Abstracts

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PLENARIES

Where music meets conservation: the incredible Palm Cockatoos of Cape York Peninsula

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In a relict rainforest on Cape York Peninsula (CYP) in far northern Queensland lives an ancient tribe with unique customs. While others of their kind have come and gone over ice-age land bridges, the Palm Cockatoos (*Probosciger aterrimus*) of Kutini-Payamu National Park have held fast and maintained their own language and culture. This population is genetically distinct from others on CYP, has unique calls including a human-like 'hello', and manufactures sound tools used during display. They are in fact the only population (let alone species) of parrot that has been observed regularly using tools in the wild, and their use of drum sticks and modified seedpods during display sets them apart from other non-human tool using species. This talk provides an overview of why they drum, the structure and history of the Palm Cockatoo meta-population on CYP and how several anthropogenic disturbances now threaten this remarkable species.

Birdsong: the female perspective

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Bird song has historically been considered an almost exclusively male trait, an observation fundamental to the formulation of Darwin's theory of sexual selection. Like male visual ornaments, song is used by male songbirds to attract females and compete with rivals. Thus, bird song has become a textbook example of the power of sexual selection to lead to extreme neurological and behavioural sex differences. I present an extensive survey and ancestral state reconstruction of female song across songbirds showing that female song is present in 71% of surveyed species including 32 families, and that females sang in the common ancestor of modern songbirds. Our results reverse classical assumptions about the evolution of song and sex differences in birds.

Restoring Ground Parrot Habitat in Gadabanud Country

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The Carlisle heathlands lie on the boundary of the Gadabanud, Keeray woorong and Gulidjan language groups of the Gunditjmara nation. The Heath is of interest regionally because of the intact mammal assemblage that it hosts and the systems highly flammable nature and proximity to communities in the Otway range. It was also notable for having been prime habitat for the Eastern Ground Parrot, a culturally identified species for the Gunditjamara. It's the complexity of these, often competing values, that has seen the formation of a group of researchers, land managers and Traditional Custodians. The group has been tasked with designing an applied research program to understand how management can be applied in a way that maintains the high diversity of mammals and plants, lowers the risk of wildfire to communities and environment and designs a pathway to restoring high quality ground parrot habitat. This presentation will explore the work done to date, the knowledge gaps and where to from here?

Birds, totemism and traditional ecological knowledge in Fiji.

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It is not uncommon for certain cultures, especially in indigenous or remote communities, to have strong beliefs and traditions associated with totem animals or other sacred symbols. These beliefs often play an important role in cultural identity and practices. Given the importance of these totem species to communities, there is often significant traditional ecological knowledge associated with them. Fiji is a country where totemism still plays a key cultural role with over 50 plant and animal species recognized as totems by over 100 communities throughout the country. Here I present on bird totemism in Fiji, the use of birds as environmental indicators in traditional ecological knowledge (TEK) and how blending TEK and modern science has contributed to improving our knowledge of Fiji's unique species, habitats and the cultures that have adapted to the diverse Fiji archipelago in the last 3000+ years.

Birds beyond borders: Progress in developing sustainable habitat networks for mobile terrestrial Threatened species in New Zealand

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Understanding the importance of migration networks that cross international borders has received much attention in recent years. However, the requirements of mobile species that use the environment at district, regional and national landscape scales, often moving across different territorial authorities and jurisdictions, has been less of a focus. Movements may be migratory, seasonal, or nomadic, and are often undertaken to exploit different feeding and breeding resources. The Department of Conservation's network of Ecosystem and Species Management Units (EMUs & SMUs), which is confined to public conservation land, aims to be representative enough to ensure persistence of all Threatened species. However, it has long been suspected that these units account for only part of the life cycle of many mobile species. To investigate this, we reviewed the NZ Threatened species listings to 1) determine how many taxa can be considered mobile, 2) describe knowledge gaps needing to be addressed before management prescriptions can be implemented, and 3) assess the relative priority of these research needs. We found 57% of Threatened terrestrial bird species and all Threatened bat species are mobile under our definition (46 species), and several major knowledge gaps require research before effective landscape-scale management prescriptions can be developed. In addition, mobile species face numerous threats that likely reduce overall survival while moving across the landscape. We suggest that a high proportion of management units are insufficient to sustain mobile species throughout their annual cycle/lifetime, and thus their persistence cannot be assured by maintaining the ecological integrity of EMUs and SMUs alone. We introduce a new Department of Conservation led research programme that, with several collaborators, aims to start addressing these short comings. New generation GPS tracking units, which provide near real-time precision tracking for up to four years/tag, are being used to describe movement networks in great detail, including species that had been too light to carry tags previously.

Tasmania - a national refuge for resident shorebirds

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Analyses of data obtained during dedicated surveys since 1992/93 indicate that Tasmania currently (2020/21) supports a minimum of 750 breeding pairs of Eastern Hooded Plover, representing approximately 62% of the sub-species population. Tasmania also supports a minimum of 1000 breeding pairs of Pied Oystercatcher, with a total population estimated to be more than 30% of the Australasian and global population. Population data for the three NRM regions and the 20 coastal councils in Tasmania that support breeding populations clearly show local and regional differences in the distributions of the two species around Tasmania. It is clear that Tasmania is of national and international significance for both taxa, supporting substantial proportions of their global populations. With mainland populations of Hooded Plover decreasing more rapidly than those in Tasmania, there can be no doubt that Tasmania is already the refugium for both taxa. As the mainland populations for both taxa decrease, so the proportion of the populations in Tasmania will increase, further reinforcing Tasmania's critical role in the conservation of both taxa.

EBird: Birding, science and conservation action

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Birds capture the human spirit, our imagination, and our passion in a way that few other organisms do. They also serve as the most accessible and sensitive indicator of ecosystem health and climate change. When combined, these two seemingly simple statements hint at the tremendous power that birds have for people. Never before have we had as great an opportunity to bring together people from around the world to monitor and understand our natural world – simply by watching birds. Already, nearly 1 million people around the world have taken part in reporting observations to eBird. Using advanced techniques at the interface of computer science and statistics, we now have unprecedented insights into the distribution, abundance and population trends of birds on a global and local scales. These data have the power to greatly inform the national and international commitments to protect and restore 30% of the planet and are being used as a valuable resource for priority-setting and management.

SYMPOSIA

A national overview of Threatened Australian birds

Declining but not (yet) threatened: a challenge for avian conservation in Australia

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Threatened species receive much attention in conservation science and practice. Species currently declining, but not yet listed as Threatened, also deserve consideration to reduce their risk of sliding toward extinction and to maintain their functional roles in ecosystems. Information on declining bird species in Australia is available from four main sources: national data bases, syntheses of historical change, regional monitoring programs, and summaries for guilds of species. Many species show evidence of decline; declines of species are occurring nationwide; and they are ongoing. Trends for individual species vary geographically; they may be declining in part of their range but stable elsewhere. Common trajectories of population decline include: a) a downward linear trend, b) a marked downturn, sustained at a lower level, and c) fluctuations through time associated with episodic events (e.g. drought) and incomplete recovery. Ongoing declines affect ecosystems through reduced species richness, homogenisation of bird communities, changes to interspecific interactions and ecosystem services, and contributing to extinction debt. Improving the conservation outlook for declining species requires systematic monitoring to know where, when, and how much decline is occurring, together with protection of critical habitats and source populations, ambitious programs of restoration, and identification and effective control of threats. Responding to declining species offers opportunities for community engagement, monitoring and action at a local and regional level. New ways are needed to incorporate such species in conservation planning and environmental regulation at a regional scale, to give them greater visibility and avoid local declines accumulating until taxa become nationally Threatened.

The South Australian Glossy Black-Cockatoo: overview of their status and conservation after the 2019-20 Black Summer Bushfires

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The Endangered South Australian Glossy Black-Cockatoo is a habitat specialist. It feeds almost solely on the seeds of drooping sheoak trees and requires large tree hollows in close proximity to foraging habitat in order to nest. But could this specialisation be the downfall or the saviour of this subspecies in the future? During the 2019-20 Australian bushfires season, around half of Kangaroo Island's vegetation was burnt during a mega-fire, in which 54% of drooping sheoak woodlands on Kangaroo Island were burnt and 47% of tree hollows used by Glossy Black-Cockatoos were completely destroyed. It will take decades for the drooping sheoak feeding habitat to regenerate to an age that is seed producing again and for new tree hollows to form. However, post-fire the Glossy Black-Cockatoo population is successfully using nest boxes to raise nestlings, and is frequently recorded feeding in revegetated stands of sheoak, which are fast growing with a high after-planting survival rate. In this presentation we outline the impact the 2019-20 bushfires have had on the Kangaroo Island Glossy Black-Cockatoo population in the three years since the fires, and the importance of historic and ongoing management actions to their persistence post-fire. We also outline emerging threats to the species, including increasing abundance of nest competitors and the risks associated with such a high reliance on nest boxes for breeding. The persistence of this species in wake the 2019-20 Black Summer Bushfires highlights the importance of long-term conservation programs for species resilience when faced with catastrophic events.

Watering wetlands for the Endangered Australasian Bittern — Lessons from a decade of floods and drought

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The Australasian Bittern (*Botaurus pociloptilus*) is an iconic, endangered waterbird that has featured in Aboriginal peoples' stories for tens of thousands of years. Its varied diet and reliance on healthy vegetation makes it a good indicator of functioning wetland systems. Large, treeless wetlands that include lignum (*Duma florulenta*) shrubland, common reed (*Phragmites australis*), and/or tall spike-rush (*Eleocharis sphacelata*) are used by bitterns for nesting and feeding. Environmental water can be used to specifically target these wetlands to support breeding and recruitment. Water delivery, alongside a series of wetter years has increased the area of available habitat for the Australasian Bittern in the southern Murray-Darling Basin. Widespread inundation also promoted increases in the abundance of prey, including the Endangered Southern Bell Frog (*Litoria raniformis*). Environmental water managers have some limitations when coordinating water for bitterns, including a lack of detailed information about the effect of the timing, duration, and extent of wetland inundation on breeding. We collated historical records and recent monitoring data from over 60 sites in the Lower Murrumbidgee and Great Cumbung Swamp to identify key habitat for the Australasian Bittern. At these key habitats, we identified significant increases in male bittern abundance over the past three years indicating widespread breeding over successive years. We also examined their responses to flows of varying magnitude and timing. This information will support the ongoing management of Australasian Bitterns in key wetlands in the southern basin to assist the ongoing recovery and survival of this species.

Insights from research into the Capricorn Yellow Chat over 20 years

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The Capricorn Yellow Chat occurs on seasonally inundated treeless marine plains, comprising six coastal plain complexes, between Broad Sound and the southern part of the Fitzroy River delta and Curtis Island. Suitable habitat is limited with an extent of occurrence of less than 6000 ha with grass-sedge swamps and tall saltmarshes comprising *Schoenoplectus litoralis*, *Halosarcia pergranulata*, *Sporobolus virginicu*s and *Cyperus alopecuroides* being the preferred vegetation. The Capricorn Yellow Chat both feeds and breeds in these areas. Over the past twenty years considerable work has been done with regards to the following;

- Surveys to determine the population in each of the six coastal plain complexes as well as to search for other populations that may exist in suitable habitat.
- Mist netting, trapping, banding and DNA sampling.
- Control of invasive weeds such as Rubber Vine (*Cryptostegia grandiflora*) and Harrisia Cactus (*Harrisia martini*).
- Control of feral animals, such as foxes, cats and pigs, that either prey on the Capricorn Yellow Chat or destroy its habitat.
- Removal of cattle from areas that have been allocated to a National Park as a result of an offset.
- Research into threatening processes such as sea level rise and possible methods to mitigate such threats.
- Advocacy to protect Capricorn Yellow Chat habitat where inappropriate development threatened its destruction.
- Public education to raise awareness.

These actions have resulted in a relatively stable population and this paper will look at the insights that have been gleaned for the protection and preservation of a threatened species.

Not to be taken lightly: an assessment of the global feather trade

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Wildlife trade is responsible for substantial biodiversity loss, with large volumes of trade often sourced unsustainably. Decades of research has identified global avian trade to largely consist of live birds for the exotic pet industry, as well as parts traded for use in traditional medicine. Preliminary observations of commercial trade data revealed bird feathers to be a common and globally traded commodity. Feathers were heavily traded in the 17th-18th century for women's fashion, yet large-scale trade mostly ceased at the beginning of the 20th century. Besides the (smaller scale) use of feathers in the 21st century fashion industry, feather trade is largely unstudied and therefore poses unknown risks to avian conservation. Trade data was imported from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), as well as the US Law Enforcement Management Information System (LEMIS). Using this data, we identified over 700 taxa associated with feather trade, with taxa in the orders Falconiformes and Psittaciformes most implicated. *Pavo cristatus* (Order Galliformes) had the most trade records of all species listed, fostering possible future conservation concerns. We explored documented use of feathers for highly traded taxa (or with higher threat status), advocating increased regulation for these practices. Our assessment and conservation recommendations will ideally provide managers and conservation practitioners with capacities for increased safeguarding of impacted species. Further research of practices encompassing the modern feather trade is advised to improve understanding of successful conservation pathways for vulnerable taxa.

Social structure and survival of Orange-bellied Parrots

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Breeding individuals in captivity to supplement declining wild populations is a conservation strategy used around the world. Unfortunately, many individuals have low rates of survival post-release. If released individuals are unable to socially integrate into a population, they might lose the safety of the group and fail to learn critical skills. The Orange-bellied Parrot (*Neophema chrysogaster*) is Critically Endangered and as part of recovery efforts, captive-bred adult birds are released each spring and juveniles are released in autumn prior to migration. Historically, captive-bred adults have low rates of migration-survival, while captive-bred juveniles survive at rates equivalent to wild juveniles. We constructed social networks to determine how captive-bred birds integrated into the wild population post-release to investigate the long-term impacts of captivity on sociality and how sociality impacts migration-survival. While we found no difference between captive and wild birds, we found significant differences between adults and juveniles. Juveniles had stronger connections, were more centrally located within networks, and greater consistency in network position through time. However, we found no impact of sociality on migration-survival. Our results suggest that released birds integrate well into the population and provide evidence for differing migration strategies previously described for adults and juveniles; adults depart first in small groups, and juveniles depart as a large flock weeks later. We suggest that the low migration survival of captive-bred adults may be attributable to missing this juvenile flocking period, which suggests a juvenile developmental phase may be impactful for this species.

Why do we care if a species or sub-species becomes extinct?

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Data from the IUCN Red List show that 49% of bird species worldwide are in decline. People from very disparate backgrounds are calling for action to halt and reverse this pattern. Understanding what motivates humans to be concerned for some, or all species (i.e., why we believe conservation is important) can influence how we go about conserving certain species, which species we prioritise for action and which actions we deem acceptable, or not, in achieving that end. Improved understanding of the different motivations people have to work for the conservation of species can reduce the likelihood that time, effort and resources that should be devoted to working for solutions are wasted resolving human conflicts. It can also enhance our ability to harness broader support by appealing to the forms of reasoning and justifications that resonate most strongly with different groups of people, thereby increasing the likelihood of forming collaborative and effective partnerships for conservation. Assuming knowledge of the scientific evidence will alone provide sufficient motivation for humans to address the extinction crisis is naïve and ignores the complexity of how human agency operates. We will explore the different philosophical and ethical rationales commonly underpinning attitudes to the conservation of species. We will examine how these different rationales might complement or conflict with one another and the potential consequences. We will reflect on the opportunities and impediments to doing better in the future.

Insights into the population dynamics and breeding biology of the Norfolk Island Green Parrot

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The Endangered Norfolk Island Green Parrot (*Cyanoramphus cookii*) has been drastically impacted by anthropogenic change since the arrival of Europeans on Norfolk Island in the 1700s. A combination of habitat loss, introduced predators and direct persecution saw a major population contraction. Significant efforts to boost population size have been made over the last 50 years, including the protection of key habitat, the provision of nest sites, predator control, as well as unsuccessful attempts at captive breeding and translocation. Despite these efforts, the population size has continued to fluctuate and significant knowledge gaps still remain, which must be filled to refine techniques for managing the species. Here we present insights gained from recent years of study on the Green Parrot, including key findings regarding nest site preferences, population genetics, contemporary breeding biology and population modelling. We found that Green Parrots did not use completely artificial nest sites and preferred nest sites with thicker walls. The Green Parrot population showed evidence of high rates of inbreeding and a low effective population size (Ne = 44). The population swelled in the years following a 2013 nadir. We modelled this population growth, showing that a significant amount of natural (undetected) nesting would be required to explain this growth. We also found and monitored several natural Green Parrot nests to examine their success alongside managed, protected nest sites. These findings can be used to refine existing management techniques and support efforts to save this endangered parrot.

Australia's Threatened Bird Index 2.0

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In 2018, Australia's first Threatened Bird Index (TBX) was released. A collaboration between BirdLife Australia, University of Queensland and the NESP Threatened Species Recovery Hub, the TBX sought to estimate abundance trends for Australia's Threatened and Near Threatened bird species. The project collated monitoring data for 43 of Australia's threatened birds, including 10,749 time-series. The resulting estimates of abundance trends, produced using the Living Planet Index methodology, was the first synthesis of monitoring data for any group of Australia's threatened species, and painted a worrying picture. On average, Australia's Threatened and Near Threatened birds were estimated to have declined in abundance by 52% since 1985. This presentation will release 'TBX 2.0' marking the first full update of the TBX since 2018. Over 2022 and 2023, the TSX team based at the Terrestrial Ecosystem Research Network collaborated with BirdLife Australia and other data providers across Australia to update monitoring datasets already in the index, collate new monitoring data for species listed as Threatened

or Near Threatened in 2018, and collate monitoring data for newly listed species (including those proposed for listing under the Action Plan for Australian Birds 2020). We will provide updated estimates of abundance trends for Australia's Threatened and Near Threatened birds, describe variation in trends among functional groups and across Australia's states and territories, and detail future plans for the Threatened Bird Index.

Plains-wanderers in western Queensland - marginal habitat or a species stronghold?

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The Plains-wanderer is a small ground-dwelling bird endemic to the sparse native grasslands of Victoria, South Australia, New South Wales and Queensland. Currently, almost all research on the species has been conducted on the populations known to occur in southern New South Wales and northern Victoria. Declines in those populations in the 1990s led to the species being listed as Critically Endangered under the EPBC Act. western Queensland represents the northernmost limit of the Plains-wanderer's distribution and has been traditionally considered 'marginal' habitat, while southern New South Wales and northern Victoria are considered core habitat. Recent modelling of the distribution of this species, however, suggests that western Queensland could support areas of equal size and quality to the southern core areas. There has been little to no research or monitoring of this species of Plains-wanderer in western Queensland until the Queensland Department of Environment and Science started a small project in 2018 on Astrebla Downs National Park. That project has grown and we now have three years of almost continuous monitoring data using bioacoustics. We present this preliminary data which, even at this early stage, indicate two things: (1) Plains-wanderers are occupying and breeding in western Queensland and (2) they are behaving differently from their southern counterparts. Further research to understand the importance of habitat in Queensland is required to better understand the contribution of the Qld populations to the survival of the species, and to inform management actions necessary to support species recovery.

Nest Box Trials and Tribulations: Insights from the South-eastern Red-tailed Black Cockatoo Project

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The nationally Endangered South-eastern Red-tailed Black Cockatoo (*Calyptorhynchus banksii graptogyne*; SERTBC) is restricted to South West Victoria and South East South Australia and is threatened by the loss and ongoing decline of critical feeding and nesting habitat. The small population of only 1500 birds relies on both stringybark and buloke woodlands for feeding and large hollows in close proximity to feeding habitat for nesting. The loss of nest trees is a significant issue for the SERTBC as the large, old (200+ years) eucalypts suitable for nesting senesce and are lost from the landscape. Given limited recruitment of new nest sites, a serious shortfall of suitable hollows is expected in the future. To address this, a supplementary nest program comprising varying artificial nest types has been established while younger habitats mature. As of 2022, The Recovery Team has deployed 108 cockatubes, 26 PVC and 21 natural salvaged hollows into the region. Monitoring has revealed several factors may be contributing to the effectiveness of supplementary nests for the SERTBC. Competition from birds and possums, use of natural hollows in the same tree, height and direction of installation, type of box and box safety affect nest box use. Surrounding land use and proximity to feeding habitat also contribute to breeding success rates. Management strategies for boosting future breeding success will be discussed.

Swift Parrot Search - A revised monitoring approach to help paint the big picture

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The Critically Endangered Swift Parrot spends the summer period breeding in Tasmania before migrating across Bass Strait to spend the winter months on mainland south-eastern Australia. Once on the mainland, Swift Parrots fly vast distances across their range in search of food - namely nectar produced by flowering eucalypts and lerp. For decades the species has been in rapid decline due to a litany of threats, with the current wild population estimated to be approximately 750 individuals.

For more than 25 years, BirdLife Australia's biannual Swift Parrot surveys have engaged skilled and dedicated birdwatchers in the collection of crucial monitoring data across the species' mainland range. In recent times, this monitoring has detected an apparent shift in the species' use of key habitats. Importantly, it remains unclear what the necessary precursors are for optimal foraging conditions to occur, such as eucalypt flowering and lerp. Launched in 2021, the volunteer-driven monitoring program Swift Parrot Search complements pre-existing Swift Parrot monitoring approaches through combining standardised 5-minute/50-metre radius bird surveys with rapid habitat assessments. This approach is aimed at identifying the specific mechanisms driving the apparent shift in Swift Parrot habitat use on the mainland, and increasing our capacity to better predict the occurrence of optimal foraging conditions (e.g., species-specific eucalypt blossom events). Since 2021, the program has received more than 4,500 completed surveys across mainland south-eastern Australia. Data gathered via this ambitious program will help address key knowledge gaps, allowing conservation actions for Swift Parrots, and also Regent Honeyeaters, to become more targeted.

Who's Hoo? Taxonomic affinity of small forest hawk-owls in Australasia, with a focus on island morepork populations: Implications for conservation

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Genetic rescue can play a crucial role in the conservation of small, isolated populations lacking genetic diversity, but often there are concerns around outbreeding depression. To determine the risk of outbreeding depression, the taxonomy and evolutionary history of the study population and those considered as potential source populations should be resolved. The Critically Endangered Norfolk Morepork *Ninox novaeseelandiae undulata* is currently considered to be a subspecies of New Zealand Morepork *N. n. novaeseelandiae*. In 1986 an extreme form of genetic rescue occurred when a male New Zealand Morepork was paired with the sole remaining Norfolk Morepork, a female. The population that arose from this single pair may now require further genetic intervention, yet the taxonomy of wider heterospecifics to inform such an intervention is not fully resolved. Using a genomic SNP dataset, we assessed patterns of genetic structure and differentiation for small forest hawk-owls from Australia, New Zealand, Norfolk Island (pre and post hybridisation) and New Guinea. Principal coordinate analysis and dendrograms showed genetic differentiation between populations in New Zealand, mainland Australia and Tasmania. We confirm previous research that identified the New Zealand Morepork as the Norfolk Morepork's closest relative. The other most likely candidate for bolstering the Norfolk Island population, the Tasmanian Morepork, appears to be more closely related to *N. boobook* of mainland Australia than to *N. novaeseelandiae*. Our analyses provide further evidence to support the decision to use New Zealand Moreporks as a source population for any translocations onto Norfolk Island, both historically and in the future.

On the search for song: Developing acoustic monitoring methods for the South Australian Bassian Thrush

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Rare, elusive species are notoriously challenging to study. One such bird, the South Australian Bassian Thrush (*Zoothera lunulata halmaturina*), has remained poorly studied due to the subspecies' shy and cryptic nature. However, over the winter breeding season, breeding pairs will often vocalise, providing an acoustic signal that can be more readily detected than with visual methods alone. Now listed as an endangered subspecies, effective monitoring will prove critical in establishing population trends and evaluating any future recovery efforts. To compare the efficacy of different monitoring methods; namely camera trapping, traditional observer surveys and acoustic surveys, we conducted a trial in conservation parks within the Mount Lofty Ranges during Autumn and Winter, 2020. As acoustic monitoring methods were still in their infancy, the development of efficient post-processing procedures was required, including the creation of an automated call recogniser. Once developed, the recogniser was able to detect Bassian Thrush contact calls from field recordings, enabling the presence of birds at field locations to be determined. Furthermore, acoustic monitoring provided considerably more presence records than both camera trapping and traditional observer surveys, offering a greater insight into occupancy and density across sites. Subsequently, the acoustic survey procedures developed during the 2020 field season were refined and scaled up to span the entire Mount Lofty Ranges. The monitoring program, now in its third year and encompassing 60 study sites, has uncovered key areas of Bassian Thrush habitat and greatly helped refine overall population estimates.

Individual preferences for sound tool design in a wild parrot

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The rarity of tool manufacture in wild parrots is surprising because they share key life history traits with advanced tool using species including large brains, complex sociality, and prolonged parental care. When it does occur, tool manufacture in parrots tends to be innovative, spontaneous and individually variable, but most cases have been in captivity. In the wild, only Palm Cockatoos (*Probosciger aterrimus*) have been observed using tools regularly. However, they are unusual because they use tools to enhance their displays rather than for foraging or self-maintenance. Males in northern Australia make two types of tool from sticks and seed pods, which they tap rhythmically against a tree during display. We analysed 256 sound tools retrieved from 70 display trees. Drumsticks (89% of tools) were used more often than seed pod tools; most males manufactured only drumsticks, but some made both types. Individual males differed significantly in the design of their drumsticks including the length, width and mass but we found no evidence that neighbours copied each other. We discuss the highly individualised preferences for sound tool design in context of the behavioural predispositions behind the rarity of tool manufacture in wild parrots.

Key science for the recovery of Australia's least well-known birds

The Regent Honeyeater: a pre-extinction inquiry

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The Regent Honeyeater is a flagship species for avian conservation in Australia. The species' recovery efforts have been relatively well funded for the past two decades, but there is no evidence the population is recovering. This talk will summarise research derived from the national regent honeyeater monitoring program — a range-wide effort that commenced in 2015 to yield more and better-quality monitoring data — to explain why the regent honeyeater continues to decline and why population models predict it will be extinct in the wild within 15 years without enhanced conservation action.

Habitat selection, is it 'plainly' obvious? Broadening the understanding of habitat use of one of Australia's pickiest birds, the Plains-wanderer.

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Arid Australia is characterised by boom-bust conditions such that variation in annual rainfall and prolonged drought are key drivers of population dynamics and behavioural characteristics in a range of taxa. Avifauna in this region are particularly well adapted to a suite of ecological challenges and are therefore often identified as habitat generalists. The Plains-wanderer (*Pedionomus torquatus*) presents an unusual contradiction; this Critically Endangered grassland specialist is known to have strict habitat requirements centred around vegetation composition and complexity. In this study we assessed habitat use of a population of Plains-wanderers in the South Australian semi-arid rangelands in the periphery of the species' range. We found the vegetation structure that was selected for rarely conformed with the criteria for 'suitable' Plains-wanderer habitat, as identified through previous studies. Plains-wanderers in our study were found to use a range of habitat niches, and at times appeared to select against grasslands. We conclude that Plains-wanderers are able to inhabit a variety of vegetation associations in the South Australian rangelands. Owing to our findings, we challenge whether this species is solely a 'grassland specialist', as it occupies and breeds successfully in a number of open plains habitats. Studies such as this are important in improving our understanding of the resource use of this critically endangered bird. Furthermore, informing management for a range of habitat types and potentially identifying new areas which may be important for Plains-wanderer populations.

Understanding the breeding biology and social organisation of the Western Grasswren to inform translocation strategies

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Translocations require enormous financial, logistical and personnel resources to execute. In addition, animal livelihood is put at risk for those individuals chosen for the move as social groups are often disturbed, territories need to be acquired and familiarized and breeding opportunities may be initially limited. Understanding the biology of the target species prior to translocation can greatly improve the planning stages of how best to source and release individuals to increase survival, resource acquisition and breeding opportunities. The Western Grasswren (*Amytornis textilis textilis*) was recently (October 2022) translocated to Dirk Hartog Island, Western Australia. Here, I present how learning more about the breeding biology and social organisation of the species had direct impacts in the decision-making of how animals should be sourced and released for the translocation. Based on three years of monitoring a source population of Western Grasswren in Shark Bay, Western Australia, I was able to provide justified recommendations on how, when and where groups should be captured, a dichotomous workflow to determine if individuals captured should be taken for translocation and provide recommendations for monitoring techniques once on the island to better determine if success criteria are met. This work has highlighted that better understanding the basic biology of the species can create better ethical outcomes for individuals and dictate logistical and harvesting methods in a translocation context.

Knowledge gained monitoring Masked Owls in tropical savanna woodlands using acoustic recorders

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The Northern Masked Owl (*Tyto novaehollandiae kimberli*) is a threatened owl of Australia's tropical savanna woodlands. Away from the Wet Tropics, the Northern Masked Owl has been rarely recorded in recent decades, despite its distribution stretching west to the Kimberley. The elusiveness of these owls in general, combined with several widespread threatening processes likely impacting their habitat and prey, has resulted in uncertainty in their current status. Here, we present on the use of remotely deployed acoustic sound recorders to detect, monitor and better understand the cryptic lives of these owls, in order to improve their conservation outlook. We show that acoustic recorder deployments are effective at detecting owls within landscapes, identifying critical habitat, monitoring prey provision to young, revealing temporal patterns in calling behaviour across years, and importantly, linking human-induced disturbances (e.g., call playback) during breeding to nest site abandonment.

Causes of extinction risk misclassification, and improving the process

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Our current knowledge of the status of Australia's birds has been well-documented over the last 30 years. Some research has aimed to synthesise this knowledge and identify species that qualify for Threatened species status under international and national legislation, and also species which are in need of the most urgent attention. In most cases, our level of knowledge enables an accurate assessment, and action is taken to save species. However, current knowledge occasionally proves to be misleading, and species slip under the radar. Subsequent analyses reveal significant knowledge gaps that have meant predictions based on current knowledge were incorrect. Identifying the reasons for these misclassifications is important; the correct prioritisation of species requiring conservation is critical to saving as many species as possible. If a species is not correctly classified, its true status may not be understood until it is already gone, or there may not be the knowledge necessary to implement strategies to conserve and recover a species. That existing techniques have failed some species, suggests the methods used must be reviewed, and adjusted if necessary to ensure they are correctly prioritising species for both research and conservation action. In this talk, we describe the classification process for Australia's birds, identify species that have been misclassified, and some of the characteristics these species have in common which make them susceptible to misclassification. We also identify some other species that are potentially vulnerable to misclassification and suggest aspects of the classification process that could be refined to avoid future errors.

Rapid and recent range collapse of Australia's rarest raptor, the Red Goshawk *Erythrotriorchis radiatus*

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Australia's Red Goshawk (*Erythrotriorchis radiatus*) is a taxonomically distinct raptor endemic to the tropics and sub-tropics of eastern and northern Australia, and the Australian mainland's rarest bird of prey. The status and distribution of this enigmatic bird remains poorly known as no comprehensive analysis of its range-wide population trends has ever been undertaken. This creates a knowledge gap which potentially delays urgent conservation management as the species appears to be in a state of widespread decline based on anecdotal evidence. Here, we bridge that knowledge gap by compiling a comprehensive dataset of 1,679 occurrence records spanning the species' historical range, develop a novel method that overcomes reporting biases centred around nest locations, then identify population trends between 1978 and 2020 at national, state, and regional scales. Our results suggest that the species has declined significantly across eastern Australia and is likely locally extinct in many regions including South East Queensland. We estimate the Red Goshawk has disappeared from 34% of its breeding range over the last four decades, and probably persists at extremely low density, if at all, over an additional 29.7% of its breeding range. These results demonstrate the species' declining population trajectory at multiple scales for the first time and justifies its recent up listing under Australian federal legislation to Endangered, using IUCN Red List criterion C2a(ii): small population size and decline. We recommend population surveys and monitoring coupled with targeted research to better understand its population trajectories in extant regions and to determine which threats are driving this fascinating species' population collapse over such large spatial scales.

Using DNA barcoding to reveal the diet and foraging ecology of a cryptic grassland bird - the Plains-wanderer *Pedionomus torquatus*

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Understanding basic ecology of threatened birds such as where they forage and what they eat is critical to conservation efforts. For cryptic species, however, this information is often lacking. The Critically Endangered Plains-wanderer is a small, mostly terrestrial bird that occurs in semi-arid grasslands of eastern Australia. The species is highly cryptic and rarely observed during the day when they forage, consequently most aspects of its diet and foraging habits are poorly understood. We use novel DNA barcoding tools and miniature GPS trackers to analyse fecal samples and movements of wild Plains-wanderers and examine their diet and foraging habits. Our findings provide new insights into preferences for specific food items across different seasons and between sexes. More broadly, our research highlights the potential of DNA barcoding to improve our knowledge of the diet of cryptic, threatened birds.

Understanding occupancy of habitat specialists with the use of detailed ecosystem mapping

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Interactions between a species and their ecosystem can allow for an insight into the spatial and environmental factors which may influence the occupancy. The knowledge of these interactions are important for the of management for habitat specialists. The Eastern Ground Parrot is a species which is found in heathland and sedgeland along the east coast of Australia, with current management relying on historical information of the feeding habits, fire ecology and spatial use between microhabitats. The introduction of passive acoustic monitoring to this cryptic species has shown to be successful in further understanding the occupancy across a landscape at the same time, which when combined with detailed ecosystem surveys can increase our understanding in how this species selects, moves and utilises their habitat. The current research aims to conduct detailed mapping of potential and known Eastern Ground Parrot habitat at Noosa National Park on the Sunshine Coast. Acoustic data will then be used to measure occupancy across these different patches of habitat mapped within this area, then results and management implications will then be discussed.

A long road to recovery: a case study of an endangered finch

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Australia's extinction rate continues unabated, with current legal frameworks insufficient for halting the decline. Existing laws have particularly failed to prevent clearing of threatened species habitat, and the Southern Black-throated Finch makes the top 10 for greatest proportion of habitat and most hectares of habitat lost since these laws were enacted. The 20-year statutory review of the national laws generated fierce debate around what is needed to meet many of the desired objectives. Meanwhile, there was a push within government to move away from the lengthy and process-heavy recovery planning for threatened species, towards a streamlined approach. At the time of writing, the exact process of how the Australian Government proposes to meet its goal of 'no new extinctions' is unclear. In this talk I will make a case for detailed planning with binding commitments, using the case study of the Endangered southern Black-throated Finch. Species, such as southern Black-throated Finch, that occur almost entirely on private land constantly face clearing, fragmentation and development of habitat from agriculture, mining, housing and solar farms. Halting habitat loss for these species will require a binding plan informing multiple levels of government of their obligations, with sufficient monitoring and habitat restoration. While it is too late to save 90% of former southern Black-throated Finch habitat that has been lost, immediate and genuine commitment to their recovery, including research of basic ecology, is required.

Does Woodswallow presence increase Southern Black-throated Finch (*Poephila cincta cincta*) detectability?

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Thirty percent of the 585 vertebrate species on Australia's national threatened species list are birds, with more awaiting assessment. Granivorous birds are particularly imperiled and among them, the southern Black-throated Finch (*Poephila cincta cincta*) has been severely impacted. The once widespread species has suffered an 88% reduction in its distribution, now residing in just two strongholds in the Townsville Coastal Plains and Desert Uplands. Multiple factors have likely contributed to the decline; however, much of the species' ecology is still unknown. Its distribution across the Desert Uplands occurs primarily on private land, intensifying the challenges associated with studying a rare and inconspicuous bird. The southern Black-throated Finch has a strong association with woodswallow species in mixed-species flocks, specifically with the Black-faced Woodswallow (*Artamus cinereus*). The primary objective of this research is to identify methods of increased detection via assessment of mixed-species flock and habitat associations. The secondary objective is to measure key habitat characteristics of sites with and without southern Black-throated Finch to increase our understanding of their habitat use. Increased detection rates will substantially aid our understanding of southern Black-throated Finch ecology and allow for greater research efforts, particularly within their seldom seen foraging habitats. The knowledge gained from this research is likely relevant to other declining granivorous and woodland birds, including components of threatened woodland bird communities.

Ecology and conservation of Carpentarian Grasswren (*Amytornis dorotheae*)

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Carpentarian Grasswren (*Amytornis dorotheae*) is an endangered Australian passerine, endemic to a narrow range of habitats within Triodia savannas in the Gulf of Carpentaria. This research aims to inform monitoring and management protocols through a detailed field study of the species ecology. We use colour banding and VHF telemetry to map breeding territories and individual movements; coupled with an analysis of ground and UAV derived habitat measures to determine fine scale habitat preferences at the site scale. Colour banding resight data also revealed how individuals respond when their territories were burnt. These fine scale habitat requirements will be discussed with respect to other chapters of this PhD research including the validation of a Species Distribution Model (SDM) and in the context of threatening processes affecting the species. I will also talk about the groups collaborating on Carpentarian Grasswren conservation, and progress in recent years.

A conservation needs ladder to assess the true status of Australian birds

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Site-specific management efforts are considered essential for recovering most of Australia's threatened avifauna given the threats they face. But for effective management to be successfully implemented, specific diagnostic knowledge is needed on where the threatened species is located and the specific habitats they need, the nature of all the processes threatening it, and the best methods that will abate these threats in-situ. For effective site-based adaptive management to occur, there will also need to be a monitoring component to see an actual uplift in population trends, if management is being effectively implemented. In this talk I will describe a 'conservation needs' ladder that is aimed at providing a comprehensive assessment on the actual state of species' conservation needs for 190 of Australia's most threatened bird taxa. Using data from the Action Plan for Australian Bids, I show that five species where there is still not enough information on the habitats and locations where the species lives to derive a clear assessments of site-based conservation efforts can be best undertaken. There are 36 species where the threats these species face are not well enough understood, meaning any attempted management could be blind to crucial needs of the species. For 76 species, there is still an incomplete understanding on how to mitigate those threats (even when they are well known). These 127 species all have knowledge deficits that should be the focus on conservation science bodies. Of the remaining 72 species, 43 did not have enough conservation action occurring to enable individual species' recovery, and if they did, 19 species did not have enough effective monitoring being undertaken to determine if the threat abatement was working. There are just 10 species for which we have the knowledge necessary to implement effective site-based management, are implementing that management at scale, and are monitoring the outcomes of that management to understand whether recovery is occurring. The use of this ladder highlights clear research, action and monitoring shortfalls that could be targeted by the conservation sector.

Conservation of the Buff-breasted Button-quail

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The Buff-breasted Button-quail is both highly threatened and poorly known, making conservation of the species difficult. Making the situation more complex is the realisation that research and management over the past four decades has likely been founded on inaccurate data. Currently the location of single population of this species is not known and the last confirmed record of the species was from 1924. Given that all contemporary research on the species in the Wet Tropics and Einasleigh Uplands is likely inaccurate we must draw from the only accounts of the species that are backed by irrefutable evidence. Here we use the diaries of William Rae McLennan from a collecting trip to Coen on Cape York Peninsula in 1921 to 1922 to describe the ecology of the Buff-breasted Button-quail. During his expedition McLennan collected six skins and four clutches of eggs of the species and describes aspects of the species ecology in detail. We use this information and an understanding of button-quail ecology to make inferences on the specie ecology and conservation status.

Onshore wind energy and Australian birds – what we do and don't know

Quantifying fatality rates of birds [and bats] at terrestrial wind farms – An introduction to good practise

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Wind energy is critical to help us alleviate the impacts of climate change, however wind turbines themselves are not environmentally neutral. Birds and bats collide at varying rates, with some groups of species particularly susceptible to collision and others not. Flight behaviours can provide some insight into collision risk, however an extensive fatality monitoring program is required to verify predicted risk and understand which species are most susceptible to collision with turbines. Fatality monitoring has 5 core design concepts with 3 bias correction factors which all need to be considered for a good fatality study. The 5 core study concepts are study durations, turbine sample, search plot size and shape, transect width (or use of dogs) and search interval. All of these core components can be very

site specific and can be influenced by the species at risk at each wind farm site. In addition to the core concepts, the 3 components which must be measured for bias correction are searcher efficiency, carcass persistence and unsearched area. In this presentation I will explore each of these components and how they influence the quality of the fatality monitoring program. I will introduce the International Good Practice Handbook and provide examples of different programs both from Australia and overseas. I will also share insights into species from Australia that are colliding with turbines in significant numbers.

Quantifying the cumulative effects to birds from wind farm development in Queensland

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The Queensland government has an ambitious decarbonisation agenda with a target of 70% renewable energy by 2032. Achieving this target requires rapid development of renewable energy projects, including wind farms. Wind farms introduce a new suite of potential impacts to birds - in addition to clearing of habitat during construction, operating wind farms pose risks of turbine collision and barotrauma. Our analysis used publicly available environmental assessments, Queensland and Commonwealth environmental approvals and bird and bat management plans to quantify the potential cumulative effects of wind farm development on birds. We consider not only threatened and migratory species, but also least concern birds, which are rarely the focus of regulatory assessments. This work is intended to support the development of a risk assessment framework that addresses potential cumulative impact to birds, which should be of interest to the wind industry and regulatory agencies as we seek to decarbonise our energy markets while minimising the environmental impact of these endeavours.

Notes from the field - we need a national standard for baseline bird utilisation studies

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Australia's transitioning away from fossil fuels for electricity generation has seen the large-scale development of wind farms across the country. Birds (and bats) are known to interact with wind turbines, frequently with detrimental consequences. Critical to understanding these interactions is the collection of bird (and bat) utilisation data to understand the potential impacts and risks. Globally, there is a wealth of best practice approaches and experience to the assessment of impacts and risks posed to birds (and bats) from wind farm development. Regardless of this wealth of information on best practice approaches, the consideration of that knowledge, and proven methods, has not been well translated into the guidance offered at the national and state levels within Australia. For example, the Clean Energy Council's guidelines simply state that the surveys should identify bird species on the site, their numbers, the height they fly, how they use the site, with a description of their behaviours. At the state level, guidelines and regulations around ecological assessment for wind farm development vary significantly. This vagueness in guidelines has led to consultants and experts designing and implementing many different approaches to assess the country's burgeoning wind farm industry. This presentation will offer insights, observations, and recommendations for a consistent, repeatable, and robust approach to the collection of bird (and bat) utilisation data for wind farm development.

Commonwealth Environment Law and Onshore Wind Farms – minimising impacts on birds

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The Australian Government's environmental protection legislation, the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), aims to protect and manage nationally and internationally important plants, animals, habitats and places. Potential impacts on birds and other protected species from onshore wind farms are managed through the EPBC Act, supported by a growing library of policy guidance and information products. In the context of the government's renewable energy ambitions and its commitment to a nature positive approach, the department is working on new ways to collect, manage and share ecological data. This presentation will focus on the work underway to improve environmental outcomes through avoidance, mitigation and better information on species such as birds that are impacted by wind farms.

Weather radar reveals a short range but highly structured bird migration system in eastern Australia

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Conserving mobile species and reducing mortality through collision with artificial structures, such as wind turbines, aircraft, and buildings, requires a profound understanding of animal movements. In Australia, knowledge of avian migration is fragmented and mostly qualitative. To quantify nocturnal bird migration in Eastern Australia, we extracted bird movement information from 12 weather surveillance radars along a latitudinal gradient during 2018-2021 and complemented this with citizen-science bird observations (eBird). Radar-captured bird movement exhibited peaks in spring and autumn for many sites with repeatable between-year phenology; majority of movement took place soon after sunset and below 1000m above ground. Analysis of observational data revealed 217 species showing abundance changes suggestive of migration. We discovered a positive correlation between radar measurements of bird movement traffic and abundance changes across the bird community. We found evidence of sequential and latitudinally progressive migration waves from Tasmania to south-eastern Queensland, the directionality of which showed strong seasonal contrasts, albeit with considerable site-level variation. Our findings strongly indicate that a short range but highly structured bird migration system exists in eastern Australia. The Australian weather radar network thus holds considerable potential for conservation decision-making in providing near real-time information on the timing, altitude and amount of bird migration for airports, windfarms and other stakeholders to mitigate conflicts and help conserve migrating birds in Australia.

Using tracking data on highly mobile birds to understand and avoid potential wind energy impacts

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Potential wind energy infrastructure impacts on birds generally fall into two main categories – turbine and transmission line collisions, and disturbance resulting in habitat displacement. Poor understanding of bird movements risks unknown and uncertain impacts on species. Numerous wind farms in Australia and New Zealand are proposed and operating across areas overlapping with highly mobile species' distributions. Assessing wind energy facility impacts on them is difficult as their movements are unknown, and are particularly important for species of conservation concern. Knowing where, when and how high birds fly is crucial in understanding and quantifying potential risk and whether flights overlap with wind energy development and turbine rotor swept areas. This is especially so for species that move long distances between non-breeding and breeding habitats, and those that frequently fly between nesting, roosting and foraging habitats around proposed wind energy facility areas. Information on movements and flights can inform assessment, avoidance and mitigation of potential risk and impacts with more certainty. Avoiding impacts can subsequently be achieved through excluding wind energy infrastructure within known movement corridors and habitats. Knowing timing and height of flights can additionally inform mitigation strategies where turbine placement does not completely avoid habitats used by birds. We present case studies on threatened and non-threatened waterbirds in Australia and New Zealand where tracking data has increased understanding of their movements. These findings can inform assessing and avoiding potential wind energy infrastructure impacts on these highly mobile species. We also highlight other species where similar studies are warranted.

From skylines to backyards: Managing urban landscapes across multiple scales

Capeweed to Carnaby's: a 34-year study of birds in an urban bush garden

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Urban biodiversity helps to keep people connected to nature, benefitting human health and conservation; but how effective can a single bush garden be in supporting urban birds and biodiversity? In 1989, the

authors began planting a bush garden on a cleared block in suburban Perth. Birds were recorded on 'bird days', with 35 to 45 such recording events each year, and the results compared with changes in perennial vegetation in surrounding suburbs, as well as in the garden itself. The bird assemblage transitioned from common grassland bird species such as pipits and magpies to woodland birds such as pardalotes, honeyeaters, parrots and cockatoos. Bird species in the garden increased from a mean of 4.8 species per bird day in 1990 to a mean of over 18.8 species in 2011, before mean numbers of species plateaued in subsequent years. Decline in vegetation cover in surrounding established suburbs as well as nearby land-clearing was correlated with slight changes in the bird assemblage. The garden appears not to be able to support sittellas, whistlers and fairy-wrens, although they are occasional visitors. By 2022 a mean of 17.4 species was visiting the garden regularly, suggesting that one garden can make a difference to urban birds; but more widespread urban greening would be required to support a more complete suite of woodland bird species.

Big changes in backyard birds: An analysis of long-term changes in bird communities in Australia's most populous urban regions

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Australia's growing and increasingly urban centric human population is driving the expansion and densification of urban environments. While many Australian bird species can persist in or around human modified landscapes with varying success, those unable to adapt experience declines. The spatial and temporal complexity of urban environments results in varying responses by different bird species. However, many bird species' population trends are not actively studied, resulting in a poor understanding of bird persistence in urban areas at the species level. Lacking such data reduces the efficacy of conservation and management interventions. We conducted Bayesian List Length Analyses on long-running citizen science survey databases to examine spatial and temporal changes in bird species prevalence in Australia's four most populous urban regions. This provided insights into the changing prevalence of hundreds of Australian bird species over time across these regions. We found that a small group of native urban exploiters were experiencing increases across cities, while many other species, including some iconic native species and introduced species, experienced declines. For many species, their response varied by urban region, highlighting the complexity of species responses to urbanization and the need for continued monitoring to inform urban biodiversity conservation.

Urbanisation and urban heat island effects on bird communities in urban parks of an Australian coastal city

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The retention of habitat within urban parks is one tool for conserving fauna in urban areas, providing refuge from the urban matrix. However, poor park design, landscape densification and urban heat island effects may degrade these park refuges. To assess the value of urban parks for birds, we surveyed 18 urban parks in an Australian coastal city to model patterns in bird species composition, abundance and community traits. Significant differences were found between parks, responding to a loss of woody vegetation cover in the landscape and reflecting an urban densification and urban heat island effect gradient. Within urban landscape types, including built-up, urban/open, and treed, species composition and abundance diverged from forest dependent foragers to assemblages of species rich, aquatic foraging and large bodied birds in response to increasing park and landscape waterbody cover and associated afternoon park cooling intensity. Trait analysis revealed that forest dependent species abundance increased with landscape woody vegetation cover. This study highlights key factors that need to be addressed in urban planning to improve bird community conservation. First, forest dependent bird species need to be supported through the retention and/or reintroduction of trees and shrubs within urban landscapes for habitat provision and urban heat island effect mitigation. Second, waterbodies may assist with improving park cooling intensity and thereby mitigating urban heat island effects on birds. We conclude that improving our understanding of the urban landscape ecology and urban heat island effects will assist with fauna conservation in urban areas.

Biodiversity sensitive urban design for birds

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Cities are critical places for biodiversity in general as well as for native birds, and are host to a wide range of species and guilds. Yet cities are human environments that are highly modified and present unique challenges and barriers to bird communities. Some species are well adapted to urban environments and thrive with little intervention; but others are more sensitive to the pressures of cities, and require a little help to survive here. Biodiversity sensitive urban design draws on a range of top-down and bottom-up approaches to create urban environments that support native species. It does so by reducing known threats to native species and providing the resources that they need to survive and thrive within the built environment. To achieve this requires engagement from urban ecologists, planners, designers and developers and residents, and a reconceptualisation of governance for conservation in cities. Drawing on case studies and examples from Australia and internationally, this presentation will explore the regulatory context for biodiversity sensitive urban design, and highlight what it might look like for Australian birds.

Big picture thinking: Managing urban bird communities at the landscape-scale

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Urbanisation transforms environments and produces complex, heterogeneous mosaics of different land-uses, including industrial land, residential neighbourhoods, green spaces and riparian corridors. This process alters habitat and resource availability for fauna, often on large spatial scales. It is therefore beneficial to consider the responses of fauna on a similar scale to better inform conservation management. A landscape-scale approach involves the pooling of data collected across multiple sites, transects, or patches, to represent a 'whole landscape'. This approach is well suited to birds, as individuals often move between different sites and land-use types; and is also spatially relevant for urban planners and local governments. This presentation reports on empirical research conducted in residential landscapes in Melbourne, Australia, to demonstrate the utility of a landscape-scale approach for managing urban birds. Our study design, which incorporated 30 landscapes (each 100 ha) selected to represent gradients of housing cover (from 9-39%) and canopy tree cover (13-63%), enabled identification of the attributes of residential neighbourhoods, and the surrounding region, that most strongly influence the richness and composition of avian communities. Housing cover had a strong negative influence on species richness, whereas the extent of native vegetation surrounding a landscape had a strong positive influence on forest birds. Additional landscape properties, such as canopy tree cover and origin (native or exotic), are also important predictors of community composition. A landscape-scale approach can offer insights into wildlife-friendly urban design and improve conservation outcomes in cities.

Planning for avian commuters: using ecological connectivity in urban bird conservation

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Protecting our urban birds becomes ever more important as urban expansion and intensification continues to reduce habitat resources across Australia. But planning actions that support biodiversity in towns and cities can become complicated, with limited funds and space available. Birds need to move around the landscape, but cities are a complex matrix of fragmented habitat, non-habitat and barriers to movement. Ecological connectivity theory is increasingly being recognised as a method to measure potential animal movement across urban landscapes, helping to prioritise where new resources should be placed, and existing habitat protected. We can use our understanding of urban bird movement and behaviour to identify areas within urban landscapes for targeted action, making it easier for species to find the things they need and helping to maintain resilient populations. Here we will demonstrate how visualising ecological connectivity can inform urban planning and biodiversity management decisions, helping planners and developers to include birds and other urban species in their thinking. We will also highlight some of the key knowledge gaps - places where researchers and community scientists can work together to make sure spatial planning for urban birds is as accurate as possible.

The garden path to conservation

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Birdlife Australia's Backyard Birds program has, for 25 years, worked to connect people with the birds that they can encounter on a daily basis. The ethos is that by fostering a love of birds (no matter how commonplace), we can motivate behaviour change individual action to support biodiversity, and social revaluing of nature, especially in our towns and cities. This session will discuss some of the engagement and citizen science initiatives we have designed to make nature accessible to a broad cohort of stakeholders, and importantly, to encourage individuals to create habitat in their own backyards. We will also share some of the social and structural barriers and successes we have encountered throughout the course of our program, as an opportunity for others looking to boost environmental engagement to build off these experiences.

Bird utilization of the vertical space and its implications for urban conservation planning

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In an increasingly urbanised world, it is crucial to understand how species interact with modified landscapes. Environments modified for high density living are characterized by tall anthropogenic structures and airborne vehicles. These obstructions can alter the available vertical habitat space and hence, impact species that rely on the vertical partitioning of resources. Nonetheless, landscape studies typically use 2D variables as proxies for 3D processes. To address this gap, I conducted bird surveys at three different types of urban environment within Brisbane City and recorded which activities species performed at different heights. I then used LiDAR data to map the vertical habitat space within Brisbane City and investigate how the extent and connectivity of vertical habitat structures varies throughout the city by applying the Circuitscape software to my individualised species models. So far, I have found that urban species interact with their environment at heights that reflect the heights of the surrounding structures. I have also identified links between traits that allow certain species to utilise these structures where others cannot. Although I did find that different species were vertically isolated from different source patches moving through an urban landscape, I also identified the many limitations associated with capturing data on species activity in the vertical realm and then trying to apply this in an all-encompassing model. Increasing our knowledge on how species utilise available vertical space will allow decision makers to determine what specific habitat features can help improve urban biodiversity.

City-wide species modelling using vegetation complexity for holistic management and biodiversity conservation

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Urban greenspaces are often managed in isolation. However, it is important to consider how a city-wide patchwork of greenspaces impacts biodiversity to ensure holistic management. Broad assumptions often guide management practices, such as that increased biodiversity is better in any given park. However, different birds require different features, and thus no park can possibly accommodate every species. Vegetation complexity is one such variable driving species presence; different species require different complexities. Therefore, vegetation complexity can be used to predict species composition in a greenspace. I investigate the influence of vegetation complexity on bird species composition within urban greenspaces in Brisbane, Australia. Using citizen science (eBird) data, I model the abundance of a range of bird species in many urban parks across Brisbane, and use this to calculate predicted diversity and abundance of each species for any park, even those without existing occurrence records. This methodology can be applied to many cities globally. Citizen science is the next frontier in biodiversity conservation research. Using this data to predict species composition constitutes a novel methodology that will optimise intra-park and city-wide management for biodiversity conservation. This innovative method to characterise bird populations across an entire city even with patchy or non-existent survey data will provide meaningful insight at a both macro (city-wide) and meso (greenspace) scales. This will lead to more efficient management of greenspaces to effectively support biodiversity conservation outcomes.

Remote telemetry in avian conservation

Global migratory connectivity in the ocean: a bird's eye view

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Advancements in animal tracking technology are enabling far greater data collection on migration patterns than ever before. These data continue to broaden our understanding of the connectivity generated by migratory marine species - the critical habitats they depend on throughout their life cycles, and the pathways between them. During these migrations, individuals traveling through national waters (i.e., within Exclusive Economic Zones) and areas beyond national jurisdiction (ABNJ) may encounter a variety of stressors, from predation and adverse weather to human impacts, including habitat destruction, direct and incidental fishing mortality, ship strikes, noise, and pollutants. In the Migratory Connectivity in the Ocean project (MiCO.eco), we reviewed migration routes from over 1200 articles on more than 100 marine migratory species, 43 of them birds, and now combine this information into digestible, synthetic data products. In this talk I will explore insights gained on connectivity between regions and jurisdictions for key avian species, as well as the implications for policy, including how migratory connectivity can fit into marine spatial planning.

Trials and tribulations of tracking in translocations: Ground Parrots and grasswrens

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In conservation translocations, being able to follow animals post-release is critical for monitoring survival and movements in the short-term, as part of evaluating short-term success criteria. This is particularly the case for cryptic species such as Ground Parrots and grasswrens, which are difficult to relocate. Here we present case-studies relating to the radio-tracking of these taxa in Western Australia. In tracking translocated Western Ground Parrots, we needed to address the trade-off between locating individuals that dispersed up to tens of kilometres versus getting accurate fixes to determine habitat usage and social behaviour. For heavier birds, which can support heavier transmitters than smaller individuals, we deployed both a satellite and a radio transmitter on the same bird. This is useful in habitat that is difficult to access, as it allows the bird's location to be estimated remotely, prior to directing subsequent searches either by drone or on foot, using VHF signals. Most translocated Western Grasswrens on Dirk Hartog Island fitted with small, light-weight VHF transmitters were successfully monitored for up to 27 days, albeit limited by small battery size required due to the light weight of the birds. Tracking has been supported by the use of a passive tracking tower array and a light aircraft. However, use of these small transmitters has been accompanied by some problems, such as antennas becoming separated from the transmitters, and significant instability in transmitting frequency with ambient temperature. Success has required identification and utilisation of multiple, relatively new, technologies, which are constantly changing.

GPS tracking reveals habitat use for Black-fronted Terns and Banded Dotterels at drylands breeding sites in inland New Zealand

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Black-fronted terns (*Chlidonias albostriatus*, Nationally Endangered) and Banded Dotterels (*Charadrius bicinct*us, At Risk - Declining) breed in the braided rivers and drylands of the Mackenzie Basin in inland Canterbury, South Island, New Zealand. The Basin, traditionally a patchwork of unique dry grassland and braided river ecosystems, has undergone high levels of modification in the form of farming, a large hydro power scheme, forestry, and urban development. Breeding Black-fronted Terns and Banded Dotterels are faced with reductions in the amount and quality of their natural habitat, but it is not well understood which areas are most important for each species. Using solar-powered GPS tracking devices we tracked the movements of twenty-four Black-fronted Terns and five Banded Dotterels during the 2022/23 breeding season, in order to better understand habitat use within the Basin and inform effective conservation management of these species. To further understand the way in which Black-fronted Terns were using key areas, we carried out behavioural observations at foraging and roosting sites. We used ground-truthed satellite imagery along with pre-existing land cover data to establish habitat availability and carried out habitat selection modelling to identify patterns of habitat use. Results from this study will enable the prioritisation of conservation management actions in key locations for both species.

Radiotelemetry-based territory mapping versus trail cameras for monitoring Stewart Island kiwi/Rakiura tokoeka (*Apteryx australis australis*)

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Radiotelemetry based territory mapping is the gold standard for monitoring kiwi populations. However, it is intensive, requiring experienced personnel, expensive equipment, and substantial effort. These factors are not always available to the many community and conservation groups that monitor kiwi. Trail cameras have been recommended as a suitable method for mobile, cryptic species like kiwi that are not individually identifiable. We used results from telemetry-based territory mapping to assess the performance of camera trapping based abundance estimates for Stewart Island kiwi/Rakiura tokoeka (*Apteryx australis australis*) at four locations on Stewart Island/Rakiura. We utilised repeated presence/absence data and count data from grids of trail cameras to estimate the point abundance and detection probability of kiwi, comparing the Royle-Nichols, Binomial-mixture and Beta-binomial mixture models. Density estimates from the different statistical approaches were compared to independent estimates from the territory mapping. The Royle-Nichols model using presence/absence data from camera trapping provided density estimates that were not significantly different to those from territory mapping. This suggests that trail camera grids could be used as a more affordable and widely applicable alternative to radiotelemetry-based territory mapping to monitor kiwi populations. This was the first study to consider the use of trail cameras for population estimates of kiwi and the results were promising.

A review of devices for tracking Waders using Latham's Snipe (*Gallinago hardwickii*) as a case study

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Understanding migratory bird movement is important to make sound management decisions and undertake appropriate conservation actions. This is particularly true for mobile species like waders. Traditional methods such as leg flagging, banding, surveys and filming only record presence, and require inferences to be made about movement. Migratory birds can be particularly challenging due to their (often) small size, and the fact that they can migrate thousands of kilometres. There is a lack of comparative information about tracking devices which makes decision-making time consuming, complex and efforts are duplicated for each new research project. The Latham's Snipe project in SE Australia has enabled a range of devices to be tested as part of researching movement of Latham's Snipe (*Gallinago hardwickii*). Methods have included leg flagging, satellite tracking, light-level geolocation, VHF radiotracking, and GPS Bluetooth tracking. Selection of devices has primarily been determined by the purpose of the research and animal welfare. Other considerations have included cost, durability, reliability, data management and accessibility. The results have been very mixed. Only a small percentage of leg flags have been resighted between seasons and within seasons at only one location. Low retrieval rates of geolocators have prevented making generalisations about the limited migration data obtained. Satellite tracking has had mixed success with five partial migrations recorded, and radiotracking has been hampered at times by site access and radio interference. GPS Bluetooth devices have successfully recorded high resolution data from 18 Latham's Snipe providing useful information about local habitat use with promising results.

How new multi-track technology can revolutionise avian fieldwork

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Locating and monitoring birds is essential for research and conservation, but is particularly difficult in forested landscapes where many methods are unsuitable. VHF radio telemetry is a useful tool, but traditional equipment has limitations - especially for aerial tracking. Standard single-frequency receivers can monitor only one frequency at once. However, sequentially scanning through a list of frequencies wastes time, and if the receiver is moving you risk missing any unmonitored frequencies. There has to be a better way! Here we describe the development of new multi-track receiver technology which revolutionises conservation research, especially for aerial tracking. The receiver monitors 500 frequencies simultaneously (instead of requiring sequential scanning), and automatically determines positions without triangulation. It can track while moving, and without needing to hover and rotate, which is ideal for efficient aerial tracking. Unlike standard receivers, the system also records position data for easy spatial analysis, and comparisons over time. Tracking from the air using aircraft or Un-piloted Aerial Vehicles (UAVs, or drones) provided many advantages over traditional ground-based survey and research

techniques, and different platforms offer different benefits. As well as making fieldwork faster, safer, and more efficient, the technology doesn't require any manual input so supports fully-automated searches for simplicity and repeatability. We discuss the evolution of this technology, including comparisons with different sensors such as visual and thermal imagery for applied conservation. We present results comparing the efficiency of different tracking methods for locating different species, including cryptic nesting penguins, and forest birds following a conservation translocation.

Ornithology science and Argos satellite telemetry: A long story of migration monitoring

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Argos is the main satellite telemetry system used by the wildlife science research community, environmental agencies, NGOs, foundations, charities, parks, reserves, etc. for animal tracking and animal data collection all around the globe, to observe, to analyze, to understand large-scale migrations. Argos tracking data collected from hundreds of animal species among birds, land animals, marine animals, fishes (more than a hundred thousand animals have been tracked since the beginning of the Argos constellation in 1986) make available a high-precision mapping of migratory corridors, feeding and foraging areas, breeding, and birth areas, and the fine description of seasonal, interannual and other time-scale dependent behavioral factors. The ornithology community has been constantly and faithfully using the Argos system since the beginning, having collected (figures from 2007 to present) millions of positions from thousands of bird platforms. The talk will illustrate the Argos-tracked birds by figures, global and regional maps, and time animations. It will also introduce the future of the Argos satellite constellation with the perennial and long-term support of the 4 institutional space agencies launching the Argos satellites and the launch by the end of 2023 of the new and innovative Kineis nanosatellites constellation, fully compatible with the Argos institutional one. Kineis will offer decisive functional and technical steps: a new downlink capacity, an improved revisit time with more than 30 satellites, an improved Argos Doppler positioning, new modulation frequencies, etc.

Estimating animal locations from automated radio telemetry data: A versatile machine learning data pipeline

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Automated radio telemetry (ART) systems have rapidly progressed in recent decades, in part due to their ability to collect high-temporal resolution animal movement data in remote environments. ART systems have been applied to study various fauna species, particularly when satellite-based tracking methods are limited by factors such as animal size or ecological considerations. Unlike satellite-based methods, ART systems do not directly receive the transmitter location. Instead, animal location is estimated from the signal strength of radio pulses received among the antennas within the ART array. Mathematically modelling the relationship between transmitter location and radio signal data is complex and difficult to replicate among studies that have a diversity of ART system design, vegetation, topography and species behaviour. To address these challenges, we present an open-source, end-to-end pipeline for estimating animal locations from ART systems. Our data pipeline leverages automated machine learning, allowing ecologists to create study-specific models that estimate animal locations from raw ART data. Training data can include both simulated and species-specific tracking data. We demonstrate this data pipeline on ART data collected on the threatened Black-throated finch southern subspecies (*Poephila cincta cincta*). We use training data that were gathered through manual radio tracking of our target species and from attaching transmitters to a simulated bird. Our presentation will discuss factors affecting the accuracy of location estimates and the ability of this data pipeline to generalise among study designs.

Tracking birds

Is the movement and spatial ecology of Australia's largest owl influenced by landscape type?

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Understanding the spatial and movement ecology of any species is key in implementing effective management strategies for protection, particularly if the species is threatened and rarely encountered. It is also key, that species management is informed by detailed research to implement the most effective strategies for conservation and impact mitigation. However, caution must be given particularly if organisations manage land across their jurisdiction that experience different pressures (such as impacts from urbanisation, agricultural expansion, logging or fire), but still utilise similar strategies to manage the same species across multiple different landscapes. Implementing the same management measures despite differing land-uses and pressures may have consequential implications on protecting threatened species and habitat values at a localised scale. The Powerful Owl (*Ninox strenua*) is Australia's largest owl and a highly mobile, elusive threatened apex predator where their spatial and movement ecology may respond depending on where they occur in the urban-rural-forest landscape gradient. To understand if there are differences of similarities between landscape types, we compared the movement and spatial ecology of GPS tracked Powerful Owls caught in urban, rural, and forested areas of Victoria, Australia. Aspects investigated include home-range size and configuration, movement pathways, distances travelled and visitation frequencies. Aims of this research are to develop clearer conservation management and impact mitigation strategies that are specific to the underlying land-uses in a region that will also enhance conservation outcomes nationally for this threatened species.

Temporal and spatial insights into parrot behaviours: combining accelerometry with GPS devices

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Accelerometers are an energy-efficient technology that may be used independently or with telemetry devices to provide abundant temporally-rich data. When used alone, accelerometers yield valuable insights into fine-scale behaviours and can be used to approximate energy expenditure. In combination with telemetry devices such as GPS loggers, identified behaviours can be localised, which can be used to address a range of ecological and conservation management concerns. In this study we attached GPS devices equipped with accelerometers to Kākā *(Nestor meridionalis)*, a species of large-brained parrot reintroduced to Orokonui Ecosanctuary in New Zealand. By applying hidden Markov models (HMMs) to the accelerometry data, we easily identified an active state as well as a resting state, which we considered to approximate sleep. Notably, each Kākā consistently averaged 8 hours of sleep within every 24-hour period, regardless of the day length. Additionally, nesting behaviour was clearly identifiable. When combined with GPS locations, we observed that Kākā resting locations were not consistently revisited, and nesting locations were identified for breeding individuals. The methods that we apply are broadly applicable to many species and study systems and may be particularly useful to further understand the behaviours of migratory species.

Using satellite products to identify key habitat resources for threatened birds

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Patterns in vegetation productivity and structure can help us to understand where, when and why threatened bird species occur in particular landscapes. However, these habitat elements can be time-consuming and difficult to measure across multiple sites and broad extents. Suitable satellite imagery products are now freely available, allowing comparison of the amount and distribution of woody vegetation and ground cover through time and space. We will discuss the strengths and limitations of these products, and how they can be applied to understanding the habitat processes important to threatened bird populations, using the example of the endangered Night Parrot (*Pezoporus occidentalis*). This highly cryptic species requires high quality feeding resources in proximity to suitable roosting habitat. To identify feeding resources, we used fieldwork, repeat digital photography and satellite imagery to measure the response rates of different vegetation communities in the arid zone. These

datasets allow us to identify higher productivity patches that are critically important food resources but are too small or change too rapidly to be mapped by current landscape-scale vegetation categorisation. While satellite imagery analysis will not replace detailed ground observations, these products can help researchers to target their effort more effectively.

GPS backpacks for cryptic curlews aids reintroduction effort, but what to do when equipment is lost? Ask a dog!

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GPS technology is a powerful tool to improve monitoring and therefore adaptive management in conservation translocations. A project to reintroduce bush stone-curlews (*Burhinus grallarius*; warabin or mulyara in Ngunnawal language) to the ACT commenced in 2014. Bush stone-curlews have declined across their southern distribution, where they are now rare and threatened. Initially, VHF tracking was used, but limitations in number of fixes (both per day and number of days) made it difficult to determine fates of reintroduced animals, let alone ask detailed questions about their spatial behaviour and habitat use. In this talk, I discuss how switching from VHF to GPS tracking not only helped us overcome major limitations in reintroduction monitoring, but opened the door to a whole new world of research potential. However, one of the drawbacks of GPS tracking is the expense of the equipment. Ideally, devices can be redeployed, but this requires retrieval of the equipment, which is often easier said than done. I trained a conservation detection dog to aid retrievals of lost GPS units in challenging field conditions. In this talk, I will also discuss lessons from training and field deployment of a detection dog for this niche challenge.

Twenty years of Black Cockatoo breeding monitoring: Where do we go from here?

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Long-term monitoring projects are essential to monitor population changes and inform conservation actions such as revegetation, predator control and habitat protection for threatened species. In addition, data derived from these projects can assist in updating recovery plans and developing new guidelines for conservation management. Birdlife's Carnaby's Black Cockatoo breeding program has, for the last 20 years, surveyed tree hollows to record breeding activity for this endangered species endemic to Western Australia. The program has produced significant outputs: providing advice on on-ground conservation actions, identifying sites where management is necessary, and estimating breeding numbers at key breeding sites. But can we do more? In this presentation, we outline the future of our program and discuss how we aim to improve our research and monitoring of the species. We suggest that utilizing remote sensing, in combination with an adjustment in our monitoring survey design, could answer other key questions on breeding habitat. Analysing this additional data on the factors which make a successful breeding area, will enable us to develop a comprehensive habitat suitability model identifying likely breeding areas across Southwest Western Australia. This would be instrumental in addressing current gaps in recovery plans, updating referral guidelines, and assisting in the implementation of more accurate environmental assessments. We argue that the information derived from these outputs will help us and our stakeholders to make better informed decisions at the landscape level for the recovery of the species. areas now traveling large distances to find food. With eradications of invasive small mammals planned for several other sub-Antarctic islands, including Auckland, Gough, Marion, Amsterdam Islands, our work informs how future eradications can impact the movements and foraging landscape of top-order predators.

Behaviour recognition facilitates the research of movement ecology through the combination of telemetry, AI and citizen sciences

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Statistical results of behaviour recognition is one of the most important data clusters for the research of movement ecology. Data collecting by field observation of researchers or volunteers is time consuming, discontinuous, and lack of standards. For decades, the classic telemetry technology has been contributing to ornithological research by providing valuable information about locations and environment situations like temperature, humidity, or light intensity. As a comparatively new player in this industry, Druid would like to contribute by adding a new dimension of data: animal behaviours recognition along the way. Debut series telemetries can output continuous ODBA (overall dynamic body

acceleration) data, which reveals activity rhyme and energy consumption of animal. Furthermore, we developed a series of tools that enable the researchers to do finer behaviour modelling based on the raw data, includes an App for real-time data labeling, gateways, data platform, and onboard algorithms. By presenting the long-term continuous behaviour monitoring results validated in our recent publications based on such tools and methodology, our work aims to share a package of tools we have designed to facilitate data collection, behaviour modelling, and furthermore, with the behaviour models in hand, how we enable the trackers to output continuous behaviour recognition results, which offers the new dimension of data with huge potential to bring considerable insight to diverse research projects.

GPS-tracking reveals migration patterns of Tasmanian Morepork (*Ninox leucopsis*)

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Anthropogenic disturbances, such as habitat loss, infrastructure development, and light pollution, pose threats to migratory birds along their fly ways. Detailed knowledge of migratory pathways can therefore be crucial to inform mitigation measures that seek to address such threats. Many bird species migrate seasonally between Tasmania and mainland Australia by crossing Bass Strait. Among these, one poorly understood putative migrant is the Tasmanian Morepork (*Ninox leucopsis*). Speculation regarding the possible winter migration of this species to Victoria began in the 1960s, when reports of mainland Ninox owls displaying Morepork-like characteristics were first circulated. More recently, this has culminated in the citizen science-led discovery of putative Tasmanian Moreporks apparently staging at a key Victorian headland prior to southward migration. No formal study of this has been undertaken, with migratory behaviour being inferred only, albeit with relatively high confidence. Leveraging these citizen science discoveries, here, we describe the first-ever recorded migration tracks of the Tasmanian Morepork demonstrating definitively that the species is a Bass Strait migrant. Using GPS-tracking, our findings include detailed information about flight route, length and duration, staging behaviour, and habitat occupancy post-migration that allows consideration of the possible drivers of migration in this species. Furthermore, we pair migration tracks with molecular screening to identify source populations of migratory individuals. Our findings allow us to characterize current and novel threats to migratory owls during overwater crossings of Bass Strait. This includes collision risks associated with light pollution and infrastructure such as offshore wind farms.

Seabirds

28 years studying tākoketai/black petrel (*Procellaria parkinsoni*) on Aotea/Great Barrier Island: Lessons learned and knowledge gaps

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The Tākoketai/Black Petrel (*Procellaria parkinsoni*) population on Aotea/Great Barrier Island, Hauraki Gulf, New Zealand has been intensively monitored for 28 years. Recognised as the seabird species at the greatest risk from commercial fishing activity within New Zealand waters, understanding the population status and trend of this species is important. Significant data on a range of population parameters including adult survival, breeding status and success, and behaviour has been collected over the past 28 years. However, despite over 5,000 chicks being banded during this period, juvenile survival and recruitment into the population has been difficult to quantify. Current return rates of juveniles to the Hirakimata/Mt Hobson colony are less than 8%. Understanding the factors affecting return rates of chicks is vital. It is important to determine whether it is related to low juvenile survival or if it is simply due to a lack of detection. Understanding juvenile survival and recruitment is also necessary for accurate population estimates and risk assessment modelling and filling this knowledge gap is critical. Tracking has been undertaken to determine whether different age classes and sex forage in different areas or migrate via different routes, which may result in differing risk profiles. In addition to fisheries, climate events and plastics have increased the risk to this seabird species and their habitat, both in New Zealand when breeding and abroad while overwintering. Focused study on these impacts is needed to determine levels of risk and identify much needed mitigation options.

Foraging behaviour and habitat use during chick rearing in the Australian endemic Black-faced Cormorant (*Phalacrocorax fuscescens*)

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Despite its wide distribution, relatively little is known of the foraging ecology and habitat use of the Black-faced Cormorant (*Phalacrocorax fuscescens*), an Australian endemic. Such information is urgently required in view of the rapid oceanic warming of south-eastern Australia, the stronghold of the species. The present study used a combination of GPS loggers and dive recorders, as well as opportunistically collected regurgitates to investigate diet, diving behaviour and habitat-use of black-faced cormorants during the chick rearing period on Notch Island. Observed prey species were almost exclusively benthic, which is consistent with the predominantly benthic diving behaviour. Males foraged at deeper depths than females, presumably due to a greater physiological diving capacity derived from their larger size. This difference in dive depths was associated with strong sexual segregation of foraging locations, with females frequenting shallower areas closer to the coastline. These findings have strong implications for the management of the species, as impacts of environmental changes on a part of the foraging range might disproportionally impact a single sex and, thereby, reproductive success.

Calling them home: reintroduction of threatened seabirds to former colony sites on Lord Howe Island

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While Lord Howe Island has been beset by invasive rodents for more than 100 years, a range of species of seabirds have been able to continually breed here. An eradication program to remove this pervasive threat was implemented in 2019. Throughout this period, two threatened seabirds have been excluded from the extensive habitat that the main island represents. Burrowing and cavity-nesting White-bellied Storm-petrels *Fregetta grallaria* and surface-nesting Kermadec Petrels *Pterodroma neglecta* have persisted on the outer islands (including the distant Balls Pyramid). An opportunity exists to accelerate their return to the main island through the use of social attraction and provision of artificial habitat. Safeguarding breeding at existing regional colonies is also a priority in the hope they will provide recruits. We used diaries of an early 20th century egg collector to scope out the previous habitat locations for both species on the main island. Sound attraction, a common method to encourage seabirds to new breeding locations, is being used to attempt to attract birds to these areas. We have also increased potential habitat with introduction of artificial habitat. Several designs of novel Storm-petrel burrows were utilised but the introduction of artificial habitat for the surface-nesting Kermadec petrel, having been trialed in a colony on Phillip Island off Norfolk, is a world-first. This paper covers lessons learnt in the establishment of these seabird attraction sites.

Probabilistic bioregion models suggest seabird assemblages are linked to the major boundary current off eastern Australia

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Identifying seabird assemblages is an essential step in understanding how species' distributions relate to their environment. To date, no large-scale assessment of seabird assemblages has been attempted for Australia. In particular, the East Australia Current (EAC) exhibits broad environmental gradients, in which a diverse range of seabird assemblages could be expected. This study examines data from at-sea seabird surveys undertaken by the Australasian Seabird Group (ASG) between 2016 and 2021 on 15 voyages, spanning ~37° of latitude. Seabird records were aggregated by season in 1° latitude x 1° longitude grids. Oceanographic and physiographic variables used to model environmental spaces (sea surface temperature and salinity, eddy kinetic energy, bathymetry, slope and 8-day averaged chlorophyll-a concentration) were extracted for each record and averaged within the same grid/season. Presence-absence and abundance mixture models ('Region of Common Profiles') were then specified for each season to describe seabird assemblages. In total, 142,646 individuals were recorded from 80 seabird species from 11 families. Models consistently suggested two assemblages across seasons: a 'northern' assemblage comprised mainly of boobies, frigatebirds and wedge-tailed shearwaters, and a 'southern' assemblage dominated by albatrosses and prions. The geographical boundary between assemblages clearly matches the region where the EAC detaches from the Australian coast, turning into its eastern extension/eddy-spawning area (~32°S). Given the EAC is predicted to strengthen and warm, the

described assemblages could be used to track environmental changes in space and time, particularly by monitoring the transition zone between the two assemblages.

Niche partitioning of nesting habitat in congeneric, morphologically similar seabirds that nest in mixed colonies

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Multispecies nesting colonies face interspecific competition for nesting habitat. On Christmas Island, Great Frigatebirds and Christmas Island Frigatebirds nest within mixed colonies, with complete overlap in nesting distribution that extends to shared nest trees. Niche partitioning theory predicts that, to minimise interspecific competition and persist in mixed colonies, these two species should display partitioning in nest-site selection. Here we determine whether these two congeneric, morphologically similar seabird species that appear to utilise the same nesting habitat display niche partitioning at fine-scale resolutions that have not previously been explored. We produced UAV-derived orthomosaics and digital surface models of a subsection of canopy within a mixed breeding colony of Christmas Island and Great Frigatebirds. During desktop analysis, all frigatebird nests were tagged, and nest attributes extracted. Christmas Island Frigatebirds nested at a significantly lower height within trees than Great Frigatebirds. Christmas Island Frigatebirds also selected trees that were significantly shorter, at a lower altitude, and with canopies of a smaller area (from birds-eye view). Christmas Island Frigatebird nests also occurred in canopies with lower frigatebird nest density and were less likely to locate their nests in emergent trees. We demonstrate hitherto unreported niche partitioning between the two species, both in terms of nest-site location within singular canopies, and canopy selection across the colony. While multiple species may appear to be using the same resources, examining fine-scale resource use can reveal niche partitioning, supporting the theory that similar, co-existing species will display niche partitioning that serves to minimise competition.

Community-driven conservation - Creating safe havens for seabirds and shorebirds in Taranaki, New Zealand

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An aspirational community-driven, regional-wide seabird and shorebird restoration project is in the initial stages in Taranaki, New Zealand. In 2020 through a community marine forum, Wild for Taranaki (a regional biodiversity trust), determined that there was significant interest in protecting sites for seabirds and shorebirds in the region. Wild for Taranaki concluded that support was needed to further build on existing activity in the region and contracted Wildlife Management International Ltd. to scope the way forward. This community-driven approach to creating a network of restoration sites and bird-minded people is enabling the project to be responsive to the needs of the groups involved. Some key focus areas that have been identified by initial discussions include the need for education in bird identification and data recording. Additionally, exploration of historical and current distributions of seabird and shorebird species, and advocacy programmes to share the importance of these species was clarified. Finally, hands-on actions such as predator trapping and replanting natives to protect sites of interest were highlighted. Outcomes of this project will be measured in traditional bird terms, such as nest counts, fledging success, and increased sightings; but also in social terms, measuring the project's ability to provide effective support to voluntary and professional groups alike. Using community aspirations as its driver, this highly collaborative project aims to guide and support the establishment of safe havens for seabirds and shorebirds initially over a ten-year period.

Is climate change a cause for the population decline of Gould's Petrel in Australia?

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Gould's Petrel (*Pterodroma leucoptera leucoptera*) is a threatened species predominantly breeding on Cabbage Tree Island, New South Wales, Australia. Conservation efforts initiated in 1996 have resulted in a significant population increase here, with downgrading conservation status from Endangered to Vulnerable in NSW. However, the population has shown a concerning decline in recent years, coupled with suboptimal breeding success. In contrast, the southernmost breeding colony on Barunguba-Montague Island has experienced population growth and higher breeding success. To investigate potential factors driving these trends, we compared body condition index of adult Gould's Petrels between the two

populations. We also examined breeding success and fledgling production, and fitted geolocators to track at-sea movements. Cabbage Tree Island breeders are known to forage in the Tasman Sea close to the south-east coast of Australia during the breeding season, while their non-breeding foraging grounds extend to the middle of the Pacific Ocean. Although the core foraging areas of Barunguba-Montague Island breeders are yet to be determined, assuming similar foraging patterns, our results suggest that Cabbage Tree Island birds may experience greater depletion due to longer foraging distances during the breeding season, compared to birds breeding further south on Barunguba-Montague Island. Southerly shifts in prey species, driven by increasing sea surface temperatures, may exacerbate this. This research will provide critical information to guide conservation strategies and protect foraging habitats for this threatened species.

Procellariform flight heights and offshore wind farms, insights from new and old studies

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Offshore wind farms (OWFs) are coming to Australasia, with construction of many projects planned in the next decade. Procellariform OWF impacts are uncertain as few have been studied in the OWF epicentre of northern Europe. However, the major impact of turbine collision risk can be ruled if seabirds are shown to fly below turbine rotor height. Here we address this issue with two projects. Firstly, a review of the sizeable procellariform literature using an OWF lens to glean what we already know about flight heights, but may have overlooked. Secondly, deployment of biologging devices to measure flight heights representative over different environmental conditions and behaviours. Procellariiform literature was found to contain an abundance of flight height information, particularly from older at-sea survey studies, with good coverage of different families. Biologging of Shy Albatross *Thalassarche cauta* revealed a flight height profile consistent with current knowledge. Both projects highlighted procellariform dynamic soaring, which sees higher flight heights at higher windspeeds, as an important uncertainty in data collected by fair-weather OWF surveys. Project results are being made accessible (e.g., formatted to plug into collision risk models) to industry to provide reference flight height profiles, to which site-specific data collected by OWF projects can be compared.

Life in plastic, it's not fantastic: A sensory ecology approach to plastic ingestion

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Sensory ecology is the study of an animal's perception of their environment through stimuli processed by their sensory systems. Seabirds possess highly developed sensory organs adapted to their exceptional lifestyle, behaviour, and environment. Highly developed sensory systems may increase seabirds' vulnerability to threats associated with sensory aspects such as plastic ingestion. However, all plastic research relies on human perception of plastics, even though seabird and human senses are drastically different. In my research I investigated plastic ingestion through a seabird's perspective. Although seabird families share many characteristics, individual differences such as feeding behaviour exhibit variation. Albatrosses (Family Diomedeidae) feed on the water's surface, gannets (Family Sulidae) employ plunge dives, and shags (Family Phalacrocoracidae) feed through pursuit beneath the water. In my research, I used morphological measurements of skeletal and sensory structures and found visual and olfactory differences between albatross, gannet, and shag species. I also conducted a multispecies survey of seabird carcasses and guano to investigate if the sensory differences of albatrosses, gannets and shags led to differences in plastic ingestion rates in Aotearoa. The survey found very low incidences of macroplastics in albatross, gannet, and shag species, suggesting documentation techniques such as ad hoc observations and low diversity in study species may be skewing our perception of actual plastic ingestion occurrences. Faecal microplastic colour and type varied between species, suggesting differences due to foraging and nesting locations. Importantly, despite being of great interest, seabird plastic ingestion is greatly understudied.

Routine operation of Remotely Piloted Aircraft Systems in areas with high densities of flying seabirds

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Remotely Piloted Aircraft Systems (RPAS), or drones have had a rapid uptake for scientific applications and are proving particularly valuable for data collection in the natural world. The potential for bird strike presents as a real hazard in these settings. Whilst animal welfare is a primary consideration when planning and executing RPAS operations, the safe operation and return of RPAS is the key to successful flight missions. Here, we asked if RPAS can be routinely and safely implemented to meet data collection requirements in airspaces with high densities of flying birds. We flew quadcopters over breeding seabird colonies in tropical island settings. A dedicated spotter adjacent to the pilot collected data on bird interactions with the RPAS unit whilst aerial population surveys were being undertaken. Over 600 interactions were recorded for nine species of seabird. We flew a large number of flights in airspace routinely occupied by considerable aggregations of seabirds over more than 2,100 minutes without a single collision. We demonstrate there is high capacity to undertake safe and successful RPAS operations in air spaces that may otherwise be crowded by flying seabirds. Whilst bird collisions remain possible, such outcomes are clearly rare and should be placed in context with routine disturbance of ground surveys for the same purpose. RPAS still regularly present as the least invasive method for collecting ecological data when compared with traditional field methods and can be undertaken with relatively low risk to the successful completion of the operation.

Inter-colony and inter-individual differences in the foraging ecology of Pacific Gulls

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The Pacific gull (*Larus pacificus*) is a widespread Australian endemic yet very little is known of its foraging ecology. Using GPS tracking and stable isotope analyses, the movements and trophic-niche of chick-rearing individuals were investigated at two colonies in northern Bass Strait, south-eastern Australia: Seal Island (SI); and Kanowna Island (KI). These colonies host approximately 150 and 60 breeding pairs, respectively. While in relatively close proximity (~40 km), the two sites offer different ecological opportunities with SI located approximately 25 km from Corner Inlet, a large shallow tidal embayment, and KI hosting a large Australian fur seal breeding colony. The foraging trip movements (approx. 400 trips from 30 individuals) revealed inter-colony and inter-individual variation. Birds at SI largely foraged east of Corner Inlet, with opportunistically observed regurgitates comprised exclusively of benthic species. In contrast, KI individuals foraged along the adjacent mainland coastline and around the island, with regurgitates indicating a more varied diet of seal placenta, seabird chicks, eggs and Antechinus. Interestingly, individuals from both colonies foraged in both marine and terrestrial ecosystems, frequenting farmlands, refuse sites and freshwater bodies up to 25 km inland. Stable isotope analyses revealed Î´13C and Î´15N values were higher at KI than SI, suggesting differences in trophic-niche relative to ecological setting. In addition, at both sites, individuals displayed high behavioural consistency (flight paths and foraging locations) suggestive of individual foraging specialisation in the species. The results of the present study provide important new insights into this widely distributed but little studied species.

Local to global: Conserving the Vanuatu Petrel (*Pterodroma occulta*) as a representative tropical Pacific Ocean gadfly petrel

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Tropical Gadfly Petrels (*Pterodroma/Pseudobulweria* spp.) are a critically understudied bird group requiring urgent conservation action. Their pelagic foraging range, island colonies, and low populations make them challenging subjects. Hence, despite exposure to range-wide threats, information is sparse about their conservation needs. This is especially true in the southwest Pacific Ocean, where most research has focused on species descriptions rather than ecology or threat profiles. The Vanuatu Petrel (*Pterodroma occulta*) is endemic to Vanua Lava, Vanuatu, and is representative of the threats faced by other petrels in the southwest Pacific. Here, we present the first research on the Vanuatu Petrel in over a decade, with a conservation focus encompassing population estimates, colony mapping, pelagic distribution, threat assessment, and taxonomy. Our research approaches will be developed

into a transferable pipeline for other species to help address the knowledge gap for endangered and understudied gadfly petrels in the south-west Pacific.

Decline of Antarctic seabirds in a warming climate

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Antarctic species are increasingly affected by contemporary climate change, and there is an urgent need to understand how species will respond. Past climatic oscillations have shaped current population distributions and genetic diversity. Understanding how species have responded to major historical climate perturbations may provide insights into species' future responses. Here we used 114 genomes of eight Antarctic breeding seabird species with varying habits and life histories to investigate the population trends relative to paleohistorical climates. We demonstrated that seabird population demographies are closely associated with cold climates and prey availability. Flight was crucial in the success of flying seabirds presumably as they were able to exploit available resources more readily than penguins. We predict that due to anthropogenic climate change Antarctic avian species populations are likely to decline to levels observed during the Mid-Pliocene warm period when global temperatures were up to 3°C warmer than present.

Birds and transportation activities

How is the bird strike risk managed at one of Australia's largest airports?

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How is the bird strike risk managed at one of Australia's largest airports? Tom Ashover from Brisbane Airport shares the science behind it. BNE has a 285-hectare biodiversity zone adjacent to its runways and sits on the shores of Moreton Bay which is home to a large migratory bird population. Proactive mitigation measures, such as habitat management, data analysis and stakeholder engagement, will be discussed.

Birds pre-adapted to a road in a heterogeneous and contiguous old growth forest

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Roads are present globally across all habitats and their negative impacts on the landscape are being increasingly reported. Yet often more is known about the identity of roadkill than how avian assemblages are impacted by roads. This study used 100 paired point counts by the road and 400 metres into the forest interior to assess if the assemblages were different and determine what species may be impacted by the road. The study was undertaken along a highway cut through one of the world's tallest forests, old-growth Karri *Eucalyptus diversicolor* forest, of South Western Australia. There was no overall significant difference in species richness and abundance between road and forest interior sites, although a small number of species (4.3%) did demonstrate preferences. Overall, we suggest that the limited significant differences resulted from: (1) the narrowness of the road with the forest canopy frequently extended fully across and (2) the natural variegation found in eucalypt forests, which has aided the birds as a pre-adaptation to the presence of this road, because eucalypt forests are a heterogeneous array of gaps due to rocky outcrops, mosaic patterns from fires, streams and rivers, and natural forest heterogeneity, which include different forest types.

Bird species richness and abundance in suburban areas where drone home delivery services operate

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A study was conducted in suburban areas of northern Canberra to measure bird species richness and abundance in areas where drone home delivery services operate. A test group of four suburbs with drone deliveries was compared to a control group of four suburbs. The control suburbs were selected to be as similar to the test suburbs in particular in terms of age of suburb and vegetation cover. Other variables were controlled for, where possible, including observer, weather, season, time of day and survey route. Transect surveys started at a point close to the centre of a suburb and a transect route was selected to be as representative of the built environment of the suburb as possible, especially avoiding adjacent parklands. Transect methodology followed standard monitoring practices. The study lasted 12 months from November 2021. Surveys were conducted once a month and where possible all surveys were completed on the same day. Suburbs were surveyed in a randomised pattern. Four experienced bird surveyors conducted all transects in all suburbs once a month. Surveyors' times of transect and suburbs were rotated on a randomised pattern. Wing, an independent Alphabet company, commenced a pilot program of drone home delivery of take-out food in the Canberra suburb of Bonython in 2017. The program was expanded to suburbs in northern Canberra in 2019. In this study, there was no statistically significant difference found between the abundance of birds or richness bird species present in suburbs with drone deliveries and those without.

A new experimental framework to improve our understanding of road impacts on birdlife

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Linear Transport Infrastructure (LTI) can have significant impacts on wildlife and landscape processes. Previous reviews have provided initial insights into LTI impacts on birdlife but were conducted before road ecology experiments were fully developed. Four factors that were identified to affect birds near roads are habitat quality, species-specific traits, traffic noise, and infrastructure. While early studies identified traffic noise as the primary selective force, recent research has shown that habitat quality and infrastructure play more significant roles. However, this research has limitations in terms of inconsistent data collection, inadequate management of confounding variables, and limited inclusion of vehicle-free environments. Additionally, the use of methodologies susceptible to bias and short-term experimental timeframes limits the inferential strength of this literature. To address these limitations, a new experimental framework is proposed to better evaluate the impact of roads on birdlife. The proposed framework aims to construct species and/or community profiles that will aid in the design, construction, and management of transport networks.

Safeguarding airports against bird strikes by managing birds off airport

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In civil aviation, 93% of bird strikes occur at or below 3500 feet AGL, meaning that birds occupying areas in the vicinity of airports are contributing to this risk. Bird populations near airports use a variety of land types (natural or anthropogenic) in a variety of ways (breeding, foraging, etc.). Bird strike management is based on risk, so each land use requires an understanding of the specific context of that location in relation to surrounding habitat features that cause birds to use the airspace that could be co-occupied in space and time with aircraft. The risk presented by a land use may not only relate to the airspace above the land use, but also to the interaction of it as a habitat feature with other habitat features in the landscape, potentially causing birds to intersect aircraft flightpaths. A land use may also contribute to the productivity of bird populations by, for instance, providing an unnatural supply of food resulting in a spillover effect with larger regional populations further increasing the probability of strikes. Key to managing bird strike risk is integrating bird hazard management into planning policies and frameworks around airports that define acceptable versus unacceptable practice and establish performance outcomes and acceptable solutions to guide land users on how to appropriately manage bird hazards. This can have positive implications for bird conservation in urban areas whereby populations are monitored and their potential conflict with aircraft is managed. Of particular benefit are those birds at conservation risk.

Birds on Country: Indigenous knowledge and conservation of birds

Nyarima First Nations bird names and stories

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The Nyarima.com.au pilot web page concept arose out of a program teaching traditional burning, which involved re-connecting with and understanding Country (land, flora and fauna), including bird life cycles as they are our great seasonal barometers. We found many of the common (western) names used by mob did not match the ornithological common names or the names were for birds that did not inhabit their custodial land. Some names were hybrids and completely unfound in literature, and some published First Nation bird lists contained many errors. This meant the name and knowledge could not be mapped to a scientific name. We decided to do something about it. Our objectives were to respect our First Nations culture and thousands of years of observation which may/has provided insights to science, help slow oral history knowledge loss associated with dispossession and intergenerational trauma and also aid reconciliation by supporting renaming birds. Nyarima contains systems designed by and for First Nations people, enabling discovery of bird names and their stories. Currently only providing work around interactive functionality for one language group, we plan to add more languages and birds and:

- Create/expand the interactive Gambay language and overlayed bird distribution maps
- Create search functionality that delivers lists of bird names/stories for languages or a selected bird
- Countrywide mapped interactive pop-up bird songlines/stories.

We have learnt about consultation processes, lessons in developing web tools, how to engage mob in birding and conservation, as well as how to change common bird names to First Nations names. We have also gained insights into bird behaviour in the stories and possible future links to science.

Creative engagement with Black Cockatoos: Exploring the ethics of fieldwork through the Beeyali Project on Kabi Kabi Country

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The Beeyali research project explores new methods for visualising the calls of wildlife on Kabi Kabi Country, the traditional lands and waters of the Sunshine Coast in Queensland, Australia. Beginning in 2021, it focuses on Black Cockatoos in large-scale aviaries of a Sunshine Coast bird rescue sanctuary. Black Cockatoos are currently facing a range of threats, including the impacts of climate change and habitat loss from bushfires, draughts and urban development, which has resulted in select species of Black Cockatoos being classified as Vulnerable. The opportunity to observe and record Black Cockatoos both in captivity and in the wild through this research allowed the team to study the natural movements and rhythm of the birds in close proximities, observe their personalities and develop relationships with the cockatoos. Black Cockatoos feature heavily in First Nations song, dance and visual arts in the Sunshine Coast region and have been an inspiration for internationally recognised Indigenous artist Lyndon Davis for over a decade. Davis paints traditional patterns referencing flora and fauna from the Sunshine Coast and was particularly interested in exploring how the visual representation of wildlife calls correlated with geometric patterns associated with Indigenous designs, to demonstrate ecological interconnection. Working in collaboration with sound artist Dr. Leah Barclay and photographer Dr Tricia King, Davis conceived Beeyali to sound an alarm for the multitude of vulnerable species on the brink of extinction in Australia. This project brings together Indigenous knowledge, environmental research, emerging technology, photography and sound to visualise wildlife calls using cymatics, the science of visualising acoustic energy or sound.

Aboriginal peoples and birds in Australia. Historical and cultural relationships

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Australia is home to many distinctive species of birds, and Aboriginal people have developed close alliances with them over the millennia of their custodianship of this country. As an anthropologist who studies Indigenous use and perception of the environment, I am interested in the broad physical, historical and cultural relationships that Aboriginal people have had with the Australian avifauna. My presentation aims to raise awareness of the alternative bodies of ornithological knowledge that reside outside of western science. It will describe the role of birds as totemic ancestors and spirit beings, and explores Aboriginal bird nomenclature, foraging techniques and the use of avian materials to make food, medicine and artefacts. Through a historical perspective, I examine the gaps between knowledge systems of Indigenous peoples and western science, with the aim of encouraging greater collaboration and acknowledgment in the future. The material for this presentation is derived from my recent book of the same title, published by CSIRO Publishing.

Preserving island biodiversity through invasive species and cultural land management practices

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Bruny Island in lutruwita, Tasmania, is a very significant area to our mob and tribes. We are connected to Bruny Island via land and sea. The Island has many cultural sites, such as rock quarries, ochre sites, petroglyphs, cultural shells, living sites, and midden sites. Murrayfield is a sheep farm on Bruny Island and is run by the local Aboriginal Corporation. It is fundamental to the learning of cultural knowledge by everyone. Being able to visit these sites and learn cultural ways of our elders on Bruny Island and Murrayfield has been a life changing experience for the better. The invasive species of plants and animals, particularly cats, are altering this ecosystem. I have learnt this through my work on Bruny Island in trying to lessen the number of cats that continue to feed on the penguins, Swift Parrots, shearwaters, and native mammals on Bruny Island, and invade the habitats of the Eastern Quolls. The South-East Tasmania Aboriginal Corporation (SETAC) with support from NRM South and many other project partners are working towards protecting the unique ecological and cultural significance of Bruny Island. Efforts are focusing on invasive species management (cat control) and reinstating cultural land management practices, such as cultural burns.

Traditional Ecological Knowledge and practices associated with the *Paradisaea raggiana* along the Kokoda Track in Central Province, Papua New Guinea

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Traditional Ecological Knowledge (TEK) is lost due to the increase of urbanization, and the lack of transfer of this knowledge to younger generations. The aim of this study was to examine the TEK of the Indigenous Koiari People of Central Province, Papua New Guinea (PNG), concerning the Raggiana bird-of -paradise (BOP) (*Paradisaea raggiana*), the national bird of PNG. Forty-eight interviews were conducted with respondents aged from 17 to 83 years of age, from the villages of Ioribaiwa, Agulogo, Manari, and Efogi, along the Kokoda Track. We collected information on the birds' language name, habitat, abundance, and conservation status. Results showed that there was high linguistic diversity in names used for birds-of-paradise. The common generic name for 'bird' is Ugu, and for the *P. raggiana* it is Vanate. Ten species of BOPs were reported by respondents to occur in the area. Respondents identified lowland wet and lower montane wet forests as habitats for *P. raggiana*. In terms of conservation status most locals (52%) said the *P. raggiana* was hunted opportunistically. Most respondents (40%) stated that the *P. raggiana* was increasing in abundance due to a reduction in disturbance, and less hunting. Our results show that action is needed to document and present TEK in Koiari, Central Province to preserve biodiversity and support conservation outcomes for at risk species; an approach that would likely be productive in other parts of PNG.

The Elusive Gooniyandi Grasswren

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Gooniyandi Country is located towards the center of the Kimberley region of WA. The landscape has a variety of deserts, flood plains, billabongs, hills and mountain ranges. Gooniyandi country is surrounded by the Bandaral'ngarri (Fitzroy River) catchment, a river system hundreds of kilometers long. In the 1990s, an image of an unknown grasswren species was taken by an amateur birder on Gooniyandi Country. The site this image was taken at is approximately 200km from the nearest know grasswren (Black Grasswren) population. Since 2022, Gooniyandi Rangers have conducted over 70 call playback surveys to locate the unidentified grasswren. Along with partners, Rangers have developed and distributed posters to spread awareness amongst locals to detect this bird and gather information on sightings. Rangers have also been deploying song meters to detect grasswren calls and have been learning about grasswren habitat from ornithological experts. Even though considerable effort has been put to find this elusive bird there is still large areas of suitable habitat that has not been surveyed. The rise of feral cats poses a growing danger to Gooniyandi's native creatures, notably birds. To safeguard not only our potential new species but also other vulnerable ones, like Nyarlgoo (Greater Bilby), Gooniyandi Rangers are actively exploring and implementing feral cat management. The Gooniyandi Rangers are determined to continue efforts to locate the unidentified grasswren and will continue to conduct good land management practices, such as right way fire and feral animal management to ensure that the area thought to house this bird is conserved.

Using two-way science to expand the knowledge of night parrots and improve threatened species management on Ngururrpa Indigenous Protected Area

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Ngururrpa Rangers have been at the forefront of the search for night parrots in Western Australia since their ranger program started in 2020. Working closely with partners and surrounding ranger groups, Ngururrpa Rangers have placed 68 acoustic recorders in the field over the past 3 years and continue to have an active surveying regime. Traditional knowledge about food, water and nesting resources is used to identify good night parrot habitat across the IPA which is then surveyed by listening for calls around dawn and dusk and setting out acoustic recorders to search for active sites. Rangers have successfully identified 11 active night parrot sites including 5 roosting sites across the IPA making it the largest known population in Australia. Traditional knowledge is also being used to manage threatened species sites across the IPA for fire and feral cats. Aerial and ground burning operations are conducted each year to break up heavy fuels and protect areas of night parrot habitat. Starting in 2023, Thylation Felixer machines were deployed at night parrot roosting sites with evidence of successful nesting to target cat control at sites with juveniles, which are the most susceptible to predation. Rangers will compile data on night parrot activity, fire management and predator numbers to expand the knowledge on night parrots in Western Australia. The success of the program is in large part due to on-country opportunities to share knowledge about night parrot research and management, especially among Indigenous ranger groups, and strong relationships with partner organisations.

Colonial Wetland Birds

Where are Africa's heronries? The role and challenges of citizen science in the HeronryMAP:Africa project

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Colonial breeding waterbirds are spread across eight bird families: Laridae, Anhingidae, Phalacrocoracidae, Ardeidae, Phoenicopteridae, Threskiornithidae, Pelecanidae and Ciconidae. Due to their conspicuous behaviour and often socio-economic and ecological impacts, most taxa have been well studied. In Africa, information on the status and distribution of breeding colonies (heronries) covering the Anhingidae, Ardeidae, Threskiornithidae and Phalacrocoracidae is severely lacking which results in a gap in the knowledge of how important these sites are in terms of location and productivity.

HeronryMAP:Africa is a citizen science initiative that aims to address this gap through the systematic collection of long-term data where colonial breeding sites occur, their species composition, nest abundance and site tenureship. Results are presented from 2013-2021, and challenges identified and discussed regarding data mobilization and sustainability. Assessment of priority sites, human-wildlife impacts and identification of conservation action for colonies under threat are discussed and highlighted.

Tracking breeding of colonial waterbirds in the Macquarie Marshes - implications for water management

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The Macquarie Marshes are a semi-permanent inland wetland system in western New South Wales, with 9,850ha Ramsar-listed. It is one of the more important sites in Australia for the breeding of colonial waterbirds. We investigated relationships between flows, inundation, and number of breeding pairs of seven wading bird species (straw-necked ibis *Threskiornis spinicollis*, Australian white ibis *Threskiornis mollucca*, glossy ibis *Plegadis falcinellus*, rufous night herons *Nycticorax caledonicus*, intermediate egrets *Ardea intermedia*, great egrets *Ardea alba* and little black cormorants *Phalacrocorax sulcirostris*) over a period 36 years (1986-2022). We used data which estimate numbers of breeding pairs within colonies from ground surveys and more recently from orthomosaics of drone images. There were significant positive effects of flooding on waterbird breeding. We discuss the long-term challenges of data acquisition and use of comparative data and differences among species and different colony sites. Further, there are significant implications for the management of environmental flows. About a third of regulated river water (334GL, when dams are full, adaptive environmental water) is available in the Macquarie River for environmental flows. This project will provide valuable insight into what drives waterbird breeding within the Macquarie Marshes on a spatial, temporal and species level, which is essential for ensuring the future success of waterbird breeding events and the health of the Macquarie Marshes.

The Murray-Darling Basin Flyway

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Waterbirds are highly mobile, with individuals of many species flying long distances of hundreds to thousands of km over short and long periods. Understanding these movements is key to effective management of waterbird populations, particularly when rates of wetland loss are increasing due to increasing water abstraction, floodplain development and long-term drying. Australian inland environments naturally experience large, often unpredictable weather amplitudes. This has led to a relatively high variability in individuals of Australian waterbird species having mixed movement strategies among individuals; some individuals migrate while others remain sedentary (partial migration). However, substantially more data on the dynamics such movements is needed to inform management. Satellite tracking of waterbird movements has recently identified a 'common route' in southeastern Australia, used by different waterbird species in multiple years. This 'Murray-Darling Basin Flyway' follows the western boundary of the Great Dividing Range, which forms the eastern boundary of the Murray-Darling Basin. The Flyway connects several important waterbird-breeding sites that are the focus of environmental watering actions which support waterbird populations and their habitats. It is possible that the Great Dividing Range is a low-permeability barrier to the movement of waterbirds from inland parts of the Murray-Darling Basin toward the southeastern coast of New South Wales and the northeastern coast of Victoria. The existence of this common movement route with a potential movement barrier provides important knowledge for water and wetland management efforts for Australia's wide-ranging waterbirds.

Waterbird recruitment beyond the MDB: a review of contributions from more remote regions

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Although the Murray Darling Basin has vital breeding habitat for Australia's continental waterbirds,

including primary sites for several species, recruitment for the majority also occurs in more remote regions. A review of remote wetland systems, mainly available intermittently though some seasonally, identifies extensive habitat from the north-west through the Barkly Tableland and Channel Country to the Great Divide, as well as northern floodplain wetlands in which half of Australia's waterbird species breed. Species such as Freckled Duck, Blue-billed Duck, Great Crested Grebe, Glossy Ibis and/or Australian Painted-snipe, once thought to breed principally in the south, breed also at widespread, more remote wetlands. These regions also support the largest-known or most regularly operating colonies of pelican and some of the herons and cormorants. However, the remoteness and limited accessibility of remote wetlands and unpredictable availability have contributed to only spasmodic surveys and thus a poor knowledge base. In the face of growing pressures from expansion of irrigated agriculture, extractive industries, weed infestation and uncertainties from global warming—as well as scarcity of protected area status—it is timely to consider how contemporary data could be effectively obtained to support wise management of these habitats.

Changes in the species abundance distribution of global waterbird communities over the past three decades

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Global biodiversity is under crisis in the anthroposphere, and a better understanding of global biodiversity changes and their magnitudes is needed for effective conservation. However, current global biodiversity indicators at the global scale focus largely on species abundance and richness and lack an understanding of community changes at the global scale. To fill this information gap, we use a global waterbird time-series dataset collected at more than 10,000 wetland sites since 1990 to assess temporal changes in species abundance distribution (SAD), which describes the commonness and rarity of all species within an ecological community. We found that the global waterbird community SAD became more left-skewed, i.e., the proportion of relatively rare species in each community became higher between 1990 and 2018. This trend was observed in all regions across the globe except in East Asia. We also investigated the possible mechanisms behind this SAD change and found that the SAD change is associated with a higher number of species gain, a lower proportion of increasing species and a higher proportion of declining species within each community. Our findings could be an early warning of the long-term disturbance and degradation of global wetland ecosystems.

The Birds and the Fishes: massed pelican breeding activity at Lake Brewster in the Lachlan Catchment in consecutive seasons

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From spring to autumn in both 2021-2022 (Year 1) and 2022-2023 (Year 2), Australian pelicans bred in large numbers on exposed banks within Lake Brewster in central-west New South Wales. Lake Brewster is one of the few sites in the Murray Darling Basin where pelicans breed in large numbers (more than 5,000 nests) on a semi-regular basis. Interestingly, Brewster is both a nationally significant wetland and a major water storage on the lower Lachlan River system. Hence, environmental water management to support pelican breeding is complex and innovative, and reliant upon ongoing partnerships. In Year 1 the colony numbered 30,000 and in Year 2 it numbered 25,000. During both seasons - which were preceded by wetter-than-average years - breeding and hatching of chicks commenced in spring and continued throughout summer and into autumn. In Year 1 recruitment success was compromised in late autumn by the onset of cold, wet weather and a reduction in food supplies. In Year 2, following major flooding, water levels in Lake Brewster dropped dramatically following damage to the inlet channel in summer. However, the colony persisted and management interventions (repair of damaged infrastructure) enabled the aquatic ecosystem to reset. Alien carp was (and remains) the major food source for the pelicans during both years. The breeding events at Lake Brewster are instructive regarding both the management of a regulated wetland in order to maximise pelican breeding success and the importance of introduced carp in sustaining such large colonies.

Habitat use by satellite tracked waterbirds informs wetland and water management

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Wetland habitats are essential for of waterbird populations and species diversity, key objectives of wetland conservation and management. Understanding how waterbirds use these habitats is a key knowledge gap informing local wetland management, including environment flow management. From 2016 to 2023, we used GPS satellite telemetry to track the movements of individuals of breeding species which nest in aggregations (ibis, *n* = 94; spoonbills, *n* = 51) for wetland and water management. Such species are often the focus of significant management effort, particularly at breeding sites, where changes in water regimes can result in breeding failures, and at foraging sites, where water regime changes may result in starvation. Our analyses of >1 million telemetry points explore among-individual and species variability in habitat use. These results can guide management of wetlands, such as environmental water, to improve conservation outcomes. Increased knowledge of the spatio-temporal interactions of waterbirds with their habitats over the whole life cycle is essential for increasing waterbird numbers and maintaining diversity.

Satellite tracking ibis, spoonbill and egret movements from the Murray-Darling Basin, Australia: Highlights

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Despite Australia's international and national obligations to protect waterbirds and their habitats, rates of wetland habitat loss are increasing and waterbird populations have declined, Waterbird breeding, foraging, stopover and refuge sites are managed by multiple agencies and different states involving decisions affecting water, vegetation and other pressures while bird movements do not respect borders. In the context of climate change and competition for water resources, selection and prioritisation of wetlands for water management requires information on movements, wetland use and connectivity for many waterbird species. Satellite transmitters have been deployed since October 2016 in key waterbird breeding wetland locations across the Murray-Darling Basin, focusing predominantly on species that breed in aggregations that are supported by environmental water during breeding, such as ibis, spoonbills and egrets. We use the latest technology in avian GPS tracking to monitor bird movements at local, regional and basin scales. Satellite tracking provides detailed information on the spatial and temporal scales of movements and site use, including routes, timing, and use of breeding, foraging, stopover, refugia and Ramsar sites. These data can be used to inform policy and adaptive management for water and wetlands to support waterbirds through their entire life cycles and to maintain or increase waterbird populations, explicit objectives of the Murray-Darling Basin Plan and the Environmental Watering Strategy. We present key highlights and discoveries from this work, while other presentations from the team during the conference will present detail for selected aspects.

Monitoring colonial waterbird breeding in the Gwydir Wetlands after a decade of no breeding events

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The Gwydir Wetlands is an internationally significant wetland of the Murray-Darling Basin in northern New South Wales (NSW) and a nationally important breeding site for many colonial waterbird species. During the 2021-22 water year, water for the environment was delivered at the tail-end of natural flow events in the Gwydir Wetlands which extended the inflow period and duration of inundation. This allowed breeding waterbirds to complete their nesting cycle and young birds to fledge successfully. Water for the environment is a management tool that has been applied by NSW Water Managers since 2007 to support a range of aquatic and ecological outcomes including colonial waterbird breeding. Collaborative monitoring of the 2021-22 breeding event was undertaken by DPE-EHG and NPWS (NSW), CEWO, Centre for Ecosystem Science (UNSW), UNE and 2rog Consulting. Over 28,000 ML of water for the environment supported 16 waterbird breeding colonies (approximately 45,000 nests total), comprising species such

as straw-necked ibis (*Threskiornis spinicollis*; 30,000 nests), glossy ibis (*Plegadis falcinellus*; 1,770 nests), intermediate egret (*Ardea intermedia*; 4,490 nests) and nankeen night heron (*Nycticorax caledonicus*; 3,405 nests). Such events are not only critical to sustain waterbird populations across Australia, but they deliver local benefits such as increased productivity of the system. Water for the environment delivery made a significant contribution to outcomes for colonial waterbirds in the NSW Murray-Darling Basin in 2021-22 and helped support the largest breeding event seen in the Gwydir Wetlands in the past 10 years.

Analysing the Movement and Population Dynamics of the Australian White Ibis (*Threskiornis molucca*)

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The Australian White Ibis (*Threskiornis molucca*) is a waterbird native to Australian wetlands. Human activities have disrupted the flow regimes of these wetlands, causing ibis populations to seek refuge in urban areas along the eastern coastline where resources are more abundant and consistent. Ibis are adaptable and can thrive in urban regions, although their movement petterns are not well understood. Urban breeding colonies may provide recruits for the declining inland populations. Their perception as a pest has prompted management efforts which are largely ineffective and may affect broader populations. My research aims to gain analyse the population dynamics of colonies in the Moreton Bay region to inform more sustainable management decisions. I utilised three methods: genetic analysis, citizen-science resightings, and survey resightings. Ibis were tagged and sampled for genetic analysis, and data from citizen science and systematic surveys were collected. Genetic analysis showed high heterozygosity and low inbreeding, indicating a population close to Hardy-Weinberg equilibrium as well as high connectivity and relatedness. Resighting data revealed that individuals travelled to sites other than their nesting site. The findings suggest that the population has high ecological fitness and viability. Ibis were found to travel between sites, indicating interconnectivity. We conclude that ibis in the Moreton Bay region are part of a larger, interconnected population, indicating that local management practices can have broader effects. Therefore, a broad-scale management approach is recommended to reduce human-ibis conflicts without threatening the stability of inland populations.

Edu-Action: Inspiring communities to rescue their future

Kids learn how to give a hoot!

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The Birds in Schools model provides a way to engage primary school students in bird monitoring and conservation using a place-based learning model. Students learn about the birds on their school grounds, monitor them, interpret their data and then design an action plan to implement. At Mount Tamborine Public School, BirdLife Australia's Powerful Owl Project has built on this core Birds in Schools project. Using the Powerful Owl as a focal point, we have delivered a range of educational activities, including field trips, workshops, and classroom lessons, all organised to engage students on topics related to bird conservation and environmental stewardship. Key themes included the significance of science and the importance of citizen scientists, ecology, and conserving/restoring habitats. Students actively participated in tree planting to restore disturbed areas between remnant eucalypt vegetation and riparian zones. Students also learned about mitigating threats to Powerful Owls and other wildlife, explored strategies for protecting natural habitats, while facilitating urban expansion, and gained hands-on experience in bird surveying methodologies. Acoustic monitoring devices and AI were introduced, allowing students to deploy monitoring devices and collect data on Powerful Owls and other species in their yards and neighbourhoods. This session will showcase how the project integrated technology and hands-on experiences to nurture the next generation of environmental advocates, serving as a model for using education to inspire action and promote environmental stewardship.

Australian Migratory Shorebird Program: Monitoring and Site Action Planning of important habitat

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In Australia, protecting important habitat for migratory shorebirds is a key conservation goal defined by the Environment Protection and Biodiversity Conservation Act 1999. The Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species (2016) provided the basis for a systematic identification of nationally and internationally important shorebird habitat. The list of identified shorebird areas around the country has been published in the Directory of Important Habitat for Migratory Shorebirds (2020). However, identification of important habitat is a crucial first step to improve conservation outcomes for migratory shorebirds and knowledge of the current state of the sites must be applied for improved site management. The Australian Migratory Shorebird Program has tackled the challenge of mobilising communities to participate in monitoring and Site Action Planning of these significant sites. These targeted activities at local sites inform management to reduce threats for overwintering birds and facilitates Australia's obligations under multiple laws and agreements on national and international scales. So far, twenty Site Action Plans for internationally and nationally significant shorebird areas in South Australia, Victoria, and New South Wales have been finalised. The plans have been produced in collaboration with a wide range of stakeholders and communities, such as local land managers, indigenous groups, and environmental organisations. Site Action Planning is relatively new, continuously being refined using the feedback received, and is becoming a significant tool to facilitate change. Our long-term goal is to see the development and implementation of Site Action Plans for as many important migratory shorebird areas as possible across Australia.

Wing Threads: Flight Around Oz

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In 2022/23, I flew a microlight aircraft around Australia to engage mid-primary students with the amazing stories of migratory shorebirds. On the way I visited over 100 schools and reached over 7000 students to present on shorebirds and the importance of protecting our wetland ecosystems. This presentation reviews the impact of Wing Threads based on post-STEM incursion feedback surveys from teachers. These results highlight the efficacy of storytelling in community engagement initiatives and show how adventure can be a powerful way to capture an audience outside of the usual birding and scientific communities.

Overwintering Project: A case study in using art as a tool to engage communities in conservation

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Engaging broad audiences with conservation issues is a constant challenge. Designing that engagement so that audiences not only learn about issues, but care about them, is an even greater challenge. Information campaigns and community science projects fulfil this function to a certain degree, but using art to engage audiences can be a powerful addition to the awareness-raising toolkit, and a way to touch hearts and minds. The ongoing Overwintering Project: Mapping Sanctuary was launched in 2017 as an art-based project designed to engage communities with, specifically, migratory shorebirds and migratory shorebird habitat. Art can introduce scientific concepts in ways that cross cultural and age barriers. Using a broad range of events, such as workshops, site visits, exhibitions, talks, school incursions and festivals, I have found it possible to engage audiences of all ages and many different backgrounds with the main challenges facing this group of birds. In this presentation, I will discuss the broad shape of the Project, which is designed so that anyone can join, and focus on specific examples of ways to engage children and young people.

Trials and strategies for engagement and participation in Beach-nesting Bird conservation

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The struggle faced by Australia's beach-nesting birds is one of the best examples of a human-wildlife conflict. These highly camouflaged birds attempt to breed in habitats heavily impacted by human recreation. Their unique behaviours make them highly susceptible to human disturbance. As these boundaries between the needs of wildlife and the recreational use of their habitats conflict, education and public awareness play an increasingly important role in biodiversity conservation. For wildlife inhabiting high human interface environments, the only way to reduce the loss of biodiversity is to gain collaboration and cooperation of individuals, organisations, and key stakeholders to act on the drivers for its loss. BirdLife Australia's Beach-nesting Bird Project has invested 17 years in developing and implementing a broad reaching education program to increase awareness of the plight of the birds by recreational beach users. Throughout that time, we have established and trialled new and novel methods for targeting a wider audience, including aiming education towards the next generation. Our education programs aim to provide connections with the local environment, an understanding of the anthropogenic threats that face beach-nesting birds and it specifically focuses on encouraging behaviour change that will aid in the conservation of a coastal flagship species.

Shout the science from the streets: maximising our strengths in conservation campaigning

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Science can change the world, and in conservation that is a clear goal. However, even the best science doesn't inherently inform political decision makers. Similarly, the point of advocacy is to effect lasting change, for which conservation advocates must be informed by the best science! BirdLife Australia prides itself on being a science-led organisation, including in our advocacy. By supporting our advocates with easy-to-understand, evocative, and scientifically informed messages, we can maximise political pressure on decision makers, societal awareness of conservation science, and better outcomes for birds, their habitat, and people alike. Hear how BirdLife Australia combines science, innovative online tactics: and community organising tactics, to inform our advocacy strategies. We will focus on two case studies, 1) how we utilised scientific data from the Action Plan for Australian Birds 2020 and empowered Australian voters with electorate-specific information about threatened bird taxa in the lead up to the 2022 election; and 2) how we assisted thousands of Australians to submit direct, ecologically-informed public comments to protect Ramsar-listed wetlands in Moreton Bay from destruction. By harnessing the strengths of both science and advocacy, we can shift the focus of governments, politics, and wider society towards conservation outcomes that last.

Gaga for Gang-gangs: Empowering communities through the Gang-gang Cockatoo Edu-Action Project

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The Gang-gang Cockatoo Edu-Action project is an inspiring initiative engaging communities in the conservation of the Gang-gang Cockatoo. Using an e-learning framework, the project uses innovative strategies, educational activities, and collaborative efforts that empower the community in environmental action and fosters a sense of responsibility and ownership among participants. Impressive participation rates, including more than 500 individuals across 3 iterations of the course and 18 schools, has led not only to demonstrated increases in knowledge amongst participants, but actions as well. These include the planting of more than 8,000 Gang-gang Cockatoo feed trees, bird baths and the amplification of conservation messages by participants holding their own workshops and advocacy events. Interestingly, despite existing as self-guided courses, we have seen participants making connections with each other—coordinating their actions and supporting each other's work. The Gang-gang Cockatoo Edu-Action project demonstrates the power of community involvement in conservation, showcasing successful strategies and the importance of collective efforts that grows from educating the individual.

Engaging community to protect Kangaroo Island birds and their habitats

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Half of Kangaroo Island (KI) burnt in Black Summer, with lives, homes, businesses and assets destroyed in wildfires driven by catastrophic conditions. The environmental impact was devastating to wildlife and habitats. Several birds lost more than 70% of their area of occupancy. Those with small home ranges, or adapted to short bursts of flight, may slowly decline without connected vegetation for dispersal. There were limited records on population and distribution of many KI birds from before 2020, including endemic sub-species. Nine of these unique birds are on Australia's list of threatened species following this unprecedented event, along with two South Australian sub-species where KI was a stronghold. BirdLife Australia has worked with partners since 2020, to address this data deficiency through the KI Bushfire Recovery Project. Surveys were established on public and private lands across the island including 100 pre-determined 'shared sites' accessible on Birdata. These baseline and long-term datasets will help detect changes over time to underpin conservation priorities. The project raises awareness in the community through workshops and events, sharing information about birds, habitats and threats. Lesson plans were created for teachers, and local students invited to create artwork for public display. We advocate bird conservation to residents, visitors, land managers, businesses, State and Local Government. Long-term funding is required to address knowledge gaps and develop conservation plans for KI's birds. With ongoing and cumulative threats from development, land use, habitat fragmentation, fire frequency, predation and climate change we must work together to save our threatened species.

Understanding and mitigating threats to migratory shorebirds at deteriorating habitats in the EAAF

The International Migratory Bird Agreements Database: A global survey of collaboration in migratory bird conservation

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Migratory birds depend on lengthy chains of intact habitat across multiple jurisdictions to complete their migrations. While international cooperation in the form of International Migratory Bird Agreements (IMBAs) is necessary for their sustainable exploitation and successful conservation, there remains no assessment of the extent to which IMBAs actually cover the broad geographic and taxonomic extent of migratory birds globally. In order to identify gaps in the protection of migratory birds we have assembled the International Migratory Bird Agreements Database (IMBAD) and have identified 51 unique IMBAs. The number of IMBAs tends to be higher for countries with a higher number of migratory bird species, with a higher mean governance indicator, and with a higher number of bordering countries. The level of protection is heterogeneous throughout migratory birds' families, still Vulnerable species tend to have more protection than Least Concern species. Nonetheless, more attention should be put into Critically Endangered and Endangered species. The establishment IMBAD will provide a reliable and accessible reference tool and inform migratory bird conservation efforts worldwide. In addition, the establishment of the current geographic and taxonomic coverage of IMBAs will open the table for international cooperation and negotiation of new IMBAs to overcome protection gaps outlined in this study.

Shorebirds of the Hunter and Port Stephens Estuaries: Using automated telemetry to track shorebird movement within and across estuaries

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Migratory shorebirds are amongst the world's most endangered group of bird species. Australia's estuaries provide overwintering habitat for some 2.5 million individuals each year. The Hunter and Port Stephens estuaries are two of just four in New South Wales of international significance to protecting Australia's migratory shorebirds. They are also amongst the regions that are losing multiple shorebird species the fastest nationally. Unfortunately, these estuaries have little to no history of shorebird research and critical knowledge gaps are impeding effective management. In this talk, I will explain how our team is using an array of motus automated telemetry stations to track 24/7 the movement of shorebirds

within and across estuaries. These data will be used by our government partners to guide future land management decisions and by our community partners to advocate for shorebird conservation.

Research priorities for migratory shorebird conservation in the East Asian-Australasian Flyway

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Migratory shorebird populations in the East Asian-Australasian Flyway (EAAF) have experienced widespread declines over the last three decades, driven largely by intertidal habitat loss. As a consequence, there has been a concerted effort by researchers and citizen scientists across the flyway to improve the information available for protecting and managing shorebirds. However, there are finite resources available to support these efforts, and therefore it is essential to clearly identify the highest priorities for future research to support conservation action. To help address this need, a research working group was convened in 2021 under the BirdLife Australia Migratory Shorebird Conservation Action Plan to compile an advisory report on research needs and priorities for migratory shorebirds in the EAAF. This was undertaken by conducting a threats and risk assessment of shorebird groups representing major habitat associations and life cycle stages, and using expert scoring of threats to determine those that are most widespread, severe and irreversible but have low knowledge to support mitigation actions. Candidate research questions were then collated from a variety of sources, rationalised to eliminate repetition, and then sorted and ranked according to the risk / threats scoring to determine the highest priority research questions. Highest ranked research questions were those most urgently needed to address major threats and knowledge gaps. These included threats to species migrating through coastal regions, and threats more generally from pollution and hunting, habitat loss, land use change, and climate change.

Repeated monitoring indicates consistently high disturbance of roosting shorebirds at a globally important non-breeding site in tropical Australia

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Roebuck Bay, in tropical Western Australia, is one of the most important non-breeding shorebird sites in the East Asian-Australasian Flyway. We investigated disturbance of shorebirds on roosts on the northern beaches of the bay with a repeated, standardised citizen science monitoring program over two year-long study periods, 2005-2006 and 2019-2020. The number of alarm flights made by shorebirds during high tide was high compared to studies elsewhere. Numbers of alarm flights did not differ significantly between the two study periods, but they depended strongly on the location within the bay and the time of year. Significantly more disturbance occurred during the austral winter (dry season), when shorebird numbers are relatively low but there is high visitation from both tourists and birds of prey. We also estimated the amount of time spent in alarm flights during high tide. These estimates indicate that energy costs due to disturbance exceed critical thresholds on some beaches during the dry season, consistent with previously described local movements away from the bay's northern shores at this time. The most frequent identified stimuli for disturbance flights were birds of prey (61%), people visiting the bay (20%), and aircraft (4%). The proportions of alarm flights attributed to different stimuli were highly consistent between the two time periods, but two raptor species significantly increased the rate at which they caused disturbance. We suggest measures to provide alternative roosting habitat and alter some visitor behaviours as possible courses of action to reduce the local impact of disturbance.

First attempt to evaluate the hunting pressure on shorebirds in the Russian Far East: summary of fieldwork in 2019-2022

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AMBI Work Plan initiates surveys of hunting pressure on Arctic-breeding shorebirds in the Russian North-East. These activities was started in 2019 by BirdsRussia and Working Group on Waders of Northern Eurasia. The main aim is to reveal areas of the largest hunting pressure on shorebirds first of all for priority EAAFP species. Besides, special attention is paid to Whimbrel, which is the most popular shorebird target species for legal hunting. Surveys were carried out in Kamchatka (2019), Sakhalin

(2020), Khabarovsk Krai (2021), Amur (2021) and Magadan (2022) Oblasts. Our methodology includes detailed interviews with hunters, anonymous questionnaires and direct observation of hunting with inspections of harvested birds. Results showed that in total hunters of these five regions, shoot at least 150,000 shorebirds a year, of which about 40% are Whimbrel. The highest hunting pressure has been revealed in the places of shorebird seasonal concentration in the west coast of Kamchatka, northern Sakhalin, Nikolaevskiy, Tuguro-Chumikanskiy and Okhotskiy districts (Khabarovsk Krai), Olskiy district (Magadan Oblast). The greatest pressure from hunting is experienced by populations of Whimbrel, Far Eastern Curlew, and a number of species that form local concentrations during migrations: Great Knot, Red Knot, Black-tailed Godwit, Bar-tailed Godwit. There is also a high risk of accidental shooting of Spoon-billed Sandpiper and Nordmann's Greenshank when shooting at flocks of birds. Hunters often shoot at dense flocks targeting small and medium shorebirds. This results in a large number of wounded birds that subsequently die.

Predicting and mitigating effects of sea-level rise on shorebird populations at the Western Treatment Plant, Australia

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Climate change is projected to cause sea level rise (SLR) of at least 70 cm by the end of the century. Many shorebird species obtain most of their food from the intertidal zone and will therefore be impacted. However, there is much to learn about how shorebirds will respond to SLR. In this study we explored likely impacts of SLR on the internationally significant populations of shorebirds (Red-necked Stint, Curlew and Sharp-tailed Sandpipers) that forage on the tidal flats abutting the Western Treatment Plant (WTP), Victoria. Although these tidal flats are small, they hold abundant food, and estimates of carrying capacity based on daily ration models (with coarse corrections to account for foraging interference) suggest that WTP shorebirds could tolerate some loss of tidal flat area as sea-level rises. However, SLR will also reduce the duration of exposure of tidal flats - a greater problem for shorebirds, as the rate at which they ingest prey is limited. We estimated that an area of 8 ha of tidal flat needs to be exposed for an average of 41.8% of the time to maintain current shorebird populations; at present this area of tidal flat is exposed at the WTP for 48% of the time. Provision of additional conservation ponds where shorebirds can forage at high tide is likely to be beneficial to WTP shorebirds as sea-levels rise, but we show they will still need some tidal flats, and that maintaining or improving the quality of the uppermost tidal flats is a priority.

Do things get worse with age? Bioaccumulation dynamics of per- and poly-fluoroalkyl substances (PFASs) in a long-lived, long-distant migrant

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Per- and poly-fluoroalkyl substances (PFASs) in the environment may threaten wildlife due to their environmental persistence. Their related potential to bioaccumulate, i.e. increasingly high pollution dosage with age, results in increased animal health risk. Bioaccumulation may be particularly profound in long-lived animals inhabiting high trophic niches. To date there is a paucity of data on PFAS bioaccumulation potential in individual wild birds despite an increased prevalence of PFASs in the environment. In this study, we analysed the extent of PFAS contamination in the globally declining long-distance migratory shorebird, the ruddy turnstone (*Arenaria interpres*), and the dynamics of bioaccumulation in individual turnstones by repeated sampling throughout their lives. We found that our sampled turnstones exhibited no evidence of bioaccumulation, and that overall pollution levels were low. We also found that older female birds exhibit lower levels of perfluorinated sulfonate pollution than their male counterparts, suggesting that female birds can clear PFAS pollutants from their system through egg laying. Additionally, we found that irrespective of the increased use of PFASs along the East Asian Australasian Flyway over the past two decades, Ruddy Turnstone survival remained consistent throughout our 15-year sampling period. These findings are congruent with our broader project which has found that migratory shorebirds that call Australia home during part of the year tend to have relatively low pollutant levels of PFASs, heavy metals and Persistent Organic Pollutants (POPs).

The need for a Site Manager's Network Training Program for the East Asian Australasian Flyway

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The responsibility for the management of East Asian Australasian Flyway network sites varies between the 39 EAAFP partners across 22 countries. While the focal point for each country generally nominates new flyway network sites on behalf of regional environment agencies, who employ flyway site managers. Focal points theoretically communicate the importance of the EAAFP to the flyway network site managers this line of communication varies from country partners. For example, in Australia management of flyway network sites is the responsibility of state and territory environmental agencies who employ site managers. The Australian Government plays no active role in the management or funding of flyway site management and provides no communication between the EAAF Partnership and state government, therefore site managers. Without doubt flyway network site managers influence the way sites are managed and protected. There is no quick way to determine the background or training of site managers in the conservation of migratory waterbirds or their habitats. It is proposed that a site manager training program be instigated for the EAAF along the lines of similar models used in other world flyways, e.g. the African Eurasian Flyway 'Wings Over Wetlands' training manual. At the EAAFP MOP11 Phil Straw, East Asian Australasian Flyway Liaison Officer, AWSG, proposed 'The need for A site Manager's Network Training Program for the East Asian Australasian Flyway'.

Using Birdata and eBird data to understand the distribution, abundance and changes in regional bird faunas

eBird Status and Trends: analyzing eBird data to describe avian distributions, relative abundance, and trends

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Over 1.5 billion observations have been submitted to eBird in the past 20 years, with significant growth in New Zealand since 2009 and Australia since 2014. This vast volume of data represents an opportunity to better understand bird populations within Australasia, but comes with challenges in extracting biological information, such as: accounting for interobserver variation in detection and counting, mitigating spatial bias and interpolating into gaps in space and time, and accounting for changes in the observation process that may falsely suggest changes in bird abundance over time. Addressing these challenges at scale requires significant computational and data resources. The eBird Status and Trends project makes the information from eBird data more accessible. Using state-of-the-art machine learning analyses, it produces standardized, full-annual cycle, high spatiotemporal resolution data products that describe variation in relative abundance through space for over 200 species and trends in relative abundance through time for over 50 species across Australia and New Zealand. As data volumes grow, our ability to analyse more species each year also grows, as does the potential of this information to inform monitoring, conservation, and research. This presentation will discuss how the project addresses the challenges listed above, highlight available data products, and give examples of conservation applications. We will discuss how working with regional partners to target data collection efforts and help improve the products for regional applications can increase the scope and impact of these data products in the future.

New Zealand Bird Atlas: The value of eBird and citizen science to support national bird research and conservation

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The New Zealand Bird Atlas has entered the final 12 months of the project's five-year data collection period. The Atlas community have put in more than 112,000 effort hours over the past four years to

gather and upload bird observations across the country into eBird. It is estimated that by the time the project ends, over $3 million worth of volunteer effort will have been put in by citizen scientists. As Birds New Zealand's (Ornithological Society of New Zealand) flagship citizen science project, this Atlas project aims to build on the legacy of the previous two projects to fill in a 20-year gap in national ornithological knowledge on bird distribution and relative abundance in Aotearoa, New Zealand. An update will be provided on how this project is progressing and key milestones reached. This nationally significant and scientifically valuable dataset will likely have lasting positive impacts on bird conservation and research in Aotearoa, New Zealand, at a variety of temporal and spatial scales. We wish to discuss the immense potential value of using eBird data and citizen science to understand the distribution, abundance, and changes in bird species in Aotearoa, New Zealand, and beyond.

Can well-structured bird surveying provide solutions to problems we don't even know we have?

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Standardised survey methods are best practice for scientific studies. The adoption of 20min 2ha surveys as the Birdata standard (before Birdata was Birdata) was designed to improve the standard of data, but not make it onerous on the volunteers who are vital to BirdLife Australia's mission. Whilst there are limitations to the 20min 2ha survey method, for general bird surveys they provide appropriate data to explore changes in bird communities, assuming the set-up of sites is appropriate to the questions being asked. This talk will explore two BirdLife Australia projects - Birds on Farms and Birds in Plantations. Both these projects work with industry to improve conservation outcomes for birds. Both projects use standard 20min 2ha surveys and Birdata to collect and/or store survey data. I will look at how the original aims of the projects influenced the survey design and consider how as projects have evolved if these original designs can continue to meet data requirements. Where project needs have changed, I explore how Birdata may be used to retrofit projects. Can we use pre-existing survey data in ways we hadn't considered before, improving on-ground management and conservation outcomes for our birds?

The Geelong Bird Report 1984-2020

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The Geelong Bird Report began in 1984 as a collation of verbal reports of member's bird observations at monthly Geelong Field Naturalists Club Bird Group meetings. Over the years this slowly grew from a few pages in the quarterly Geelong Naturalist until, in 1993, it became a stand-alone publication. From 1984 to 2012 the database grew from several hundred to thousands of observations annually. Records going back to 2009 were entered into eBird Australia, which is now used as a tool for collating the local dataset. This transition to eBird Australia heralded an explosion in data volume, with 300,000 records informing the 2013-2016 Geelong Bird Report, and an increasing degree of sophistication in the types of summary data such as seasonality that could be presented. This trajectory is continuing as the next edition takes shape - a breeding and non-breeding atlas of the birds of the Geelong region informed by more than 1.3 million records over 8 years from 10 LGAs! By integrating our regional bird report system into eBird Australia, we have effectively been able to capitalize on the effectiveness and popularity of the platform, with additional records from Birdata, especially shorebird and waterbird surveys, to keep track of our local bird populations.

Enhancing the Atlas of Living Australia as an aggregator of bird observations

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The Atlas of Living Australia (ALA) is the Australian node of the Global Biodiversity Informatics Facility (GBIF), an organisation that seeks to aggregate biodiversity data from multiple sources and make it available for reuse. Over 67 million of the ALA's 114 million occurrence records relate to birds (59%), and of these, 47 million records are sourced from eBird or BirdLife. Over 150 other providers supply additional records, including state government agencies; other citizen science apps and agencies such as iNaturalist, NatureMapr and Questagame; museums from across Australia; CSIRO surveys and other research groups. The ALA harmonises these datasets by converting them to a common standard, and by augmenting each record with standardised information on threatened species status, taxonomic

classification, and spatial context. This approach has been highly successful in supporting research applications in species distribution modelling, taxonomy and applied ecology; but more work remains. In 2023 we will release enhanced tools for downloading occurrences, images and sounds in R or Python; improved documentation on data cleaning workflows for research applications; and trial an updated data storage model that supports observation 'events', rather than reducing datasets to unrelated groups of occurrences. In combination, these innovations have the potential to greatly improve the quality of the insights that researchers can derive from data sourced from the ALA and its partner organisations.

Birdata or eBird, why not have both?

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With both common and rare Australian birds in decline, Australia's citizen science apps provide birders of all levels with a rare and tangible opportunity to help facilitate conservation action. However, the question that many birders are asking is, should I be using Birdata or eBird? The answer to this question is that we can and should use both! This presentation will explain the unique benefits of each platform and provide practical guidance on choosing the right tool for the right survey scenario. We will highlight how both platforms are linked and demonstrate how combining the strengths of each can significantly improve outcomes in scientific research and conservation. By harnessing the power of these tools together, we can ensure that every survey and every birder can make a valuable contribution to citizen science.

Resilient Rockwarblers: using targeted citizen science to assess fire impacts and the importance of dedicated volunteers

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Natural disasters are predicted to increase with climate change, and can have devastating consequences for wildlife populations, but in many instances impacts can be difficult to quantify unless there are adequate data before an event for comparison. For robust conclusions to be drawn pre-impact data need to cover areas that were both affected and unaffected, without knowing ahead where natural disasters will occur. Thanks to decades of contributions by many dedicated birdwatchers, databases Birdata and eBird are an invaluable resource providing widespread baseline data for many bird species. The Rockwarbler (*Origma solitaria*) is a small cinnamon-brown bird endemic to NSW. Approximately 40% of the Rockwarbler's range was burnt in 2019/20 megafires that swept across much of south-eastern Australia, but it is unclear how populations were impacted, and if they are recovering. Assessing impacts is particularly challenging for this species because it occurs in steep rocky habitat and has low detection rates. We established a network of Birdata 'shared sites' to measure impacts of the bushfires on Rockwarblers. Sites were selected that had adequate prefire data, but lacked post fire data, across burnt and unburnt habitat. Targeted surveys conducted at these sites were used to supplement Birdata records, and data were fed into a before-after control-impact model to determine if populations have declined in response to the fires. Factors affecting detectability and long-term trends are also explored.

Putting site selection in the hands of volunteers for large-scale Glossy Black-Cockatoo surveys using Birdata

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Manual allocation of volunteers to appropriate survey sites for citizen science events can be a time-consuming process for survey organisers, and restricted resourcing can constrain survey scale. Limitations of manual allocation, particularly for large-scale events, include difficulty in or inability to ground-truth survey sites for safety, accessibility, and suitability; problems meeting volunteer site preference requests; and where assigned volunteers can no longer participate, complications in ensuring important sites are still surveyed. The Great Glossy Count is a citizen science event that first took place in 2022 (run by BirdLife Australia in partnership with the Glossy Black Conservancy) across the entire distribution of South-eastern Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami*), following the extensive impact to habitat by the 2019-20 Black Summer bushfires. Over 400 citizen scientists volunteered across Queensland, New South Wales, the Australia Capital Territory, and Victoria to collect important post-bushfire information on the birds and their feed trees, with each volunteer manually allocated a survey site for the Count. Since that event, the Birdata site booking tool was developed and

trialed for a smaller Count on the Coffs Coast in New South Wales and will be used for the Great Glossy Count 2023 in September. In this presentation we discuss the Birdata site booking tool and its current benefits and limitations as a resource for survey organisers, in context of the Great Glossy Count.

Birdata/eBIRD

eBird and Merlin Bird ID

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eBird and Merlin work together to engage people in birds across all levels of expertise and interest, building capacity, gathering biodiversity information, and making data and resources available to decision-makers worldwide. Learn about the resources and opportunities provided to your work by these free tools.

Using eBird data and bird club data to review Pilotbird in the Australian Capital Territory: a case study

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Increased eBird use in the Australian Capital Territory has created the opportunity to build larger and arguably stronger datasets than earlier locally held data allowed. One such dataset was created and then used to review the status of Pilotbird (*Pycnoptilus floccosus*) in our area. eBird data was merged with nearly 40 years of data compiled by Canberra Ornithologists Group (COG). This presented challenges! The resulting review article provided interesting insights into the status of the species locally, but the insights gained from the merging of eBird data with COG data were just as interesting. An almost record-by-record comparison of both datasets had to be made, with metadata differences, duplicate records (and possible duplicates) and newly added but historical eBird records all requiring thought and action. Ultimately, all the issues were resolved and a dataset of 555 records covering the period 1986 to 2021 allowed a reasonable overview of our local Pilotbirds. This paper will expand on these themes and also put forward thoughts on the rewards and challenges eBird presents for community bird groups' data collection and data analysis activities.

Development of Bird Community Condition Metrics for the major terrestrial bird communities of Australia

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To be able to effectively measure environmental change, we need simple, easily computed metrics for tracking the health of biodiversity in restoration sites, carbon plantations, farmlands, and protected places - and an ability to scale these up to track biodiversity at regional, state, and national levels. Existing metrics that describe the condition of ecological communities primarily focus on plant communities and habitat structure. However, plant communities can be in good condition but missing key fauna, and some degraded plant communities support valuable faunal assemblages. We are developing a system to measure and track the condition of fauna communities relative to a benchmark state, starting with Australian birds. We will present a new typology of terrestrial bird communities across Australia, and preliminary condition metrics. These metrics are intended to augment the measures used in current practice (e.g., vegetation condition, presence of threatened species), providing a more holistic picture of the state and trend of entire bird communities. Our metrics will be sample-based to allow for tracking and reporting of community condition at sites and properties, and, through aggregation, at regional and national scales, thanks to extensive citizen-science datasets.

The State of Tasmanian Birds – Using Birdata to assess regional bird populations

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For the last five years, Tasmanian members of BirdLife Australia have produced an annual State of Tasmania's Birds (SoTB) Report. Our purpose was to demonstrate how Birdata contributes to the conservation of Tasmanian, birds. In 2022, SoTB adopted the methods of the Action Plan for Australian Birds 2020 (APAB 2020) to assess the status of 12 Tasmanian endemics, including the first ever estimates of their population sizes. Key achievements of SoTB included identifying trends in regional populations of the Blue-winged Parrot, Strong-billed Honeyeater and Dusky Robin, contributing to their assessment as Vulnerable in the APAB 2020. The latter two species are Tasmanian endemics. The Blue-winged Parrot was subsequently listed as Vulnerable under the EPBC Act in March 2023. Other achievements of SoTB have been a 10-fold increase in the submission of Birdata surveys, especially standardised surveys regularly repeated at sites. Participants are inspired when the usefulness of their efforts is demonstrated, not only increasing their effort, but adhering to protocols that facilitate data analyses. SoTB is an example of volunteers taking the initiative and analysing their own data in a timely and rigorous manner, unconstrained by the availability of funds, and clearly adding substantial value to conservation outcomes from their local knowledge and ownership of their data.

What do eBird data tell us?

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Over the past decade eBird has come to dominate the bird watching world with their app, eBird, and their willingness to curate the millions of observations that 'citizen scientists' are now submitting each year. Numerous authors have recognised the potential of this vast volume of data to suggest that they represent an invaluable resource for conservation and understanding. The best practice for using eBird data suggest that while this claim might hold there are several caveats that any analyst needs to recognise if they are to extract value from the data and any analysis and not be led into dark alleys. Six challenges are identified that can be associated with the eBird data and not generally found in conventional scientific data. These are taxonomic bias, spatial bias, temporal bias, spatial precision, class imbalance and variation in detectability. The best practices recommend 'solutions' for each of these challenges that range from s addressing the biases to recognition that some questions of interest may have to be addressed at very different scales from traditional site-based data. I will illustrate some of the more interesting challenges and offer some thoughts about how they might influence the inferences that can be drawn from the analysis of eBird data or how potential questions may have to be re-framed to accommodate the potential biases of eBird data.

Inferring the structure of shorebird migratory routes from eBird data

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Every year, millions of birds migrate from overwintering habitat to their breeding grounds, but migratory species are declining globally. Arresting these declines requires knowledge of the routes followed by migrants, but the relative numbers of animals moving between stopover sites is poorly understood. Tracking data provides highly detailed routes for a small number of individuals, but it is expensive to collect, and it can be difficult to extrapolate from individuals to the population level. Count data, although subject to several biases, are widely available and provide detailed information about bird observations at specific locations. Our goal is to use these count data to predict the routes birds fly between count locations. We use a discrete network model and observed eBird count data to determine the most likely migration routes using statistical modelling and efficient inference tools. Unlike previous studies, our approach accounts for noisy observations, mortality and flexible stopover durations by modelling using interacting Hidden Semi Markov Models. We designed two dedicated estimation algorithms to determine the proportion of birds moving between regions. We compared the efficiency and quality of estimation of these approaches on synthetic data and an applied case study using citizen science count data of the Far Eastern Curlew (*Numenius madagascariensis*) in the East Asian-Australasian Flyway. Our algorithms performed well on benchmark problems, with low absolute error and strong correlation between

estimated and known parameters. Our algorithms may be used to better understand migratory behaviour at the population level and inform improved conservation outcomes for migratory birds.

Tweets, chirps and trills: Using bioacoustics to unravel the mysteries of bird calls, songs and and behaviour

Lost in translocation: the impacts and restoration of lost song culture in an Critically Endangered song bird (Regent Honeyeater *Anthochaera phrygia*)

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The Regent Honeyeater (*Anthochaera phrygia*) is a Critically Endangered Australian songbird with an estimated population of fewer than 300 individuals remaining in the wild. To mediate the risk of imminent extinction in the wild, zoo breeding to bolster the wild population through reintroductions and provide an insurance against further population decline is a high priority strategy in the species' national recovery plan. However, the ongoing supplementation of the wild population with zoo-bred Regent Honeyeaters has had limited success in arresting the population decline. Regent Honeyeaters raised in captivity exhibit abnormal songs compared to their wild counterparts. Their songs are simpler, shorter and contain fewer distinct syllables, none of which overlap with the wild population. Understanding the factors affecting the success of animal reintroductions is crucial for facilitating endangered species recovery. Cultural differences between individuals from different animal populations can lead to assortative mating, whereby individuals prefer to breed within their own familiar cultural cohort. Assortative mating can hinder the assimilation of zoo-bred individuals into wild populations, so quantifying this risk becomes important for informing adaptive management strategies in conservation. Here we demonstrate the differences between wild and zoo-bred Regent Honeyeaters, experimentally show that zoo-bred females prefer the familiar but abnormal songs of zoo-bred males and show promising results of cultural restoration of wild-type song within the zoo breeding context. Our study demonstrates how small-scale experiments conducted within applied zoo-breeding settings can yield useful information to refine husbandry techniques and reduce cultural divides between wild and reintroduced populations.

Using intraspecific variation in bird song as a tool to inform conservation

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The songs of many bird species can vary both within and across individuals, and between populations. This variation has been the subject of much scientific interest, yet it has only rarely been considered in the context of conservation. Bird song is often learnt socially, meaning that the degree of variation can depend on the number and diversity of available song tutors. Song diversity can therefore reflect issues important in conservation such as population size and isolation. Here I will discuss the value of using variation in bird song to inform conservation management, using my research on the Albert's Lyrebird as a model system. Male Albert's Lyrebirds perform complex multimodal displays including their own songs and vocal mimicry of other species. I found that males varied geographically in their species-specific song and in the species they mimic and the sequential order of the mimicry. The results implied that both species-specific and mimetic song are socially transmitted, and variation in song therefore reflects cultural processes. Furthermore, the size and composition of mimetic repertoires were related to the amount of suitable habitat in each area, suggesting that the cultural diversity of some populations has been depleted by habitat loss and resulting population isolation and decline. I will discuss what these results mean for Albert's Lyrebirds, and how an understanding of song variation can be useful in population monitoring and conservation efforts. I will further discuss current gaps in our understanding of cultural conservation, and how they can be addressed.

Sex-specific song use across breeding stages in a non-duetting Australian passerine

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Peaks in birdsong during breeding compared to non-breeding are well-established, but variation in avian

singing behaviour also occurs within breeding stages. Ecologically distinct stages of nesting often require differential investment by the female and male of a cooperating pair, and therefore communicatory needs may be sex-specific and change across a nesting attempt. Comparisons of these changes may help to elucidate when song is important for female and male birds, which can facilitate future hypotheses for song functions. We examined song rates across a nesting attempt in Grey Fantails (*Rhipidura albiscapa*), breaking the nesting attempt into nine stages: nest building, egg laying, early, mid, and late incubation, early, mid, and late hatchling rearing, and fledgling rearing. We found females and males showed different patterns of song use across stages, indicating that song may serve different functions for females and males. Female song peaked during fledging, while male song peaked during nest building, but both sexes showed lowest song outputs during early hatchling rearing. In addition, we found Grey Fantail song decreased with advancing date for females, but not males, and that song rates were not affected by time of day. We found little evidence that Grey Fantails had stage-specific song types, though some song types appeared to become more or less common based on breeding stage. By comparing the timing of song rate peaks, we highlight similarities and differences in the behavioural patterns of female and male song use and contribute to our understanding of the function of female song.

Using acoustic data to resolve species boundaries in Lyrebirds, the masters of mimicry

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Birds depend on acoustic communication for mate recognition, as a display of genetic fitness and consequently mate selection. The change in bird calls over geographic ranges which lead to unique dialects has been studied in many bird species. As an examination of a living fossil taxon in Australia, this study has focused on the phylogeography and vocalisations of Lyrebirds (Menura), a genus renowned for diverse vocal repertoires. Genetic data obtained in this study have confirmed that Albert's and Superb Lyrebirds are separate species, but also identified a recent contact between them and showed that Superb Lyrebirds are separated into two populations, north and south of the Hunter Valley. Consequently, the variation in call structure across boundaries between the species and proposed sub-populations of Superb Lyrebirds' range requires investigation. No study has yet compared the call characteristics and variation between these two relict Lyrebird species native to Australia. This study will examine whether calling varies with distance from species/population boundaries, potentially indicating character displacement and reinforcement of mating barriers or alternatively, convergence and breakdown of barriers. Vocalisations have been recorded using SM3BAT song meters in national parks across the range of both species including the boundary zone. These recorders were set to record for 3 hours covering 30 min before dawn to 2.5 hours after dawn between May- July 2022 during the breeding season. Results based on manual analysis of call elements will be presented.

Audio Search for Ecoacoustic Understanding

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Bird vocalizations contain a wide range of clues about behavior and population health. But machine learning efforts have mostly focused on coarse species identification, largely due to the need for large amounts of training data required for classifiers. This data hunger has also led to difficulties when working with rare and endangered species. In recent work, we have found that we can efficiently obtain new classifiers for call-types (and much more!) using audio search over large unlabeled datasets. We will highlight our work with QUT and the Australian Acoustic Observatory, demonstrating search over the A2O's 2 million hours of passively-collected audio, and show how we can use search to rapidly develop new classifiers to produce new insights into critical populations and ecosystems. We find that these new approaches encourage the curation of small, high-quality datasets, and foreground the importance of expert ecological understanding.

New slang: Do local factors drive variation in Australasian Treecreeper song?

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Variation of acoustic signals can ultimately result in the divergence of populations, yet the mechanisms which cause these dialects to occur remain poorly understood. Australasian Treecreepers are a fascinating model species to explore these processes; they are largely sedentary, have relatively simplistic

vocal organs, and have diversified into most wooded habitats in mainland Australia. Despite this, there has yet to be a comprehensive analysis of the diversity of their vocalisations, and how these vary across their range. This study aimed to address this by exploring the within species variation of *Climacteris picumnus* and *Cormobates leucophaea* vocalisations. Acoustic recordings of songs were collected from 10 geographic locations throughout Queensland (16 sites for *C. picumnus* and 27 sites for *C. leucophaea*). Birds were caught and measured for morphological data, and site vegetation measurements were taken. Acoustic data were process in Raven Pro and analysed in
R statistical software. The results showed that for both species there was considerable variation between study locations, particularly with frequency- based metrics, however sites within locations remained remarkably similar. Both morphological (wing length, tarsus) and vegetation characteristics (shrub density, tree density) were significant predictors in a range of acoustic measurements (peak frequency, duration, and band width), the degree of which depended on the function of the call (contact or territorial). This study highlighted that both morphology and environmental constraints drive the formation of regional dialects.

Understanding Noisy Miner adaptation to novel stimuli using their vocal repertoire

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Human presence provides diverse challenges for animals, including both persecution and beneficial interactions. Animals in urban environments would benefit from recognizing and categorizing specific humans as 'good,' 'neutral,' or 'bad' based on previous experiences. Herein, we provide empirical evidence of urban-tolerant Noisy Miners (*Manorina melanocephala*) promptly recognizing and differentially responding to humans based on experimental mask colour. In the New England Region of New South Wales, Australia, we conducted experiments with three wild colonies of Noisy Miners exposed to individuals wearing different masks, and interpreted responses by assessing functionally referential signals miners produced. 'Bad' masks were worn during Noisy Miner capture, 'good' masks during supplemental food provisioning, and 'neutral' masks during non-interacting observations. Mask colour did not affect the bird's response prior to application of the treatments. Comparing pre- and post-capture responses, we found that Noisy Miners increased terrestrial alarm and distress calls in the presence of humans wearing the 'bad' mask. Responses to humans wearing the 'neutral' mask remained comparable between the beginning and end, while a high proportion of foraging social calls occurred near the 'good' mask. Noisy Miners flexibly adapt their behavioural responses to humans and transfer this knowledge to naïve colony members, indicating a high information processing capacity that promotes cooperative behaviour and species success.

Listening from inside the egg: what do external communication signals sound like in-ovo?

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Recently, there has been a surge of research into avian parent-offspring and sibling-sibling communication prior to hatching. Additionally, studies investigating effects of other sounds, such as anthropogenic noise, have identified potential impacts on bird embryos, with potential health and developmental consequences. However, whether the egg itself offers any protection from external sounds, amplifies parental signals, or potentially distorts acoustic information is unknown. We completed an experiment to test any detection differences of signals originating outside eggs by recording these sounds inside eggs (both with and without albumen) from three species. These initial tests included a frequency sweep and recorded juvenile emu hatchling 'pip' signals, as detected and processed inside emu, chicken and cassowary eggs. Specifically, since signals had to travel through multiple media (air, shell and albumen) signal amplitudes were converted to pressure signals as per microphone or hydrophone input for analyses. Signals appear overall as loud inside eggs as outside, validating the results and interpretation of much of the past and current research into embryo-directed acoustic communication.

Acoustic monitoring

Decoding complex repetoires: The importance of understanding vocal behaviour in automated detection of cryptic species

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This presentation investigates the role of vocal behaviour in the automated detection of cryptic threatened species, focusing on the Eastern Bristlebird (*Dasyornis brachypterus*), Powerful Owl (*Ninox strenua*), and Albert's Lyrebird (*Menura alberti*). Acoustic monitoring, combined with machine learning, has the potential to provide a highly efficient, non-invasive methodology for monitoring at large temporal and spatial scales. However, there are significant challenges associated with monitoring species with complex vocalisations. For example, how do you train a model to detect a species which is notorious for mimicry? By analysing extensive field recordings, we trained machine learning models to identify these species based on their vocalisations, taking their complex vocal repertoires and geographical calling variation into account. This research emphasizes the importance of understanding vocal behaviour prior to developing models for automated detection. Analysis of calling behaviour can yield more nuanced insights from automated outputs, extending beyond presence or absence to include factors such as breeding success. Ultimately, our models were significantly improved by adjusting them in response to an improved understanding of the species' calling behaviour. The improved models are currently being used successfully for large-scale monitoring.

Automated detection of Swift Parrot and Tasmanian Masked Owl vocalisations using convolutional neural networks: towards a better conservation

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Passive acoustic monitoring offers new avenues for species monitoring over large areas and extended time periods; however, manually identifying species from large acoustic files is time-consuming and expensive. Automating the recognition of vocalisations in an efficient and reliable manner provides exciting opportunities to analyse large datasets that would not otherwise be possible. In this study we present a robust automated method for detecting the Tasmanian Masked Owl (*Tyto novaehollandiae* subsp. *castanops*) and Swift Parrot (*Lathamus discolor*) from acoustic data. We independently trained two Convolutional Neural Networks, one for diurnal data (*n*_site > 20) and the other for nocturnal data (*n*_site > 30). Each dataset comprises thousands of hours of recordings collected across a wide range of vegetation types in Tasmania, in different weather conditions and times of year. The model's performance is assessed on independent real-world data from multiple locations by comparing predictions with manual identification from experts. A comparison with a commonly used acoustic identification software (Kaleidoscope Pro) shows a much higher performance including lower rates of false positives and false negatives. Our method is already providing ecological insights that are increasing our understanding of the spatial distribution, ecology and behaviour of these two species. For example, identifying the timing and prevalence of Masked Owl vocalisations, Swift Parrot nesting sites and breeding success. Our approach is already delivering conservation outcomes for these two species, and we aim to expand our approach to other threatened taxa in Tasmania.

Engaging Audiences Visually with Acoustic Data

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Communicating and contextualising the importance of soundscapes to wider audiences, and particularly the general public, can be challenging. Acoustics play an important role within natural ecosystems, allowing birds and other animals to communicate and find food. This presentation will discuss ways that visual communication can be used to engage audiences with acoustics data. The researcher has been developing a series of creative works that use ecoacoustic visualisations within immersive mixed reality environments to support and enhance the auditory experience. These works aspire to showcase the complexity of natural soundscapes to a broader audience while enhancing science communication through visualisation, a way to see acoustic information in a new, and more insightful way, blurring the line between art and science. The focus of the presentation will be on methods of visually engaging audiences with acoustic data by providing examples from the researcher's ecoacoustic visualisation

works. It will also include a full exhibit of one of the researcher's art science digital media works that uses augmented reality as a science communication tool.

Acoustic Localization - A simplified workflow

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Acoustic localisation aims to calculate the positions of calling animals by analysing the arrival times of sounds from multiple recorders. This spatial information can greatly increase the accuracy and ease of survey counts and reveal other behavioral and occupancy information about a target species. However, to date acoustic localization is still poorly resolved and leaves most of the challenging and cumbersome tasks up to the user to solve. Here we present a workflow and analysis software that aims to solve most of the cumbersome tasks associated with acoustic localisation and achieves sub-meter accuracy.

Hoo is hoo? Assessing BirdNet's automated species detection for Australian woodland birds

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We commonly use acoustic methods to monitor species or measure the general complexity of a soundscape to make inferences about biodiversity. Measuring community composition, even to describe the diversity of functional groups, is a major challenge in the application of acoustic methods. The Cornell Lab's BirdNet tool utilizes machine learning to automate the process of deriving species lists from acoustic data. BirdNet has been tested for North American and European birds, and it performs relatively well for many species. BirdNet has recently been extended to include Australian species, however, training datasets for Australian species are relatively small and the tool is yet to be thoroughly tested in its performance in Australia. Without such assessment to inform when and how it should be used, there is the risk that BirdNet will be widely applied under the assumption that the results it generates are correct. If species are recorded in locations they are actually not present in, or vice versa, this could disrupt decisions surrounding appropriate conservation management and protection measures. Through detailed, manual validation of BirdNet detections at 15 sites across two Bush Heritage reserves in Queensland, we assess the performance of this tool and recommend a detection confidence threshold to apply when monitoring woodland bird communities. Furthermore, we describe performance during different recording schedules and highlight commonly mis-identified calls to promote increased recording of these species to help build more complete training datasets.

Acoustic monitoring to understand Eastern Ground Parrot (*Pezoporus wallicus wallicus*) to inform management planning at different latitudes

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The Eastern Ground Parrot (*Pezoporus wallicus wallicus*) is listed as Vulnerable under both Queensland (Nature Conservation Act 1992) and NSW (Biodiversity Conservation Act 2016) legislation. Eastern Ground Parrots inhabit low, dense grassy heathlands and sedgelands, which are highly fragmented by clearing for agriculture and residential developments. These habitats are prone to extensive and intense fires, and fire frequency is important in ensuring available foraging resources. Both the Wide Bay Training Area and Evans Head Air Weapons Range provide large areas of quality habitat important for the conservation of the species. The aim of this project was to understand Eastern Ground Parrot habitat selection on the Defence reserves to inform management of risks to Eastern Ground Parrots and their habitat. While there can be some variation due to season and climatic conditions, Eastern Ground Parrot calling is a reliable means for monitoring the species. Traditional surveys for this species involve aural censuses, however, we used acoustic recording to collect large, standardised datasets of calling activity. We compare two analysis methods that provide measures of local abundance, at two disparate habitat areas (southeastern QLD and northeastern NSW). This is the first concurrent acoustic study of two populations of the species at different latitudes, providing us with insights in variation in temporal and spatial calling behaviour in response to prevailing environmental conditions and habitat.

Multi-year acoustic monitoring reveals novel insight into the spatial and temporal dynamics of Plains-wanderers in northern Victoria

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Effective conservation management of threatened species relies on spatially and temporally explicit data on occupancy, but on-going monitoring of cryptic, threatened species at scale is challenging. For vocally active species, passive acoustic monitoring can provide a means for simultaneous surveys at scale. Beginning in 2017, a collaborative, multi-agency acoustic monitoring program commenced for the Critically Endangered Plains-wanderer (*Pedionomus torquatus*) across the Northern Plains of Victoria. Since then, between 27 and 56 sites have been monitored in the region twice yearly, revealing consistently higher occupancy than observed from traditional spotlight nocturnal surveys. Although call activity varied seasonally and annually, a high proportion of sites (86%) were occupied at least some time during the surveyed periods, and Plains-wanderers were detected with acoustic recorders at 32 native grassland sites where they had not been seen previously. Calling was strongly associated with breeding activity; 67% of sites with calls showed evidence of breeding during on-ground surveys. Monitoring sites simultaneously was also able to reveal birds called within 'clusters' of ideal, connected habitats with less or no calling found in ideal, but isolated habitat sites. Results from the acoustic monitoring program have revealed novel insights into the population dynamics, spatial distribution, and habitat preferences of Plains-wanderers in northern Victoria, enabling more effective conservation and land management practices that can ultimately improve outcomes for the Plains-wanderer.

Building a bioacoustics dataset for research and conservation in the Australasian region

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Recent innovations in sound recording and machine learning are revolutionizing research on, and conservation of, birds across the globe. Yet significant challenges remain. In particular, training machine learning algorithms requires (1) an adequate number of recordings per species, and (2) expert annotation of those recordings. We will discuss the magnitude of these challenges, and also approaches being developed at the Cornell Lab of Ornithology to meet them. These approaches include a data cycle that broadly engages the public in collection of audio recordings and tools to facilitate annotation. Development of these approaches with partners in Australia and Asia can make bioacoustics and other powerful tools available for use in these regions, which in turn holds considerable potential for slowing or even reversing global declines in avian populations.

How to conserve birds in farmland: ecological theory in practice

Tree-cover transitions, bird communities, and forest regeneration with changes in a dairy industry

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Extensive rainforest was converted to dairy pasture in the Australian subtropics during the 1800s, when many of the formerly diverse indigenous birds declined greatly, becoming confined to scattered small forest remnants. A rebound in tree cover following dairy declines in the mid-1900s may augur potential recovery. Moreover, birds play a key ecological role driving forest regeneration and re-expansion: some 80-90% of rainforest trees depend on fruit-eating birds to disperse their seeds. Common paradigms in deforestation and restoration are: (1) habitat fragmentation theories focused on species' disappearance from small remnant patches or when forest cover is low; (2) efforts to remove non-native trees, assuming a consequent benefit to native fauna. Data from structured bird surveys across 42 sites in the Big Scrub region show that both these approaches have limited application to real world changes in bird communities. As expected, continuous rainforest sites had typical high-diversity bird communities whereas treeless pasture had one-fifth as many birds, mostly of different species. Rainforest fragments 4-20 ha had broadly similar bird communities to continuous rainforest, with more difference in the

smallest rainforest fragments (1-3 ha), which had similar bird communities to Camphor regrowth patches 2-20 ha. However, many seed-dispersing bird species were much less sensitive to these differences in habitat type, being moderately common even in isolated pasture trees. Overall (with some caveats) fragmentation effects were probably offset by high regional cover of non-native regrowth; local habitat structure could account for some apparent patch size effects; and non-native Camphor regrowth supports bird-mediated rainforest regeneration.

Change over time in the composition of bird communities along a farmland restoration gradient

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Revegetation plantings are a key activity in farmland restoration and are often assumed to support bird communities that, with time, match those in reference habitats. Restoration outcomes can vary greatly however, and so documenting success can help improve future efforts. Here, we test whether the avifauna of revegetation plantings replicate reference habitats over time. We surveyed birds in 255 sites in south-western Victoria, representing a restoration gradient of three habitats: unrestored farmland, revegetation plantings (up to 52 years old) and reference habitats. Surveys were undertaken in 2006/07 and 2019. Results showed that bird communities differed between habitats, and each was temporally dynamic. Over time, assemblages in revegetation diverged away from those in unrestored farmland and converged towards those in reference habitats. Birds associated with mature treed vegetation showed greatest change over time in revegetation. Revegetation age was the only planting attribute to influence this transition: communities in young plantings (<10 years old in 2006/07) were most likely to have converged towards those of reference habitats 12 years later. Results show that revegetation contributes to farmland restoration by: 1) supporting a richer and more diverse avifauna than farmland, 2) enhancing beta diversity, and 3) shifting bird assemblages towards those in reference habitats over time. However, findings also indicate that even after ~50 years, revegetation plantings do not replicate reference habitats in this region, and complete convergence may take centuries if at all. Thus, conservation in farmland will depend on retaining and protecting natural and semi-natural habitats as well as restoration.

Novel water policy for conserving threatened waterbirds in irrigation landscapes

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Managing water resources to enable efficient food production alongside biodiversity conservation is a key global challenge. In Australia's Murray-Darling Basin (MDB), water management is typically divided by environmental and economic interests, overlooking opportunities for land sharing and fuelling polarised debate. To improve collaboration and conservation in the irrigation landscapes of the MDB, we identify threatened species that are associated with agricultural wetlands, develop novel policy options and show how they would be implemented. Three integrated farming-conservation approaches are illustrated: 1) amalgamating environmental and irrigation water; 2) environmental water use in dedicated refuges; and 3) subsidies for specific irrigation crops and growing methods. We show how the policies can advantage threatened species, notably the Australasian bittern, Australian painted-snipe and southern bell frog, that readily use channels, storages and rice fields. A survey of 1478 Australians showed a clear majority were supportive of such policy amendments, with a multinomial logit model identifying key characteristics. Using measures of biodiversity benefits per megalitre, alongside social and economic metrics, different scenarios could be prioritised. These new incentives could address sustainability trade-offs (e.g., where saving water and maximising efficiency comes at the expense of biodiversity). Future MDB water reforms could be moderated with policies that maximise multifunctional benefits, building community trust and ownership, and offering a political conduit between conflicting interests.

Patch quality and isolation affect bird diversity and associated ecosystem services and disservices across a rotation of 3 conventional field crops

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Understanding the effects of habitat patch quality and isolation in agroecological matrices continues to be an important frontier in avian ecology and conservation. Understanding how birds utilizing agroecosystems interact with and affect those systems is key to maximizing biodiversity gains while

minimizing costs to farmers. However, most studies on the net services from birds on farms focus on a single crop within a study region, whereas most farmers utilize crop rotations (where different crops are grown in the same field across years) to minimize weeds, balance soil nutrients, and increase crop diversity. We ran exclosure experiments across a total of 78 fields in three crop types (tomatoes, alfalfa, and sunflowers) in California's Central Valley to understand the role of non-crop habitat on bird diversity, and on the net effects of birds in each crop. Field margin patch quality was positively associated with avian species richness and diversity and this effect was most pronounced for insectivorous birds. We found that birds had no significant impact on insect pests in tomatoes or sunflowers, but that birds reduced pest-insect abundance in alfalfa by 33%. Sites with higher patch quality had lower insect pest pressure, whereas more isolated sites (higher distance to natural areas) also had lower insect pest pressure. Sites with higher patch quality also did not suffer higher bird-damage to sunflowers. Our results have implications for the management of croplands globally, including in Australasia.

Back to the Farm: Relaunching Birds on Farms in Western Australia

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Historical broadscale clearing of the Western Australian (WA) Wheatbelt largely reduced remaining vegetation to isolated islands in a matrix of agricultural activity. Landholders since have had to face the ecological consequences of these practices, to combat declining rainfall, salinisation, wind erosion etc. Against this backdrop, between 1995-1997 (then) Birds Australia's Birds on Farms (BOF) program was run as a national citizen-science program using birds to monitor the revegetation efforts of landholders and Landcare groups to restore connectivity, soil health and ecosystem function. Today the region's extant eucalypt woodlands are recognised as a Critically Endangered Threatened Ecological Community. While they still provide vital habitat for Threatened flora and fauna, there are records of local extinctions. In WA, the BOF project relaunched in 2022 to connect with landholders old and new and to see how wheatbelt birds are faring. We assess the response of 15 functional bird guilds to categorical habitat classes and land-use management practices. We explore how vegetation connectivity and patch size relate to species richness and guild composition. Finally, we also assess landholder and volunteer participation and engagement in the first year of this project in WA. Birds on Farms is an opportunity to understand the status of woodland bird populations of WA's Wheatbelt. We expect these preliminary results will help direct the focus on recruiting landholders and properties to survey in the following year of the project. It will also help disclose specific habitat and farm management issues or species-specific requirements necessary to improve biodiversity in WA woodlands.

Key concepts for conserving birds in agricultural landscapes

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Agricultural lands that produce food, fibre and biofuels to sustain the human population represent the most widespread land use on Earth. Conserving global biodiversity in general, and birds specifically, will hinge, in large part, on how effectively species, communities and ecological processes are sustained in agricultural landscapes worldwide. In this presentation, we outline key concepts for the conservation of birds in agricultural landscapes, highlighting the importance of four broad landscape properties: i) total extent of suitable habitat; ii) composition (relative proportion of landscape elements) of landscapes, including heterogeneity and keystone habitats; iii) spatial configuration of elements, including fragmentation and connectivity of habitat and the 'grain' of land parcels; and iv) temporal changes that occur in agricultural landscapes. We suggest that the land sparing - land sharing paradigm provides valuable insight into the inherent trade-offs between agricultural production and conservation. In landscapes with a long history of agriculture, widespread loss of natural habitats and dominance of agricultural land means that a land-sharing approach often benefits more species. In contrast, land sparing will have the greatest value in regions with a limited history of 'settled' agriculture, or where agricultural is currently expanding into extensive natural areas and few species have experienced, or are associated with, farmland habitats. In practice, an intermediate position will likely produce the best outcomes in many regions, depending on landscape properties, context and land-use history.

Accounting for birds on farms - spatially explicit models of bird diversity and natural capital

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Agricultural lands constitute the most widespread land-use on earth. Biodiversity conservation, globally, hinges on the ability of agricultural lands to sustain species and ecological communities. Natural Capital Accounting, which involves a 'spatial inventory' of all the types of ecosystems present on a farm, has emerged as a promising tool that farmers can use to identify areas of high biodiversity value on their farm and track changes in the ecological integrity of the farm over time. This has economic implications for farmers including, for example, access to emerging 'biodiversity friendly' markets. However, uncertainties remain around how the Natural Capital on a farm, as captured in Natural Capital Accounts, relates to the diversity of birds sustained by the farm. We surveyed birds at 1158 sites on 50 farms across NSW, Victoria and Tasmania and related the bird species recorded at sites to the type and condition of natural capital at sites. We made spatially explicit models of overall bird diversity, as well as for key groups such as woodland birds. High-quality woodlands sustain the greatest bird diversity, but patch characteristics are important. Tree cover on farms is important for birds, particularly woodland birds in open ecosystems. High-resolution maps of bird diversity on farms provide a useful tool that farmers can use to identify and conserve important areas for birds and plan restoration actions.

Long-term insights for restoring woodland bird habitat on farms

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Woodland birds are an assemblage of conservation concern and the loss and degradation of woodlands across their range is their primary threat. Given the scale of the conservation challenge for woodland birds, it is essential that restoration efforts are guided by scientific evidence and that these efforts are targeted and optimised. The Sustainable Farms project has conducted bird research on farms in the heavily modified woodlands of south-eastern Australia for over 20 years. This presentation focuses on key insights from this research that relate to optimising restoration efforts for woodland birds on farms. Two of the critical landscape elements that support the persistence and recovery of woodland birds in agricultural landscapes are patches of remnant vegetation and restoration plantings. Here I will discuss the nuances of size, geometry, structure, landscape context and management of restoration plantings and their associated bird responses. I will also address the management and enhancement of remnant vegetation patches on farms. Habitat restoration is often perceived as competing with high value agricultural land uses. I will discuss the importance of restoration techniques that have co-benefits for agricultural operations.

Long-term livestock exclusion increases bird richness and abundance, and improves nesting and food resource provisioning in arid rangelands

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Herbivore exclusion is implemented globally to recover farmlands from grazing impacts, but evidence for biodiversity benefits is inconsistent in arid ecosystems. We examined the effects of livestock exclusion on native bird and plant communities of arid Georgina Gidgee (*Acacia georginae*) woodlands in central Australia. Over a three-year period including drier than normal conditions and a large rain event stimulating productivity, we conducted point counts of birds in 68 sites across one continuously grazed cattle station and two destocked conservation reserves (Ethabuka and Pilungah, managed by Bush Heritage Australia). We collected data on plant flowering and fruiting, rainfall and grazing intensity. We used structural equation modelling to examine the effects of cattle grazing on the richness and abundance of birds with different nesting and feeding resource needs. Grazing reduced vegetative groundcover, and caused declines in the provision of flowers, fruits and seeds, particularly by perennial shrubs (e.g., chenopods, Eremophila). Livestock exclusion had a positive effect on bird richness and abundance, and was of equal or greater importance than the effect of rainfall for richness of insectivores, nectarivores, ground-nesters and bird species that forage in the midstory and canopy (e.g., honeyeaters, robins). The effects of livestock exclusion were modified by rainfall for insectivores, ground-nesters, and midstory to canopy foragers - these species were more abundant in ungrazed sites during dry times, and were equally abundant in grazed and ungrazed sites during wet times. Our results indicate substantial

benefits to dryland bird diversity and abundance from excluding livestock, and indicate the importance of studies across varying environmental conditions.

The community composition of woodland birds in agricultural landscapes in south-east Australia: trends and responses to restoration over 20-years

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Birds on Farms, run by BirdLife Australia, is a citizen-science monitoring program assessing woodland bird communities in agricultural landscapes. Originally operating from 1995 - 1997, Birds on Farms was re-established in 2017. Here, we assess responses of 14 functional bird guilds to a range of habitat characteristics and land management approaches using data collected during >5000 bird surveys. We compare results between the 1995 - 1997 project and present day (2017 - 2021) for those properties represented across both survey periods. Management implications from this study, and practical steps for landholders to improve bird habitat, are discussed. We found that several habitat features (including presence of tree hollows and mistletoe) and landscape variables (including increased patch size and landscape-scale connectivity) positively influenced woodland bird presence. Remnant woodland with a restored understorey and farmhouse gardens were important habitat for many woodland bird guilds. The presence of Noisy Miners was associated with reduced woodland bird diversity. Mean abundance for 13 of 14 woodland bird guilds was significantly greater in 2017–2021 compared with 1995–1997, a trend most pronounced for understorey specialists. This increase was likely linked to restoration activities, as over 50% of the associated properties had restoration carried out between the two survey periods. Birds on Farms highlights the importance of rural properties for wildlife conservation while helping to inform best-practice habitat management for rural landholders seeking to improve biodiversity in their regions.

Investigating the effects of different cattle grazing intensities on a threatened ground-nesting bird.

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Domestic livestock grazing is the largest anthropogenic disturbance today covering >30% of the planet's terrestrial land surface and has been identified as a primary driver of habitat degradation and decline in avian populations. Bird species can have highly specific responses to livestock grazing and may respond positively, negatively, or neutrally to different grazing intensities (i.e., number of livestock per ha). Avian species that nest or feed on the ground, such as the nationally threatened southern squatter pigeon (*Geophaps scripta scripta*), tend to have a negative association with increasing grazing intensity. Yet, in some contexts, intermediate grazing intensities where plant biomass is not heavily degraded have maintained avian richness and abundance. To date though, much empirical research has focused on livestock grazed versus ungrazed sites. Here, we use a permanent camera trap array to continuously monitor avian fauna across multiple large (~20,000 ha each) sites interspersed with paddocks of low, medium, and high cattle grazing intensities in Queensland. Preliminary results show that squatter pigeon presence is highest at sites associated with intermediate to high grazing intensity. Identifying sustainable cattle grazing practices is vital if we aim to increase global agricultural food production by a further 45% to meet estimated human population demands, whilst balancing avian conservation.

On-ground action to mitigate the impacts of climate change on bird species and communities

Water Cooled Colony: Using irrigation to mitigate heat stress in nesting Northern Royal Albatross

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Northern Royal Albatross at Pukekura, New Zealand, are recent colonisers. The first breeding attempt was in 1918 but it wasn't until 1938 that the first chick fledged. The colony has grown steadily to over

250 individuals, with around 40-50 pairs breeding each year. This represents 1% of the total population of Northern Royal Albatross, with 99% of birds breeding at Rēkohu. Colonising birds are experiencing a warmer and drier climate than at Rēkohu, and the impact of climate change is further exacerbating what was already a challenge. Heat stress during nesting in the summer months alters incubation behaviour and also causes nest desertion, breeding failure and mortality. Purposeful water cooling of nesting birds began in the 1990's with a manually pumped, handheld unit. Systems have evolved over time and today, purpose-built irrigation is in place and customised annually so that each nest site has a valve and mister. Water cooling nesting birds is not as simple as turning on a tap. Rangers need to monitor and manage individual bird behaviour and the positioning, quantity and direction of water in relation to wind and topography. Many challenges have arisen over the years. Rangers have adapted systems in response and are always open to suggestions for further improvement.

Climate change and intra-group conflict over optimal group size

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Natal philopatry is a key step in the evolution of group living and cooperative societies. Understanding the decision of whether young are allowed to stay at home or not requires consideration of not only the direct, but also the indirect (inclusive) fitness benefits, which is notoriously hard to quantify due to both empirical and theoretical challenges. Furthermore, although cooperative breeding is thought to have evolved to deal with climatic variability, no studies have explored how inclusive fitness considerations of cooperation will be affected by climate change. Here we quantify the inclusive fitness decisions for individuals of different sex and social status, and how it depends on group size, using data of long-term studies of the cooperatively breeding Superb (*Malurus cyaneus*) and Red-winged Fairy-wrens (*Malurus elegans*). We show that strong intra-group conflict exists over the decision to allow young to stay: cost and benefits of group living vary among individuals of different sex and social status and is further shaped by complex relatedness patterns due to promiscuity in both species. Our study sheds light on the selective forces that allow for complex societies and suggest that these social systems are shaped by the interplay of competing incentives among group members, which is further amplified by climate change.

Modern nest box designs for a changing climate

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Hollow-dependent fauna are declining worldwide, due primarily to the widespread clearing of hollow-bearing trees. Artificial cavities such as timber and plywood boxes are commonly used to increase hollow availability, yet there is increasing evidence that they are poor facsimiles of natural cavities, characterised by lower insulative properties and a shorter field life. We evaluated whether plastic materials could create a nest box with a stable thermal profile that more closely resembles the complex shapes and textures of natural tree hollows while containing fewer mechanical joins that represent potential failure points when installed. We developed three sets of prototype nest boxes comprising various combinations of plastic density, insulation, nesting chamber and bedding, and compared their thermal performance in a temperature-controlled laboratory to compare internal temperature and relative humidity. We found the double-walled plastic nest box with an internal timber-lined chamber was best able to buffer ambient temperature fluctuation, consistently recording internal temperatures of 6+oC below maximum ambient temperature, maintaining high levels of relative humidity (76%-92%) when furnished with decomposed heartwood. This design also performed better during a simulated hot day; internal temperatures exhibiting twice the lag time of single-walled designs. While the recruitment and protection of hollow-bearing trees must be a priority, this work shows significant potential in improving the design and functionality of artificial hollows that are critical to the conservation of hollow-dependent species.

Climate-sensitive birds' use of restored habitat in the Wet Tropics uplands.

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Fourteen bird species and sub-species endemic to Queensland's Wet Tropics region have undergone significant declines and are of national conservation concern. A further eight species have declined in

abundance at mid-elevations. Climate change is implicated in all these cases. Habitat restoration on cleared land is a practical measure to expand habitat. It can assist some bird species and communities maintain populations and ecological functions. I surveyed three wildlife corridors on the Atherton Tablelands in the Wet Tropics and assessed the extent to which they provide habitat for climate-sensitive bird species. Now in their third decade, the corridors are providing habitat for a suite of rainforest-dependent bird species including most of the Wet Tropics endemics. Sixteen of the 22 climate-sensitive species and sub-species were recorded in the corridors. Some, such as the Wet Tropics Brown Gerygone, were found throughout the three corridors, while the more specialised Chowchilla was only recorded in a single site adjacent to primary forest. Fernwren were not recorded in any of the corridors. In the face of climate change, habitat restoration can help maintain species' populations and ecological functions but may not be able to assist some specialists.

Can landscape-scale exclosures help a habitat specialist through climate change?

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Climate change is predicted to disproportionately affect taxa with specialised habitat preferences. One such species is the Eyrean Grasswrens (*Amytornis goyderi*) which are considered closely associated with Sandhill Canegrass (*Zygochloa paradoxa*) in the Lake Eyre Basin. Following widespread ephemeral vegetation growth in the Strzelecki Desert after above-average rainfall in 2020-2022, Eyrean Grasswren were observed at dozens of sites in Sturt National Park, NSW, extended their known range southeast of previous records into habitat without any Sandhill Canegrass. Our fenced exclosures built for the NSW National Parks and Wildlife Service's Wild Deserts project in Sturt NP - where Grasswrens persisted for over 16 months - provide the ideal framework to determine what aspects of the species' ecology have driven this range extension into non-typical habitat, and whether it is temporary. Inside these landscape-scale exclosures, theorised threats from feral predators and overabundant herbivores are absent which may result in improved long-term vegetation cover and Grasswren persistence, even during drought. This type of management may prove a useful tool to maintain or even increase the distribution of Eyrean Grasswrens despite the threat climate change poses to specialised desert wildlife.

A database of options for climate-effective management of threatened species and protected places

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Conservation management efforts necessarily requires a shift from considering intervention and management in a static climate to one that must consider adapting to both long-term climate change and short-term extreme events and seasonal conditions. To aid climate adaptation efforts, we present decision-support tools that contribute to climate-effective conservation of threatened species and protected places in Australia. We introduce our growing database of adaptation interventions for species and ecological communities to provide managers with options for on-ground action in the face of climate change. We place the process of selecting adaptation interventions on the roadmap of a broader adaptation journey and share approaches to incorporate and consider the broader implications of implementing on-ground adaptation for biodiversity conservation. As a result of co-developing these products alongside conservation practitioners in Australia, we share practical examples demonstrating how conservation management can incorporate a climate lens using our research outputs.

Mistletoe propagation - Partnering with communities to mitigate climate change impacts on threatened woodland birds.

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Mistletoes are hemiparasitic plants that play essential ecological roles in various ecosystems worldwide, contributing to biodiversity conservation, nutrient cycling, and providing vital habitat for species such as the Critically Endangered Regent Honeyeater and Vulnerable Painted Honeyeater. The devastating 2016-2019 drought and Black Summer bushfires caused death and dieback of several mistletoe species: key resources for both birds. BirdLife Australia and project partners have been propagating mistletoe in degraded and threatened habitats within both species' ranges, aiming to restore and enhance ecological functions while mitigating climate change effects. We present results from a project site in Tomalpin

Woodlands (Hunter Valley, NSW), one of the most important wintering and breeding sites for the Regent Honeyeater. Since 2019, BirdLife Australia and Mindaribba Local Aboriginal Land Council have been restoring mistletoe to burnt woodlands on their traditional lands. These scientifically informed on-ground actions are being used in conjunction with releases of zoo-bred birds to reverse the steep decline experienced by the Regent Honeyeater in recent decades. About 4,500 mistletoe seeds have been planted since mid-2020, and monitoring is showing promising results, with the earliest surviving plants already producing fruit and nectar. A successful mistletoe propagation program not only requires a comprehensive ecological understanding of the target mistletoe species, such as host preferences and dispersal mechanisms, it also relies upon strong engagement with local communities to help drive these conservation efforts. We report on the practical challenges, successes, and learnings to date, and discuss next steps for evaluating long-term effectiveness of this novel restoration technique.

Widespread morphological adaptation to climate change in birds

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Biogeographical rules describe latitudinal gradients in morphology, which be viewed as adaptations to climate conditions. Two prominent examples of this are Bergmann's rule, describing smaller bodies in warmer conditions at low latitudes, and Allen's rule, describing larger appendages in warmer conditions at low latitudes. These spatial trends are often attributed to thermoregulatory properties, wherein a larger surface area to volume ratio (i.e., a smaller body but larger appendages) is beneficial for losing excess heat. Therefore, it is thought these spatial trends might extend temporally in response to climate change and the altered climatic conditions it causes. Some examples of morphological change in response to climate change have been identified, but few studies have tested this on a broad taxonomic scale with morphological metrics covering both body and appendage size. We measure morphology of over 5 000 bird skins in museums around Australia, to test whether climate change is driving morphological adaptation (here called 'shape-shifting'). Our dataset contains 78 species from 14 orders, covering diverse diet categories, foraging habitats, and behaviours. We find strong evidence of shape-shifting through time in bill surface area, tarsus length, and wing length, consistent with previous studies. These relationships persist regardless of diet category, foraging habitat, and thermoregulatory behaviours for bill and tarsus size, but are variable between diet category for wing length. Our results demonstrate the generality of Allen's rule-style shape-shifting responses to climate change, indicating that wild populations are facing significant pressure under current climate scenarios.

Health and disease of wild birds

High pathogenicity avian influenza: risks for Australian wild bird populations and priority preparedness actions

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In the last two years, new strains of high pathogenicity avian influenza (HPAI) have caused an unusual number of outbreaks in wild birds in the Americas, Europe, Asia and Africa, with unprecedented impacts on wildlife biodiversity and population viability. Significant mortality events have been recorded for wild bird species across a range of taxa, including raptors and seabirds, and many threatened species have been impacted. While the virus strains circulating overseas have not been detected in Australia to date, there is an increased risk of these strains being introduced compared to previous years, and consequently there is a recognised need to raise awareness and update prevention and preparedness activities. In Australia, the National Avian Influenza Wild Bird (NAIWB) Steering Group ensures national coordination of wild bird avian influenza virus surveillance activities Australia-wide and continues to consider the threat of HPAI. Wildlife Health Australia supports the NAIWB Steering Group and coordinates the wild bird surveillance program. This presentation provides and overview of the national surveillance system for avian influenza and gives an update on WHA activities and priority measures aiming to equip people with the latest advice on prevention and preparedness for HPAI.

Avian diseases associated with urban sugar water feeding

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Despite the increasing popularity of sugar water bird feeding in residential backyards in New Zealand, there needs to be more research on its impact on wild birds. One concern is that feeding stations can promote the spread of infections among birds, negatively affecting their health. This study, the first of its kind in New Zealand, examines the relationship between sugar water feeder presence, city climate, season, sugar water concentrations, the prevalence of pathogenic and parasitic infections, and the body condition of urban birds. The study found that birds caught in gardens with feeders had poorer body conditions than those without feeders. However, birds had better body conditions in warmer climate, during summer and at feeders with high sugar concentration. No lethal avian pathogens, such as *C. psittaci* and *Salmonella* spp., were detected in the screening tests. Avian *poxvirus* prevalence was higher in city with warmer climate. Chewing feather lice occurred less in gardens with feeders, warmer city, during summer and at feeders with higher sugar concentrations. Coccidia infection was more prevalent in gardens with feeders. These findings suggest that while winter sugar water feeding may benefit native nectarivorous birds, caution should be exercised, paying attention to the type and hygiene of the feeders to minimize the risk of infection transmission.

Using spatial epidemiology to track the source of antimicrobial resistance in silver gulls

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Anti-microbial resistance (AMR) is a major threat to humanity, reducing the effectiveness of antimicrobial treatments in healthcare and food production systems. The incidence of AMR carriage in wildlife populations has been shown to correlate with exposure to anthropogenic activities, including intensive livestock production, urbanisation, refuse (landfills), and sewage. However, transmission risk is yet to be assessed at the individual level, which is critical to the identification of environmental point sources and transmission pathways. Moreover, AMR incidence in wildlife is largely quantified using diagnostic approaches focused on single bacterial species with a pre-defined resistance phenotype. Because the genes encoding AMR are often mobile, capable of horizontal transfer between cohabiting bacterial species, a more holistic approach is needed to identify environmental point sources and transmission pathways. In this study, we use detailed information on individual movement behaviour to assess the association between foraging habitat and carriage of AMR in an urban adapted wildlife species - the Australian Silver Gull (*Chroicocephalus novaehollandiae*). Foraging behaviour was tracked in 38 adults over two breeding seasons using GPS loggers with an off-colony duty cycle of 128-256 seconds, combined with land-use layers denoting foraging habitats. Carriage of resistance was determined through selective isolation of Enterobacteriaceae on each of three critical last-line antibiotic classes (Carbapenems; ESBLs; Fluroquinalones). Based on the results of population-level studies, we expected that higher use of anthropogenic habitat, particularly refuse sites, by silver gulls would correlate with higher AMR carriage, however complex patterns of exposure and resistance were found.

Influenza A viruses in Australian Silver gulls - more questions than answers

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Gulls (family Laridae) are increasingly recognised as playing a unique role in the epidemiology and evolution of influenza A viruses. In North America and Europe in particular, gulls both maintain unique variants of the antigenically-important hemagglutinin gene and contribute to the reassortment of other gene segments between continent-specific gene pools, leading to novel evolutionary trajectories. Our understanding of influenza A viruses in gulls outside these regions is, however, far less well developed. In this study, we quantify antibodies to the conserved nuceleoprotein gene segment of influenza A viruses in one of the largest Silver Gull (*Chroicocephalus novaehollandiae*) breeding colonies in Australia. Based on five consecutive years of sampling, we find dynamic exposure events within and between seasons across the population. By sampling of adults prior to hatching, and weekly sampling of chicks from hatching through fledging, we have also been able to assess infection dynamics in families, generate nascent insights into the development of immune responses in immunologically naïve chicks, and assess the impacts of infection on the health and development of chicks. Our results emphasise the importance of both exposure and susceptibility in the ecology of influenza a viruses, including their interactions with other pathogens, in wild birds.

Unexpected pathogen diversity detected in Australian avifauna highlights potential biosecurity challenges

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Birds are hosts for numerous pathogens, including Chlamydia, beak and feather disease virus (BFDV), avipoxviruses, *Columbid alphaherpesvirus* 1 (CoAHV1) and *Psittacid alphaherpesvirus* 1 (PsAHV1), all of significant biosecurity concern in Australia. While Chlamydiaceae and BFDV have previously been detected in Australian avian taxa, the prevalence and host range of avipoxviruses, CoAHV1 and PsAHV1 in Australian birds remain undetermined. To better understand the occurrence of these pathogens, we screened 486 wild birds (kingfisher, parrot, pigeon and raptor species) presented to two wildlife hospitals between May 2019 and December 2021. Utilising various qPCR assays, we detected PsAHV1 for the first time in wild Australian birds (37/486; 7.61%), in addition to BFDV (163/468; 33.54%), Chlamydiaceae (98/468; 20.16%), avipoxviruses (46/486; 9.47%) and CoAHV1 (43/486; 8.85%). Phylogenetic analysis revealed that BFDV sequences detected from birds in this study cluster within two predominant superclades, infecting psittacine and non-psittacine species. BFDV disease was only observed in parrots. Avipoxvirus sequences were identical to other global reference strains. Similarly, PsAHV1 sequences from this study were detected from a series of novel hosts and are identical to sequences detected from Brazilian psittacine species, raising significant biosecurity concerns, particularly for endangered parrot recovery programs. These results highlight the high pathogen diversity in wild Australian birds, the ecology of these pathogens in potential natural reservoirs and the spillover potential of these pathogens into novel hosts.

What can feathers tell us about the metal levels in internal bird tissues: an analysis of the global literature

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Anthropogenically-produced metal and metalloid pollutants continue to have a detrimental impact on the health of wild birds. Monitoring metal levels in birds is necessary to understand how and where birds are impacted but this is somewhat fraught with difficulty. The reliable method of sampling liver or kidney requires the death of the bird so is not ideal, particularly in the case of threatened species. Sampling feathers is a non-invasive and easy alternative, but studies have found conflicting results regarding the relationship between metal levels in feathers and metal levels in internal tissues. As different bird species occupy different habitats and trophic guilds and differ in moult patterns, this feather-tissue relationship could be influenced by many factors. The aim of this study was to determine whether feathers provide a reasonable indicator of the levels of internal tissue contamination, possibly for some species better than others. We analysed the relationship between metal levels in feathers and metal levels in internal tissues in birds globally, focussing on mercury, cadmium, lead, copper and zinc. We collated metal data from more than 90 papers covering more than 120 bird species from more than 30 families. The ratios of metal levels in feathers to internal tissues were analysed to determine the strength of relationship among different bird families and whether it varied with life history after accounting for the contribution of common ancestry. I will present our findings and discuss what they mean for future work examining the impact of pollution on avian health and conservation.

Lord of the Flies: hippoboscid flies as agents of transmission for beak and feather disease

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Beak and feather disease virus (BFDV) causes psittacine beak and feather disease (PBFD) in both captive and wild parrots worldwide. This disease is of conservation concern because it typically presents as a chronic disease leading to high death rates in nestlings and long-term immunological suppression in adult birds. In Australia, PBFD has been listed a key threatening process under the EPBC Act, and is implicated in declines of 17 threatened parrots in Australia including Critically Endangered species such as the Orange-bellied Parrot and Swift Parrot. Ectoparasitic Knemidokoptes mites have recently been shown to concentrate BFDV within their faeces, which raises the possibility of other ectoparasites, such as hippoboscid flies, acting as vectors of transmission. Avian hippoboscid flies live under feathers but are also found on the walls of cavities and nest boxes of hollow-nesting birds. In this study, we use

immunohistochemistry (IHC) to examine the potential for native hippoboscid flies to act as vectors for BFDV in hollow-nesting birds in Tasmania. Samples of hippoboscid flies were collected from nest boxes containing the chicks of Green Rosella *Platycercus caledonicus*, Swift Parrot *Lathamus discolor*, Orange-bellied Parrot *Neophema chrysogaster* and Tree Martin *Hirundo nigricans*. In addition to discussing the epidemiological ramifications of these findings, we consider the conservation implications of this novel pathway of disease transmission for threatened Australian parrots.

OPEN FORUM

Random mating in a bird species harbouring two lineages with predicted mitonuclear incompatibilities

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Interactions between mitochondrial- and nuclear-encoded mitochondrial genes (mitonuclear interactions) have been proposed as evolutionary drivers of sexual selection, adaptation, and speciation. We investigated the role of non-random mating in maintaining functional mitonuclear interactions and whether it facilitates divergence. We studied this in a wild population with two divergent, co-adapted and putatively climate-adapted mitonuclear lineages of the south-eastern Australian bird, the Eastern Yellow Robin (*Eopsaltria australis*). The two mitolineages and are strongly differentiated (~7%) on a small sex-linked section of a nuclear genome enriched with mitochondrial genes, while being undifferentiated on autosomes. This pattern indicates female-linked selection accompanied by male-mediated gene flow across a narrow hybrid zone. It is unknown whether lineage divergence is driven extrinsically by different adaptation of mitonuclear genotypes to local climates, intrinsically by poor metabolic performance of female hybrid offspring, or both. We used field observations and genetic data from the hybrid zone, parentage assignments, and genetic markers for a mitolineage and Z-linked region differentiated between lineages, to test whether females reproduce non-randomly with (1) males of their own mitolineage and/or males with similar Z-linked variation, as expected under intrinsically-driven divergence, or (2) putatively locally-adapted males (irrespective of a female's own lineage), as expected under extrinsic drivers. Comparison of field observations with random simulations showed no evidence of non-random mating. This suggests that sex-linked selection is likely operating via post-mating isolation. Future studies testing for female-biased mortality at different life stages should clarify the mechanisms of female-linked selection, improving our understanding of mitonuclear incompatibilities, divergence and speciation.

Waterbird monitoring on the estuary of Derbarl Yerrigan (the Swan River); 1981 to 2022; negative and positive impacts of sea level rise.

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The estuary of Derbarl Yerrigan (the Swan River) is surrounded by the city of Perth and has experienced nearly two centuries of change due to European settlement, primarily from hunting, landfill and disturbance, and more recently from sea level rise. Despite this, it is recognised as an important site for waterbirds. Annual waterbird counts commenced in 1981, after hunting and landfill impacts had ceased, but in a period of increasing disturbance and rising sea levels. There is some management of disturbance, but the estuary is particularly sensitive to sea level rise due to a small tidal amplitude. The most abundant migratory shorebird, the Red-necked Stint, has declined from regular counts of 2,000 to 3,000 birds in the mid-2000s to counts of <50. It remains abundant on nearby sites not affected by sea level rise. Other migratory shorebirds have also declined drastically or effectively disappeared from the estuary. In contrast, the Pied Oystercatcher, a shorebird of marine coasts, was first recorded in 1986 and is now a breeding resident, while the Black Swan and some ducks have become abundant. These changes are consistent with sea level rise that has caused the virtual disappearance of tidal mudflats but an increase in shallows, and an increasingly marine environment.

Back from the brink: Saving the Northern population of Eastern Bristlebird (*Dasyornis brachypterus*)

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The Eastern Bristlebird (*Dasyornis brachypterus*) is a small, ground dwelling bird that predominantly inhabits dense, grassy understoreys of open forests and heathlands of eastern Australia. Listed as Endangered by Commonwealth and State legislation across the taxon's range and Critically Endangered in Victoria, land use changes and displacement of traditional fire management practices have caused dramatic range contractions for this species, most evident from data collected in the 1980s and '90s. Historically distributed along the coast and adjacent ranges from south-eastern Queensland to eastern Victoria, Eastern Bristlebirds are now restricted to just four, geographically disparate regions:

- south-eastern Queensland/north-eastern New South Wales (NSW) (northern population)
- Jervis Bay/Illawarra region of NSW (central population)
- Coastal NSW/Victoria border region (southern population)
- Wilsons Promontory National Park (consisting of 28 translocated individuals reintroduced from the central population in 2022-23).

The northern population is the smallest of the naturally occurring populations with approximately 40 wild individuals remaining, meeting IUCN criteria for Critically Endangered. Imminent threat of extinction prompted the National Eastern Bristlebird Recovery Team to convene a Northern Working Group in 1998. Charged with overseeing implementation of recovery actions for the northern population, this collaborative partnership of state government agencies, conservation organisations, zoos, ecologists and universities has worked to identify priority habitat areas essential to recovery, develop best practice for restoration and maintenance of these areas, support research on fire ecology requirements, establish a captive breeding and genetic rescue program and is now supporting translocation of birds bred in captivity into the wild to reinforce wild numbers and improve genetic integrity. With the northern population occurring on private lands and national park estate, taking a collaborative, cross-tenures approach is essential for successful recovery. Long-term landholder partnerships are connecting conservation science with on-ground actions and facilitate sharing of knowledge, skills and resources needed to achieve effective weed control and prescribed burning programs. Reinstating traditional fire management practices is reversing successional changes that have caused habitat losses, creating conditions that are stimulating expansion in the wild population. A program of releasing birds bred in captivity into prepared habitats is commencing. In this paper the authors will discuss the success of captive breeding and the collaborative work for saving the northern population of Eastern Bristlebird.

Changes in species composition and population sizes of woodland birds over 37 years at a site in South East Queensland

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The birds of an area of undisturbed primary woodland near Mt Cotton, SE Queensland have been monitored by a banding program that has been running monthly for 37 years from 1986 until the present. A total of 76 species have been banded. Changes in community composition and population sizes are documented for both resident and migratory species based on more than 6000 banding records. At least 15 species, e.g., *Stizoptera bichenovii* (Double-bar Finch), *Pomatostomus temporalis* (Grey-crowned Babbler) and *Gerygone olivacea* (White-throated Gerygone), have disappeared at different rates from the site. Eighteen species have not been recorded in the last 10 years. Six species still present, e.g., *Zosterops lateralis* (Silvereye), *Pachycephala rufiventris* (Rufous Whistler) and *Malurus melanocephalus* (Red- backed Fairy Wren), have declined markedly. Most of the common honeyeater species, e.g., *Caligavis chrysops* (Yellow-faced Honeyeater), *Myzomela sanguinolenta* (Scarlet Honeyeater) and *Manorina melanocephala* (Noisy Miner) appear to have approximately decadal cycles of abundance that are not related to local rainfall. The results are discussed in relation to increasing human population size, urbanisation and loss of woodland habitats in this part of South East Queensland, and the value of long-term monitoring is emphasized.

Recognising diversity in the Australian Magpie *Gymnorhina tibicen* Latham, 1802: insights from its New Guinean representative

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Phenotypic diversity among populations of the Australian Magpie was recognised early, with five species named by 1903 and 11 subspecies including New Guinean *papuana* by 1926. At century's end, Schodde and Mason's analysis identified seven differentiated Australian mainland forms but with extensive and largely unstudied intergradation. The authors named nine subspecies including *papuana* and Tasmanian *hypoleuca* in a single species but considered their revision incompletely resolved. Mitochondrial DNA studies have identified western and eastern phylogroups but provide no support for a traditional northern black-backed and southern white-backed division. The New Guinean isolate is sister to the western phylogroup. Yet eastern nuclear genes are present in north-western populations suggesting extensive secondary contact across northern Australia. We have collated available evidence of plumage diversity and morphometry among New Guinean and Australian representatives of the species and tested its present infraspecific taxonomy against criteria for subspecific division in a polymorphic species. We propose recognising only four subspecies of Australian mainland magpies among the extensive populations of varied intermediate phenotype, namely: Black-backed *G. t. tibicen* and White-backed *tyrannica* in the eastern clade, and Western dorsalis and Long-billed longirostris in the western clade. We recognise three island subspecies, G*. t. papuana* in southern New Guinea, G*. t. hypoleuca* in Tasmania and the Furneaux Group, Bass Strait, and *G. t. eylandtensis*, restricted to Groote Eylandt Northern Territory.

Investigating the effects of multiple anthropogenic stressors on behaviour in an urban-living bird

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Climate change and anthropogenic noise are two of the most serious human-induced stressors affecting wildlife populations globally. However, the effects of these stressors are rarely investigated together, despite the fact that they often co-occur, particularly in urban areas. Previous work has found both heat stress and anthropogenic noise to affect the behaviour of avian species, however the combined impact of these stressors on behaviour has not yet been considered. Here, we investigate the simultaneous effects of heat stress and anthropogenic noise on the behaviour of wild Western Australian Magpies (*Gymnorhina tibicen dorsalis*), an urban-living bird species exposed to increasingly warm temperatures in the south-west of Western Australia. Birds were presented with playback of background noise and playback of anthropogenic (plane) noise under both heat-stress and non-heat-stress conditions. Heat stress and anthropogenic noise caused an additive increase in the time individuals spent vigilant following playback. Our findings reveal that both heat stress and anthropogenic noise increase the vigilance behaviour of an urban-living bird species, and as such may alter the predation-starvation trade-off as birds spend more time vigilant and less time foraging. Such findings highlight the importance of considering multiple stressors when looking at the effects of human-induced environmental change on animals.

The effect of feral predator management on Malleefowl nest mound activity in the north-eastern wheatbelt, Western Australia.

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Malleefowl (*Leipoa ocellata*) are a threatened Australian bird best known for the large and conspicuous mounds they build to incubate their eggs. Once widespread over most of the southern half of the continent, Malleefowl populations declined dramatically following European settlement of Australia. Drivers of decline include habitat loss, disturbance by changing fire regimes and livestock grazing and, particularly, predation by introduced predators such as cats and foxes. A national mound monitoring program is implemented by volunteers who measure mound activity each year at about 140 sites. Land managers throughout the species' range have also been engaged in an adaptive feral predator management experiment exploring the impact of fox baiting programs on Malleefowl mound activity. A population of Malleefowl in the north-eastern wheatbelt of Western Australia provide a good opportunity to compare the impact of different levels of feral predator management on mound activity. Using mound activity data collected annually by WA Malleefowl Recovery Group volunteers, we compared mound activity between three adjacent sites, one where feral predators are not managed, one where a consistent

fox and cat baiting program has been in place for > 10 years and a third site within a feral- predator free exclosure. While evidence of an effect of baiting on Malleefowl mound activity nationally is equivocal, we show that the number of active mounds was significantly higher in the feral-predator free exclosure compares to sites with some feral predators present. By focusing analysis efforts on a regional case study, we can more clearly evaluate the potential benefits of continued efforts to eradicate and/or control introduced feral predators for Malleefowl conservation.

Time to hatch: how do birds time their emergence into a changing world?

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The most predictable environmental cycles in nature are the daily cycles of light and darkness, which have programmed the timing of biological activity since the first emergence of life on the planet. Across broad taxonomic groups we know that organisms use these cycles to optimally time their transitions from early life stages (e.g., hatching, pupal emergence), but we know next to nothing about the role of light cycles in controlling the timing of hatching in birds. Biologically, emergence at the 'best' time diurnally seems likely to maximise nesting survival, through increasing their chance to feed, stimulating parental care and avoiding predation during their most vulnerable day of life. For diurnal bird species, we therefore predict that eggs hatch early in the day, whereas we might predict that eggs of nocturnal species may hatch towards the end of the day. However, hatch timing is likely a function not only of light and dark cycles, but also communication with parents and between siblings within the nest. Here, I present an (almost) data-free presentation focused on offering an opportunity for citizen scientists to contribute to answering this question, by using remote webcams to monitor nesting birds. Understanding the environmental stimuli which contribute to determining the timing of hatching in wild birds is important for avian conservation, particularly with the increasing prevalence of light at night.

Individual variation in nestbox attendance patterns of kororā (Little Penguins *Eudyptula minor)*

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Birds, like other animals, have consistent individual behavioural and physiological responses to changes in their immediate environment which are known as personalities. The size of a corticosterone response of a bird is a physiological measure of the sensitivity of the bird to stimuli from the environment. In a previously study, we found marked individual variation in corticosterone responses of kororā (Little Penguins). In the current study, we investigated individual variation in behaviour in kororā. Nestboxes in a kororā colony at Port Tarakohe in Golden Bay, New Zealand, were checked regularly in autumn and winter (April to July), and in winter and spring the following year (July to October). Individual birds could be identified from their microchip numbers. In autumn and in winter, before egg laying started, there were clear cycles of the total number of penguins in nest boxes during the day. Some birds were regularly in their nest box for 8 to 10 days, then away for approximately two weeks, while other birds did not have such clear patterns of nestbox attendance. In some pairs, members of a pair were always seen together, while other pairs were not consistently together in their nest box. There were also individual differences in patterns of attendance at nestboxes in the weeks immediately preceding egg laying. In the future, relationships between corticosterone responses and patterns of nestbox attendance can be explored to determine if penguins with different physiological responses to environmental stimuli have characteristic behaviour patterns, and if these are linked with breeding success.

From nestling to adult: ontogeny and ecological relevance of personality in Superb Fairy-wrens

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Animal personalities are defined as differences between individual behaviours that are consistent over time and across contexts. Yet the ontogeny of these behavioural differences as well as whether they are maintained across ontogenetic stages remains unclear. In addition, studies linking personality differences (often measured in captivity) to ecologically relevant behaviours in the wild are sparse and contradictory. Here, we measured three personality traits (boldness, exploration, and aggressiveness) across three

life stages (nestling, fledgling, and adult) in a wild population of Superb Fairy-wrens (*Malurus cyaneus*) and investigated whether personality traits measured in short-term captivity correlated with risk taking and foraging behaviours in the wild. Personality differences were often consistent within life stages but never across them, and personality traits were only repeatable in adults. Exploration and aggressiveness correlated positively with each other, and exploration phenotype was a good indicator of individual fitness in the wild: individuals with extreme exploration phenotypes defended their territory more vigorously against conspecific intruders and slow explorers used fewer foraging substrates than intermediate or fast explorers. These results suggest that personality traits may not become established until adulthood and support the importance of animal personalities for individual fitness and survival.

Potential impacts of a rodent eradication program on the Lord Howe Island lowland terrestrial avifauna

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In response to a request from the Lord Howe Island Board, spring surveys were conducted on the lowland terrestrial avifauna in the spring of 2013, 2014, 2016 to 2018 prior to the rodent eradication programme that commenced in 2019 and a final spring survey was conducted in 2022. The spring surveys were based on 96 2 ha plots each surveyed four time during a one-week period and the number of individuals recorded. The plots were spatially stratified across the northern and western part of the Lord Howe Island lowlands. The count data were analysed using a generalized linear mixed model with Rodent control, Vegetation type and Time after sunrise as fixed effects and Observer, Plot and Year as random effects. Of the 15 species recorded across the 96 plots only nine were recorded with sufficient frequency to permit analysis. Our emphasis here was to assess the extent to which the rodent control programme had caused a detectable change in abundance (were the numbers in 2022 outside the range of abundances recorded across 2013 to 2018) and to match avian response to rodent removal in terms of the known biology of the species. Emphasis was placed on the Lord Howe Island Woodhen to see if this endangered species would show a positive response to rodent removal.

Falling of their perch: understanding the decline of Western Australia's more enigmatic threatened birds

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A key threat to Australian birds, particularly those with cryptic habits or in remote locations, is lack of monitoring. Without adequate monitoring of populations or changes in range, it is difficult to manage bird species and implement early actions to prevent their decline. This talk synthesises four recent studies on 3 threatened (Western Partridge Pigeon, Abrolhos Painted Button-quail and Southwest Barking Owl) and one extinct (Rufous Bristlebird) West Australian endemic birds. It garners an insight into the key drivers of species loss and recommendations to alleviate the worsening conservation status of West Australian birds. These species are unanimously characterised by a lack of survey data, key population parameters and a lack of understanding of foraging and habitat selection. Using targeted on-ground surveys, historical data and data from Birdlife Australia and indigenous partnerships, we empirically assess the status of these bird species and highlight a worsening trajectory for two of the three extant species with cryptic habits and occurrences in remote locations. Western Partridge Pigeon has an improved status due to positive land management arising from indigenous management of country and increased survey effort. An analysis of the extinct Western Rufous Bristlebird uncovered a precipitous decline due to collecting of a species with a highly restricted distribution in a habitat undergoing European-induced changes particularly fire management. Key outcomes include recommendations for enhanced monitoring and taxonomic work to mitigate against the further loss of endemic species and sub-species.

Harnessing intraspecific variation in social group size to elucidate ecological correlates of cooperative breeding

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Cooperatively breeding species exhibit a range of social behaviors associated with different costs and benefits to group living, often in association with different environmental conditions. For example, recent

phylogenetic studies have collectively shown that the evolution and distribution of cooperative breeding behavior is related to the environment. However, little is known about how environmental variation may drive differences in social systems across populations within species, and how the relationship between environmental conditions and sociality may differ across species. Using a combination of transect observations and eBird data gathered in the Malurus fairywrens, as well as theoretical modeling, we examine how different benefits of social living can generate variable patterns of group size in response to ecological variation. Specifically, we show that group augmentation benefits (e.g., increased reproductive success) produces the largest groups in harsh environments, while the lack of such benefits and the presence of high reproductive conflict produces the largest groups in benign environments. These findings suggest that nuanced differences in the benefits of helping and dispersal behavior observed in the Malurid fairywrens likely contribute to misaligned ecogeographic patterns of variation in group size across species and suggest integration of ecogeographic studies within and between species can provide novel insight into social trait evolution.

Male-performer male-receiver displays at a communal display platform of the Albert's Lyrebird (*Menura alberti*)

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Albert's Lyrebirds (*Menura alberti*) occur in fragmented habitat, with many populations classified as meta-populations (i.e., spatially separated populations of a sedentary species that have no to minimal interaction). Previous studies documented individual mature male ownership and exclusive use of display platforms during breeding season. Displays contained song and dance elements characteristic of each meta-population, with less variation in elements within than between meta-populations. It was proposed song elements were passed generation to generation by passive aural mechanisms as no active mechanisms were observed. Scant information has been published on out-of-breeding season behaviour. A longitudinal study of display platforms of a meta-population in the eastern fall of a cool-subtropical rainforest is in progress. During breeding season, platforms were located binaurally, confirmed visually and observed by camera trap, with GPS locations, physical characteristics, preference and frequency of use recorded. Findings to-date are in agreement with, and an extension of, previous studies. In 2022, mapping of display platforms commenced in the western-fall of confluent rainforest. In contrast to previous findings outlined above, out-of-breeding season observations recorded communal use of a display platform. During a 30-day period individual sub-adult males and mature males displayed to individual mature males and females, on nine occasions. Male-performer male-receiver displays at communal display platforms may be an active mechanism for transfer of song and dance elements from generation to generation.

Evolution of avian heat tolerance: the role of atmospheric humidity

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The role of atmospheric humidity in the evolution of endotherms' thermoregulatory performance remains largely unexplored. Raised atmospheric humidity is known to affect the thermoregulatory performance of endotherms by impeding evaporative cooling capacity. Using a phylogenetically informed comparative framework, we tested the hypothesis that birds occupying hot, humid habitats have evolved physiological mechanisms to compensate for impedance of evaporative cooling by comparing heat tolerance limits (HTL; maximum tolerable air temperature), maximum body temperatures (Tbmax) and associated thermoregulatory variables in humid (19.2 g H2O mâˆ' 3) versus dry (1.1 g H2O mâˆ' 3) air among 30 species from three climatically distinct sites (arid, mesic montane and humid lowland). Humidity-associated decreases in evaporative water loss and resting metabolic rate were 27 - 38% and 21 - 27%, respectively, and did not differ significantly between climatic sites. Decreases in HTL were significantly larger among arid-zone (mean 3 SD = 3.13 3 1.12 °C) and montane species (2.44 3 1.0 °C) compared to lowland species (1.23 3 1.34 °C), with more pronounced hyperthermia among lowland birds (Tbmax = 46.26 3 0.48°C) compared to arid-zone species (45.23 3 0.24Â°C). Our findings reveal a functional link between facultative hyperthermia and overcoming humidity-related constraints on evaporative cooling and provide novel insights into how hygric and thermal environments interact to constrain avian performance during hot weather.

Testing innovativeness in wild *Cacatua galerita* through specific cognitive tasks

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To disentangle geographical, social, and individual characteristics impacting innovativeness in wild Sulphur-crested Cockatoos, I propose to present them food-motivated problem-solving tasks that will require innovation to be solved. The puzzles will be divided into 3 categories of difficulty, with low, medium and advance complexity. The tasks will be placed on trees in 13 different roosts distributed in the north/ north-west region of Canberra, that differ both in group size (number of individuals at the roost), urbanization levels, distance from the closest un-urbanized area, and environmental complexity. All of these characteristics will be considered as variables in the experiment. The tasks will need to be solved only ones, and from camera footage, I will record latency, number of visits and attempts until solving, behavior at the task, as well as sex, age, and individual identity (if known). I will concurrently take population-level measures, and data on population genetics will be collected as a proxy for movement rate.

Large-scale biodiversity monitoring to measure bird responses to fire regimes in Victoria, Australia

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The need for evidence-based fire management is at an all-time high as biodiversity loss continues and the risk of megafires increases. We designed and implemented a large-scale monitoring program across four fire-prone ecosystems in Victoria to understand bird response to recurrent fire and to assess effectiveness of fire management in maintaining and enhancing ecological resilience. We collected bird data at approximately 800 sites from 2021 to 2023 in four mixed species eucalypt forest or woodland ecosystems: box-ironbark forest, grassy-heathy dry forest, high altitude shrubland/woodland, and tall mixed forest. Site selection was stratified by fire type (wildfire or planned burn), time since the last fire, and the interval between fires. We recorded 47,173 observations of 138 species over two spring and two autumn seasons using bird point counts. Preliminary analyses indicate that time since fire and mean fire interval are influential drivers of individual species, functional groups (foraging guild and diet), and ecosystem resilience in each ecosystem. This work forms one part of the most extensive fire and biodiversity dataset ever assembled in the southern hemisphere, with ongoing work at an additional 800 sites and concurrent sampling of habitat, floristics, and mammal populations. These results will significantly advance ecological knowledge and fire management and provide a strong base for long-term monitoring and research.

Frugivores at the edge of rainforest and semi-cleared land.

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For twelve years (2009 to 2021) I walked five transects close to the southwest corner of Mt Chinghee National Park, South East Queensland, on five separate mornings, in each of four seasons, recording all birds. The National Park chiefly harbours seasonally dry rainforest, the neighbouring land comprising forest regrowth (new and mature), paddocks with *Eucalyptus tereticornis*, and riparian woodland. In addition to examining seasonal and year-to-year differences for all species, I'm assessing seasonal occurrence of seed dispersers, fruit thieves and seed predators. The birds showed various differences: for instance, Lewin's Honeyeaters were found at all sites, all seasons and all years, while figbirds favoured the riparian sites and were largely absent from all sites in winter, regent bowerbirds appeared in early years and were then replaced by satin bowerbirds. I've also been recording where potential seed dispersers sit when not foraging at fruit (type of tree, distance from rainforest and creek, and ground cover and canopy cover within a 5m radius), and thus where they are likely to drop the seed, as well as conducting (on-going) germination and early growth experiments with local plant species. This information is then combined with results from my previous research on birds visiting fruiting trees to assess which birds are most likely to disperse seeds of local fruits to favourable sites. The goal is ultimately to assess which birds are the best dispersers of each local fleshy-fruited species, with a view to enhancing conservation management of birds and plants on local farmland.

Avian sex ratio management in a changing world

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It has recently been observed that sex ratios in wild animal populations are changing in response to anthropogenic effects such as global climate change, habitat loss, urbanisation and invasive species. When a population sex ratio becomes skewed to either male or female, it can act as an underlying mechanism in species decline. Most concerningly, sex skews are more prevalent in threatened taxa. To understand these trends and implement successful recovery actions, we will require a greater insight into population sex ratios and how key drivers such as breeding systems and sex allocation may respond to change at the individual and population level. The ex-situ environment provides an unparalleled platform from which to test sex allocation theories and predict sex skew patterns that may be incorporated into population models and inform proactive conservation management both in-situ and ex-situ. We analysed sex ratio data from over 182,000 birds in global ex-situ populations to determine the status of adult sex ratio variation in populations and compared them with published reports of their in-situ counterparts. Overall, our results showed that male-biased sex skews are twice as prevalent ex-situ than they are in the wild, and although sex skews vary greatly at the institutional level, were closer to parity at a global level. I will discuss further insights from our study in the context of threatened species, sex allocation in a changing environment and will make practical recommendations for future research.

Secrets revealed from EagleCAM - the challenges of fledgling Sea-Eagles in an urban setting

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There has been a White-bellied Sea-Eagle nest in the Newington Nature Reserve by the Parramatta River, for many years, with a succession of eagle pairs using a nest in the breeding season. The nests have been studied using video CCTV cameras from the time of nest renovation to fledging and beyond where possible. In 2022 the 2 nestlings fledged at 77 days and 82 days. Both young birds left the area very soon after fledging. This study has observed a disturbed and shorter post- fledging period of dependence, reported as 2-3 months. It is considered that disturbance in the surrounding residential and industrial area as well as constant harassment by other birds contributes to their premature dispersal from the nest area. In 2022, after some time lost nearby, both were eventually captured and taken for veterinary care. The injured older bird SE29, despite surgery and care, was eventually euthanased. The younger, after care and rehabilitation, was fitted with a satellite tracker as part of the research project of Australian Raptor Care and Conservation Inc. and was released in the same approved area as a previously tracked juvenile from 2021. Her dispersal northwards is being followed. It is considered that release in the natal urban area on the Parramatta River is not recommended after the post-fledge disturbance of this and previous seasons. Life is hard in the city for young Sea-Eagles.

Recovery of the Endangered Rufous Scrub-bird after the Black Summer fires

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Large areas of Rufous Scrub-bird habitat were burnt in the Black Summer fires of 2019-2020, including the habitat of important populations in the Werrikimbe/Carrai area, New England National Park, and Gibraltar Range/Washpool National Parks. Post-fire surveys in these areas were carried out in 2020-21 (the first breeding season post fire) and in 2022 (the third breeding season post fire). The lack of systematic pre-fire monitoring for most populations makes it difficult to quantify the impacts of the fires. Results suggest that tracts of rainforest functioned as refugia for Rufous Scrub-birds during and in the aftermath of the fires. Rufous Scrub-bird habitat in wet eucalypt forest close to rainforest has recovered well, and birds have returned to some areas of recovering eucalypt forest where they were recorded pre-fire but not in the first breeding season post-fire. The rate of recovery appears to be faster in areas with higher rainfall/greater productivity. In Werrikimbe a considerable expansion of Rufous Scrub-birds into burnt habitat occurred between the first and third post-fire breeding seasons, but in Gibraltar Range/Washpool and New England National Parks the distrGeoibution of birds changed little between 2020-21 and 2022.

Smaller Australian raptors have greater urban tolerance

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Urbanisation is occurring around the world at a rapid rate and is generally associated with negative impacts on biodiversity. Examining the behavioural responses of wildlife to urbanisation helps differentiate between urban tolerant and urban avoidant species and aids in assessing the likelihood of species persisting in urban environments. Species-specific responses to urbanisation are poorly understood in the Southern Hemisphere for raptors despite their high diversity in the Southern Hemisphere and critical role within ecosystems as bioindicators of environmental health. We explore this knowledge gap using community science data sourced from eBird to investigate the urban tolerance of 24 Australian raptor species at a continental scale. We integrated eBird data with a global continuous measure of urbanisation, artificial light at night (ALAN), to derive an urban tolerance index, ranking each species from positive to negative responses according to its tolerance of urban environments. We then gathered trait data from published literature to assess whether certain traits (e.g., body mass, habitat type, nest substrate, feeding guild, and migratory status) are associated with urban tolerance. Out of the 24 species analysed, 13 species showed tolerance profiles for urban environments, and 11 species showed avoidance profiles for urban environments. Body size was negatively associated with urban tolerance, as smaller raptors had greater urban tolerance than larger raptors. The results of this study provide impetus to conserve native habitat for larger-bodied raptor species in an increasingly urbanised world.

Feather Forensics: tracing the origins of parrots in wildlife trade with stable isotopes and citizen science

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To supply the high demand for wildlife as exotic pets, animals may be illegally and unsustainably harvested from the wild and laundered as captive bred. Consequently, there is considerable interest in wildlife forensic tools that are capable of verifying captive breeding origins. Stable isotope analysis is an emerging tool for verifying captive and wild origins by identifying key differences in dietary intake. We tested the accuracy of stable carbon (Î´13C) and nitrogen (Î´15N) isotope ratios to verify captive and wild origins using bird species that are common in pet trade. Through the citizen science project Feather Forensics, participants provided naturally dropped feathers from four native Australian cockatoo species: Galahs (*Eolophus roseicapilla*); Sulphur-crested Cockatoos (*Cacatua galerita*), Little Corellas (*C. sanguinea*), and Long-billed Corellas (*C. tenuirostris*). We compared isotope ratios of captive and wild birds and calculated the classification accuracy and repeatability of using stable isotopes to determine origin. While Î´13C and Î´15N values were significantly different between captive and wild birds, and could successfully differentiate Eolophus origins. Captive birds had significantly higher Î´13C and Î´15N than wild birds, and individual Eolphus could be classified with high accuracy (88%). However, Cacatua showed large overlaps between the origin groups, which reduced their classification accuracy (74%). Stable isotope analysis can be a potential classification tool in wildlife trade; however, before on-ground implementation, we recommend that variation from different diets across a species' geographical range be more thoroughly investigated to better understand and explain the full range of possible Î´13C and Î´15N values.

Helpers greatly reduce the risk of nestling predation in the Purple-crowned Fairy-wren

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Nest survival is a major component of reproductive success in birds. Many nest attempts fail, and the causes of failure are often diverse. To predict how nest survival may be impacted by anthropogenic change, it is important to model these competing sources of failure simultaneously. Here we take such an approach with the Endangered Purple-crowned Fairy-wren (*Malurus coronatus*). This cooperatively-breeding passerine is endemic to the monsoonal tropics of northern Australia, where both predation and flooding pose important risks to nest survival. We monitored 807 nests for 13,231 exposure days between 2005 and 2022. Predation was the main cause of nest failure (399 nests), followed by flooding (108) and abandonment (41). To predict the daily probabilities of these sources of failure, we created a Bayesian multi-fate nest survival model incorporating nest-specific (height, distance to water, habitat quality, group size, catchment) and time-varying covariates (nest stage, date, daily maximum temperature,

rainfall). The probability of flooding predictably varied with rainfall, but predation risk was not affected by climate. Habitat quality altered flood risk of lower-placed nests, but it did not affect predation probability, which was instead related to social group size. Around half of nests of unassisted pairs were predated during the nestling stage, compared with just 30.4% of nests of groups with three helpers. This highlights a need for further research on links between population density, group size, and recruitment to understand the potential for a feedback loop that may threaten population persistence.

Looking into the future of migratory parrots: assessing vision of iconic species to assist conservation planning

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The world's only long-distance migratory parrots, the Swift (*Lathamus discolor*), Orange-bellied (*Neophema chrysogaster*), and Blue-winged (*Neophema chrysostoma*) Parrots, are endemic Australian species. All three species are facing population decline, two are Critically Endangered. In other avian orders, migratory behaviour has been linked to reduced visual and cognitive abilities which may increase their risk to collisions, pollution, and habitat changes. For this study, we test if qualities of the eyes and brains of migratory parrots have diverged from their non-migratory relatives and if they share similarities with other migratory species. To achieve this, we use Î¼CT scans of specimens to measure the visual pathways and brain regions which are evident in skulls. Preliminary results from a captive Swift Parrot indicate that this specimen does not share the same neuroanatomical adaptations which are typically present in migratory birds of other avian orders. Instead, the anatomy measured in this individual does not substantially differ from the non-migratory relatives in this study. Due to this being a singular captive specimen, however, the results cannot be interpreted with confidence. Nonetheless, there are captive breeding programs for the conservation of these birds, knowing how captivity influences these species may assist with planning for potential limitations. Because of this, measurements from both wild and captive specimens of all migratory parrots will be collected to determine if the neuroanatomy of these parrots co-vary.

Fire management prescriptions based on plant vital attributes: what are the impacts on birds?

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Using the fire responses of plants to inform management decisions is a global approach. In Australia, application of prescribed fire is largely guided by the responses of fire-sensitive plants through setting minimum and maximum tolerable fire intervals (TFIs). The assumption is that maintaining floristic diversity will also satisfy faunal requirements. While limitations of this approach have been recognised, few have assessed the efficacy of plant-based fire prescriptions in sustaining faunal populations. We surveyed birds in two semi-arid vegetation types across two spatially distinct sub-regions in the Victorian Mallee. We conducted four survey rounds at 253 sites representing a 75-year chronosequence of fire-age; and used generalized additive models to predict relationships between species occurrence and fire-age. The time required for each species to reach peak occurrence probability following fire was estimated from response curves and compared with current management prescriptions. Of the 18 species influenced by fire, 61% are unlikely to reach peak occurrence by the minimum TFI, while 50% are unlikely to peak by the maximum TFI, in their respective vegetation types. Additionally, the generalised nature of these prescriptions does not adequately account for variation in the responses of some species between vegetation types and sub-regions. Our findings suggest current prescriptions are unlikely to ensure the persistence of birds in the region. With fire frequency predicted to increase under climate change, the need for greater consideration of the requirements of fauna is becoming more urgent.

Effects of a megafire vary with fire severity and forest type: the impact of Australia's Black Summer fires on the iconic Superb Lyrebird

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Megafires, predicted to become more frequent with a changing climate, pose a global challenge for conservation. Initial assessments of the megafires of Australia's 'Black Summer' highlighted widespread, severe impacts for many species. We investigated the impacts of these megafires on the southern Superb Lyrebird (*Menura novaehollandiae victoriae*), a functionally important ecosystem engineer in forest

ecosystems. First, we used spatial datasets to quantify the extent of lyrebird habitat burned at differing levels of severity, and how this varied among forest types. Second, we carried out field surveys, one-year post-fire, at 226 sites stratified by fire severity and forest type, to assess habitat use by lyrebirds. In total, 41.5% (~2.1 million ha) of habitat throughout the range of the lyrebird was within the footprint of the Black Summer fires. Habitats of higher suitability were disproportionately affected. One-year post-fire, Lyrebirds remained strongly affected by fire severity: foraging activity was greatly reduced in forest burned at low and high severity, but patchily burned forest differed little from unburned forest. Foraging was absent from most sites that sustained high severity fire. Rainforests have the greatest post-fire value for lyrebirds and serve as local refuges for recolonization. For this and other species, impacts of megafires vary greatly in relation to fire severity and forest type. Such knowledge can be used to identify geographic refuges for long-term conservation of species of concern.

Shorebirds are shrinking and shape-shifting: declining body size and lengthening bills in the past half-century

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Birds around the world are shrinking in size and are predicted to change shape as the climate warms. Smaller size and longer bills are advantageous for maximizing heat loss in hot environments. However, whether morphological changes are driven by thermal adaptation to warmer climates or other potential drivers - including increasing nutritional stress and developmental effects - are not well understood. To better understand the implications of global change for species evolution and survival, we need to know which species are shrinking and shape-shifting and why. We investigate climate impacts on shorebird size and shape using an outstanding dataset of >200,000 observations of 25-30 shorebird species collected over 46 years by community scientists of the Victorian Wader Study Group and Australasian Wader Studies Group. We show that shorebirds from hot, tropical northern Australia have longer bills and smaller bodies than members of the same species from southern Australia. This geographic pattern is consistent across ecologically diverse species, supporting the expectation that shorebird size and shape is influenced by thermal adaptation to minimize heat stress. We further demonstrate that shorebird body size is declining, and their bills are lengthening over time as the climate warms.

Call-playback surveys to investigate the occurrence and status of the Marbled Frogmouth on private lands in north-eastern New South Wales

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Call-playback surveys for the southern subspecies of the Marbled Frogmouth *Podargus ocellatus plumiferus*, a cryptic, restricted-range, wet forest-associated species were undertaken on twelve private properties, two small Nature Reserves and one larger Nature Reserve within Kyogle, Lismore and Byron LGAs in north-eastern NSW from 2020 to 2022. Marbled Frogmouths were detected in eight of the twelve properties surveyed and in the larger Nature Reserve. Records from the private lands extended the range of a recently discovered population in the Mackellar Range and confirmed the presence of a population in the Broken Head Nature Reserve. They also demonstrated the importance of private lands in providing dispersal and connecting habitat between State reserves containing core populations of the subspecies. The survey records, together with other records of the subspecies from north-eastern NSW are assessed relative to the current occupancy model and suggestions are made to improve the model.

The challenges of artificial wetlands as bird habitat in an urbanised environment

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Habitat restoration and creation since construction has increased the diversity of woodland and aquatic environments that provide habitat for a range of resident, migratory and nomadic bird species. Approximately 170 species have been recorded at Laratinga Wetland. The increase in habitat diversity and creation has shown to be beneficial in the number and richness of species present since inception of the wetland. State and/or regionally threatened bird species including the Blue-billed Duck, Australasian Shoveler, Baillon's Crake, Buff-banded Rail, Crested Shrike-tit, Freckled Duck, Fork-tailed Swift, Great Egret and Rainbow Bee-eater are among those recorded. Each year migratory birds such as the Latham's Snipe are present. Previously, water levels were manipulated throughout the 10.7-hectare wetland that

contains 3 basins and 12 individual cells to optimise habitats for a variety of species. However, in recent years, operational constraints have resulted short-medium challenges meeting habitat preference, breeding requirements and the birding community expectations. The implications of sub-optimal environmental flows, ecological impacts, various management approaches have been considered to reduce impacts.

When fallacies become facts - avian breeding seasons in tropical and subtropical Australia

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Despite the impression purveyed by many popular bird books, the breeding biology of many Australian birds, especially those of the tropics and sub-tropics, is poorly known. For example, the role of the sexes in nest-building and incubation is unknown in about 40% of the 70 Australian species of honeyeaters, and incubation and nestling periods are unknown for 33%. Knowledge of the breeding seasons of birds is particularly important to detect the effects of climate change on their reproductive phenology. However, the term breeding season covers many stages from nest-building to post-fledgling care, hampering informed analyses. In this presentation I compare unpublished data on estimated egg-laying months of honeyeaters in tropical Northern Territory and subtropical South East Queensland with information published in five popular bird books. In tropical NT, the first egg-laying month of most species was in autumn, 2-5 months before the first breeding months alleged by popular sources. In South East Queensland, contrary to conventional wisdom, egg-laying peaked in winter, thereby avoiding the hottest and wettest period. Reproductive phenology may also vary geographically within species. Peak egg-laying of Fuscous Honeyeaters in lowland South East Queensland occurs in May-June, yet 400 km away in highland North East NSW, it occurs five months later. This study illustrates how suppositions based on erroneous or biased historical records can lead to entrenched misconceptions that pervade both popular and scientific literature, and which are virtually impossible to eliminate.

Counting Cockies: The evolution of the citizen science-based Great Cocky Count over the years

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Large, mobile and flocking birds can often give the mistaken impression that they are common and abundant within the landscape. Southwest WA is home to three threatened species of Black-Cockatoo —Carnaby's, Baudin's and Forest Red-tailed—which often occur in large flocks within both urban and regional areas. The Great Cocky Count (GCC) is a long-term, citizen science-based survey which uses a standardised methodology to count Black-Cockatoos as they fly into their overnight roost sites. The GCC is designed to both engage with the community and increase awareness and understanding about the conservation status of Black-Cockatoos and the threats they face, as well as obtain meaningful data to track the changes in populations of Black-Cockatoos over time and area. The GCC has taken place annually since 2010 and has evolved over time to include all three species of southwest Black-Cockatoo across the extent of their range and improve data collection. Over the last seven years volunteer participation has remained high with over 600 registered volunteers annually counting from east of Esperance to north of Geraldton. Tracking the population trajectory of these species and identifying their critical habitat in the landscape remain central to their ongoing conservation, and are relied upon to help inform decisions at local, state and national levels. The GCC demonstrates how harnessing people power and using citizen science can gather much-needed data on mobile flocking species, and is well placed to continue tracking the population trends of threatened southwest Black-Cockatoos into the future.

Wren round-up: implementing the successful translocation of Western Grasswrens to Dirk Hartog Island GPS session?

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Conservation translocations are a tool necessary to restore species to areas where they have been extirpated and cannot naturally re-colonise. These management actions can be challenging and risky, requiring significant effort and planning to maximise the likelihood of a positive outcome, while minimising risks to animal welfare. The Western Grasswren (*Amytornis textilis*) was last recorded on

Dirk Hartog Island (DHI), Shark Bay in 1918 and is one of 13 species identified for translocation for the purposed of ecological restoration of DHI under the ambitious 'Return to 1616' project. No grasswren species have previously been translocated and prior translocations of other Maluridae species have had mixed outcomes. We took a rigorous and collaborative approach to this process, aiming to learn and build on experiences from previous translocations while incorporating species-specific knowledge, to minimise impacts to animal welfare throughout the translocation process. Here we describe how we undertook the translocation of 85 Western Grasswrens to DHI from adjacent mainland populations in Shark Bay. No adverse welfare events were recorded throughout the capture, transport or release phases of the translocation. Initial monitoring using radio-transmitters provided promising information regarding the establishment of birds in their new home, with only one post- translocation mortality recorded. Preliminary results from autonomous recording units have also confirmed the ongoing presence of animals in the release area. This project highlighted the value of a collaborative planning and execution process, and the importance of carefully considering the team structure and personnel roles and responsibilities.

Female investment strategies in a cooperative breeder: do helpers really help?

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Approximately 9% of birds breed cooperatively, whereby sexually mature individuals (subordinates or helpers) forego their own reproductive opportunities to help raise the offspring of a dominant breeding pair. Cooperative breeding is particularly common in harsh and unpredictable climates such as in Australia, possibly because helpers could buffer the impact of adverse environmental conditions on breeders. Assistance from helpers can result in improved offspring care and/or compensatory reduction in parental care by breeders, enhancing breeder survival. Such helper benefits can be hard to detect due to confounding effects of individual quality or resources: high quality breeders can allocate more resources to both reproduction and survival and will also accumulate more helpers. To disentangle breeder quality from the presence of helpers, we performed a three-year experiment in cooperatively breeding Superb Fairy-wrens (*Malarus cyaneus*). We reduced the quality of breeding females by clipping two wing feathers and investigated the effect of helpers on relative female investment in reproduction and self-maintenance. We quantified egg size, nestling size, incubation and nestling provisioning effort, and survival of experimental (clipped) and control females, with and without helpers (cross-factored design). Preliminary results suggest that clipped females reduce investment in current reproduction, laying smaller eggs and investing less in offspring provisioning, but this reduction could be buffered by the presence of helpers. Our study provides an opportunity to detect subtle helper effects on breeder investment and quantify how important helper contributions are in determining reproductive strategies in avian societies, particularly those declining due to habitat loss and climate instability.

Are Willie Wagtail (*Rhidura leucophrys*) using humans as protection against Torresian Crow (*Corvus orru*) invasion in sub-urban Papua New Guinea?

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Nest-site choices greatly influence avian reproductive performances and survival. Predation pressure with its associated risks is one of the major factors that determine nest-site selection in birds. We studied the effect of extremely prolonged dry-season induced Torresian Crow (*Corvus orru*) invasion in nest site selection by Willie wagtails in a suburban setting where we compared the nest-site/location of Willie Wagtails (*Rhipidura leucophrys*) before and during the Torresian Crow invasion of Bird Sanctuary at Pacific Adventist University main campus in near Port Moresby. Our results show the Willie Wagtails nests (N = 29) were located closer to human structures (houses/buildings, mean dist. = 4.87 m and human tracts/vehicle roads, mean = 6.93) during the invasion than after the invasion (houses/buildings, mean dist. = 17. 13 m and human tracts/vehicle roads, mean = 10 m). Concealment and height of nests, two very important microhabitats factors did not differ. Our studies suggest Willie Wagtails are probably using humans as protection against increased nest predation by the Torresian Crow. Despite this, the survival rate of the nest during the Crow invasion was just 14% compared to 80% before the invasion as the Torresian Crows are also humanized birds.

Long-term monitoring of birds in the semi-arid zone: a case study from Bowra Wildlife Sanctuary

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Bowra Wildlife Sanctuary is located in the semi-arid Mulga Lands bioregion, on the traditional lands of the Kunja people. A diversity of habitats on the sanctuary support high bird diversity with more than 220 species of bird recorded. In collaboration with Birds Queensland and volunteers, three different survey techniques have been used to monitor bird populations for the last 12 years, including citizen science techniques (daily bird lists), fixed route surveys, and annual bird banding at predetermined sampling locations. We discuss some of the key findings from this long-term monitoring program, with particular focus on three key iconic species, the Eastern Major Mitchell's Cockatoo (*Lophochroa leadbeateri leadbeateri*), Bourke's Parrot (*Neopsephotus bourkii*) and Hall's Babbler (*Pomatostomus halli*) and indicator species from three dietary guilds: insectivores, granivores and partial nectarivores. Overall bird species richness (number of species detected each year) has remained stable from 2010 to 2022. Major Mitchell's Cockatoo is the most frequently detected of the indicator species, recorded on 85.9% of observer days, with Bourke's Parrot recorded on 53.6% of days, and Hall's Babbler recorded on 31.5% of days. Capture rates of the selected insectivore indicator species have remained relatively consistent, whereas captures of selected granivore and partial nectarivores varied markedly with changes in rainfall. We compare results and findings from each survey technique, and discuss the advantages and limitations of each. We discuss the value of these results for monitoring ecological health, as well as implications in relation to current and future changing climatic conditions.

Conservation fences provide benefits to ground nesting birds

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Conservation fences are one of many strategies used in Australia to improve conservation outcomes for highly threatened species. Associated land management activities including removal of feral predators (foxes and cats) and introduced herbivores, likely provide benefits to ground active birds. In NSW at AWC's fenced Scotia Sanctuary and partnership projects with the NSW government in the Pilliga and Mallee Cliffs National Park, there is growing evidence of behavioural and population responses of some ground nesting species such as Malleefowl and Painted Button-quail. However, such responses are not consistent among all ground nesters and can vary from year to year to suggest interactions with other variables such as climatic conditions and resource availability.

Monitoring and adaptive management of bird translocations

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Translocations are a common tool for restoring ecosystems and conserving threatened bird populations. However, there is still huge variation in success rates, with many bird translocations failing, especially in large, connected habitats. Post-release monitoring is crucial for informing management and conservation outcomes. Yet there is still reluctance to committing to ongoing monitoring that supports structured decision making and adaptive management. We present research on how post-release monitoring of toutouwai/North Island Robin (*Petroica longipes*) in Aotearoa NZ has informed management and improved conservation outcomes. Following translocation, intensive post-release monitoring was undertaken to update prior predictive models of population growth. Monitoring detected patterns of dispersal and habitat selection that has helped identify core habitat areas for management. The first breeding season had lower than expected nesting success and adult survival due to predation by invasive ship rats (*Rattus rattus*), which could cause potential translocation failure if management changes were not implemented. Guided by monitoring, we implemented immediate changes to management to try to improve the translocation outcome. This involved deploying an intensive baiting regime targeting ship rats within core breeding habitat and increasing the trap network across the larger dispersal range. Monitoring from the second breeding season confirmed that management actions had successfully improved vital rates. Ongoing monitoring will continue to inform this translocation, and allow for more efficient, targeted management that supports population persistence. We show how vital it is to develop effective and consistent monitoring strategies so that changes to on-ground management can be quickly implemented to support bird translocations.

Reproductive strategies in the Superb Fairy-wren: older males are attractive, but do they produce quality sperm?

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Strict monogamy is rare, especially in songbirds. In many pair-bonded species, males can obtain extra-pair paternity, which involves not only acquiring copulations with extra-pair females, but also outcompeting the sperm of other males. Thus, siring extra-pair offspring requires pre-copulatory investments such as ornamentation to attract females, and post-copulatory investments such as sperm quality and quantity to win sperm competition. However, the relationship between pre- and post-copulatory investments is not well understood. Here, we test two competing hypotheses: (1) sperm competition theory, which predicts a trade-off between pre- and post-copulatory investments, and (2) the phenotype-linked fertility hypothesis, which states that pre-copulatory traits such as sexual ornaments act as signals of male fertility to females. We studied free-living Superb Fairy-wrens (*Malurus cyaneus*), which exhibit extremely high extra-pair paternity. Male attractiveness is determined by the annual timing of his moult into breeding plumage, and the earliest-moulting males will acquire most extra-pair copulations. We followed 40 males over two breeding seasons and collected data on moult date, sperm number, sperm morphology, and sperm swimming speed. We found that earlier-moulting males produced shorter, slower, less competitive sperm, which provides support for sperm competition theory. Additionally, sperm number, as well as morphological sperm components associated with swimming speed, both increased with the proportion of fertile females in the population, suggesting that, when there are greater opportunities for copulation, males invest not only in sperm quantity, but also quality. Our findings underscore the growing appreciation of the role played by sperm quality in shaping male reproductive strategies.

Fear, flight, and fitness: The adaptive significance of escape response in Hooded Plovers, *Thinornis cucullatus cucullatus*.

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This research project investigates the adaptive nature of flight initiation distances (FID) in the Threatened Hooded Plover *Thinornis cucullatus cucullatus*, i.e., the distance at which they initiate escape in response to an approaching threat. Escape responses in birds are critical to avoid predators and are therefore expected to be under strong selection to improve survival. Previous work on FIDs has consequently assumed that differences between individuals and species in escape responses have an adaptive evolutionary basis, but this research is explicitly testing this assumption. Specifically, it is addressing a key issue in escape ecology, by examining how FID is linked to survival and individual fitness (longevity and reproductive success) in environments associated with different levels of human impact, as well as the examining the heritability of FID. Understanding these relationships is a crucial aspect for identifying how threatened bird species, such as the hooded plover, adapt to human-induced disturbance, and whether they can mitigate these impacts by evolving their anti-predator responses. Overall, this research provides insight into how different human and predator pressures influence escape behaviour, and how this relates to the survival and reproductive success of the Threatened Hooded Plovers. This can be used to inform management practices within hooded plover habitat, particularly to ensure appropriate and meaningful implementation of buffer zones for planned development and ongoing threats.

To flee or not to flee: cautiousness in the Eurasian Blackbird and Song Thrush

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More colourful birds are often more cautious (wary) than duller ones. Being colourful may increase predation risk due to increased conspicuousness (visibility) to predators. Therefore, more colourful birds are predicted to be more cautious to compensate for their higher predation risk (the 'compensation hypothesis'). Studies of birds where the sexes differ in colouration usually support the compensation hypothesis, finding that colourful males are more cautious than duller females. However, another possibility is that female birds are less cautious than males because they invest more time and energy in reproduction, which could limit their ability to be cautious. I tested these theories in the Eurasian Blackbird (*Turdus merula*) and Song Thrush (*Turdus philomelos*) by recording the cautiousness of birds which varied in colouration at the species, sex, and individual levels during the breeding and

non-breeding seasons. Cautiousness was measured as vigilance while foraging and escape behaviour in response to a potential threat. I found that breeding birds, especially females, were less cautious than non-breeding birds, but that more colourful birds were not more cautious than duller ones. In this presentation, I will discuss my findings and their implications for the relationships between colouration, reproduction, and antipredator behaviour in birds. I will also address how the study species being non-native to Aotearoa/New Zealand and in a highly urban environment may have affected my results.

When more litter is a very good thing: parasitic plants boost insectivore prey availability in semi-arid woodlands

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Evidence is mounting that insects and the insectivores they sustain are undergoing declines worldwide. To discover more about relationships between occurrence patterns of insectivorous birds and insects, and evaluate determinants of prey availability, we studied three semi-arid woodlands, quantifying visitation rates of insectivores and evaluating litterfall, litter composition, soil health and arthropod availability for 11 tree and shrub species, representative of the characteristic plant groups of Australian woodlands. Three parasitic species (Australian sandalwood, quandong and leafless cherry) were twice as likely to be visited by insectivores (timed watch and camera trap data) as other plants of comparable dimensions, generated three to five times more litter, boosting availability of macro and micronutrients in topsoil which sustained three times more invertebrates, especially those groups known to be favoured insectivore prey. Combined with microclimatic data which demonstrated the high water content of parasitic shrubs led to ameliorated conditions during summer, these findings extend prior work on aerially-parasitic mistletoes to their root parasitic relatives. In arid and semi-arid systems that are characteristically low in productivity, we demonstrate that parasitic plants boost heterogeneity via small-scale nutrient subsidies, concentrating limiting resources into productive patches where insectivores preferentially forage. Reducing commercial harvesting of sandalwood and including parasitic plants in revegetation initiatives are essential to safeguard insectivores and avert further declines.

Begin the clock: uncovering the influence of circadian rhythm on avian development

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Among all taxa, birds are widely recognised for utilising circadian time keeping to schedule their daily cycles. Birds can time keep thanks to the entrainment of their circadian system to environmental cues, which governs the timing of most, if not all, physiological and behavioural processes. Yet, despite our growing understanding of circadian rhythm in adult birds, fundamental knowledge on the influence of circadian rhythms within avian embryos is poorly known. In insects and fish, evidence suggests that embryos can entrain the timing of life transitions during early development to a circadian rhythm. Here, we present results from an experiment testing the influence of circadian rhythms of light and temperature on avian development, in which Domestic Chicken (*Gallus gallus domesticus*) eggs were exposed to factorial combinations of lighting and temperature cycles. First, we test the hypothesis that avian embryos utilise environmental cues to time their hatching, optimise hatching synchronization and maximise potential fitness. Second, we test the potential influence of environmental rhythms on mitochondrial function, which generates the energy needed for growth and development in avian embryos. To conclude, we discuss the significant implications of our research. In particular the role of changing light and temperature regimes in influencing the growth and development of wild Australian birds and nestlings.

Low tide site use and feeding ecology of threatened migratory shorebirds in two Ramsar-listed NSW estuaries

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Migratory shorebirds have experienced significant declines in NSW estuaries over the past few decades. The Hunter and Port Stephens estuaries are recognised internationally as key areas for shorebird conservation and each host a Ramsar-listed wetland. Yet, they are also amongst the coastal estuaries that are losing migratory shorebird species the fastest nationally. Thanks to significant community effort invested in counting shorebirds at high tide roosts, we have high quality whole estuary population

estimates and good knowledge of where birds roost at high tide. However, it is equally imperative to locate and protect the sites used by these birds during the critical low tide foraging window, and to quantify the food chain that supports shorebird feeding. In this study, we undertook numerical and behavioural surveys of shorebirds at low tide foraging sites and modelled shorebird richness and diversity as a function of a range of environmental predictors. We also collected faecal samples and used DNA metabarcoding methodologies to identify the macroinvertebrate organisms consumed by two common shorebird species, the Bar-tailed Godwit (*Limosa lapponica*) and the Eastern Curlew (*Numenius madagascariensis*). We will present our findings and illustrate how these data will inform future food chain research. We are working with a range of government agencies to make sure that these findings are used to protect key low tide foraging areas within these internationally significant estuaries.

POSTERS

Where lie the lyrebirds? Predicting the potential distribution of a rapidly spreading introduced species

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The deliberate introduction of the Superb Lyrebird to Tasmania in the 1930s for protection against threats to their native mainland Australian population has resulted the species spreading into the central and southern parts of Tasmanian Wilderness World Heritage Area. Lyrebirds are ecosystem engineers known for their impacts on forest-floor restructuring, and as such, their occupation of new areas raises management concerns. In this study, we investigated the regional, landscape, and vegetative drivers of lyrebirds' occurrence in their novel range. We developed a novel spatially explicit stochastic dispersal-diffusion model to forecast the timing of future spread of lyrebirds across currently unoccupied regions of Tasmania. Using citizen science data, camera-trap detections, and species distribution models, we found that the open-temperate forests of western Tasmania are ideal, well-connected habitat for Lyrebirds. The availability of extensive, unoccupied habitats across western Tasmania means that lyrebirds will likely become widespread and abundant through this region. Our spatially explicit stochastic dispersal-diffusion model projects that Lyrebirds will spread and establish across most suitable habitats in the west by the year 2095. We present a novel modelling framework that uses citizen science data, camera detections and species distribution modelling to predict at-risk regions of spreading species, enabling effective monitoring, and potential control. Using the Superb Lyrebird as a case study, we show how management and impact assessment can be targeted within the periphery of species' expanding range boundary. This approach has broad applications for the monitoring and management of other spreading, and potentially invasive, species.

How do Southern Emu-wrens respond to noise pollution?

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Traffic noise is prevalent in environments worldwide and studies have shown that traffic noise negatively influences a range of animal behaviours including reduced foraging, sleeping and breeding, plus increased vigilance and movement. Disturbance behaviour may differ between populations of a species and investigation is required to better understand potential behavioural adaptions to disturbance within a species. This study asks whether anthropogenic noise has a negative effect on patterns of territorial behaviour of the Threatened Southern Emu-wren (*Stipiturus malachurus*), and whether these patterns differ across geographically isolated sub-species in South Australia. The study uses an experimental design, observing change in behavioural responses to conspecific playback (a potential territory threat) in the presence and absence of traffic noise. We predict that resident birds have a delayed response and increased investigative behaviour (calls, movement, time out of cover, and time by the speaker) to playback with traffic noise, indicating potential signal masking. Preliminary analyses suggest that Southern Emu-wren respond less frequently to playback when traffic noise is present and latency of response may vary between sub-species. This information is crucial to understanding the effects of geographic isolation on behavioural responses to anthropogenic influences and highlights the importance of conserving behavioural adaptations between isolated populations/sub-species.

Social information can alter the effect of habitat fragmentation on bird diversity and improve its stability

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Habitat fragmentation is considered to be one of the greatest threats to biodiversity of our time. However, there are few studies addressing how the different measures of biodiversity (namely – taxonomic, phylogenetic and functional diversity) react to the habitat fragmentation when comparing one to another. There are also few studies addressing the question of how the effects of habitat fragmentation could be mediated by the social public information. Our goal was to examine how the measures of biodiversity of bird communities in forest patches change with the increasing isolation of those patches, and how those changes could be mediated by manipulating social information. To answer that question, we have inspected over 150 forest patches in Central Europe. For each bird community inhabiting a given patch, measures of phylogenetic and functional diversity were calculated. After that we have conducted a large scale behavioral landscape experiment, where we have broadcasted a different types of social information (songs of similar species, voices of predators, neutral sounds etc) on those stands. As expected, different measures of diversity reacted in a different way to changing the values of parameters describing stand features and its isolation. Social information proved to be able to mediate the effects of patch size and isolation. Our research helps to understand the importance of individual patches of forest habitats in the farmland for the preservation of biodiversity.

What do leg bands tell us about pair bonds and dispersal in Glossy Black-Cockatoos?

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Leg banding birds can yield data over long periods of time, and can provide insights in to movements over an individual's lifetime. Here we outline the results of a long-term leg banding program with South Australian Glossy Black-Cockatoos on Kangaroo Island. Re-sighting data was collected over a 10-year period between 2013 and 2022. In total, 598 Glossy Black-Cockatoos were banded between 1995 and 2022, and during our 10-year study period we recorded 548 band re-sightings from 189 individuals. Glossy Black-Cockatoos were observed forming long-term pair bonds, and in each instance where both individuals in a pair had bands and were identified (n = 30), the male was always at least 2 years older than the female of the pair (mean 4.5 years). The distance between where an individual was sighted and its natal nest was recorded for each re-sighting record. The mean distance from natal nest recorded for re-sighted individuals was lower during the first two years of life, indicating individuals dispersed further distances from the age of two. The mean distance from natal nest also varied significantly when sightings were grouped according to natal nest site, indicating individuals from some nest sites were more likely to move larger distances in their lifetime. Our data suggests dispersal distances in Glossy Black-Cockatoos varies depending on which geographic region a nestling fledges from on Kangaroo Island. We discuss possible reasons for differences in dispersal distances between different regions of the island.

Monitoring the responses of waterbirds to flows in the NSW Murray-Darling Basin

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Waterbirds are an important indicator of wetland health. Their diversity and abundance reflect the broad-scale availability of productive aquatic habitats that support their breeding cycles and provide sufficient food resources. Long-term monitoring of waterbird populations provides important information to assess changes and impacts to wetlands, such as those caused by river regulation which is recognised as a key threat to waterbird communities. Since 2012, we have been undertaking waterbird surveys in significant floodplain wetlands across the Murray-Darling Basin as part of the NSW Water for the Environment Monitoring and Evaluation Program. The monitoring is part of a large collaborative effort by government agency staff, researchers, non-government organisations, and volunteers. Each spring, we survey 185 sites (9,300 ha in survey area) in nine wetland regions including the Gwydir Wetlands, Narran Lakes, Macquarie Marshes, Lower Lachlan, Lowbidgee Floodplain and Mid Murray. We collect data on waterbird species richness, abundance, and breeding activity. The monitoring data is used to assess progress towards national and state objectives and targets for key wetland areas, and to support management

of Ramsar wetlands and sites managed as part of NSW National Parks Estate. Information about the location, size and stage of active colonial waterbird breeding sites is also used to inform environmental water delivery over spring and summer. Our long-term monitoring data provide relevant information to support environmental water management, which is essential for maintaining the health of wetland habitats, and for providing foraging and breeding opportunities for a range of waterbirds, including threatened and migratory species.

Radio-tracking cryptic threatened birds in a fire affected landscape, Kangaroo Island South Australia

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Understanding how animals move through their landscape - to access food, shelter and breeding resources - is critical when managing wildlife, even more so for threatened species impacted by fire. The Black Summer fires of 2019-2020 burnt over 210,000 hectares on western Kangaroo Island, South Australia, leading to a number of the island's bird species being up-listed under the EPBC Act (1999); including two cryptic species, the Endangered Kangaroo Island Western Whipbird (*Psophodes nigrogularis lashamri*) and the Western Bassian Thrush (*Zoothera lunulata halmaturina*). Both species are notoriously difficult to observe, with no data on key habitat characteristics or home range size, which makes it difficult to accurately monitor or estimate their population sizes and recovery post-fire. We trialled a rubber band harness designed specifically for species inhabiting dense vegetation, as neither species had been previously radio-tracked. Sample sizes were small given the extreme difficulty in catching both species (n = 2 whipbird, n = 2 Bassian Thrush), however valuable information on ease of harness attachment, transmitter retention (14-22 days), breeding biology, and mortality was collected over a short time period, and showed the feasibility of radio-tracking whipbirds and Bassian Thrush for future studies, or after major fire events.

Short-term response of Kangaroo Island's endemic birds to the Black Summer fires

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The catastrophic wildfires that swept across eastern Australia during the Black Summer of 2019-2020 were unprecedented in their size and impact on both biological communities and the environment. Although the scale of the South Australian fires were not as extensive as those experienced on the east coast their proximity to densely populated areas and areas of conservation importance made their impact just as severe. The Kangaroo Island Fire burnt over 210,000 hectares, just under half of the island. The western half of the island is ecologically important for the islands' unique biota, retaining relatively high coverage and quality of native vegetation. The island is home to 17 endemic bird subspecies, plus a number of mainland species faring considerably better than their mainland counterparts. To test the fires' impact on the island bird community we surveyed 104 transects across the fire scar in burnt and unburnt vegetation over a 29-month period (May 2020 - October 2022). Results from the generalised linear mixed-effect models show a negative relationship between unburnt to severely burnt vegetation and effective species numbers. Recolonisation of burnt habitat was immediate for some species (i.e., Kangaroo Island Shy Heathwren, *Calamanthus cautus halmaturina*), within 12-months post-fire (i.e., Kangaroo Island Western Whipbird, *Psophodes nigrogularis lashamri*) or not as yet for others (i.e., Kangaroo Island Southern Emu-wren, *Stipiturus malachurus halmaturinus*). Understanding how species respond to fires of this scale is vital for their recovery, highlighting which species might be of greater conservation concern and how managers might aid recovery and protect future populations.

Species distribution model reliably predicts the distribution of a key habitat resource for the Endangered Forty-spotted Pardalote.

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In conservation, the use of unvalidated models to inform management has the potential to impede project success, waste resources and inhibit species recovery. Using independent, field-collected data, we conducted a validation of a species distribution model for White Gums (*Eucalyptus viminalis*), on mainland Tasmania. White gums are the preferred food tree of the Endangered Forty-spotted Pardalote (*Pardalotus quadragintus*), a songbird endemic to Tasmania for which reintroduction has been proposed

as a future management strategy. Validating this model is a crucial step in the process of identifying high quality habitat for possible translocation. We visited a total of 63 sites within areas of high, medium and low probability of white gum occurrence to confirm the species presence. Overall, the model performed well under field validation. White gums were present at 38 of 63 sites in the field. A generalised linear model confirmed that the distribution model successfully predicted variation in white gum presence and absence across our sites. Given that the model included only bioclimatic data, it therefore did not predict finer scale habitat elements, including the abundance of large white gums or the availability of nest sites. We recommend that future efforts seeking to identify potential reintroduction sites focus on areas with high modelled white gum probability (>0.8) and focus on locating areas that also satisfy these other key habitat elements. These results provide baseline information that will inform targeted habitat assessments for the reintroduction of the Forty-spotted Pardalote.

Presence of plastic pollution on seabird islands: identifying hotspots for Toanui/ Flesh-footed Shearwaters

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Through their ingestion of plastics whilst foraging, seabirds act as vectors of plastic transmission from the marine environment to their terrestrial breeding grounds. Previous work almost a decade ago showed that the seabird colonies on Ohinau Island off the Coromandel Peninsula was a hot spot for plastic pollution within New Zealand. Here, we report on the incidental plastics found at, or near to, burrows while undertaking routine population monitoring of Toanui/Flesh-footed Shearwaters (*Ardenna carneipes*) on Ohinau and Lady Alice Island (within the Hen and Chicken Island chain, Northland) during the 2021/22 breeding season. Additionally, we report on the lack of plastic debris found whilst undertaking a Flesh-footed Shearwater population census on Titi Island within the Marlborough Sounds during the 2021/22 breeding season. We show that the seabird colonies on Ohinau Island continue to be a hotspot for plastics, whereas only a handful of plastics were recovered from Lady Alice Island. The Titi Island seabird colonies thus far appear to be untouched by plastic pollution. We discuss possible reasons underlying these island differences and discuss the importance of monitoring plastics across seabird colonies in New Zealand.

Corticosterone responses and the sensitivity of kororā (Little Penguins; Eudyptula minor) to stimuli from the environment

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When birds perceive a situation to be threatening the glucocorticoid hormone corticosterone is secreted. The size of the corticosterone response of a bird is a measure of the sensitivity of the bird to stimuli from the environment. In the current study, we found marked individual variation in corticosterone responses of Kororā (Little Penguins). We described the complete time course of Kororā corticosterone responses, measured corticosterone responses in chicks, and determined corticosterone responses of penguins to exposure to sounds and to a novel object. For the time course study, we collected blood samples from Kororā following our standard protocol, returned penguins to their nest boxes 60 min after the first blood sample, and then collected an additional blood sample up to 360 min later. Mean corticosterone concentrations declined to initial values two hours after birds were returned to nest boxes. This is the first report of the complete time course of the corticosterone response of a penguin species. Corticosterone responses of Kororā chicks increased with age and by the time of fledging were similar to responses of adults. Exposure of penguins in their nest site to the sound of human talking or the sound of dog barking (dogs are predators of Kororā) did not initiate corticosterone responses, whereas exposure to Kororā alarm calls and to a novel object in the nest site both elicited responses. Thes results show that penguins at their nest site did not perceive the sound of a predator to be a threat.

Breeding Biology of the Black Swan (*Cygnus atratus*) on the Gold Coast, Queensland, Australia from 2007 to 2021

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The breeding biology of the Black Swan (*Cygnus atratus*) was studied in sub-tropical Australia from 2007

to 2022, in a study area on the Gold Coast in South East Queensland. The study aimed to identify factors influencing recruitment to the breeding population and evaluate the factors impacting reproductive success in this species. The number of pairs has increased since the study started rising from 20 pairs in 2007 to 61 pairs in 2021 with a maximum of 78 pairs recorded in 2020. The increase has occurred in both breeding and non-breeding pairs. The number of successful breeding attempts has also increased over time with 18 breeding attempts in 2007 rising to 52 in 2021. Almost 40% of pairs breed two or more times per calendar year with 3% of breeding pairs making 5 nesting attempts in a single year. Over time the number of cygnets hatched and reared per breeding attempt has also increased. Pairs have been recorded as hatching cygnets in every month of the year with a peak in hatching recorded in the Austral winter. In some years the breeding season extends over the whole year and in others may only occur over a three-month period. The reasons for these variations are unknown and require further investigation. Only 34% of cygnets banded entered the paired population and birds first pair from two and three years old and first breed in their third and fourth years. Recruits to the paired population are not significantly larger or smaller than their non-breeding counterparts but are significantly heavier.

The Eungella Four

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The birds know Eungella in central Queensland is special. That's why there are four birds found nowhere else in the world but that thin strip of forest at the top of the escarpment. This poster gives some insight into the special birds in this special place.

Impact of urban afforestation on native bird communities in New Zealand: insightsfrom the Mangemageroa Reserve

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Restoring degraded and fragmented habitats presents challenges like species re-colonization failure and ecological traps. While habitat restoration is assumed to restore biodiversity, full recovery of pre-disturbance biodiversity in restoration projects needs to be documented. Therefore, understanding early-stage animal-plant interactions is crucial in conservation projects. Urban afforestation and blue-green infrastructure management have positively affected native species worldwide. This study explores how urban afforestation affects native bush bird communities in New Zealand. The research site in Mangemageroa Reserve offers a diverse habitat (primary forest, self-regenerated bush, and replanted areas) with a restoration history of 23 years. We conducted a series of bird counts in areas at different stages of maturity (N=286) and compared species compositions across the vegetation types. Preliminary results revealed varying abundance and species richness across different habitats. Unsurprisingly, bird sightings were highest in spring and summer, decreasing in winter. There were more individuals of introduced species in all habitats. However, alien bird abundance decreased as the restored habitat resembled the primary bush. Multivariate analysis showed that the primary forest bird community was distinct from communities in self-regenerated and replanted areas, highlighting challenges in achieving pre-disturbance biodiversity recovery. Generalised linear mixed models will be employed to determine the significance of planting age on bird presence in the ongoing data collection.

Conservation genomics of Kuaka Whenua Hou/Codfish Island Diving Petrels

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Kuaka Whenua Hou/Codfish Island Diving Petrels (*Pelecanoides georgicus whenuahouensis*) represent an Aotearoa New Zealand endemic subspecies of the South Georgia Diving Petrel (*P. georgicus*). Restricted to a single colony in a 0.018 km2 dune system, Kuaka are at risk of extinction due to climate change and population dynamics associated with small population size. In addition, Kuaka have been observed to hybridise with Common Diving Petrels (*P. urinatrix*) that co-occur on Whenua Hou. With conservation management of this seabird likely to include translocations to establish additional populations beyond the current species range, we employed whole-genome resequencing methods to assess the current extent of genomic diversity remaining in this Critically Endangered subspecies. We first sequenced and assembled a draft Kuaka genome assembly using PacBio HiFi technology for use as a reference in population-level analyses. We then generated whole-genome resequencing for 40

Kuaka and 28 Common Diving Petrel samples collected from Whenua Hou. Following alignment of the population-level data to the draft Kuaka genome assembly and additional data processing, preliminary analysis of 8556 single nucleotide polymorphisms (widely used genomic markers) reveals moderate interspecific differentiation, and relatively lower diversity among Kuaka than the more numerous and widespread Common Diving Petrels. By determining the current baseline of genetic diversity, we will be able to understand the impacts of initial translocations on both the existing and any newly established populations, which may help to inform additional future translocations.

The global distribution of saproxyly in birds

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Saproxylic species, including microbes, fungi, plants, and animals, are integral parts of wood decay systems, delivering crucial ecosystem services such as wood decomposition, nutrient cycling, and carbon stocks, and constituting an important reservoir of biodiversity. However, the species association with wood decay, here termed "saproxyly", has never been explored on a broader taxonomic level. Here, we reviewed both scientific and popular sources to systematize saproxyly in birds as a whole, and we identify the diversity, evolutionary history, biogeography, and extinction risk of saproxylic avian species. First, by reviewing the scientific literature, we show that avian saproxyly might be perceived as foraging on invertebrates living in dead standing trees, dead branches or fallen logs, bark or wood injuries, arboreal insect nests, epixylic structures, or sucking sap from wounded trees. Additionally, saproxyly refers to birds nesting in excavated, fungi- or abiotic-formed tree holes (mainly in dead standing trees) or using uprooted trees as shelters or camouflages. Second, by summarizing the online handbook Birds of the World and correcting for research biases, we estimate that saproxyly can be attributed to a significant proportion (~16%) of avian species. Third, we show that saproxyly is well conserved in avian phylogeny and taxonomy, suggesting that it evolved gradually but independently in several lineages. Fourth, saproxylic species are more likely to be found in temperate and tropical forests, neotropics, and afrotropics, indicating that these regions are important hotspots for saproxylic species and over-averagely complex wood-decay systems. Sixth, we also demonstrate that saproxylic species face an over-average extinction risk, indicating a serious threat not only to birds but also to other associated (saproxylic) organisms and healthy wood decay systems. Our study points out the knowledge gaps that urgently need to be addressed to recognize the position of saproxylic biota in global ecosystems. We also provide *SaproxylicBirds*, a species-level database to consider avian saproxylic species in further multidisciplinary studies.

The Temperate Woodland Bird Conservation Action Plan: Ensuring a brighter future for woodland birds of south-east Australia

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The Temperate Woodland Bird Conservation Action Plan (TWB CAP) 2020 is a multi-stakeholder partnership, lead by BirdLife Australia, which addresses key threats, contributing to woodland bird declines across south-eastern Australia. Nationally 1/3 of Australia's woodlands (80% of temperate woodlands) have been cleared, leaving fragmented or degraded remnants as poorly represented habitat in need of active management. The vision of the TWB CAP is to protect, recover and stabilise woodland bird populations. It identifies landscape scale interventions that will conserve habitats and manage threats. It draws on National Recovery Plans, research and knowledge from conservation practitioners to set out a practical program of high-priority actions to address woodland bird declines. Fifty-one threatened or declining woodland bird species are identified as priority taxa. These are grouped into ten functional guilds (with 'flagship' species) including Shrubby-understorey Specialists (Speckled Warbler), Bark and Foliage Gleaners (south-eastern Brown Treecreeper) and Hollow-dependent Parrots (Swift Parrot). A Steering Group, spanning five States and the ACT, works together to identify and address key initiatives, knowledge gaps and promote key actions. The TWB CAP provides a framework that underpins BirdLife's Birds on Farms program and supports regional groups that aim to protect woodland bird habitat.

A bird in the hand reveals the impacts of drought on avian demography and diversity

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Birds of arid and semi-arid regions face increasing pressures as climate change influences the duration and frequency of extreme droughts. Changes in vegetation cover due to decreased rainfall can greatly impact resource availability for both resident and nomadic species, however the impacts on a species' demography can vary vastly depending on their ecology. As such, there is a requirement to understand how the population dynamics of different taxonomic and functional groups respond to the boom-bust cycles of these regions. Satellite-derived vegetation indices provide a means for understanding changes in habitat structure and productivity in response to environmental conditions and can be a good indicator of bird species richness. This study explores the relationship between vegetation change and bird populations through a combination of remote sensing and long-term (10 year) capture data in the Mulga Lands of Western Queensland. We examine vegetation dynamics and changes in climatic conditions over the study period, to test the relative importance of environmental variables in driving the response of different functional groups. Linear models were used to explore the relationship between diversity and demography metrics (Species Richness, Abundance, Functional Diversity, proportional juvenile rates), and changes in vegetation cover (NDVI, SAVI) through a drought cycle. The results of the study will provide insight into the role of environmental conditions on the population dynamics and response of arid zone avian species.

How urbanisation and greenspaces affect encounters with birds in Brisbane

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Increasing urbanisation as more people move to live in cities can have significant impacts on urban biodiversity and human-wildlife interactions. Birds are a popular group that can adapt to city habitats, particularly generalist species. People regularly engage with birds in cities through recreational activities such as bird watching. Increasingly these encounters are made available through digital records, for instance, citizen science and social media. The aim of this study was to explore patterns in people's engagement with birds in Brisbane, a highly bird-diverse city, through digital records. More specifically, it examined whether greenspace and human footprint affected where people encountered birds. We used records from the Atlas of Living Australia, eBird, iNaturalist and Flickr of encounters with birds in Brisbane and examined their spatio-temporal relationships with greenspace and human footprint through GLMs and other analyses. Encounters with over 95% (356/374 species) of the birds known to occur in Brisbane were recorded by the citizen science and social media platforms. Overall, encounters were recorded from across the entire city but there were differences in encounter hotspots depending on the data source. Social media data were more strongly associated with high human footprint areas while ALA and eBird data appeared to reflect areas of higher bird diversity associated with higher vegetation cover. Our results highlight how the human-bird encounter records on citizen science and social media platforms can be used to measure human-wildlife engagement and can potentially be used to monitor how birds respond to urbanisation over time.

Penguins, pups and predators: non-conventional conservation using Maremma guardian dogs to protect Little Penguins on Middle Island, Warrnambool (Aus)

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A colony of Little Penguins (*Eudyptula minor*) breed on Middle Island, located in Stingray Bay, Warrnambool, Victoria. Ongoing monitoring of the population has documented the change from over 800 penguins in 1999 to 4 penguins by 2005. The introduced predator, the Red Fox (*Vulpes vulpes*), is responsible for the majority of this decline. In 2006 Maremma guardian dogs were deployed on Middle Island in a world first guardian dog conservation project now known as 'The Warrnambool Method of Wildlife Conservation.' Penguins have been monitored on an annual basis since the projects inception to inform project success and conservation management practices. The protection by Maremmas on Middle Island saw the colony recover to over 200 penguins in the 2016/17 breeding season. The project is continually adapting to new threats as they arise, including changes to both predator behaviour and climatic conditions. Foxes are becoming bolder around humans and active during the day. On one occasion, a fox braved the rough conditions and swam to Middle Island resulting in a significant decline in the penguin population in August 2017. Ongoing monitoring suggests climate change is another

possible threat to the colony and the potential cause of changes to the once predictable annual cycles of Little Penguins that current conservation practices are based on. As such, continued monitoring of the population and investigation into how these conditions drive Little Penguins is important for informing ongoing management of the colony as threats continue to evolve and potentially form synergistic effects.

Seabird monitoring in the Capricorn Bunker Island Group - Wedge-tailed Shearwaters

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Automated monitoring techniques have become highly popular in recent years owing to their capacity to reduce high costs and labour, access to remote locations and invasion of sensitive habitat in estimating seabird populations at breeding colonies. Bioacoustic monitoring has seen particularly widespread use with many successful applications. However, regular plot-based sampling required to cross-validate bioacoustic data can make this method unsuitable in remote and sensitive habitats such as densely burrowed Wedge-tailed Shearwater (*Ardenna pacifica*) colonies on offshore islands of the Great Barrier Reef. Here, we demonstrate the use of autonomous camera trapping to collect cross-validation data for Wedge-tailed Shearwater (WTS) colonies to mitigate issues associated with plot-based monitoring. This technique takes advantage of the predictable diurnal foraging behaviour of WTS and their tendency to utilise 'runways' that naturally corral the population into easily monitored locations. Camera traps can reduce time, costs, and risks to the colony associated with invasive techniques by monitoring these runways and automatically uploading data to databases. This timely study offers improved techniques of monitoring populations of WTS, a species recently listed under legislation as Vulnerable in Queensland. Our findings offer improvements in effectiveness, invasiveness and efficiency in monitoring of the breeding success/population trends that enhance the capacity of managers to conserve WTS populations and potentially other species with similar behaviours.

Got a noisy miner problem? Here are your options

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Native but highly aggressive, noisy miners exclude dozens of similar-sized and smaller birds from the territories they occupy, including threatened species. Noisy miner occupancy and domination of woodland habitat throughout eastern Australia is a worsening conservation problem and is recognized under Australia's Environment Protection and Biodiversity Conservation Act as a Key Threatening Process (KTP). Under the EPBC Act, Threat Abatement Advices (TAA) are tools that identify actions required to help abate KTPs. TAAs are most useful if they are tailored to the needs of practitioners - in content, language, and format. We translated published research and expert knowledge to prepare a TAA for the KTP Aggressive exclusion of birds from potential woodland and forest habitat by over- abundant Noisy Miners (*Manorina melanocephala*). We created a series of simple decision trees providing guidance on how to identify which management interventions to apply in various circumstances, based on a site's habitat structure, floristics, the overarching management objectives, and resource availability. We designed decision trees to be concise, easily digestible and used by anyone - irrespective of their previous experience managing noisy miners. The decision trees are further supported by an accessible literature review. We present a summary of the TAA, including how to identify whether a Noisy Miner 'problem' exists, and the decision trees with worked examples demonstrating their use. We provide recommendations for development of data and knowledge syntheses such as this to support a more streamlined translation of research into management advice.

Distributions of Australia's terrestrial bird communities: a step towards the improved integration of faunal communities in conservation

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Attention has been increasingly shifting towards the conservation of whole communities and ecosystems. However, current work is biased towards vegetation communities and assumes other taxa will naturally be encompassed under this approach. This may poorly represent faunal communities; animals are affected by different threats and ecological factors than plants, thus they may exhibit different ecological patterns. To address this gap, a preliminary typology of Australia's terrestrial bird communities was drafted by

using cluster analysis on surveys from BirdLife Australia to identify distinct groups based on their species compositions. These survey data were then inputted as presence data into a series of Maxent models to create maps identifying predicted suitable habitat as a proxy for the distribution of each community. This project, to our knowledge, is the first attempt at mapping bird communities on a continental level and provides insight into how these communities relate to specific habitats and vegetation communities.

Birds queensland citizen science surveys at Sundown National Park

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A review of progress on surveys using GPS to more accurately locate birds in the different habitats around a 4km circuit, which includes riverside and ridge-top situations. The results from the last six and a half years are mapped against the various habitats and can show the significance of this area on a major divide in regional ecosystems and topography. A number of field recording techniques have been used to improve the accuracy and better understand these less familiar habitats. The site is located about four hours drive south-west of Brisbane.

Birds Queensland citizen science surveys at Sandgate

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A review of progress on regular surveys over the past three years at Dowse Lagoon, set in the midst of suburban Sandgate. This has been done in partnership with Keep Sandgate Beautiful Association (KSBA), and involves monitoring six different segments around the lagoon. It utilises an expertise within KSBA which is involved in bushcare on this site and has a number of experts familiar with the local vegetation. Mapping and graphs are used to find patterns of bird behaviour which may assist in environmental management of this Reserve.

Cooperative breeding in a plural breeder: the Vulturine Guineafowl (*Acryllium vulturinum*)

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Cooperative breeding is widely reported across the animal kingdom. In birds, it is hypothesised to be most common in altricial species (where chicks are dependent on parental care in the nest after hatching), with few described cases in precocial species (where chicks are more independent immediately after hatching). However, cooperative breeding may also be more difficult to detect in precocial species and therefore has been overlooked. In this study, we investigate whether vulturine guineafowl (*Acryllium vulturinum*)—which have precocial young—breed cooperatively and, if so, how care is distributed among group members. Using data collected from colour-banded individuals in one social group of vulturine guineafowl over three different breeding seasons, we found that multiple females can simultaneously attempt to breed within a group. Broods had close adult associates, most of which exhibited four distinct cooperative breeding behaviours: babysitting, within-group chick guarding, covering the chicks, and calling the chicks to food. Further, we found that offspring care is significantly male-biased, that non-mother individuals provided most of the care each brood received, that breeding females differed in how much help they received, mothers also provided a small proportion of the total care that the offspring received and that carers pay a foraging cost when providing care. Our results confirm that vulturine guineafowl are cooperative breeders, which they combine with an unusual plural-breeding social system. Our study also adds to growing evidence that cooperative breeding may be more widespread among species with precocial young than previously thought, thereby providing a counterpoint to the altriciality-cooperative breeding hypothesis. The impact of the 2011 and 2022 floods on birds at Oxley Creek Common

Long-term ecological data confirm and refine conservation assessment of Critically Endangered Swift Parrots

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Swift parrots are one of Australia's most endangered birds yet the interactions of their major threats – habitat loss and an invasive predator - are not well understood. The Swift Parrot was the first and only bird listed as Critically Endangered in Australia based on population viability analysis (PVA). How reliable were modelled projections in context of unabated threats and ongoing population monitoring? We use PVA, ten-years of data and new habitat information to re-evaluate the accuracy of the earlier conservation assessment. First, we updated a range of life history parameter estimates, and then we repeated the same PVA as per the original conservation assessment. We identify that high forest landscape integrity and abundant hollow-bearing trees best predict nest daily survival rates. Based on the updated PVA, we predict a 92.3% population decline over three generations (11 years). This supported the predictions of the original conservation assessment, and the main benefit of the additional data was improved confidence in projections (the magnitude and direction of the population decline were similar between the original and updated PVAs). We show that PVAs based on imperfect data can predict accurate trends for threatened species. Given that rare species are inherently limited by data availability, our results support using population modelling for making accurate projections and informing conservation assessments for species.

The impact of the 2011 and 2022 floods on birds at Oxley Creek Common

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There are many studies of the impact of catastrophes on birds in Australia, especially fire, but very few for floods. I counted birds for a year before and after two separate floods that entirely innundated Oxley Creek Common, Brisbane, Australia, in 2011 and 2022. The long term impact on most terrestrial birds is negligible, although a few species that spend most of their life on the ground or in grasses and low shrubs (e.g. Brown Quail, Fairy-wrens) were significantly affected. Creating predator free refugia on high ground need floodable open space might ameliorate the impact of floods.

Archerfield Wetlands: Monitoring the impacts of the transformation from a light industrial wasteland to a suburban birding hotspot

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Oxley Creek catchment, in particular Oxley Creek Common (OCC), is one of the top birding areas in Brisbane. Archerfield wetlands is a suburban ex-light industrial wasteland on Oxley Creek, just upstream and to the south of OCC. Operations ceased approximately 10 years ago with the land only used for grazing cattle. The site has waste pits, tidal creeks, lagoons, freshwater creeks, grassland, woodland and riparian zones. It has infestations of weeds and pests. Access has been difficult, so the site has been relatively undisturbed by people and has a high avifauna diversity. Oxley Creek Transformation (OCT) has been tasked with the rehabilitation of this site along with other Oxley Creek catchment sites. In Archerfield Wetlands this has involved the construction of tracks, creek crossings and seating, a district park (playground, BBQ, toilets, picnic spots etc); weed and pest control and plantings. The site is flood prone with one flood event since the project commenced. OCT was interested in monitoring the impact of the development on site biodiversity. Led by Birdlife Southern Queensland, a monitoring program of structured avifauna surveys on 8 transects has been conducted 4 times per year for 2 years. While the project is still in an early stage, there are indications of impacts of development, and it is proposed that similar monitoring be undertaken at all developments in sites with high biodiversity.

The abundance of Grey Fantails at four locations in the greater Brisbane area and the relationship with winter rainfall

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The abundance of Grey Fantails over winter at four sites in the greater Brisbane area declined by an average of 71% between 2015 and 2020 and then recovered in 2021. This was significantly correlated with winter rainfall. The decline in Grey Fantails is at a local level as it has not been seen in other regions examined and there is no indication of a national decline. It is proposed that lower winter rainfall results in lower insect abundance and fewer Grey Fantails migrating into the greater Brisbane area over winter.

Addressing a significant knowledge gap: connectivity between two subpopulations of southern Eastern Bristlebird

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The southern population of the Endangered southern Eastern Bristlebird (*Dasyornis brachypterus brachypterus*) is restricted to the coastal border region of southern New South Wales and eastern Victoria. Two subpopulations are recognised: birds inhabiting the area around Howe Flat in Croajingolong National Park (NP), Victoria, and those recorded in the coastal heaths of Nadgee Nature Reserve (NR), NSW. While these two subpopulations are monitored annually, it is unclear whether they are connected as the area between them has not been systematically surveyed. Following the 2019-2020 bushfires, which burned the majority of Croajingolong NP and Nadgee NR, BirdLife Australia was funded by the Australian Government's Regional Bushfire Recovery for Multiregional Species and Strategic Projects Program to examine the occupancy and distribution of Eastern Bristlebirds in this previously unsurveyed area. The project also investigated potential habitat connectivity between the two subpopulations. Field surveys included systematic call playback and habitat assessments across the study area, as well as deployment of acoustic recorders. We recorded Eastern Bristlebirds at 21 of 87 survey sites, indicating that the species is more widely distributed than was previously thought. Our findings also suggest the two subpopulations are connected; the maximum distance between any two Eastern Bristlebird records across the study area was <1.5km, a distance that the species is known to be capable of moving in just one day. Connectivity between the two subpopulations has important implications for the genetic diversity of the southern population, as well as for recolonisation of burnt areas by the species after fire.

Maintenance of predator recognition in the critically endangered helmeted honeyeater: assessing reliability of alarm calling through call context and heterospecific response

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Loss of anti-predator behaviours in captive-bred populations is a common and major challenge to reintroduction programs, however few studies directly examine anti-predator behaviours in captive populations. One reason may be the ethical constraints of experiments on threatened species, particularly where they expose individuals to stress or physical risk. Here we demonstrate a novel approach to experiments in a captive population of the conservation dependent Helmeted Honeyeater *Lichenostomus melanops cassidix*, examining acoustic interactions in the ecological community, thereby avoiding presentation of stimuli to the honeyeaters themselves. First, we examined environmental recordings to determine if captive honeyeaters simply produce alarms in response heterospecific calls, or call independently, as expected if honeyeaters recognise predators. Second, we conducted a playback experiment to determine if wild heterospecifics consider honeyeater alarms as reliable signals of predator threat. Environmental recordings showed honeyeaters produce alarms independently of heterospecifics, suggesting they recognise and call to predators. Playback experiments found wild heterospecifics without contact with honeyeaters treated alarms no differently than controls, while those living near captive honeyeater aviaries flee to honeyeater alarms at the same rate as conspecific alarms, suggesting they consider honeyeater alarms to be reliable indicators of predator threats, and implying that honeyeaters recognise and call appropriately in response to predators despite decades of captivity. These results suggest retention of complex anti-predator behaviours in this population, in contrast to the few other studies into anti-predator behaviour in captive populations. We hope these results andmethods will encourage more studies into this crucial conservation challenge in the future.

Acoustic detection surveys of Eastern Ground Parrot *Pezoporus wallicus wallicus* using autonomous recording units in south-eastern Queensland

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Autonomous Recording Units (ARU) are increasingly being utilised in ecological studies of vocal species because they offer an opportunity to record information about focal species simultaneously over wide geographical areas for extended time periods. We undertook ARU surveys of Eastern Ground Parrot (EGP) to confirm that they offer an appropriate monitoring tool compared with traditional Observer-based Listening Surveys (OLS) for the species. We compared detection results for EGP from ARU against traditional OLS and we examined calling rates across dawn and dusk periods to reveal fine scale diurnal calling patterns and the variation that is observed across the breeding season. Our results substantiate the results of traditional OLS from previous studies and add previously underappreciated detail about calling rates in time and space.

Superb City Wrens

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The Superb City Wrens project is a partnership between BirdLife Australia, City of Melbourne, RMIT University and University of Melbourne. This is a citizen science based monitoring project, aimed at answering applied questions on the effectiveness of the City of Melbourne's targeted revegetation strategy, and understanding the behaviour and habitat preferences of small urban birds, using Superb Fairy-wrens (*Malurus cyaneus*) as a key indicator species. Focused on the Superb Fairy-wren population in Royal Park, strategic monitoring sites in existing and new vegetation have been established. Community scientists are directed to these locations to survey for a range of species, though the focus is on looking out for unique colour-banded wrens. Fairy-wrens were individually marked in order to track the dispersal of young birds through the city using these vegetation patches. The project launched in mid-2021, with the first banding taking place in November 2021. Results so far confirm Superb Fairy- wrens are successfully breeding within a restricted area of Royal Park and a subset of these birds are no longer detected within the breeding area, suggesting dispersal out of the park is occurring. However, to date few Fairy-wrens have been reported in the defined survey sites, and other than a single observation, no records of banded birds outside of the immediate banding area have been reported.

Heritability of cognitive performance in wild Western Australian magpies

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Individual differences in cognitive performance can have genetic, social and environmental components. Most research on the heritability of cognitive traits comes from humans or captive non-human animals, whilst less attention has been given to wild populations. Western Australian Magpies (*Gymnorhina tibicen dorsalis*, hereafter Magpies) show phenotypic variation in cognitive performance, which affects reproductive success. Despite high levels of individual repeatability, we do not know whether cognitive performance is heritable in this species. Here, we quantify broad-sense heritability of associative learning ability in a wild population of Western Australian Magpies. Specifically, we explore whether offspring associative learning performance is predicted by maternal associative learning performance, or by the social environment (group size) when tested at three time points during the first year of life. We found no significant relationship between maternal and offspring associative learning performance, with an estimated broad-sense heritability of just -0.004 3 0.024 (CI: -0.050/0.044). However, complementing previous findings, we find that at 300 days post-fledging, individuals raised in larger groups passed the test in fewer trials compared to individuals from small groups. Our results highlight the pivotal influence of the social environment on cognitive development.

Understanding the Status of Emerging Contaminants in Shorebirds, Waterbirds and their Ecosystems in Victoria, Australia.

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Emerging contaminants are widely distributed and arise because of various anthropogenic activities which leads to a significant impact on birdlife. These contaminants negatively influence the environment as they are known to be persistent in the food chains with transmission through interconnected species. To provide evidence of contaminant exposure or the effects of chemical pollutants, biological organisms from different trophic levels have been widely used as an indicator. However, very little research has focused on birds and only a few of the studies were conducted in the Asia-Pacific region to fully understand the effects of environment contaminants on the shorebirds and waterbirds in the Australian coastal or wetland ecosystems further research is required. The current project aims to fill those gaps by understanding the status and potential effects of different environmental contaminants by focusing on shorebird and waterbird species in three unique habitats (Phillip Island, Lake Colac and Warrnambool) in Victoria, Australia. The project also aims to develop and optimise chemical characterisation of emerging contaminants in soil, water, feathers, tissue, blood and faecal of selective bird species in order to build a platform approach to this type of analysis in complex sample matrices. The work focusses on Masked Lapwings and will be extended to Black Swans and Little penguins.

Birds on Farms Southern NSW

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BirdLife Australia's Birds on Farms program is for rural landholders, scientists, bird-lovers, and the public to learn more about birds and their habitats on private rural properties - and to use this information in woodland bird conservation and protection. The project's long-term objective is to support landholders and local communities to enhance woodland bird populations, diversity and habitats within a landscape that continues to be agriculturally productive and profitable. BirdLife provides opportunities to be involved in a range of activities including regular bird monitoring surveys and site visits, development of tailored habitat plans, training workshops and educational events, and access to partnerships and subsidies for on-ground works. Surveys are undertaken by experienced birdwatchers (landowners and/or volunteers) on private rural land. Survey plots are in a variety of natural and agricultural habitat types, surveyed using the 20 minute-2-hectare method, every 3 months. Records are compiled within BirdLife Australia's database (Birdata), with the results periodically summarised and distributed to the participants and more broadly. Birds on Farms southern NSW project began in summer 2019-20 - encompassing an area north of the Murray River from Corowa in the west to Tintaldra in the east and includes Holbrook. It has grown to include 60 properties with over 1200 surveys completed and over 190 species recorded so far. This includes 29 threatened and declining woodland bird species. Three staff members engage with passionate volunteers, landholders and partnering Landcare and community groups in the region to raise awareness of woodland birds to Save Birds. Save Life.

The development and trial of a bioacoustic survey technique for the Australian Masked OwlfGei

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The emerging field of bioacoustics is a powerful tool for understanding ecosystems and monitoring biodiversity. It has the capacity to integrate the disciplines of conservation biology and computer science to offer innovative approaches to studying animals. Bioacoustics is particularly useful for monitoring cryptic and threatened species which are at low density and difficult to survey using conventional techniques. This study, based in the Shire of Augusta-Margaret River in south-western Western Australia, used bioacoustic approaches to study the ecology and formulate new survey methodologies for the southern sub-species of Australian Masked Owl (*Tyto novaehollandiae novaehollandiae*). This nocturnal forest-dwelling raptor is cryptic, at low densities in tall forests, and is often regarded as a difficult to study species. Utilising autonomous recording units and acoustic recognition software, I developed a methodology that may be more effective than conventional survey methods, and with continuing advancements in technology may become a viable and cost-effective option. I deployed 25 autonomous

recording units around three nest sites of *T. n. novaehollandiae* at six different occasions, with the aims of characterising their spatial ecology and behavioural interactions. I then used acoustic recognition software to analyse the audio data collected. Preliminary results have shown that *T. n. novaehollandiae* may be adapting to a semi-urban environment by exploiting the presence of open fields and paddocks for hunting, while nesting in the fragmented remnants of dense forests that are scattered throughout the region. In order to test the efficacy of bioacoustic approaches, I deployed autonomous recording units at forty sites throughout suitable habitat and simultaneously compared this methodology to the conventional technique of play-back surveying at the same sites. Initial results indicate that autonomous recording units and acoustic recognition software are twice as effective at detecting *T. n. novaehollandiae* compared to playback surveys.

Elucidating the genomic differences between the Northern and Southern Giant Petrels

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Taxonomy provides the fundamental basis of understanding biodiversity. The species limits between the Northern (*Macronectes halli*) and Southern Giant Petrels (*M. giganteus*) remain unresolved. The current treatment follows the proposed split by Bourne and Warham (1956) based on subtle morphological differences and the absence of hybridisation. However, hybridisation events have been documented on islands where both taxa breed in sympatry, producing viable and fertile offspring. To understand the extent of genomic and population differentiation between the Northern and Southern Giant Petrels, 72 whole genomes from across their distribution were sequenced. Population genomics will be used to elucidate the population structure within the Giant Petrel. Genomic comparisons and selection analyses will also be done to elucidate the regions of the genome that have remained intact or have been introgressed during the evolutionary history of the Giant Petrels. As well as to understand the regions of the genome that maintain species lineages. Outcomes of this study will advise on how both species and future hybrids should be treated in a taxonomic and conservation context.