2018 University Student Grants Scheme winners

The Australian Wildlife Society's University Research Grants are scholarships offered to honours or postgraduate students at Australian universities. Each year, ten grants of $1,500 are awarded. Grants are available for research projects of direct relevance to the conservation of Australian wildlife – plant or animal. Grants may be used for the purchase of equipment and consumables, travel expenses related to field research, or attendance at conferences at which you are presenting your work.

The Australian Wildlife Society is delighted to announce the winners of the ten grants of $1,500 each to honours or postgraduate students conducting research that will contribute to the conservation of Australian wildlife. The winners for 2018 are:

MICHAEL G. BERTRAM - School of Biological Sciences, Monash University
Project Title: Sex on steroids: Effects of a widespread agricultural pollutant on reproductive processes in fish

KIMBERLY CHHEN - School of BioSciences, University of Melbourne
Project Title: Preying upon a pathogen: The effects of species interactions on chytrid fungus

ANITA FREUDMANN - School of Earth, Environmental and Biological Sciences (Queensland University of Technology)
Project Title: Foraging ecology and behaviour of eastern tube-nosed fruit bats (*Nyctimene robinsoni*)

ANGELA HANSEN - University of Tasmania
Project Title: Plastic pollution in Australian waterfowl and wetlands

JACINTA HUMPHREY - La Trobe University
Project Title: Beyond the fringe: Temporal and spatial change in peri-urban land-use and avian communities

OLIVER JEWELL - Centre for Sustainable Aquatic Ecosystems, Harry Butler Institute, Murdoch University, Western Australia
Project Title: Functioning without food? Energy landscapes and foraging energetics of white sharks

PETER PUSKIC - University of Tasmania; Institute for Marine and Antarctic Studies (IMAS)
Project Title: More than skin deep: Examining the cellular-level effects of ingested plastic on the flesh-footed shearwaters of Lord Howe Island

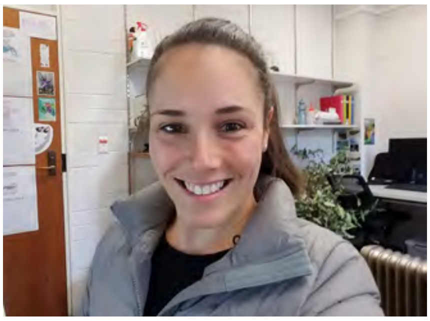
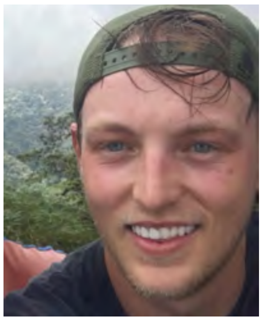
ALEXANDRA ROSS - Centre for Ecosystem Science, University of New South Wales
Project Title: The Nailtail Nursery: Assessing a novel conservation strategy

ANTHONY WADDLE - James Cook University
Project Title: Using emergent genetic tools to identify genes associated with resistance to chytridiomycosis

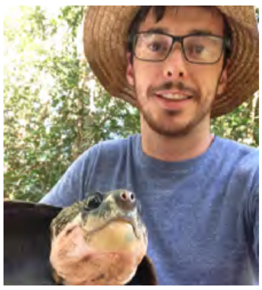
WYTAMMA WIRTH - James Cook University, Epidemiology
Project Title: Epidemiology of *Ranavirus* in Australian freshwater turtles









The Nailtail Nursery: Assessing a novel conservation strategy

ALEXANDRA ROSS
Centre for Ecosystem Science,
University of New South Wales

You may have never even heard of a bridled nailtail wallaby, but there was once a time when it was the most common species in eastern Australia. Today there are just 500 individuals left in the wild. Although land clearing has played a big part in their decline, their top threat is currently invasive predators like the feral cat and fox. In fact, **cats alone kill almost half of all juvenile wallabies**. We realised that in order to save the species we needed to focus on protecting that half. But how?

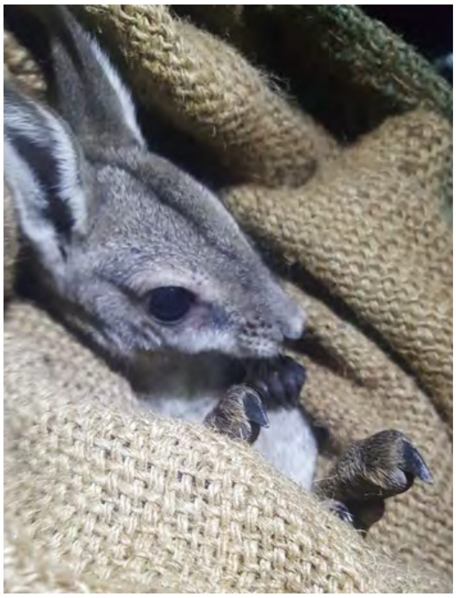
Sometimes we protect animals by building a fence around them to stop predators getting in, but fences can act like 'inland islands', and fenced populations tend to lose all their anti-predator behaviours. Have you ever seen the quokkas on Rottnest Island or the kangaroos at wildlife reserves? Sometimes they'll hop right up to humans without being scared! That's because they've been isolated for so long that they've lost their predator avoidance strategies, which actually makes them *more* susceptible to predation if they are ever faced with a real predator. We call this 'prey naïveté', and it's one of the key reasons why many conservation strategies fail.

So how do we protect a wild population of nailtail wallabies without turning them into a naïve population?

Introducing the Nailtail Nursery!

To protect vulnerable juveniles, a 'nursery' was constructed within one of the last remaining bridled nailtail wallaby populations. The nursery is fenced and predator-free and was designed to hold juveniles in the most vulnerable weight range (less than three kilograms) until re-release. At three kilograms and above, their survival rate increases from 47 percent to 80 percent as they become less vulnerable to feral cats. This means that we can **protect juveniles when they're most at risk of predation without creating a naïve fenced population**.

Bridled nailtail wallabies have distinctive markings, including the white and black stripe beneath their arms, giving them the name 'bridle'.



Juvenile bridled nailtail wallabies weigh less than three kilograms and are the perfect size for a hungry cat.

The Nailtail Nursery is the first of its kind and could herald a new era of conservation in Australia. Construction of the nursery was completed by the non-profit organisation WildMob in 2015, and since then over fifty individuals have hopped in and out of its gates.

There are many species in Australia which suffer from the dual threat of predation and prey naïveté, and the Nailtail Nursery may offer a solution that allows protection of a wild population without individuals losing anti-predator behaviour.

To assess the success of the nursery, I'm comparing nursery-raised and wild-raised individuals. I'm radio-tracking wallabies every month after release and checking their wariness using a 'flight initiation distance' comparison. I'm also analysing the size and growth of the population over the last decade to determine how effective the nursery is as a strategy not only for protecting vulnerable juveniles but also for increasing population size and saving the species from extinction.

I would like to express my gratitude to the Australian Wildlife Society, who have made this project possible! With their help, I am now able to continue this research and provide definitive answers on the success of the Nailtail Nursery as a novel conservation strategy.

The VHF radio-collars are lightweight and have been modified to include a weak link.

2014 Community Conservation Award

The award for 2014 was made to the WildMob of Brisbane. Although WildMob has a Brisbane base its work ranges from the Barrier Reef to Tasmania. They have focused their attention on saving endangered species. WildMob chooses to collaborate with partners as the most effective way of making a difference. Accordingly, they have collaborated with scientists, government departments, educational institutions (both schools and universities), environmental groups and volunteers. Their work began with eradicating invasive weeds on Brampton Island and, while the removal of weeds is still important, particularly in the educational work with students, the work of WildMob is now much more diverse. They have thrown their weight behind continuing the preservation of the bridled nailtail wallaby and are raising funds to build a nailtail nursery on Avocet station near Emerald. In Tasmania they are working at the mouth of the Arthur River in the north west of the State and have focused on weeding in areas of importance to the endangered orange-bellied parrot, surveying seabird populations, monitoring the number of feral cats and Tasmanian devils and gathering data on rare plant life such as endangered orchids. Where possible, educational talks are given to local groups.

Response from Andrew Elphinstone

The WildMob team is thrilled to receive this award from the Australian Wildlife Society. We are a small team of only eight people and we work across many projects ranging from Central Queensland to the Great Barrier Reef islands, and from Tasmania to Norfolk Island.

This award serves as a great motivator to continue giving everything we can to our projects and partners.

In all our project areas we work closely with the local community. We draw on their expertise as well as that of universities and industry partners. This is well known as the collective impact approach. It ensures we have the skills and background knowledge to determine what success looks like for each project.

Importantly, it also means that while we're working to save species now, we're also contributing to our overarching goal, which is to equip communities with the tools to manage their own environmental assets.

If you would like to find out more about us or join a conservation expedition visit www.wildmob.org

Plastic pollution in Australian waterfowl and wetlands

ANGELA HANSEN
University of Tasmania

Are Australian waterfowl eating plastic? That is a question I have been asked by school children, university students, professors, duck hunters and other people in the community. The reason why we are worried is that plastic ingestion by wildlife has become a big problem in ocean environments, and what is upstream of the ocean? Rivers, streams, lakes and wetlands of course, and our pollution makes its way downstream through many of these habitats to the ocean. My research is answering this question, and related questions, such as: how contaminated with plastic and metal pollution are important wetland habitats? Are Australian waterfowl still ingesting lead shot since the ban on the use of lead shot a decade ago? Are levels of lead and other toxic trace elements high enough to cause harm to the birds or to people who harvest them?

Birds are a very useful indicator species for monitoring habitat changes, such as human impacts on resource availability and pollution levels. In other parts of the world, including North America, Europe, and Africa, waterfowl have been used to monitor levels of toxic trace elements and plastic in their freshwater habitats. Here in Australia native waterfowl species are harvested annually by recreational hunters, providing an opportunity to answer some of these questions, while engaging citizen scientist hunters to provide the samples needed.

To answer my research questions, I have collected duck stomach samples from hunters, conducted shoreline surveys, and collected sediment and water samples from Moulting Lagoon, a relatively unpolluted and remote Ramsar wetland on the east coast of

Angela collects a spent shotgun shell during a shoreline survey of plastic debris from hunting and other human activities at Moulting Lagoon, Coles Bay, Tasmania.

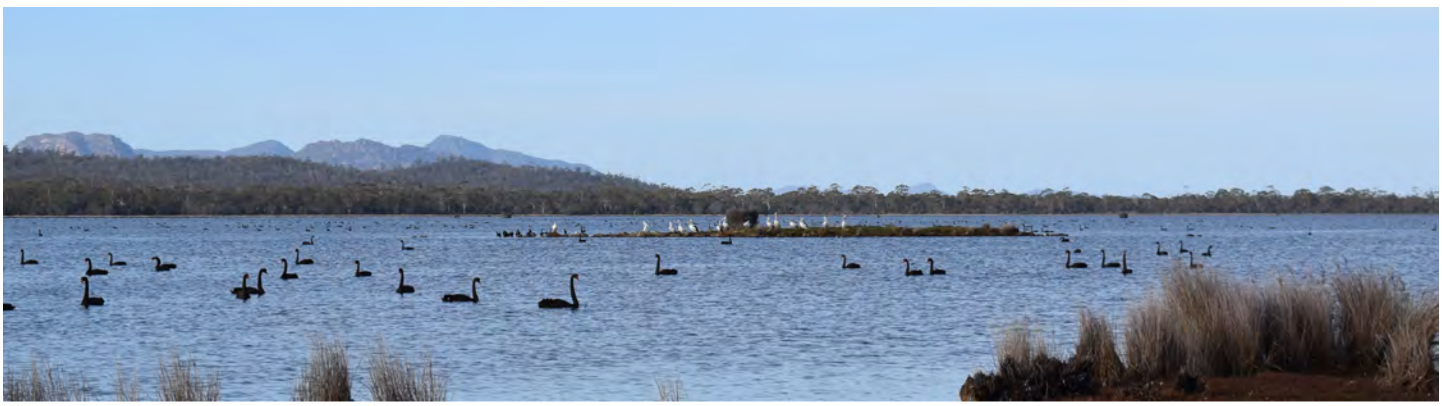
Tasmania. For comparison, I will also collect duck stomach samples from Geelong, Victoria, near Melbourne to look for ingested debris in ducks collected near a major city.

Preliminary results have found no evidence of plastic ingestion in ducks from Moulting Lagoon, Tasmania, and a low incidence of spent metal shot ingestion. However, approximately half of the metal shot ingested was toxic lead, which can be very harmful to birds. Next steps are to measure concentrations of trace elements in the tissues of the ducks analysed from Tasmania, along with the sediment samples, to see if lead and other toxic trace elements pose a risk to the health of birds or humans. I will also analyse stomach contents from ducks collected in Geelong, Victoria, to see how they compare to the those of the ducks collected in Tasmania.

Wetlands are vital habitats with environmental, cultural, social and economic values here in Australia, but humans are impacting wetlands here and globally, causing degradation through over-use, development and pollution. The conservation of wetlands and wetland birds is vital to the health of upstream terrestrial ecosystems and the ocean downstream. Greater awareness and understanding of all the pressures from human activities such as pollution is invaluable for effective conservation and management efforts in the future. This project will help to illuminate the risks posed by plastic, toxic metal and trace element pollution to birds in Australia, and I am honoured to be awarded a University Grant by the Australian Wildlife Society in support of my research.

Are ducks eating plastic? Graphical abstract of research project by Angela Hansen.

Two hunters walk out to their hide on Moulting Lagoon for the evening shoot. Ducks and swans spot the surface of the lagoon in the background.



Moulting Lagoon is a temperate coastal saltmarsh and a vital habitat for waterbirds on the east coast of Tasmania. It is home to 80 percent of Tasmania's black swan population, supports numerous waterfowl and aquatic bird species year round, and is an important feeding and resting habitat for shorebirds during seasonal migrations.

Foraging ecology and behaviour of eastern tube-nosed bats (*Nyctimene robinsoni*)

ANITA FREUDMANN
School of Earth, Environmental and Biological Sciences
Queensland University of Technology

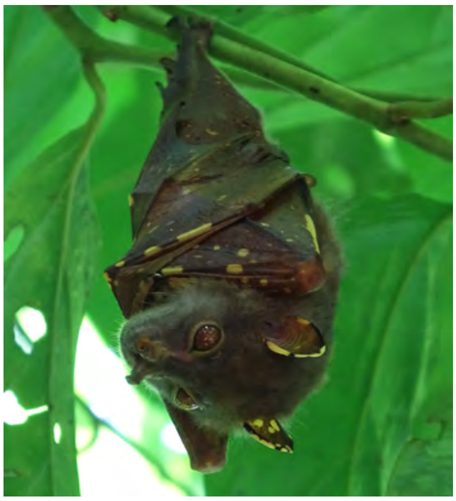
Although fruit bats (Order Chiroptera: Pteropodidae) play crucial roles in maintaining healthy forest dynamics by contributing ecosystem services such as seed dispersal and pollination, particularly the smaller and inconspicuous species remain considerably understudied. One such example is the subfamily of tube-nosed bats (Nyctimeninae), comprising species listed as Endangered, Vulnerable or Data Deficient by the IUCN. The need for research on their ecology has been emphasised in the Action Plan for Old World Fruit Bats (1992), yet the subfamily as a whole is still poorly understood.

Eastern tube-nosed bats (*Nyctimene robinsoni*) are native to the north-eastern coast of Australia. These frugivores easily manoeuvre through the dense understorey and subcanopy and may be important seed dispersers for plants that the large flying-foxes cannot easily reach. Unfortunately, information on these charismatic bats is dominated by anecdotes rather than rigorous scientific data. As their elusiveness and cryptic lifestyle (inconspicuous roosting habits and fast, agile flyers) complicate direct behavioural observations, virtually nothing is known about their mating behaviour and social lives. Their presumed solitary lifestyle is confounded by observations of multiple bats roosting together in the foliage. Home ranges are alleged to be small, yet individuals are frequently found caught on barbedwire fences in considerable distances from forest, indicating longer travel distances.

My project will make an important contribution to a better understanding of the foraging ecology and behaviour of eastern tube-nosed bats by investigating their habitat and resource use. To identify movement patterns and roost characteristics, bats are captured in mist nets and fitted with small, self-detaching glue-on GPS dataloggers (including a radio-transmitter). This allows me to locate the animals in their roosts daily and collect valuable data on their roosting behaviour until loggers detach and have to be retrieved to obtain the movement data. Overall project outcomes will be the identification of landscape utilisation patterns, home ranges and key habitat features of roosting areas.

The identity of bats found roosting together is confirmed using an established picture library of individuals, based on their unique wing spot patterns. Analyses of relatedness in the study population will provide first insights into the secret social lives of these bats and whether the observed roosting associations are explained by kinship. Pollen swabs from their fur and identification of food plants from faeces using DNA-metabarcoding will give an overview of their food spectrum. Integrating tracking and dietary data will elucidate the role of eastern tube-nosed bats as seed dispersers and potential pollinators, as well as identify their food sources and foraging grounds at the interface of rainforest habitat and an anthropogenic landscape in the Queensland Wet Tropics. Understanding their movements and foraging behaviour is crucial as even small bats can disperse relatively large seeds or pollinate over considerable distances, and thereby help maintain functional connectivity in fragmented landscapes.

Radio-tracking is used to find the roost sites and to retrieve the GPS tag once it has detached.



An eastern tube-nosed bat (*Nyctimene robinsoni*) roosting in foliage.

Using emergent genetic tools to identify genes associated with resistance to chytridiomycosis

ANTHONY WADDLE
James Cook University

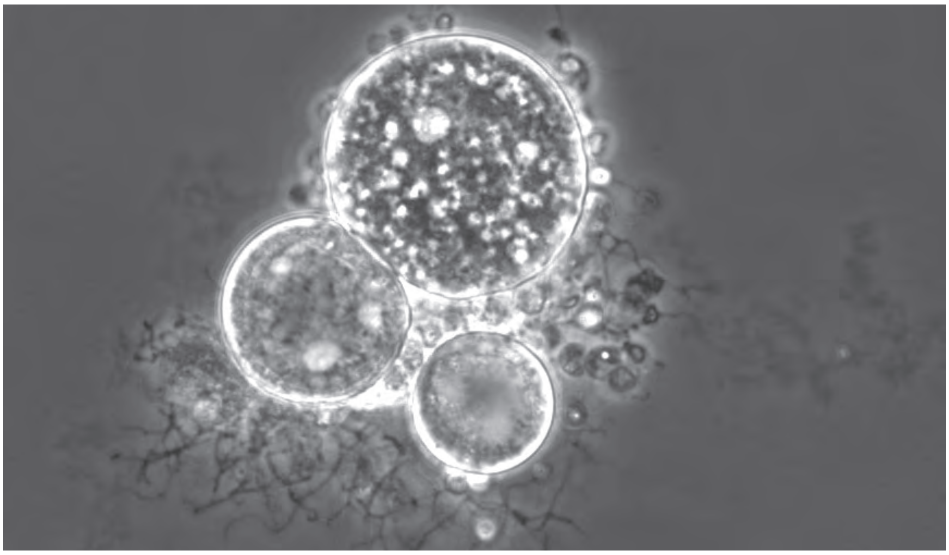
The amphibian chytrid fungus (*Batrachochytrium dendrobatidis* – *Bd*), which causes the disease chytridiomycosis, has had devastating impacts on amphibian populations and species worldwide. **Australia is particularly affected, with the pathogen having driven six species to extinction and causing the decline of 37 others.** For many persisting amphibian species that are highly susceptible to chytridiomycosis, the main reason they still exist is captive breeding and reintroductions. One such species, the critically endangered southern corroboree frog (*Pseudophryne corroboree*) has experienced precipitous declines since the arrival of *Bd* and is now functionally extinct in the wild. Though captive breeding and reintroductions allow for the persistence of a small number of frogs in the wild, mark-recapture data indicates that many of the frogs are still succumbing to chytridiomycosis. Without efforts to increase the survivorship of reintroduced frogs, this iconic species may never serve an ecological role in its former habitat and may ultimately go extinct.

My research will use a powerful comparative genomics approach coupled with disease challenge studies to identify gene regions associated with resistance to chytridiomycosis. These data will be a key to developing breeding programs aimed at producing resistant frogs and establishing wild, ecologically functioning *P. corroboree* populations.

About me:

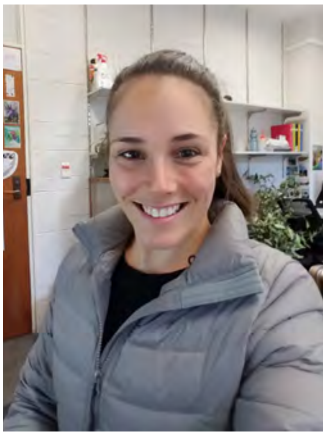
My commitment to wildlife conservation stems from a life-long fascination with biodiversity. I grew up in fabulous Las Vegas, Nevada, which is better known for its casinos than its wildlife. This infamous city, however, is settled in a beautiful Mojave Desert valley and is located just a few hours away from the Grand Canyon and Death Valley national parks. Although not an intuitive place to start a career in wildlife conservation, many iconic and endangered species call these areas home, including amphibians! While in the United States, I became interested in research aimed at decreasing the negative impacts of chytridiomycosis on amphibian populations. To continue these efforts, I am now undertaking a PhD with the world-class researchers of the One Health Research.

The critically endangered southern corroboree frog (*Pseudophryne corroboree*).



Phase contrast micrograph of *Batrachochytrium dendrobatidis.*

Barred frog , *Mixophyes fasciolatus*, from south-east Queensland showing clinical signs of chytridiomycosis. Photo: Dr Lee Berger



Beyond the fringe: Temporal and spatial change in peri-urban land-use and avian communities

JACINTA HUMPHREY
La Trobe University

Increasing urban development is a global issue which threatens native wildlife. While some animals can adapt to life in the suburbs, many others are unable to persist in urban areas. What is it that excludes some species from living in our streets? What roles do housing density and native vegetation play? And can we predict which suburbs will be home to the greatest diversity and abundance of species?

Today, around 85 percent of Australia's human population resides in cities and towns, and these urban centres are expanding. Such expansion often occurs around the urban fringe of a city within what is termed the 'peri-urban' zone. Peri-urban areas are characterised by low-density housing within a mixture of agricultural land and native bushland. As development in these areas occurs in close proximity to natural habitats, it has the potential to impact the distribution and abundance of native species. Knowledge of how urbanisation affects fauna, and the factors that increase the likelihood of species persisting in urban environments, can assist in planning for more sustainable, wildlife-friendly cities.

Urban development has the potential to impact native birdlife due to an increase in housing density and a decrease in native vegetation.

Birds are a well-studied group in urban ecology and can provide valuable insights into the consequences of landscape change. Research to date has indicated that urban development has an overall negative impact on avian species richness, but may promote the abundance of urban-tolerant species. Much of this work, however, has been carried out in the northern hemisphere. Urbanisation in Australia is relatively more recent than in many European cities, so there is a need for further research into the processes of change associated with Australian urban centres.

The most recent *State of Australia's Birds* report indicated that many bird species in eastern Australia are currently in a state of decline. This is especially true for woodland birds, hollow-nesters and aerial insectivores – species likely to be affected by further development throughout the urban fringe. Conversely, Melbourne's human population is booming. By the year 2051, the population of Greater Melbourne is predicted to reach eight million people, at which point Melbourne will surpass Sydney as Australia's most populated city. Given the ongoing urban expansion required to meet the needs of this growing population, and the increasing pressure on native avifauna, it is vital that we, firstly, determine the extent and types of impacts of urbanisation on avian communities, and secondly, identify practical measures to conserve native birdlife in the face of future development.

My PhD research aims to investigate the influence of urban development on wildlife at the landscape scale, using avian communities in Greater Melbourne as a case study. I will test the relative influence of a) extent of native tree cover, b) housing density and c) the presence of waterways on the structure and composition of avian communities. I will conduct bird surveys in 30 suburbs around Melbourne along a series of urban–rural gradients. I will assess the influence of these landscape attributes on avian species richness and community composition, and on the occurrence of individual species. In addition, I aim to investigate the human perspective in wildlife conservation by quantifying the knowledge, attitudes and behaviours of local residents towards birdlife in different urban environments. Finally, by using historical bird data, I aim to investigate the change in avian communities over time around Greater Melbourne.

Overall, I hope that my research will help to generate practical advice for landholders, natural resource managers and local governments on how to conserve native avifauna as the city of Melbourne continues to grow. I am incredibly grateful for the financial support of the Australian Wildlife Society University Research Grant. This funding will be used to cover the costs my fieldwork travel throughout the upcoming spring field season. My research is also generously funded by the Field Naturalists Club of Victoria Environment Fund and the BirdLife Australia Stuart Leslie Bird Research Award.

About the author

Jacinta Humphrey is a PhD candidate at the Research Centre for Future Landscapes, La Trobe University. After completing her undergraduate degree in Wildlife and Conservation Biology, Jacinta was keen to pursue a career in applied conservation research. She went on to complete her Honours in Zoology studying the efficiency of detection methods for the threatened swamp skink (*Lissolepis coventryi*). She is interested in understanding how animals persist in, and adapt to, urban environments, and is passionate about improving the way our society coexists with native wildlife in and around cities.

As the city of Melbourne continues to expand, neighbouring natural environments may be at risk.

Some species are able to persist in urban areas, such as this little corella, photographed in suburban Melbourne.

Jacinta will be conducting bird surveys across the northern and eastern suburbs of Melbourne to gain a better understanding of how urban development impacts birdlife. Photo: Sui Lay, La Trobe University.

Preying upon a pathogen: The effects of a species interaction on chytrid fungus

KIMBERLEY CHHEN
School of BioSciences
University of Melbourne

Frogs around the world are currently experiencing a mass extinction event. Many frog populations have severely declined – some to the point of no return. The cause of this is the infectious frog disease, chytridiomycosis.

The frog killer

Chytridiomycosis, caused by the chytrid fungus, *Batrachochytrium dendrobatidis,* spreads through sperm-like zoospores in water. These zoospores infect the outermost layer of the frog's skin containing keratin. Once a frog has been infected, chytrid fungus can result in an imbalance of water and salts in the frog's body fluids. This then leads to cardiac arrest and ultimately, death.

Because it is a highly infectious disease, chytridiomycosis has been associated with the global extinction of around 200 frog species. Approximately 52 percent of vulnerable frog species found in Australia are also threatened with this disease.

While it has been decades since the identification of chytrid fungus, there are currently no practical methods to mitigate this disease. But a tiny water flea may just be the solution to this.

The predator

Water fleas are aquatic crustaceans known as *Daphnia*. They are commonly found in ponds and lakes around Australia. Like chytrid fungus, they are prevalent in winter but are predominantly absent in summer.

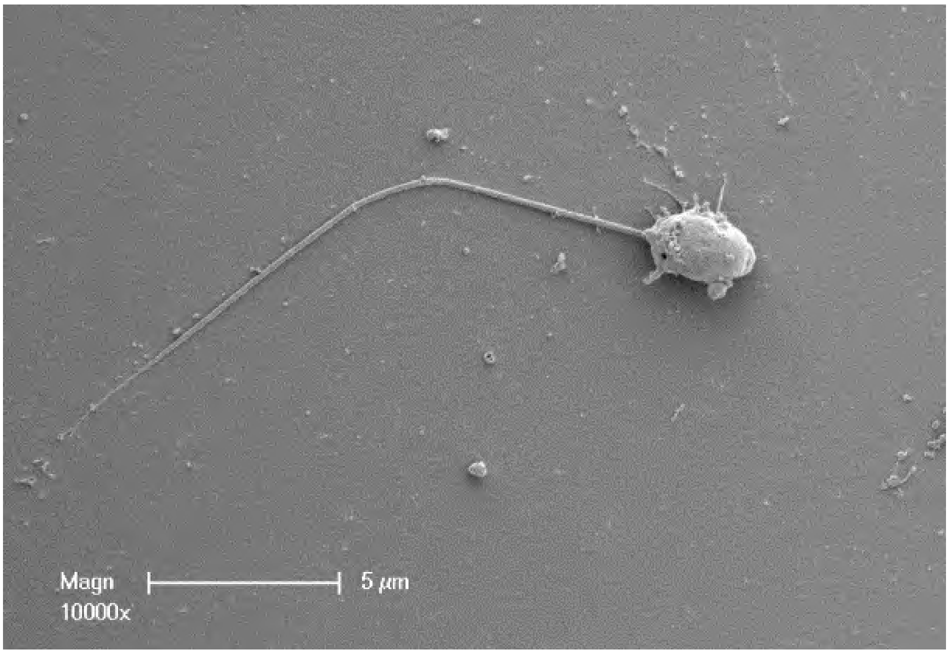
Being filter feeders, the water fleas also prey on chytrid fungus zoospores in the water. Therefore, they can potentially reduce frog infection rates by this disease. However, they are, in turn, preyed upon by the invasive eastern mosquitofish, *Gambusia holbrooki*.

The invader

The eastern mosquitofish was initially introduced from North America to control mosquito larvae. But like most introduced species, they were able to flourish and invade our Australian environment.

The eastern mosquitofish's destructive nature includes feeding on frog eggs and tadpoles. As such, they have been associated with the decline and disappearance of multiple frog species. They can also indirectly decrease frog populations by feeding on the water fleas. So where these invasive fish occur, the water fleas are often absent, allowing chytrid fungus to flourish.

A key characteristic of the eastern mosquitofish is their preference for dense aquatic vegetation. But this results in a trade-off. Dense aquatic vegetation may impede the fish's movement and access across the water column. As such, if water fleas were present, vegetation might also provide refuge for the water fleas to escape from the eastern mosquitofish. This, in turn, would lower the eastern mosquitofish's predation rate on the water fleas.



A chytrid fungus zoospore. Chytrid fungus spreads by releasing zoospores into the environment. These zoospores then infect the outermost layer of the frog's skin. Photo: Dr Matthew West

I have been catching eastern mosquitofish (*Gambusia holbrooki*) from ponds located around the University of Melbourne. Photo: Alison Fong

The investigation

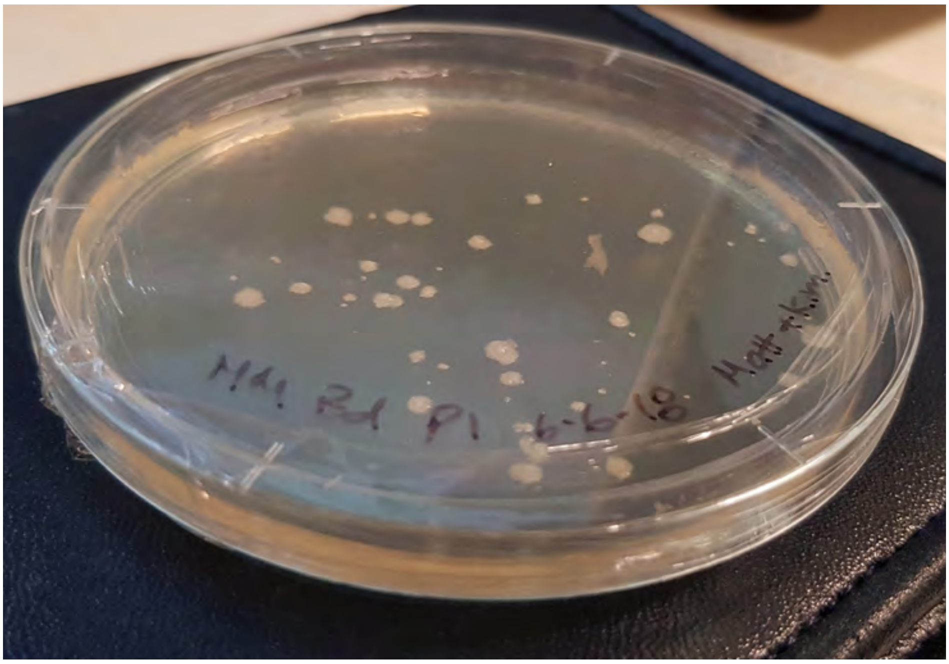
I will be researching the effects *Daphnia carinata* and the eastern mosquitofish will have on chytrid fungus, and likewise, whether vegetation can also indirectly impact chytrid fungus zoospore concentration in the water. To do this, I will measure chytrid fungus zoospore concentration in the presence of only the water flea, only the fish, and both species, with and without vegetation.

To conduct these experiments, I have been growing chytrid fungus cultures on agar plates. After growing them for a few weeks, I then harvest the zoospores and transfer them to a liquid medium. After another few weeks of growth, the end products are zoospores that I can use in my experiments.

I have also caught the eastern mosquitofish from ponds located around the University of Melbourne. Using these fish, I have conducted pilot studies to investigate the number of water fleas the eastern mosquitofish will feed on in 24 hours. This allowed me to determine the initial number of water fleas required for several of them to persist for 24 hours in the presence of the fish. Using these results, I have incorporated them into my primary experiments involving the chytrid fungus zoospores.

Based on my research and with the generous support of the Australian Wildlife Society, we will be able to clarify the role water fleas may play in controlling chytrid fungus in the environment. Likewise, how the eastern mosquitofish and aquatic vegetation may affect these outcomes. From our results, we may be able to encourage the revegetation of natural habitats, particularly in areas where frogs are also subject to habitat loss and degradation. Finally, we may be in the position to suggest whether water fleas have the potential to act as a biological control agent of chytrid fungus. Such results will aid current efforts to conserve our Australian frog species.

Daphnia carinata, an aquatic crustacean also known as a water flea. They can reduce the rate of chytrid fungus infection in frogs by feeding on zoospores released by the fungus. Photo: Sally Drapes



I have been growing a culture of chytrid fungus on agar plates. Photo: Kimberly Chhen

Female eastern mosquitofish (*Gambusia holbrooki*). An invasive species, the eastern mosquitofish has contributed to the decline and disappearance of multiple frog species. Photo: Kimberly Chhen

Sex on steroids: Impacts of hormonally active agricultural pollution on freshwater fish

MICHAEL BERTRAM
School of Biological Sciences
Monash University

Pharmaceuticals are used across the globe in human and veterinary healthcare, as well as for growth promotion in livestock. However, over the past decade, there has been a growing recognition that pollution resulting from the production and consumption of pharmaceuticals poses a major threat to wildlife, ecosystem function and human health. Furthermore, this issue is escalating, with the number of pharmaceutical doses dispensed per annum being predicted to reach 4.5 trillion by 2020, an increase of 24 percent from 2015 levels. This has been driven by a growing and ageing human population, as well as increasing use of pharmaceuticals in food production. Indeed, one of the leading sources of pharmaceutical pollution is run-off of veterinary pharmaceuticals used in agriculture.

While the use of pharmaceuticals in agriculture is primarily for the prevention and treatment of disease, currently, vast amounts of hormonal growth promotants are also administered to beef cattle worldwide. Among the most commonly administered growth promotants globally, including in Australia, is trenbolone acetate. After being implanted, trenbolone is broken down and excreted, and this excrement is often allowed to run off into freshwater systems. Trenbolone has frequently been detected in these systems at concentrations that are sufficient to affect survival, development and reproduction in aquatic species. Despite this, relatively little is known about the potential impacts of exposure to trenbolone – or pharmaceutical pollutants in general – on the behaviour of wildlife. This is concerning because behaviour is vital to individual- and population-level fitness, the functioning of ecosystems and the evolution of species. Furthermore, recent research has shown that animal behaviour is particularly vulnerable to disruption by exposure to low levels of pharmaceutical contaminants, such as trenbolone.

My collaborators and I use freshwater fish, and various other model species, to investigate the potential impacts of contaminants of emerging environmental concern on ecological and evolutionary processes in wildlife.

Guppies are an excellent model for investigating the impacts of chemical pollution. The physiological mechanisms that are targeted by drugs like trenbolone are highly conserved across diverse fish species (as well as other taxa), meaning that common species, like guppies, can be used as a 'proxy' for other organisms inhabiting contaminated systems.

To address this, my collaborators and I exposed wild-caught adult male guppies (*Poecilia reticulata*) to an environmentally relevant level of trenbolone and tested for potential changes in reproductive behaviour. In standard reproductive trials (i.e. a male–female pair), recent studies have shown that exposure to trenbolone can alter mating behaviour in fish. However, in reality, natural mating systems are complex and very little is known about the potential for chemical pollutants, in general, to disrupt behaviour under more ecologically realistic reproductive scenarios, such as when females are encountered sequentially. Hence, we tested the response of exposed and unexposed males to sequentially presented large and small females. Because female guppy fecundity (i.e. brood size) increases with body size, larger females often represent better reproductive value and are generally preferred by males.

Fish were collected from Alligator Creek, Queensland, and allocated to either trenbolone-exposed or unexposed tanks within a flow-through system for 21 days. To investigate the potential impacts of trenbolone on sequential male mate choice, after the exposure period, we carried out video-recorded behavioural trials in two stages. In the first, a single male and a single stimulus (unexposed) female were placed into an observation tank and allowed to interact freely. The stimulus female was then removed and replaced with a second stimulus female, which was allowed to interact freely with the focal male. Males were presented sequentially with 'small' and/or 'large' females in four different combinations (small/small, large/large, small/large, large/small). Behavioural videos were analysed for the number of courtship bouts and coercive 'sneak' mating attempts performed towards females. Courtship bouts involve a male orienting his body towards a female while performing sigmoid mating displays to solicit copulations, while sneak attempts involve the male surreptitiously approaching a non-receptive female from behind and attempting to mate coercively.

We found that exposure to trenbolone disrupted reproductive behaviour in male guppies, although sequential mate choice was not affected at the tested dosage. More specifically, in the first presentation, regardless of trenbolone exposure, males demonstrated a preference for larger females by courting these females more often. Further, irrespective of female size, exposure was associated with a trend towards increased male sneaking behaviour. In the second presentation, males from both exposure treatments again demonstrated a preference for greater female size in terms of both courting and sneaking behaviour. Furthermore, exposed fish again performed more frequent sneaking behaviour towards females.

We found evidence for sequential male mate choice, although this was not disrupted by exposure. This is because, regardless of exposure, males 'traded down' by significantly reducing the frequency of their courtship behaviour towards small females if they had previously encountered a large female. Considering the pivotal role that mate choice mechanisms play in population dynamics and broader evolutionary processes, this study highlights the need for a greater understanding of the potential impacts of chemical contaminants on sexual selection in wildlife populations.

We use flow-through exposures (pictured here), as well as long-term mesocosm systems, to expose fish to environmentally realistic levels of contaminants of emerging concern.

Functioning without food?
Foraging landscapes and movement energetics of white sharks

OLIVER JEWELL
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Sharks are among the most important marine life forms, often moderating the numbers of other species and keeping ecosystems balanced in their role as top predators. However, the global demand for shark fins has driven down populations and today over 30 percent of pelagic species are at risk of extinction with the status of many other populations unknown. One of the biggest hurdles in shark conservation is a lack of basic understanding of the animals and the fear and misunderstanding spread by a never-ending stream of negative news stories, over-hyped television documentaries and an unrealistic portrayal of sharks as man-eaters in Hollywood movies.

As a marine scientist, I've spent almost my entire career striving to learn more about sharks while dispelling misperceptions whenever I can. This has taken me to South Africa, California and has now brought me to Australia, giving me a unique opportunity to study the three main populations of white sharks at their densest aggregation sites. My colleagues from Murdoch University, Monterey Bay Aquarium, Stanford University and the Dyer Island Conservation Trust and I have tagged almost one hundred individual white sharks with high-resolution biologgers, or animal tags, from sites such as Dyer Island in the Western Cape of South Africa to the Farallon Islands off the Californian coast. We fit these tags to white sharks, using a long pole to position a clamp over the dorsal fin as the shark swims by, usually distracted by a piece of bait or a seal-shaped carpet decoy. The

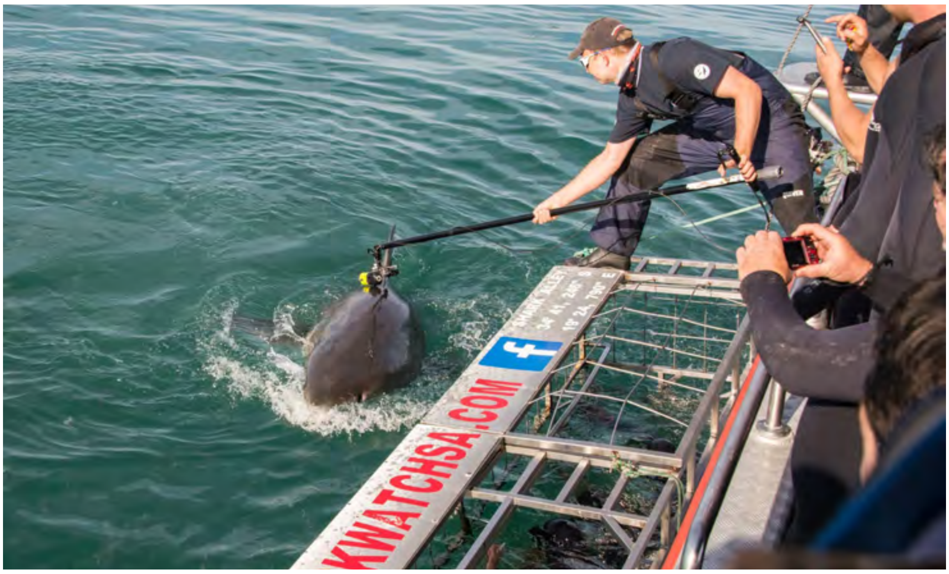
Oliver Jewell preparing to tag a white shark.

clamp then shuts securely on the fin and the shark swims off, immediately collecting data for us. The tags contain a suite of sensors and cameras that allow us to visualise the animal's movements in three dimensions and calculate where, when and how it interacts with its environment, and peeking into the private lives of sharks in a way that was previously inconceivable.

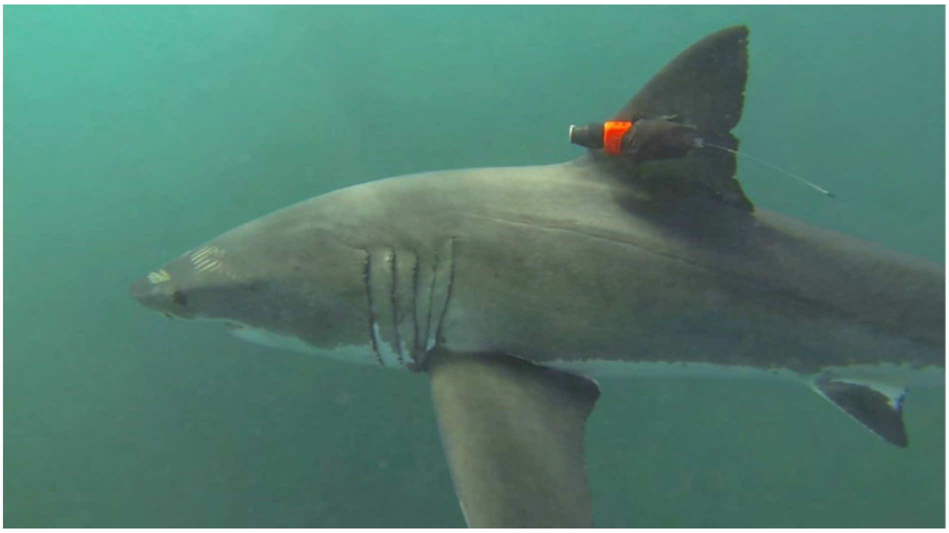
One difficulty with this type of tag, however, is that all the data is logged and stored within it, meaning if we can't get it back then we lose all the data! After a set amount of time, usually determined by how long until the next severe weather approaches or how far the shark is likely to swim, the tags detach from the shark's fins and rise to the surface where they float until we pick them up or they wash ashore. We can track the tags at sea with a satellite or VHF transmitter and bring them back to our field stations to download the data. A significant advantage of this method is that no part of the tag remains on the shark and the tags are completely reusable (as long as you can find them!). We often see sharks within days of the tags detaching with little or no sign that any clamps were ever placed on them.

Once we have downloaded the data, we can calculate measurements of swimming effort, such as bursts of speed, tail beats per minute and vertical velocities, while the camera allows us to determine what kinds of habitat the animals are using, such as reef systems or kelp forest, and what types of potential prey they encounter. We hope to produce research which is both new and important to the basic understanding of sharks as well as being beneficial to their management and conservation. Already these tags have taught us so much about these animals, and I feel myself growing as a scientist under the daily guidance of my supervisors.

The Australian Wildlife Society Student Grant has made a massive difference in the funding of this project and will play an important role as we progress towards adding Australian shark data to our database. Thank you so much for the support! You can follow the progress of the project on Research Gate (www.researchgate.net/profile/Oliver_Jewell) or Twitter (@JewellResearch).



A CATS (Customized Animal Tracking Solutions) Cam biologging tag being placed on the dorsal fin of a white shark as it swims past a cage diving vessel in Gansbaai, South Africa. Photo: Anna Phillips, Marine Dynamics.



A white shark in Gansbaai, South Africa with a CATS Cam in place. Photo: Chapple et al. (2015) Animal Biotelemetry.

Retrieving tags is always a great relief! Photo: Paul Kanive, Monterey Bay Aquarium

Alone at sea, when the world comes to visit

PETER PUSKIC
University of Tasmania; Institute for Marine and Antarctic Studies (IMAS)

There is an island, alone in the middle of the sea, far from the reach of many humans. If you were lucky enough to venture into the island's jungle and sit patiently on the forest floor beneath the palms and banyan trees, after dark an unlikely creature would emerge from a hole deep within the ground with an unlikely story to tell.

Arriving on this island is a surreal feeling. Its mountains rise from the ocean defying all expectations. When landing, the plane soars so close to the water's surface that you almost want to hold your breath in case you go under. Looking out the window, you can glimpse the cliffs and reefs below where tropic-birds dance by their precariously placed nests.

I travelled to Lord Howe Island in May 2018 to continue my research on anthropogenic impacts on our oceans. It seems the least likely location for this work to take place: the beaches are composed of golden sands, the birds and insects are unique and mostly endemic, and the jungle appears green and full of life. This island is paradise. Yet, if you walk through the forest, you need not look hard to find the influence of humans. The dirt is littered with junk – plastic items that have been thrown 'away' carelessly and without thought. But people did not bring these items here; this plastic was carried from land by wind and waves and ends up in the stomachs of the creatures nesting in the burrows – the shearwaters.

Palms and shearwaters: one does not exist without the other. The shearwaters meticulously engineer this island ecosystem through the excavation of their burrows.

I watch the sunrise with a wedge-tailed shearwater (*Ardenna pacificus*) fledgeling, another species of shearwater which inhabits Lord Howe Island.

With the assistance of the Australian Wildlife Society, I studied these incredible seabirds during my honours research year. I explored how the strong and elegant shearwaters undertake a migration from one side of the world to the other after only ninety days of life. I wondered how this was possible when they have never seen the ocean before and live on a diet of only fish and squid. Unfortunately for the shearwaters, many do not get this chance to migrate. Increasingly, their parent birds mistake marine plastic debris floating on the sea's surface for food and starve their chicks with a meal of toxic and sharp plastic.

This is what I have come to bear witness to: the impacts of plastic ingestion on flesh-footed shearwaters (*Ardenna carneipes*).

The first morning on the island was one of the hardest. We woke at dawn to walk stretches of the picturesque beaches across the island collecting dead and dying chicks, washed up in the waves – those that never made it out to sea. Upon inspection, every one of them had ingested plastic debris. This shouldn't be surprising: between 90 and 100 percent of this population ingests plastic. Nonetheless, to read about this is one thing, but to see it is another.

At night we venture out to the colony searching for the shearwaters. My supervisor tells me, "Once the calls of the shearwaters in the forest were deafening". Now, the forest is quiet, and the birds are "thin on the ground", though some persist. They run across the dirt with their wings stretched out, falling over tree roots and logs, even stumbling over their own feet.

These endearing birds are clearly not designed for life on land; the open ocean is where they soar free.

They are not designed to consume plastics, either. This year's record-holder is a 90-day-old chick with 94 pieces of plastic in its stomach(the highest ever recorded amount is more than three times that). Large pieces may puncture the stomach or cause a bird to starve, but plastic, when ingested, may also act as a toxic bullet: the chemicals that make up the plastic as well as those it has absorbed while in the ocean are allingested by the bird. In this way, even small amounts of plastic may pose great danger and unknown risks. This is what my research will explore: the consequences of ingesting plastics and the associated chemicals to the birds' organs, tissues and cells.

Working on the island takes an emotional toll on a person. There is rarely a dry eye in the lab when a shocking bird finds its way onto the necropsy table. To clear my head, I spent my precious spare moments on my third and fourth day exploring the cliff sides, the forests and the beaches, escaping the impacts of the world. Sunlight breaks through the canopy and dances on the palm fronds, to the side of the path, in clearings where shearwaters have dug their nests. These seabirds are ecosystem engineers, excavating vast sandy openings where nothing but the palm is permitted to grow. Amongst the sand and vegetation, balloon clips, bottle caps and an array of plastic items follow me to the beach

This year's record holder: a 90-day-old chick with 94 pieces of plastic in it (the highest amount ever recorded is more than three times that).

where even more plastic has drifted ashore. Here I stand, in the middle of the Tasman Sea, on an island whose small human population are conscious of their impact on the land, where conservation is integral to their way of life and an affinity for the island and all life is ingrained in the people.

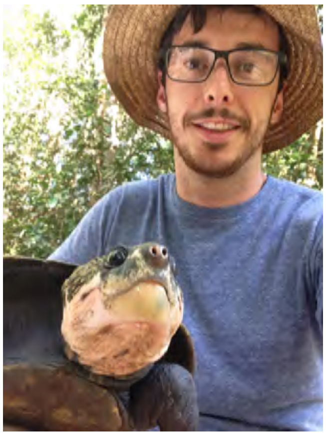
I am alone on an island at sea, and the world has followed me here.

I spend seven more days on the island, each very much the same. Morning walk, lab work throughout the day, the search for birds at night, collecting plastics along the way. I have fallen in love with the shearwater all over again. Against all the odds, the power of the ocean and the pelagic gale-force winds, they return to this island every year to breed, but I fear the threat from plastic they now face is too overwhelming. Their population is in decline. Will even the lucky birds that are able to fledge and that have ingested only small amounts of toxic plastic ever return to breed? The question remains, how much plastic is too much plastic?

About the author

Peter Puskic is a research student at the Institute for Marine and Antarctic Studies, University of Tasmania. He studies seabirds as sentinel species to indicate the extent and impact of plastic pollution. His PhD project is titled 'More than skin deep: examining the cellular-level effects of ingested plastic on the Flesh-footed Shearwaters of Lord Howe Island'.

Lord Howe Island, New South Wales, sits alone in the middle of the Tasman Sea, yet it is frequently impacted by what the mainland throws 'away'.



Wytamma Wirth with adult freshwater turtle (*Elseya irwini*, Johnstone).

Epidemiology of *Ranavirus* in Australian freshwater turtles

WYTAMMA WIRTH
James Cook University

Wytamma releasing freshwater turtle hatchling (*Emydura macquarii krefftii)* in the Ross River, Townsville. Photo: Matt Curnock

Juvenile freshwater turtles (*Myuchelys latisternum* and *Emydura macquarii krefftii*).

My name is Wytamma Wirth and I am a PhD student at James Cook University. My project is focused on ranaviruses and Australian freshwater turtles. At James Cook University we have an excellent Turtle Health Research team that works many aspects of turtle health.

Infectious diseases, such as ranaviruses, pose a risk to Australian freshwater turtle species. A general lack of understanding of the health and disease of Australian turtles limits our ability to predict and control disease outbreaks.

Ranaviruses are emerging and highly lethal pathogens that infect fish, amphibians and reptiles. First discovered in 1965, ranaviruses were initially studied for their interesting molecular biology but rose to reportable pathogen status as they increasingly caused disease in wild animal populations. Ranaviruses are now found all over the world and scientists are working to understand what drives their expansion. Wild species of Australian fish and amphibians have been found with ranavirus infections.

These same viruses infecting amphibians in the wild are able to infect Australian freshwater turtle species but we don't know what ranaviruses are doing to our wild freshwater turtle populations. Through my project we aim to learn about these viruses in wild freshwater turtles and improve our overall understanding of freshwater turtle health. We will be conducting a survey of freshwater turtles looking for ranaviruses. Using DNA sequencing, we will categorise and describe the distribution of these turtle ranaviruses. The results of the project will help to improve freshwater turtle health and conservation.