far north in Australia. Remarkably, not a single European honeybee was observed. We identified thirty-seven species of flowering plants, many of which are endemic to the Northern Territory.

### Unravelling the Web of Bee-Plant Interactions

In the lab, we collected pollen from each bee specimen and traced the DNA from pollens to the DNA of potential source plants growing in the region. This analysis, known as

Turkey bush (*Calytrix exstipulata*) is a common flowering plant species in the region. Image: Clancy Lester.

A potentially undescribed *Leioproctus* native bee species collected from Barrkira. Image: Clancy Lester.

Members of the Barrkira research team, from left to right: Josepha, Hamish (Yirralka Ranger), Clancy, and Sean. Image: Clancy Lester.

Dr Rachele Wilson and Dhimurru and Yirralka Rangers speaking to Learning on Country participants. Image: Clancy Lester.

DNA metabarcoding, uncovered a complex web of interactions between native bees and flowering plants. Our analysis identified seventy-eight different plant species from bee-collected pollen. Notably, Jacksonia (*Jacksonia dilatata*) from the Fabaceae family and both turkey bush (*Calytrix exstipulata*) and Darwin stringybark from the Myrtaceae family were the most frequently foraged plants, highlighting their importance as critical resources during the dry season.

As the season progressed, we observed shifts in bee pollen diets, with Jacksonia becoming more prevalent over time and turkey bush less so. These findings suggest that bee foraging behaviour can be dynamic in nature. There were several generalist bee species that foraged from upwards of fifteen different species of flowering plants. Several species demonstrated more specialised foraging patterns, only collecting pollen from a single family of flowering plants. We are currently looking at historical herbarium records of key flowering resources like the turkey bush, Jacksonia, and Darwin stringybark to find the data to support the claims of shifting flowering times observed by Yolŋu knowledge holders.

## Engaging the Next Generation: A Two-Way Learning Experience

In the spirit of reciprocity, we volunteered to co-host a school camp at Barrkira through the Yirrkala School's Learning on Country Program alongside Dhimurru and Yirralka Rangers. Over one hundred participants across Arnhem Land attended the camp, which focused on learning 'two ways' – integrating Western scientific methods with Yolŋu traditional knowledge.

Students eagerly learned about pollination, plant reproduction, and the intricacies of collecting insects. The honey harvesting and insect-catching activities were particularly popular, with students quickly mastering using aspirators to catch bees. Elders, teachers, and rangers played a crucial role in translating and incorporating traditional knowledge into every aspect of the camp, ensuring that Yolŋu science, song, and dance associated with bees are passed on to the next generation. I invite you to follow my journey and ongoing research on Instagram @ beesandblossoms.aus.

**Funds provided by the Australian Wildlife Society will** assist in sequencing the DNA of pollen foraged by native bees.

# Tracking an Elusive Predator:

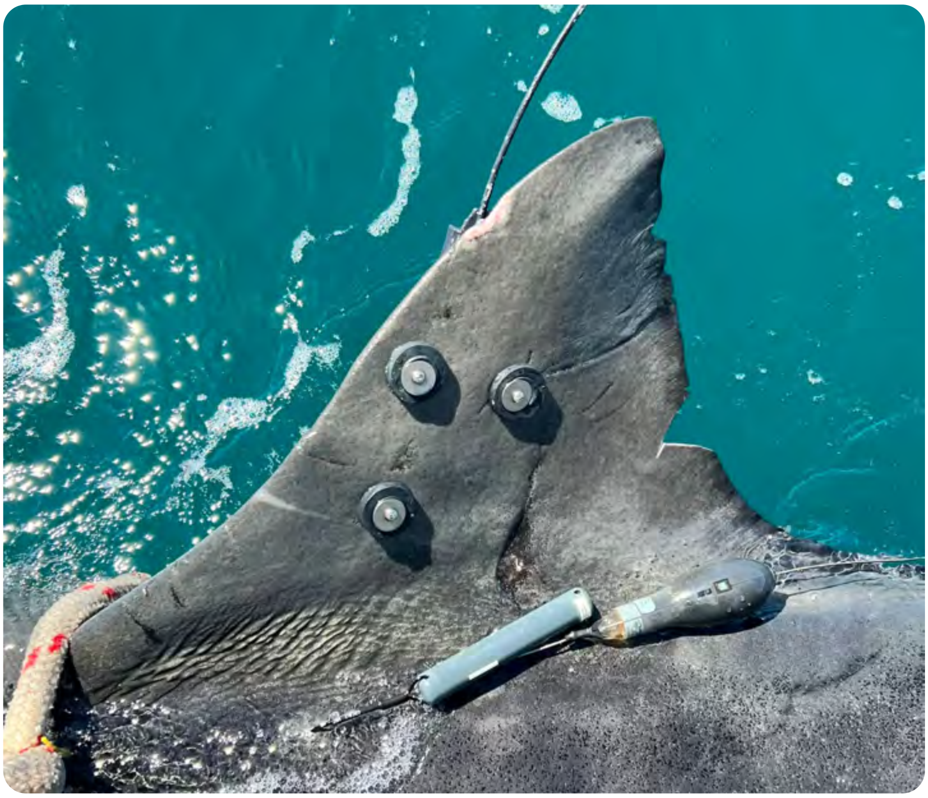
## Mature Male Tiger Sharks, Along Eastern Australia

**Alexandra Ikpe**
School of Science, Technology and Engineering,
The University of the Sunshine Coast

### Sharks are Friends, Not Food

As apex predators, sharks affect ecosystems through direct predation and indirect influence on the behaviour of other animals, trickling down to affect plant life. The prolonged absence of sharks in any given environment can trigger longer-term changes to community assemblages, and given enough time, it can result in entirely new ecosystems. While natural absences of sharks exist in nature (i.e., seasonal distributions), unnatural and prolonged changes due to climate change or shrinking populations allow for the increase of other species, leading to larger, potentially irreversible shifts. Despite their importance and minimal evolution over the last one hundred million years, many sharks remain scantly studied.

Current assessments find that 37 percent of shark (and ray) species are threatened with extinction, meaning the probability of shifting marine environments increases as shark populations dwindle. Not only do sharks face the threat of population decline, but climate change in the form of warming water temperatures has led to shifts in distributions geographically and temporally of both predator and prey species. While all sharks face similar issues, along the eastern coast of Australia, the large apex tiger shark (*Galeocerdo cuvier*) exerts significant influence on marine life and is thus the focus of my research.



An example of double tag positioning of a tagged mature male tiger shark (*Galeocerdo cuvier*). Image: Alexandra Ikpe.

### Tigers Down Under

Tiger sharks are commonly sought out in the adventure world of freediving and scuba diving but are also a source of fear with their linkage to human bites. However, the tiger shark is an essential keystone species in the warm reef and coastal waters of the Atlantic, Pacific, and Indian Oceans. This shark is remarkable for the long distances it swims throughout seasonal and multi-year migrations and the deep depths it dives during diel movements, linking distant and distinct coastal and oceanic marine ecosystems. While research between regions differs slightly, a strong link between water temperature and seasonal migration has been identified for the species. However, species-specific reasons for this link, or potential drivers behind their movement, have yet to be determined.

In Australia, tiger sharks occupy the west, north, and east coasts and surrounding seas. Genetics indicates one population occupies the entire Indo-Pacific region, highlighting the massive spatial distribution and tolerance of the species. In Western Australia, a few critical publications have focused on assessing the influence of tiger sharks on their environment and determined that this species plays a vital mediating role that helps maintain ecosystem stability and homeostasis.

In a highly dynamic ecosystem, it is imperative to identify and understand the movement behaviours of this keystone species. Most information on the distribution and dispersal patterns of tiger sharks along eastern Australia comes from recreational and commercial anglers and the Queensland and New South Wales shark control and management programs. While this information has aided in laying the foundation for species assessment, they fail to provide useful information surrounding residency, migration, and offshore movement and activity.

A 378 centimetre male tiger shark (*Galeocerdo cuvier*) was tagged in Coffs Harbor, New South Wales, on 13 December 2022. Image: Alexandra Ikpe.

### Advanced Technology

As technology has advanced and satellite tagging has cemented itself as a valuable and effective tool for tracking shark movement, researchers can better infer patterns, trends, activity, and migrations. Basic movement theory reasons that movement is the external response to the internal act of balancing energy acquisition and expenditure, which is influenced by environmental factors (e.g., habitat types), biological factors (e.g., age), and ocean conditions (e.g., water temperature). A comprehensive understanding of movement should enable the backward tracking process of determining the main drivers of energy acquisition and expenditure, deriving more robust representations of tiger shark ecology and biological processes.

### Think Like a Man

Current tracking data related to tiger shark movement in eastern Australia has mainly focused on coastal movements of juveniles and mature females. This data results from opportunistic sampling using readily available support, such as shark control programs and fisheries operating along the coastline. It may also be the result of a sex-biased movement.

In 2018, 4,750 records of tiger shark capture from Cairns, Queensland, to Wollongong, New South Wales, spanning sixty-five years, were analysed, and the ensuing report indicated that 61 percent of the catch was female. The under-representation and lack of data on mature male tiger sharks may indicate sex-specific activity, movement, or segregation. As is seen across the animal kingdom, sex biases result from different biological needs and, consequently, result in different ecological uses. These differences in life requirements for males and females likely drive the differences in behaviour and habitat use across local and regional scales.

Several publications from other regions have already suggested that sex-specific patterns exist for tiger sharks, although these are highly variable between regions. Mature females exhibited extensive migrations in the Coral Sea and Chesterfield Island reefs, while mature males showed site fidelity. In the Gulf of Mexico, mature males showed higher levels of dispersal. With such variability across the species seemingly dependent on region, research focused on mature male movement in eastern Australia is necessary to ascertain any sex-biased movement for this ecologically important area and to understand its impact on regional marine ecosystems.

### Tracking an Elusive Predator

The lack of current data on male tiger sharks, combined with a concern about the shifting distributions of marine species due to climate change-induced shifts in oceanic conditions, including evidence solidifying the shifting patterns of tiger sharks, forms the foundation of my research into the movement of tiger sharks along the east coast of Australia.

The project aims to quantify the movements of mature male tiger sharks using an assembly of satellite tags to gain a more comprehensive understanding of this species' movements. It will identify where male tiger sharks travel, what type of movement characterises migrations, and what may be driving or initiating dispersal. In comparing data from these tracked males with data acquired from mature females and juveniles, evidence of important habitats such as mating or birthing grounds, significant migratory corridors, residency, and refuge habitats may come to light. Determining these various areas of importance and identifying patterns and trends is critical for monitoring and managing the population, particularly when preparing for a future dramatically impacted by climate change.

Satellite tagging offers the ability to track marine animals through their environment, collecting and archiving data that reflects depth, speed, and location during swimming. Captured mature male tiger sharks will be fitted with satellite tags that remain active between 150 days and two years and transmit data through the satellite system, so no tag retrieval post-release is required.

Preliminary data has displayed incredible results, with satellite tags tracking from 34 to 630 days and resurfacing along the eastern coast and over one thousand miles away in New Caledonia in the South Pacific. The most challenging aspect of the research is finding mature male tiger sharks. Suspected sex-biased dispersal from the lack of mature males caught coastally means catching this sub-section of the population requires more targeted fishing efforts. Records from recreational fishing competitions and previous field studies have shown that mature male tiger sharks frequent waters around the continental shelf and in bays such as Hervey Bay and Moreton Bay in Queensland, narrowing the study range to specific areas to increase successful fishing.

**Funds provided by the Australian Wildlife Society will** assist in financing transportation to field sites and hiring boats for days at sea.

# Can we use Soundscapes to Monitor the Biodiversity of Marine Habitats?

**Alice Howie**
School of Natural Sciences,
Macquarie University

**We are presently witnessing an alarming decline in our marine and coastal ecosystems, primarily due to unsustainable land uses, coastal development, and a changing climate. Coral reefs, seagrass, mangroves, salt marsh, oyster reefs and kelp forests each play a crucial role in supporting healthy and productive seascapes – that, in turn, support communities and economies. Some ecosystems, such as oyster reefs, have already become functionally extinct globally. Conservation alone cannot solve this problem, and increasingly, scientists are looking towards ecological restoration to recover these ecosystems and the services that they provide.**

In recent years, the rate and spatial scale of ecological restoration of marine ecosystems has increased, accelerated by the United Nations Decade on Ecosystem Restoration, Ocean Science, and the Kunming-Montreal Global Biodiversity Framework – with a target to restore and conserve at least 30 percent of all ecosystems by 2030.

### What is 'Ecological Restoration'?

The United Nations Decade on Ecosystem Restoration defines restoration as "the process of halting and reversing degradation, resulting in improved ecosystem services and recovered biodiversity". Ecosystem restoration encompasses a vast continuum of practices depending on local conditions, threats, and societal choices.

### How is Restoration Progress Measured?

Traditional biodiversity monitoring of marine habitat restoration projects typically relies on visual census surveys (i.e., diver transects or underwater cameras) or coring (i.e., collecting a vertical profile of invertebrates hiding within the habitat). We can compare the biodiversity present at an impact/restoration site to a reference site (remnant, intact habitat) – and track how the biological community of the restoration site slowly evolves over time to resemble the community of the reference site.

However, these methods only capture a snapshot in time of ecological data, are labour intensive, expensive, logistically complex, limited by visibility (night and water clarity), destructive (coring) and often poor at monitoring cryptic organisms and ecological connectivity. Restoration and conservation programmes are generally also time, resource, and funding limited, making it challenging to report on their progress using traditional methods, particularly over extended time frames.

### Can Monitoring Soundscapes Help?

Parallel to the terrestrial realm of bird calls and cicada choruses, marine biophony (biological sounds) is

Hydromoths – underwater microphones will be deployed for one month across the seascape to collect acoustic data. Image: Alice Howie.

An example of ecological restoration in action. Planting ribbon weed (*Posidonia australis*), a seagrass, into old boat mooring scars in Port Stephens, New South Wales. Image: Grumpy Turtle Creative.

comprised mainly of soniferous fish and snapping shrimp – and can reflect a range of important biological processes, from spawning to feeding, competition, and courtship. The abundance and diversity of biophony measured across a landscape can reflect species richness and habitat and local environmental conditions. It can also be summarised with acoustic metrics. Whilst this is well established in monitoring terrestrial biodiversity, the application of acoustic monitoring to marine biodiversity assessments is still in its infancy. It is also largely limited in its applications outside of research. Yet, a growing body of evidence demonstrates relationships between the marine habitat soundscapes and traditional ecological metrics (i.e., benthic cover, habitat condition, fish communities, ecosystem functioning).

The prospect of passive acoustic monitoring complementing traditional biodiversity monitoring could reduce the cost of monitoring in the short term, potentially allowing longer-term monitoring periods. Long-term monitoring of restoration and conservation projects is important to document the trajectory of species/habitats after human intervention, inform adaptive management approaches, and orient future conservation actions.

### The Research Project

Developing an acoustic monitoring program for seascapes requires understanding factors influencing sound attenuation across the seascape and how soundscapes reflect the ecological community composition of habitat patches. Over the 2024–2025 summer, we will conduct field-based experiments across several intertidal/shallow subtidal habitats (seagrass meadows, mangrove forests and oyster reefs) to understand whether acoustic biodiversity indices will correlate to traditional biodiversity metrics.

**Funds provided by the Australian Wildlife Society will** assist with travel expenses, fieldwork costs, and equipment to collect and store samples.


Project contractors are moving reef material for the intertidal Sydney Rock Oyster Reef Restoration project in Port Stephens, New South Wales. Image: M&J Marine.

Researchers collecting invertebrate samples from remnant oyster reefs in Port Stephens, New South Wales. Image: Vicky Cole.


Mangrove forests (top left), seagrass meadows (top right), and oyster reefs (bottom right). Images: Francisco Baena-Martinez and Alice Howie.

# Thermal Drones as a Promising Tool for Monitoring Endangered Spectacled Flying-Foxes (*Pteropus conspicillatus*)

**Emmeline Norris**
Centre for Tropical Environmental and Sustainability Science, James Cook University

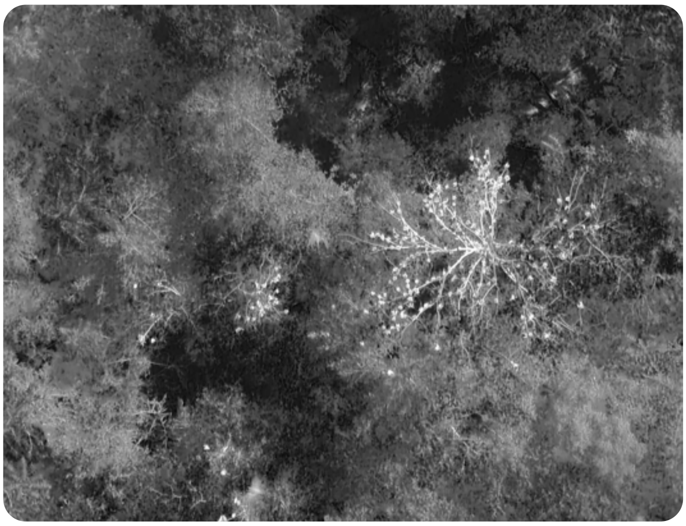
**Wildlife population declines are accelerating globally due to anthropogenic climate change and habitat destruction. Tropical forest fauna is particularly susceptible to extinction due to the combined impacts of agricultural land clearing, hunting, edge effects, and lower thermal tolerances of many species to extreme heat events. Rigorous population assessments are needed to evaluate the effectiveness of management actions and direct limited conservation resources where they are most needed. Obtaining reliable population counts can be challenging, limiting the accuracy of population assessments. This is particularly true of tropical forests where dense vegetation and complex terrain hinder access and obscure animals. Fortunately, recent advances in thermal imaging and drone technology offer promising solutions for improving threatened species monitoring.**

One species that could benefit from these innovations is the spectacled flying-fox (*Pteropus conspicillatus*), a fruit bat endemic to tropical forests in north-eastern regions of Queensland. As a keystone species involved in pollination and seed dispersal services, conserving the spectacled flying-fox is important for preserving Australia's ancient tropical forests. Over the past two decades, this species has suffered a severe population decline, exacerbated by a heatwave in 2018 estimated to have killed roughly a third of the remaining population. Spectacled flying-foxes were subsequently up-listed as endangered under state, federal, and international conservation acts. With the recent ending of the National Flying-fox Monitoring Program, there is an urgent need to reevaluate methods to monitor population recovery and inform policy decisions.

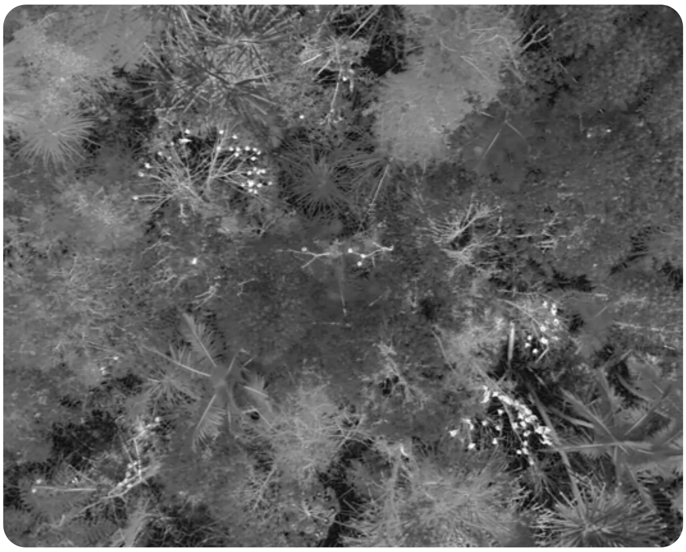
Accurate population estimates are essential for effectively conserving spectacled flying-foxes as they help determine whether the population trend is stabilising, improving, or deteriorating. Current abundance estimates generally rely on ground-based methods, such as counting fly-out streams at dusk or walking through colonies of flying-foxes roosting in trees, known as camps, to count individuals. However, these methods have significant limitations. Fly-out counts, which tally flying-foxes as they leave camps to forage, often over- or underestimate colony sizes, while walk-through counts are impractical in dense forests where flying-foxes are obscured by foliage and dangerous in

DJI Matrice 350 RTK drone equipped with a Zenmuse H30T thermal infrared payload used for capturing aerial thermal imagery of roosting spectacled flying-foxes (*Pteropus conspicillatus*). Image: Emmeline Norris.

Spectacled flying-foxes (*Pteropus conspicillatus*) roosting in a tree canopy in El Arish, North Queensland. Image: Emmeline Norris.



Drone-acquired thermal imagery showing spectacled flying-foxes (*Pteropus conspicillatus*) (bright spots) roosting in an open woodland dominated by *Corymbia* spp. at El Arish, North Queensland. Image: Emmeline Norris.



Drone-acquired thermal imagery showing spectacled flying-foxes (*Pteropus conspicillatus*) (bright spots) roosting in a Pandanus swamp at Feluga, North Queensland. Image: Emmeline Norris.

Emmeline uses a hand-held thermal camera to ground-truth spectacled flying-fox (*Pteropus conspicillatus*) thermal signatures in the drone-acquired thermal imagery. Image: Richard Hopkinson.

swamps and mangroves where crocodiles lurk. Moreover, counts from both methods are heavily influenced by observer bias. As a result, population estimates rely on incomplete and unreliable data, introducing substantial errors when forecasting population trends. Developing more reliable and repeatable methods to conduct a census of spectacled flying-foxes is thus an important step in detecting and preventing further declines.

Drone-based thermal imaging offers a promising alternative to ground counts by minimising observer error, reducing labour costs, and overcoming challenges posed by site inaccessibility and poor visibility in tropical forests. As spectacled flying-foxes roost in the tree canopy, they can theoretically be detected more efficiently by a thermal camera mounted to a drone than by a human observer looking up from below. Nonetheless, canopy foliage and high ambient temperatures could prevent individuals from being detected in drone imagery if their thermal signature cannot be distinguished from the background environment. It is currently unknown whether censuses using drone-mounted thermal cameras can provide accurate and precise population counts for this species since the technology has not yet been tested for spectacled flying-foxes or in the tropical forests of northern Australia.

This project, therefore, has two main objectives. First, it aims to determine the optimal technical parameters and environmental conditions for detecting spectacled flying-foxes in drone-acquired thermal imagery across the various forest ecosystems they inhabit. This will inform a drone-based monitoring protocol for censusing spectacled flying-foxes to be implemented by Terrain NRM, the natural resource management body for the Wet Tropics, in collaboration with the Rainforest Aboriginal People's Land and Sea Ranger groups and funded by the Australian Government. Population data obtained from two years of drone-based censuses will contribute to the second aim: establish a standardised and widely applicable method for assessing population trajectories in highly mobile species with spatially and temporally unpredictable population dynamics.

Preliminary results from surveys conducted in the Atherton Tablelands and Cassowary Coast of North Queensland have shown that spectacled flying-foxes can be readily detected in drone-acquired thermal imagery despite high ambient temperatures (27-30°C) and humidity (60-80 percent). Notably, spectacled flying-foxes have shown no disturbance response to drones flying 20 metres above the canopy. In contrast, they display visible signs of agitation when human observers walk beneath roost trees by vocalising, climbing higher, or flying away. These observations suggest that drone-based surveys may offer a less invasive alternative to ground-based monitoring methods.

The results of this study will have immediate and critical applications to threatened species conservation that align with current national priorities. This project is also expected to positively impact tropical conservation research by enhancing census techniques for difficult-to-monitor species, refining methods for modelling population trajectories and informing conservation listings. We aim to reach a global audience to support prioritising conservation resources through an improved understanding of population trends.

**Funds provided by the Australian Wildlife Society will** assist with purchasing equipment and consumables for drone surveys, software required for image processing, and fieldwork-related expenses, including car hire, fuel, and accommodation.

# Mycorrhizal Diversity in Australian Temperate Forests in the Context of Drought and Nitrogen Deposition

**Luke Florence**
Department of Environment and Genetics,
La Trobe University

**The forests of eastern and south-eastern Australia are not just beautiful; they are living museums of biodiversity and evolutionary history, containing some of the world's most ancient plant lineages. However, these natural treasures face growing challenges. One major threat is the increasing drought-induced tree mortality, which is putting pressure on the biodiversity of these ecosystems. Another concern is that these forests are located in areas with the highest human population density in Australia, making them hotspots for nitrogen deposition – a global change factor driven by human activities such as burning fossil fuels and industrial agriculture.**

Mycorrhizal fungi form a vital partnership with tree roots, helping them access nutrients and water. In return, trees provide the fungi with carbon sourced from photosynthesis. There are two main types of mycorrhizal fungi: arbuscular mycorrhizal fungi and ectomycorrhizal fungi, each with its own strategies for acquiring nutrients and coping with drought. Arbuscular mycorrhizal fungi thrive in nitrogen-rich soils, while ectomycorrhizal fungi perform better in nitrogen-limited soils and are particularly adept at helping trees withstand drought.

While much is known about how nitrogen deposition and drought dynamics play out in the Northern Hemisphere – where research has shown that increased nitrogen can tip the competitive balance in favour of arbuscular mycorrhizal fungi, leading to significant changes in forest tree composition, often exacerbated by drought – the situation in Australia is less understood. Our biodiversity is distinct, and our soils are notoriously low in nutrients. Given these unique conditions, it is crucial to explore how increased nitrogen and drought are affecting our trees and the fungi they depend on.

This component of my PhD research aims to shed light on the impact of soil nitrogen and water limitation on mycorrhizal fungal communities in Australian forests by sequencing fungal DNA from the soil in over one hundred forest plots across eastern and south-eastern Australia. By identifying which mycorrhizal fungal species are most vulnerable to increased nitrogen and water limitation, I hope to provide insights that could help protect these vital ecosystems. Understanding how these ancient partnerships between trees and fungi change will be critical to developing strategies to help our forests survive and thrive in a rapidly changing world.

**Funds provided by the Australian Wildlife Society will** contribute to soil DNA extraction and sequencing costs.

*Cantharellus concinnus* is an ectomycorrhizal fungus that commonly grows in mixed forests of *Casuarina* and *Eucalyptus* across eastern and south-eastern Australia. Image: Steve Axford.

The subtropical rainforest surrounding Sheepstation Creek in northern New South Wales is home to some of the world's most ancient plant lineages. Understanding the challenges these rainforests face is crucial for protecting their future. Image: Steve Axford

# Determining The Distribution and Migratory Flyways of Bogong Moths (*Agrotis infusa*) Using Genetic and Stable Isotope Analyses

**Rose Lownds**
School of Science,
Western Sydney University

**The iconic migratory Bogong moth (*Agrotis infusa*) has been slowly declining since the 1950s and dramatically crashed between 2017–2019 when the number of moths arriving at monitored alpine sites fell to less than 5 percent of the expected four billion moths. In 2021, Bogong moths were listed as Endangered on *the International Union for Conservation of Nature Red List of Threatened Species* due to their declining alpine habitat quality. If Bogong moth numbers are to be stabilised and maintained in the face of global change, knowledge gaps surrounding their ecology must be studied further. The most significant knowledge gap is identifying their distribution and migratory flyways.**

Bogong moths are known for their remarkable annual migration of up to one thousand kilometres from their breeding grounds across the lowlands of southern Australia to the Australian Alps. Over the hot summer months, they remain dormant in a hibernation-like state known as aestivation in cool caves and crevices. In autumn, the moths migrate to breeding grounds to produce the next generation before dying. The same migratory process occurs during the next spring with new individuals.

Bogong moths are deeply culturally important to many First Nations Australians. They are essential in the ecosystem functioning of the Australian Alps, where they provide crucial transport of nutrients from the lowlands to the high-elevation areas of the mountains and have critical roles in the local nitrogen and phosphorus nutrient cycles. The moths are also the primary food source for critically endangered mammals, including the mountain pygmy possum (*Burramys parvus*) and southern bent-wing bat (*Miniopterus orianae bassanii*).

Agricultural intensification and chemical pest control methods have likely driven the decline of Bogong moths since the 1950s. It is also thought that the drought experienced between 2017–2019 impacted the survivability of Bogong moth larvae by causing a lack of food plants and inhospitable soil moisture and temperature levels. Climate change, as a whole, has likely had a significant impact on the survival of bogong moths in all life stages in

Mount Buffalo, Victoria, at sunset. Mount Buffalo's granite terrain is home to many migratory Bogong moths during their aestivation period through the hot summer months. Image: Kate Umbers.

their winter breeding grounds, and their aestivation habitats are also becoming restricted to areas of higher elevation due to declining thermal quality.

Knowledge of where Bogong moths are at each time of the year is fundamental in designing and implementing effective conservation strategies, promoting citizen science recording schemes, and in the future study of the effects of global change on the moth's ecology and habitat quality. There is limited knowledge regarding the extent of the Bogong moth's breeding grounds, so it is difficult to know the migratory flyways used as the locations encompassing the beginning and end of the annual migration cycle are unknown. By creating accurate maps of their flyways and distribution, we can provide critical information to design effective monitoring and management schemes and establish the foundation for all future Bogong moth conservation actions.

This project will use a combination of cutting-edge molecular techniques to investigate the migratory movements of Bogong moths. Geographic assignment of the moth's place of birth (natal origin) using stable isotope analysis will be combined with population genomic analysis to estimate the geographic areas where the moths begin their migration. Pollen identification through metabarcoding analysis will inform us of areas where the insects may have fed along their migration routes.

Stable isotope analysis can determine an animal's natal origin by assigning an individual's isotopic signature to those in their distribution range. Determining the natal origins of collected Bogong moth specimens will develop our understanding of the migratory flyways used by the moths, and stable isotope analysis can also be performed in combination with pollen analysis to develop our knowledge of the nutritional ecology of Bogong moths. Analysis of pollen collected from moth specimens may also reveal specific migratory flyways if the identified plants are found to have local distributions. This information can also be used to design planting schemes for 'Bogong-friendly' plants along their migratory routes.

Additionally, estimates of features such as population size and structure from using genomic analysis can be useful in inferring migratory routes and predicting a population's capacity for persistence and adaptation in response to environmental change. If distinct Bogong moth populations are found to occur, e.g. distinct populations in western versus eastern Australia, then moths of unknown origin may be able to be geographically assigned with the data contributing to the mapping of migratory flyways.

The primary project outcome is to map the main flyways used by the Bogong moths during migration and collect information on where they may refuel during their journey. Researchers and policymakers will use this knowledge to inform future conservation actions. The mapping will also be integral to future state and national-level listing proposals for this species. Overall, this project will deliver conservation-focused research to support future management actions to protect the Bogong moth. Recorded observations of Bogong moths by the general public are instrumental in helping us to understand their migratory flyways – Bogong.org is a platform where you can find further information on how to record observations and provide data for essential conservation efforts for this endangered species.

A Bogong moth (*Agrotis infusa*) at Snowy River in Charlotte Pass, New South Wales. Bogong moths have an overall dark brown appearance with two light-coloured spots on each forewing and are 25–35 millimetres in body length. Image: Kate Umbers.

Granite boulder fields near Dead Horse Gap in Kosciuszko National Park, New South Wales. Bogong moths prefer cool dark caves and crevices for their aestivation sites as the temperature and humidity levels tend to be more stable, reducing their water loss through the extended period of dormancy. Image: Kate Umbers.

**Funds provided by the Australian Wildlife Society will** assist with travel expenses and accommodation to field sites where Bogong moths will be collected for stable isotope and genomic analyses.

# Perish or Persist?

## Marine Invertebrate Responses to Climate Change Impacts

**Jasmine Towle**

School of Biological Sciences,
The University of Adelaide

**Temperate Australia is a global hotspot for marine biodiversity. However, unprecedented rates of environmental change, such as rising ocean temperatures, fluctuations in salinity, and wave exposure, threaten species survival. Species can either adapt in situ or shift their range to persist under climate change impacts. Marine species are particularly vulnerable due to the narrow latitudinal range of Australia's temperate coastline. As anthropogenic climate change pressures increase, it is critical to assess marine species' responses to climate change to understand the impact on temperate marine ecosystems.**

Intertidal marine invertebrates play a critical role in maintaining the structure, health, and functioning of intertidal habitats and provide essential ecosystem services to inshore subtidal habitats. Temperate intertidal ecosystems in Australia have a unique biodiversity, hosting more mollusc endemic species than anywhere globally due to historically stable geography, rocky shorelines, and unique oceanography, including divided east and west boundary currents. Climate change has modified the distribution and habitat availability of marine invertebrates in Australia. Coastal temperate Australian species are more at risk of climate change than species occurring in tropical or pelagic systems due to their reduced capacity to extend their range and move poleward.

Phylogeography allows us to discover historical and contemporary barriers to gene flow, such as past glacial events. There are many types of barriers to gene flow for marine coastal invertebrates, including physical and oceanographic. Physical barriers include land bridges arising during past glacial events and currents. Oceanographic barriers include changes in water temperature, salinity, and pH. Historical barriers such as glacial events have influenced species distributions through glacial refugia and postglacial dispersal events such as secondary contact of populations. Phylogeography allows us to see how populations have responded to past environmental change, which we can compare to current studies to understand how populations respond to contemporary climate change.

An intertidal site on the Eyre Peninsula, South Australia. Image: Jasmine Towle.

Marine invertebrates have a high degree of phenotypic plasticity, which can make species more adaptive to climate change. Therefore, by studying their behavioural and physiological responses to climate change impacts, scientists can examine different ecosystems most vulnerable for prioritised conservation efforts. Scientists have also found that marine invertebrates, though they can be the most adaptive species, are also the more vulnerable; therefore, studying their life history traits is critical to species mitigation. Different morphological traits affect how species adapt to an increasing climate; for example, foot muscle size and shape in marine snails promote resistance to increased wave action. Key morphological differences of species, such as shape and size variation, can be studied in populations across environmental gradients to understand what climate change impacts affect species the most. Species may have altered adaptive responses across different environmental gradients, which, along with a species plastic ability, affect their overall fitness under climate change.

The research project will identify phylogeographic barriers and adaptive traits of intertidal marine invertebrates in temperate Australia. We will be able to explore climate change-induced environmental changes affecting biodiversity and predict if species will shift their range in the future.

The project will aim to answer the following research questions:

1. Has past (i.e. Pleistocene) climate change affected gene flow between marine invertebrate populations across temperate Australia, and are there currently barriers to gene flow?, and
2. Are there morphological differences in shape between replicate populations across existing environmental gradients that may allow us to predict how species will respond to future change?

Data will be collected from twenty-one sites across temperate Australia. The data collected will include genetic (tissue samples) and morphological (measurements) from six species. The species are waratah anemone (*Actinia tenebrosa*), tall-ribbed limpet (*Patelloida alticostata*), rough beaked mussel (*Brachidontes erosus*), little blue periwinkle (*Austrolittorina unifasciata*), purple four-plated barnacle (*Tetraclitella purpurascens*) and the black-fingered crab (*Ozius truncatus*). All species are endemic to Australia. The species are from three different phylum, Mollusca, Cnidaria, and Arthropoda and occupy different zonations within their intertidal habitat.

The genetic data will be used to identify phylogeographic variation between species across an environmental gradient. We will examine populations of each of the six species to evaluate if populations are currently connected by gene flow or if there are phylogenetically distinct sub-populations. This will tell us whether climate change has influenced the population structure of species across temperate Australia and whether the ranges of species are shifting.

The morphological data will be used to infer information about physiological traits to determine how they are adapting to increasing climate change. Each species has different environmental adaptations and/or significance for examining how climate change affects them. Morphologies of species control different functions that affect their fitness, so examining morphology across different species allows us to examine more variation across an environmental gradient. Since the species inhabit different zones within the intertidal zone, we can assess how and if environmental variables affect one zone more than the other.

Genetic, morphological, and ecological data will generate species distribution models. These models can be linked with environmental data to predict how species will respond to future climate change. Understanding which environmental variables contribute to species distributions allows us to predict future range shifts of species.

**Funds provided by the Australian Wildlife Society will** be used for travel costs and sampling consumables. Many of the sites are very remote and have not been studied before.

One of the intertidal sample sites near the coastal town of Port Rickaby, South Australia. Image: Jasmine Towle.

A rough beaked mussel (*Brachidontes erosus*) pictured in a mussel bed. Image: Jasmine Towle.

# Reef Collapse, Functions and Alternative Desirable States

**Matthew Rose**

**Institute for Marine and Antarctic Studies, University of Tasmania**

## Habitats and Species in a Warming World

Reef habitats, species, and the functioning of ecosystems are intimately intertwined. Living habitat-formers, such as corals and macroalgae, produce food and shelter for associated fish and invertebrate communities. In turn, these communities alter habitat through consumption. The configuration of habitat and the composition of species resulting from these interactions can be considered broadly as reef 'state'.

Human cultures, societies, and economies have evolved around and come to fundamentally depend upon certain reef states and the resources they provision. Across Australia, warming waters have caused recurrent mass bleaching of Great Barrier Reef corals, a one hundred kilometre range contraction of golden kelp (*Ecklonia radiata*) in Western Australia, and the loss of 95 percent of giant kelp (*Macrocystis pyrifera*) cover from Tasmanian reefs. If recovery does not occur, these represent significant shifts in reef state, from high spatial complexity that results in more species exposed to simplistic 'collapsed' states. Such collapses occur alongside community reshuffling as 'range-extending' species radiate poleward with warming waters. In combination, these collapses and novel communities are altering the historical functioning of reefs, calling into question the persistence of reef states that humans find desirable.

Desirable Temperate State

Collapsed Temperate State

Desirable Tropical State

Collapsed Tropical State

Remote underwater GoPro videos capture desirable and collapsed reef states in temperate (top) and tropical (bottom) systems. Socially desirable states are characterised by complex habitat cover (left), supporting more diverse wildlife; collapsed states contrast this (right). Image: Matthew Rose.

## Shifting Functions and Desirable States

Primary production by coral and macroalgae introduces energy into ecosystems as matter. Consumers feed on them, facilitating energy flow through food webs, culminating in the spectacular array of inhabitants found on tropical and temperate reefs. In essence, this flow of energy and matter is the 'functioning' of an ecosystem, primarily driven by species.

Ecosystem functioning can be divided into discrete 'functions', which, depending on the context, can carry polarising consequences for reef states. For example, algae removal by herbivores occurs across both tropical and temperate systems, yet high rates of algae removal can promote desirable or undesirable states in each system, respectively. Quantifying this flow, from production to every step of consumption, is a crucial goal of 'functional ecology' research. Such research is critical to understanding how functional processes are altered by the novel communities formed as species shift their ranges. Understanding these processes can best inform conservation and restoration efforts, ideally maintaining historical reef states and functioning. But, as species and functions shift, we face increasingly challenging management decisions and perhaps need to consider 'alternative desirable states' – defined as a degraded ecosystem state that, through time, retains functions deemed critical by cultural, social, and economic values.

## Alternative Desirable States

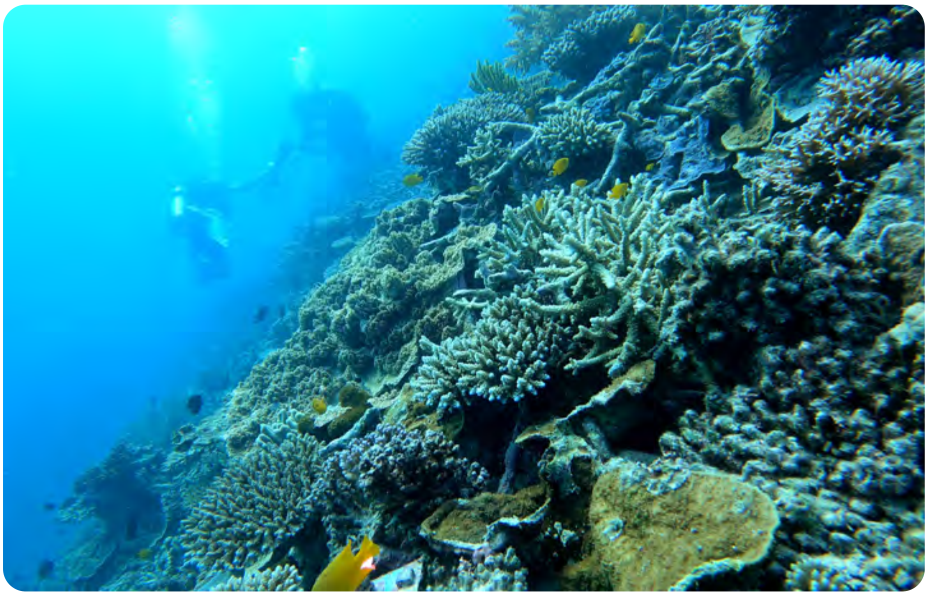
Cultural, social, and economic values dictate that ecosystems have desirable states. Such values have evolved around the resources provisioned by ecosystem functions. For example, the functional processes of primary productivity, herbivory, and predation all successively work to produce populations of abalone and rock lobster species. These reef species have supported First Nations people for millennia, resulting in a deep cultural connection to Sea Country.

Since the British invasion, further economic values have been formed around these same resources in a very different context. Continued access to such target species is dependent on reef states that support their populations, so it is clear that there are ideal desirable states that best provide two contrasting value systems. However, continued habitat collapse threatens the persistence of such historical states and functional processes. If conservation and restoration efforts cannot halt this trajectory, we may need to consider 'alternative desirable states'. By quantifying reef functions, we increase our capacity to conserve historical states and form evidence towards identifying and preserving these 'critical functions'.


A day octopus (*Octopus cyanea*) finding shelter in a crevice at Mermaid Cove, Lizard Island, Queensland. Image: Matthew Rose.

### The Research Project

Our team has employed standardised video and functional assay methods, measuring herbivory and carnivory and the relative contributions of each species. Using multiple methods, our team captures the different ways different species feed and their contrasting impacts on habitat. The research sites span from tropical Far North Queensland to the increasingly less frigid waters of south-east Tasmania. Importantly, by replicating methods across tropical and temperate locations, we quantify the functional roles of species within different ecological contexts. Understanding how much a given species consumes within its historical home range can better forecast impacts as they shift poleward.


PhD colleagues, Paula Ruiz-Ruiz and Matthew Rose, rigging camera tripods at Wistari Reef, Heron Island, Queensland. Image: Matthew Rose.

The research project, supported by the Australian Wildlife Society, Australian Research Council, and Holsworth Wildlife Research Endowment Fund, will contribute to understanding the dynamic relationships between reef species, functional processes, and reef states. This understanding is critical for forming evidence-based solutions for the complex challenges faced in ecosystem management today. In understanding reef functions, we are best equipped to conserve and restore desirable historical reef states or collectively decide upon alternative desirable states.

**Funds provided by the Australian Wildlife Society will** support travel expenses and associated fieldwork costs, including food and SCUBA diving-related equipment for multiple sites at three key locations: Orpheus Island, New South Wales, and Tasmania.


A banded morwong (*Chirodactylus spectabilis)* swimming through crayweed (*Phyllospora comosa*) and golden kelp (*Ecklonia radiata*) at St Helens Island, Tasmania. Image: Matthew Rose.

# Does Fragmentation Alter Predator Diets?

**Natalie Grassi**
School of Environmental and Conservation Sciences, Murdoch University

**Red foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) pose a significant threat to native Australian wildlife. Current estimates suggest that foxes kill 88 million reptiles, 103 million birds, and 108 million mammals annually within Australia, while cats (including pets, strays, and ferals) kill an average of 609 million reptiles, 399 million birds, and 1067 million mammals per year. The combined impact of these predators is believed to have caused at least twenty extinction events since their arrival in Australia, which is expected to rise without continued control efforts. Both predators exhibit flexible diets, adapting to the prey items that are most available and easiest to catch, a pattern that varies across landscapes and over time. Much of what we know about the threats these predators impose on wildlife comes from diet analyses and dissections of either scats or stomach contents. This analysis helps us identify at-risk native species, elucidate trophic interactions, and effectively prioritise conservation actions.**

Unfortunately, introduced predators are not the only threat facing Australian wildlife. Habitat fragmentation is another significant threat, and it is the process in which large, continuous expanses of land are broken into smaller, more isolated patches. One such landscape that has experienced severe fragmentation is the Fitz-Stirling macro-corridor (occupying a seventy kilometre stretch of the south-west Australian Floristic Region between the Stirling Range and Fitzgerald River National Parks in Western Australia), which has experienced a loss of over 90 percent of its original vegetation cover and has since seen decades of extensive revegetation. This fragmentation works hand in hand with introduced predators to further exacerbate the extinction risk to native wildlife.

The process of habitat fragmentation removes natural shelters (such as logs or shrubs) from the landscape that native wildlife would have once used for escape or avoidance behaviours, and the isolation of patches means that wildlife must traverse large distances of cleared farmland when travelling between patches to seek new resources. The large amounts of cleared matrix from fragmentation form the preferred hunting grounds for introduced

The Fitz-Stirling is a highly fragmented landscape. Habitat patches have become smaller and more isolated. Wildlife in this landscape is particularly vulnerable to predation by introduced predators. Image: Natalie Grassi.

predators. Similarly, the mosaic of remnant habitat, revegetation, and cleared farmland creates ecotones, boundaries, or zones of gradience between two different habitat types, which are often relatively open and prone to edge effects, another preferred hunting ground for foxes and cats. Therefore, highly fragmented landscapes are particularly vulnerable and should be a focal point for predator diet analyses.

Using the Fitz-Stirling as a case study, the project aims to provide the first published diet analysis on foxes and cats within this landscape and compare dietary overlap between the two predators. Preliminary results of the study show that native mammals, birds, and invertebrates were the top three most frequently consumed items in a cat's diet. Native mammals found in cat stomachs were generally small-sized prey, including pygmy possums (*Cercartetus concinnus*), honey possums (*Tarsipes rostratus*), and ash-grey mice (*Pseudomys albocinereus*). The birds were mostly honeyeater species, including New Holland honeyeaters (*Phylidonyris novaehollandiae*) and larger species, such as the ground-dwelling malleefowl (*Leipoa ocellata*). The invertebrates were mostly crickets and grasshoppers, consumed more by kittens than adult cats.

In contrast, invertebrates, introduced mammals, and native mammals were the top three diet items for foxes. In the fox diet, consumed invertebrates mainly included earwigs (*Dermaptera*), while consumed mammals were predominantly sheep (*Ovis aries*) and western grey kangaroo (*Macropus fuliginosus*). Preliminary results show that foxes consumed mammals more frequently than cats. However, most of the sheep and kangaroo consumed by foxes were scavenged carcasses, so in this region, cats pose a greater predation risk to native wildlife.

Studying the diets of introduced predators, such as the red fox (*Vulpes vulpes*), helps quantify their threat to native wildlife. Image: Natalie Grassi.

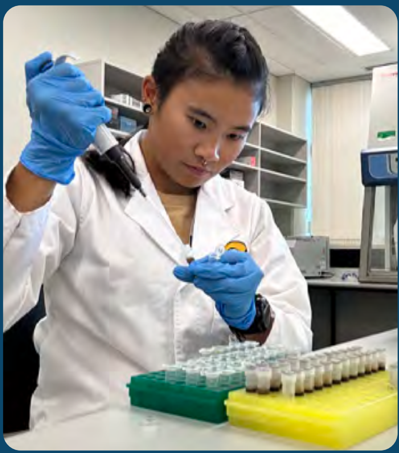
The next aim of this study is to determine how fragmentation alters predator diets. To do this, we will compare how diet changes with the percentage of revegetation and remnant vegetation cover around the point of sample collection within a buffer zone the size of each predator's respective home range.

The results of this work will provide insight into which native species are most at risk of predation by cats and foxes and identify which habitat types our native wildlife are most at risk. The results of this work will be shared with Bush Heritage Australia and the Department of Biodiversity, Conservation, and Attractions to motivate further predator control in the region.

**Funds provided by the Australian Wildlife Society will** support fieldwork to collect stomach samples and purchase ethanol and storage jars for sample preservation.

Kangaroos were one of the most frequently consumed prey within the fox diet. However, these large kangaroo populations create ample carcasses which support fox populations in the area. Image: Natalie Grassi.

Malleefowl (*Leipoa ocellata*) are a large, ground-dwelling bird and are highly vulnerable to fox and cat predation. Image: Natalie Grassi.



# Is There Mush-Room for Bettongs?

## Resource Use and Availability for Bettong Reintroductions to Dirk Hartog Island

**Rebecca Quah**
School of Science,
Edith Cowan University

**Mycophagous mammals (mammals that consume fungi) play an important role in ecosystems by dispersing fungi, which are essential for decomposing organic matter, recycling nutrients, and forming mutualistic relationships with plants. Many mycophagous mammals also serve as bioturbators, crucial for aerating soil, redistributing nutrients, and promoting seed germination while digging for truffle-like fungi underground. Unfortunately, European settlement profoundly impacted Australia's mammals due to the introduction of feral species, changing land use, and altered fire regimes. In particular, Australia has the highest percentage of threatened and extinct bioturbator mammals worldwide.**

Conservation translocations, which involve the movement of an organism from one location to another, offer a vital lifeline for threatened species and are a powerful tool for restoring ecosystems. However, inadequate planning and a lack of knowledge about target species have led to the failure of many translocations in the past. Mycophagous species present a particularly complex challenge due to their unique dietary requirements. Fungal assemblages are seldom studied due to the vast number of undescribed species and the resource-intensive nature of conducting such research.

Two mycophagous mammals, the boodie (burrowing bettong; *Bettongia lesueur lesueur*) and the woylie (brush-tailed bettong; *Bettongia penicillate ogilbyi*), are listed respectively as Vulnerable and Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999* and have been identified for reintroduction to Dirk Hartog Island in Western Australia. They are among thirteen species planned for translocation to the 620 km$^2$ island as part of the 'Return to 1616' project in the Shark Bay World Heritage Area of Western

**Above:** Rebecca extracting DNA from scat samples in the lab. Image: Rebecca Quah.

Dirk Hartog Island is a large, remote island off the coast of Shark Bay, Western Australia. Image: Rebecca Quah.

Australia. The goal of this project is species conservation and ecological restoration.

In the late 19th century, Dirk Hartog Island was managed as a pastoral lease, grazed by sheep and goats. During this time, feral cats also became established on the island. Pastoral activity altered the island's landscape and, combined with cat predation, led to the loss of ten native mammals, including boodies and woylies. Today, Dirk Hartog Island is designated as a national park, and the initial threats posed by introduced predators and herbivores have been successfully eradicated; however, it is uncertain whether fungal resources required by the bettongs will remain.

Boodies and woylies can supplement their diets with plant matter, such as fungi – particularly truffles – which are known to make up a substantial component in the diet of both species. Despite this, our knowledge of the fungal assemblages that form their diet and occur in their habitats remains limited. Furthermore, there is a significant gap in our understanding of species' capacity to adapt to resources across various ecosystems, particularly in the context of translocations. This study seeks to better understand resource use and availability for boodies and woylies by asking: what fungi are these bettongs consuming in their extant environments?, what fungi are available and likely palatable for the bettongs on Dirk Hartog Island?, and will there be competition between the two species for limited resources?

Advances in technology, including applying environmental eDNA metabarcoding techniques to scat and soil samples, will allow us to understand the resource requirements of the bettongs and guide their reintroduction to Dirk Hartog Island. Scat samples will allow us to study the diet of the bettongs non-invasively, in contrast to the method of analysing gut contents. Soil samples will enable us to study fungal assemblages in the environment, offering a more efficient alternative to manual searches for fungal fruiting bodies, which are time-consuming, destructive to habitats, and labour-intensive. Next-generation DNA sequencing of these samples will help us overcome the limitations of taxonomic identification due to the high numbers of undescribed fungi by referencing fungal sequence libraries.

Over 120 scat and 100 soil samples have been collected from extant and potential source populations of boodies and woylies. These sites span temperate to arid environments to assess both species' capacity to adapt to resources in different landscapes. Additionally, 180 soil samples have been collected from various habitat types across Dirk Hartog Island over an autumn and spring season to represent the seasonal availability of fungi on the semi-arid island.

A boodie (*Bettongia lesueur lesueur*) was released after measurements and scat samples were taken. Image: Rebecca Quah.

Soil samples were collected at Mt Gibson Sanctuary, Western Australia Image: Rebecca Quah.

In the lab, samples will undergo DNA extraction, PCR amplification, library preparation, and sequencing. Raw fungal sequences will be clustered using bioinformatics software and identified using reference libraries. Statistical analysis will reveal species richness, diversity, relative abundance, and the overlap of fungi in scats and soils to answer the questions regarding resource use and availability. The results are anticipated to guide the selection of release sites for boodies and woylies on Dirk Hartog Island and future conservation decisions for these species. If successful, this novel application of eDNA will help improve translocation success for mycophagous species, which is vital to maintaining and restoring ecosystem health.

**Funds provided by the Australian Wildlife Society will** support the cost of consumables for lab work and sequencing.

Rebecca undertaking soil sampling on Dirk Hartog Island, Western Australia. Image: West Matteeussen.