Island Ark Symposium VII

Partnering for Land, Sea and Coast

Abstracts

Phillip Island
NATURE
PARKS

Challenges and opportunities in trying times for island conservation in Victoria, Australia

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The state of Victoria faces south into the wild and cool seas of Bass Strait, lashed by ocean swell coming all the way from Antarctica. Victoria's many islands range from low sand rises nestled in bays, inlets and coastal lake systems, through to exposed and remote rugged islands of granite or basalt. The cultural and natural values of these islands are extremely rich and diverse. As with terrestrial systems, the conservation challenges are equally diverse. Pressing and overlapping issues include climate change impacts and threats, protection of tangible and intangible cultural heritage, pest and weed impacts, threatened species conservation, past and current (direct) human impacts, roles as nature refuges, indicators of ecosystem health (e.g., results of marine heatwaves), sites for arrival of climate migrating native species (including threatened species in need), access and safety issues, resourcing needs and stakeholder involvement. Recent adoption of the RAD (Resist-Accept-Direct) framework across international natural resource management is informing PV's thinking in relation to responding to ecosystem transformations and the role islands can play as prime candidate sites for 'Resist' strategies. This presentation will discuss the conservation challenges and opportunities across Victoria's diverse islands in extremely challenging times.

Implementing the Lord Howe Island rodent eradication project - project overview and planning and implementation challenges

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Eradications either succeed or fail, there is no middle ground.

In the LHI REP keynote session, former project manager Andrew Walsh will overview the project, set the scene for the session and explore the challenges in planning and implementing to eradicate every last rodent on the island. Challenges overcome and lessons learnt pre, during and post eradication include:

Technical challenges

- Multiple techniques, rats and mice, rugged terrain, keeping people and non-target species safe
- Concurrent masked owl eradication

Permitting and approvals:

- Satisfying regulatory requirements
- Court challenges
- Program delays
- Biosecurity control order

Funding

- Securing initial and ongoing funding

Logistics:

- Planning for redundancy and contingency
- Recruitment and mobilization of 120 staff
- Getting everything to a remote island
- Pushing the organization beyond capacity

Community support and opposition

- Livestock and waste reduction
- How we got bait into every single property and building on the island

Lord Howe Island rodent eradication Project - community engagement in complex community-based conservation projects

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Eradications conducted in an inhabited setting must engage community as a key pillar of project planning and feasibility or risk project failure through project compromises arising from lack of support.

The largest community-based rodent eradication attempt to date on Lord Howe Island in 2019 has provided an opportunity to understand the interaction of a community within the framework of an eradication attempt.

From the criticality of community engagement to the advantages of using a local workforce the lessons learned on Lord Howe Island during this controversial project are both numerous and at times unexpected.

One example of this is property access.

The requirement for bait to be placed not only on every property but also within every home created unique property access complexities.

In many cases promises were made in negotiating property access that required complex coordination with many promises unable to be delivered during wide-scale implementation, leading to further distrust in the process.

This led to the creation of a dedicated property management team that was unplanned and built during active implementation stage, taking 7 weeks of development to work effectively.

Focusing on key community values led to unanticipated project outcomes many of which can be shared to provide a template for future community-based conservation efforts.

The journey towards biosecurity improvements on Lord Howe Island

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Best practice island pest eradication identifies biosecurity as the cornerstone of eradication work and not an adjunct.

Prior to the Lord Howe Island Rodent Eradication Project (REP), biosecurity was primarily undertaken in a piecemeal manner with the Lord Howe Island Board (LHIB) administering its legislative powers for all plant and animal imports. Existing budgets for biosecurity were inadequate so funding was secured to develop the initial biosecurity strategy in 2003 and a revised strategy in 2016.

Biosecurity pre-REP was largely implementing island wide weed and pest animal eradication projects that conducted on ground treatments, monitoring and property inspections (e.g., noxious weeds & African Big-headed Ant).

REP funding provided for the purchase of two rodent detection dogs and two full time equivalent trained biosecurity dog handlers, in 2017, two years prior to the implementation of the ground baiting operation.

During the REP audits were conducted outlining what biosecurity improvements and post REP rodent monitoring grid system was required. 2018 saw the beginning of inspections of the ship on Lord Howe, with pre border inspections of freight commencing in 2019.

Limited funding was secured to engage a biosecurity team leader and conduct a technical audit to determine what further biosecurity improvements were required. This laid the foundation for outlining resource requirements for developing a best practice for biosecurity.

The detection of rodents in April 2021 resulted in a further allocation of emergency resources to improve biosecurity measures.

In 2022 ongoing funding has been secured that will lead to a significantly enhanced pre and post border biosecurity system for LHI.

This is a necessary step to protect investments of over $30M in implementing a range of island wide eradication programs and ensure protection of the islands World Heritage values.

Protection and mortality of non-target terrestrial bird species during the eradication of rodents on Lord Howe Island, Australia

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To eliminate the destructive impact of rodents on islands, conservation practitioners commonly use rodenticides to eradicate these pests. Frequently used rodenticides, such as brodifacoum, are non-specific. Consequently, non-target species (NTS) may be susceptible to the poison. While mitigation actions to protect against unwanted impacts on NTS are often included in eradication planning, such impacts are rarely measured or reported. In 2019, a rodent eradication program (REP) was implemented on Lord Howe Island to remove ship rats and house mice. To protect the island's unique suite of endemic avian fauna, a comprehensive monitoring and mitigation plan was implemented. Following assessments of potential effects of baiting on island-species, two endemic species were taken into captive management during the REP. To assess effects on other species, a total of 243 ha of bushland was searched over a 14-week period and an additional 3000 ha was searched in the island's settlement area for NTS carcasses. These surveys found that buff-banded rails suffered the highest level of mortality, but few carcasses of endemic species were found. The captive management program was successful with more than 95% of individuals that were taken into captivity being released at the end of the program. Post eradication surveys of captive-managed species have shown that the endemic woodhen population has increased by nearly 200% on pre-eradication levels and that endemic currawong numbers have also increased. Surveys of other bush birds have found higher numbers for most species and shows that pre-eradication assessments of these species being at lower risk were appropriate.

Captive management of at-risk non-target species during the Lord Howe Island rodent eradication program: insights into insurance population management in a remote location

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Brodifacoum based baits are used extensively in eradication programs aiming to eliminate rodents and relieve pressure on endemic species. However, this leaves some non-target species susceptible to primary and secondary poisoning.

The Lord Howe Island Woodhen (*Hypotaenidia sylvestris)* and the Lord Howe Island Currawong (*Strepera graculina crissalis*) were identified to be at significant risk of primary and secondary poisoning during the baiting program. Taronga was contracted to design, construct, and resource an in-situ captive management facility for the baiting period, and for 100 + days post baiting while brodifacoum was potentially still present in the environment.

In 2013 Taronga completed trials on Island to refine captive management strategies with 10% of the LHI Woodhen and Currawong populations. With lessons learned from the trial Taronga designed species-specific facilities and captive management plans. Taronga managed the construction of the facilities throughout 2018.

In 2019 during the REP Taronga managed over 350 individual birds comprising approximately 85% and 60% of the extant populations of the LHI Woodhen and LHI Currawong respectively. The captive management project and associated translocations have been highly successful, with very low mortality and with high breeding success post release.

The captive management project was essential for the implementation of the eradication program, mitigating risk to non- target species and allowing a comprehensive baiting strategy.

This paper describes the unique challenges of managing insurance populations of two threatened species at a temporary facility, in an isolated island location, over an extended period. We explore the expected and unexpected challenges during the project in an effort to inform future captive management programs of a similar nature.

The Lord Howe Island rodent eradication: lessons learnt from an inhabited island

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The 2019 rodent eradication on 1,455-ha Lord Howe Island was the second and largest attempted on a permanently inhabited island. It presented numerous novel challenges, resulting in an operation best summarised in four words: Compromise, Commensal, Complexity, and Cost.

The baiting operation consisted of a ground-based operation utilising 22,500 bait stations across the built-up portion of the island (300ha), 9,500 hand-broadcast points, and two aerial bait applications on forested higher ground (1,200ha). Over 60 field staff were employed locally, from Australia and overseas, to run the baiting operation for 5.3 months.

Complications relating to the implementation of the baiting operation included: effectively integrating three different baiting methods within the landscape; initial active opposition to private land access; unaccepted personnel by some private landowners; resistance to livestock removal requiring novel bait station infrastructure; possible significant bait loss to invertebrates; and a small proportion of rats apparently avoiding bait stations.

Other complexities were introduced by the requirement to bait all dwellings and structures, and the complex nature of data capture and management requirements.

Biosecurity planning, infrastructure, processes, and funding arrangements were not sufficiently developed or supported by the cessation of the eradication effort putting the eradication effort at risk.

Eradication practitioners should prepare for a significantly more complex operation with a concomitant increase in resourcing and planning when compared to uninhabited islands, and the need to work with Island managers who may not be familiar with eradication and biosecurity theory or practice.

Lord Howe Island rat response: removal of rats following detection 18 months after a rodent eradication attempt

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In April 2021 black rats (*Rattus rattus*) were detected on Lord Howe Island, following an eradication operation in 2019 that targeted black rats and house mice (*Mus musculus*). A limited permanent surveillance network of 'passive' detection devices (wax tags, chew cards, tracking tunnels, trapping boxes) had been installed in the inhabited area of the island following the eradication. Rodent incursion response guidance documents and planning had been prepared to respond to a small-scale incursion of a limited number of individual rodents.

Initial response actions were designed to simultaneously remove detected individuals and determine the extent of rodent presence. The presence of juvenile rats confirmed that a breeding population had established over a large portion of the Northern Settlement.

The response faced numerous challenges including immediate resourcing of a large-scale field operation; engagement and mobilisation of the necessary expertise; effective triage of limited resources; detection and removal of individuals with a low population density and plentiful natural food; obtaining property access and community support; and biosecurity practises and standards that were still in development.

96 rodent bodies were retrieved to late July 2021 when the final positive detection was made. Numerous lessons were learnt. These included: the relative reliability of rodent detection dogs, wildlife cameras, and passive rodent detection devices for rodent detection at low densities in a resource-rich environment; best complementary use of monitoring tools; rat interaction with snap traps; and how to effectively implement a novel rodent removal technique.

This case study presents a technical overview of the response and attempts to pass on valuable lessons learnt, that may assist with other complex rodent removal operations.

Bunurong Land Councils New Environment Team

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In early 2017, The Bunurong Land Council Aboriginal Corporation (BLCAC) began discussions with several regional stakeholders with a view to establishing a Natural Resource Management (NRM) Team. BLCAC consider the development of a NRM team to be a logical extension of the activities of the BLCAC, and the Bunurong Traditional Owners more broadly. This Department will provide meaningful employment, jobs and roles that were aligned with the core goals of the BLCAC; the promotion and strengthening of culture, and connection to country. It was decided that a partnership and collaborative model was the best way forward and that's when the Environment team was established at the start of 2022.

The Environment Team will work towards land management outcomes including weed control, pest management, wildlife management, revegetation and many other conservation opportunities within our scope of works including works on islands such as French Island and Phillip Island to create our island arks.

The power of conservation partnerships on Phillip Island and beyond: preserving Western Port from industrialisation

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Partnerships and alliances in conservation promote community engagement, political action, and collaborative environmental stewardship.

The process of developing partnerships to preserve Western Port from industrialisation by the Phillip Island Conservation Society has a long history, including the recent campaign against a proposed Container Port in Western Port which ran for three years from 2014 and was ultimately successful.

We learned how to partner and pool all the skill sets that were necessary for the campaign. We now have strong partnerships with locals, State-based environmental organisations, including Environment Vic, and internationally with Sea Shepherd.

In the AGL campaign against a gas factory being located in Western Port, our alliance partners were Victoria Nature Parks Association, Environment Victoria, the Save Westernport Group and the Westernport and Peninsula Protection Council. The campaign received enormous local community support that included Island eco-businesses and the wider community lodging thousands of submissions to the Government hearing. The campaign was successful, and the Minister supported the Phillip Island Conservation Society's position that the adverse impact on the marine eco-systems adjacent to Phillip Island would be unacceptable.

Work is now underway to legally protect Western Port for the future through a partnership that includes the Bunurong Land Council Aboriginal Corporation. The vision is 'To effectively manage, restore, and legally protect the marine and coastal environment of Westernport Bay, and establish an environmentally sustainable economy for the future'. This initiative is being taken to Government with a governance model that puts Traditional Custodians, community, and government agencies as equal partners.

Collaborative enterprises for island sustainability: a story of community action as told through two alliances on Phillip Island

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In 2018 a public forum was held on Phillip Island which led to unanimous agreement to form Totally Renewable Phillip Island with a vision for the Island to be carbon neutral by 2030. A series of workshops led to the formation of six working groups encompassing education, regenerative carbon farming, clean energy, clean transport, food and waste, and carbon accounting, as well as a core coordinating group. In 2022, Totally Renewable Phillip Island (TRPI) is a movement or collective of 15 Phillip Island groups - including the Bass Coast Shire, Westernport Water, the Phillip Island Nature Parks, and the Phillip Island Landcare Group – that share the Totally Renewable Phillip Island vision to build a sustainable environment. This collaborative community spirit saw the formation and launch of the island's most recent collective, the Phillip Island Land Alliance (PILA). PILA's vision is 'A connected community who respects and protects the unique and biodiverse environment of Phillip Island' and brings together the island's nine coast care groups plus the Phillip Island Landcare Group and Phillip Island Conservation Society. PILA provides a strong voice for addressing island-wide conservation issues.

Manaaki Whenua, Manaaki Tangata, Haere Whakamua (Care for the land, Care for the people, Go forward) A few examples of how this works in Aotearoa

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Every project starts with an idea often from one person, breathing life and sustaining that idea into a project requires a community working together. People and restoring our environment depend on each other. Getting in behind is a great Kiwi tradition – doing stuff that you feel matters. It's the core fuel of the predator free movement in Aotearoa, the one that brings the greatest rewards when you work on community-based projects. On inhabited offshore islands, walking the talk and involving the community in every aspect is key to making a project work. Full time employment or even just regular part time work is often the difference between being able to live and bring up a family. Even on our main two big islands (the North and South ones), valuing communities and involving local people always brings great rewards – small seeds of ideas grow into trees of multiple projects that all connect and inspire others - this stuff is common sense, not rocket science. Connecting people together also creates networks of knowledge and shared experience that gives individuals and projects confidence that they are not alone, problems become challenges to overcome together, few challenges are unique to one project. Trust is also a big part of community-based biodiversity restoration projects as is respect for existing work and projects especially when a new project is a landscape scale one which can easily be perceived as out to take over all the small projects but have led to that larger project being funded. Local knowledge and using that to both get a new project cracking and reality check planning documents is a vital tool towards gaining trust and valuing the community in which a project is to be undertaken. We can only go forward caring for the land when we genuinely care for and respect the people.

Community-led engagement for a rabbit free Phillip Island

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Rabbits are the single most threatening process that we have the power to manage' said Gidja Walker in an assessment of threats to vegetation on the Surf Beach to Sunderland Bay coastal reserve of Phillip Island (Millowl), Victoria.

In 2007 an enthusiastic group of local volunteers formed Surf Beach Sunderland Bay Coastcare Group, aiming to protect the vegetation and biodiversity of Surf Beach and Sunderland Bay.

A 2009 flora survey documented highly intact and diverse remnant Coastal Tussock Grassland (EVC 163) with many species being long-lived, such as Grass Trigger-plants which grow from extensive root systems. Successive surveys noted their dramatic decline, along with serious erosion issues and cultural heritage impacts due to rabbits.

If nothing was done to control rabbits many native plant species were likely to become locally extinct, weed control, restoration and revegetation efforts would be ineffective and feral cats would be sustained by preying on rabbits.

Rabbit Free Phillip Island is a local initiative to make sure that doesn't happen. The challenge is the community as a whole has to appreciate often unseen damage caused by rabbits to coastal vegetation and commit to doing something about it and safe innovative urban control techniques need to be applied.

In 2016 exclusion cages were laid in the reserve to monitor the effects of removal of the threatening process of rabbits, since then the regeneration results have been remarkable.

SBSB Coastcare is collaborating with Phillip Island Nature Parks (PINP), Landcare and Coastcare groups running online community conversations and field days to inspire, engage, educate and facilitate community action.

Bass Coast Landcare Network (BCLN) has developed a Rabbit Strategy for Phillip Island and provide support and funds to assist homeowners to rabbit proofing homes.

A rabbit exclusion fence is planned to protect the reserve and a citizen science program is underway using RabbitScan to map warrens and understand rabbit abundance and behaviour.

Ongoing monitoring through vegetation quality mapping, photo points, and quadrat data analysis will help assess the effectiveness of the program.

The snowball effect of social licence: limiting pest invasions on the islands of Auckland's Hauraki Gulf

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The Hauraki Gulf, *Tīkapa Moana o Hauraki*, is on the doorstep of New Zealand's largest city. Within the Hauraki Gulf is a diverse array of islands, big, small, inhabited and restricted access. The increasing value of the islands by the public has allowed increased funding which has in turn enabled regulatory mechanisms, operational pest prevention and communication strategies on a scale not seen before in New Zealand. There are opportunities, challenges and learnings for taking on region wide island biosecurity initiatives. Elements of this protection include a Regional Pest Management Plan, a Controlled Area Notice declaring nearly 300 pest organisms, Pest-free Warrants for commercial craft, a holistic biosecurity management action plan, and a combination of broad and specifically targeted communications strategies.

Development of an integrated island biosecurity framework

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Due to the geographic isolation, islands are often the last refuge for many threatened and endemic species. Human activities such as tourism, fishery and industrial development, along with climate change, facilitate the introduction of invasive alien species and disease (hereafter, IAS). Over the last decades, there has been increasing number of biosecurity plans developed, with the aim of protecting the interests of agriculture, production and fisheries converted to the inclusion of environmental and socio-cultural concerns. These plans encompass biosecurity activities (pre-border, border and post-border) to varying degree and types of related strategies employed. They further differ in the targeted ecosystems (terrestrial and marine), taxonomic groups, methods implemented for risk assessments (quantitative and qualitative). Such diversity could ensure that the limited resources are applied cost-effectively and efficiently, while resulting in unintentional gaps in the development of plans. Currently, there exists no objective biosecurity framework to guide the development of island biosecurity plans. The new plans tend to be a sub-set of existing plans developed through neighboring states or foreign aid. The omission of island-specific biosecurity considerations may cause inadvertent introduction of IAS and waste of limited resources.

We undertook systematic review and meta-analysis of the island biosecurity management plans cross the globe. Through the contribution of knowledge from and collaboration among global biosecurity experts and managers from government, academia and industry, we identified gaps in island biosecurity knowledge (e.g. area-specific and industry-specific) and isolated key areas for further research and capacity building. A heat map will be further developed to enable us to understand usage patterns of the different biosecurity categories and visualize the research outcomes. By the end of this project, an integrated, objective and systematic island biosecurity framework, that incorporates all island biosecurity elements, will have been developed to facilitate consistency and transparency in creating island-specific plans.

Vulnerable marine littoral faunas

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Invertebrates that are specialised to live in the upper marine littoral zone are frequently ignored in island surveys. It is not widely appreciated that such a fauna exists let alone that it may include endemic species even genera. This is partially because it requires particular collecting techniques. Traps set out for more than a few hours obviously run the risk of tide inundation. Hand collections can miss small fauna and funnel extraction of weed debris of sand are often ineffective. Instead, pitfall traps set just below high tide mark for a few hours, pits dug at the same location down to the water table and skimming surface of water with a net and hand searching under stones are more effective.

Collembola (springtails) are a group that includes genera specialised for this habitat and island faunas are no exception. For instance, the upper marine littoral fauna of Coral Sea Islands, Barrow Island, Cocos and Keeling Islands and Indonesia islands such as Krakatau and Sulawesi have been shown to possess unique faunas and even include a genus restricted to this habitat with endemic species that seem restricted as to region. Moreover, distinctly different faunas are found on different types of beaches such as mud flats, mangroves, coral rock and high-energy sands. They can also be primary colonisers, as shown by early collections from the newly emerged island Anak Krakakau.

Documented threats to this fauna are oil spills offshore, vehicles on beaches and excessive use of shore for recreation.

Marine threatening processes for island arks: a case study of Australian fur seals

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After near extirpation by colonial sealers in the early 1800s, Australian fur seals were considered a conservation success as their populations recovered from 1975-2007. Over the last 13 years, we have identified a reduction in pup abundance throughout their range in Bass Strait and an increase in some Tasmanian sites that are further south. Seal Rocks is the largest colony and the site for which we have the most information on diet, pup abundance and health. With drone surveys allowing for more frequent surveying due to reduced disturbance, indications are now emerging that the pup decline may be caused by high pup mortality rather than reduced births; however, abortion rates have also increased. Recent research has identified high levels of potentially toxic PFAS chemicals and exposure to human waste, high levels of entanglement in marine debris, as well as risks to breeding sites from ocean inundation under climate change. Without mitigation, we predict that anthropogenic threats will exacerbate pup reductions and recruitment to the breeding population. As Bass Strait continues to warm, heat waves will increase in frequency and food webs alter: Australian fur seals will likely respond by moving to sites further south if they can. It will be critical to identify and prepare for this emigration to emerging Island Arks in Tasmania.

Are insidious infectious abortions contributing to decreased Australian fur seal recruitment?

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Despite the cessation of commercial seal harvests in Australian Waters for more than three decades, Australian fur seals have made a significantly slow recovery compared to other pinnipeds. Is this purely a problem of a poorly productive ocean or are infectious organisms contributing to low recruitment rates through abortion and perinatal loss of pups? The authors use multiple diagnostic modalities to survey for common pathogens associated with abortions. The question arises, do these organisms pose a threat to the future fur seal populations and what could be the potential implications of these pathogens if oceanic conditions continue deteriorating?

Sherlock Holmsing in the South – applying a smart sentinel approach to understanding the triggers and responses of marine predators to environmental and anthropogenic change

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Seabirds and marine mammals are dual island residents and ocean sentinels, integrating anthropogenic and natural signals into their behaviour, breeding success and survival. Tracking the movements, arrival times, body condition and health of these oceanic explorers can tell us much about their changing environments on land and at sea; however, gathering this data poses real challenges across their island ranges. Can an integrated smart sentinel approach incorporating novel technologies such as terrestrial and oceanic cameras and acoustic recorders, animal borne bio-logging devices, drones, weather stations, DNA metabarcoding and one health molecular tools be incorporated with other forms of knowledge to privide near real-time opportunities to simultaneously gauge island wildlife responses to changing terrestrial and oceanic signals and threats? We show how these emergent tools are being incorporated in studies of marine vertebrates in Tasmania and further south, to hone an integrated and networked smart sentinel approach to measuring and predicting the health of these island sentinels and their environments into the future.

Supporting community conservation initiatives in Aotearoa-New Zealand: some personal observations and suggestions

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Islands have been a focus for biodiversity conservation in Aotearoa – New Zealand for more than 50 years. Recognition of the impacts of invasive predators and the significant outcomes that can be anticipated following their removal, and growing capacity to eradicate suites of pests from larger islands have this progress. Increasingly attention is being directed at treating larger inhabited islands as well as "mainland" restoration sites where people live nearby. While important progress has been made in developing capacity to address technical, scientific and logistical challenges on uninhabited islands it is clear that social dimensions will also be important. If restoration goals are to be achieved on inhabited islands and other sites which people call "Home" practitioners will need to adopt new perspectives and acquire new skills. While social dimensions are likely to vary between initiatives incorporating cultural dimensions, in Aotearoa – New Zealand in particular, is critical. The case studies presented here illustrate changes to better- acknowledge, consult and collaborate with tangata whenua (local indigenous people). A focus on forging and maintaining relationships with other local stakeholders such as landowners and community groups is also illustrated. Other social dimensions such as political advocacy and institutional and financial support are also identified in the case studies. We conclude that while much is being learned about opportunities to address social dimensions those involved in promoting and implementing island restoration will need to remain flexible and apply locally nuanced approaches that reflect social as well as other circumstances at each site.

Safeguarding our sacred islands into the future: taking action beyond mere words

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A timely collation of case studies, written by and with Traditional Owners of diverse Australian offshore islands, offers direct insights into benefits arising from strategic and participatory action planning for biocultural island conservation and monitoring. We pay respect to the Old People and Elders whose dedicated care of their island homelands means we today can still experience their cultural and natural diversity. We extend greetings to our Pacifika neighbours, and to carers of islands around Earth. Our paper scopes socio-economic benefits arising from planning for islands, for Aboriginal peoples and Torres Strait Islanders, and more generally. Global, national, state and local co-investments support place-specific planning for some islands by Traditional Owners as a starting point toward shared governance and caring for country. Case studies describe country planning for Mayala Country in Australia's northwest, Woppaburra experiences within the Great Barrier Reef World Heritage Area and integrated biocultural health monitoring arising from remote island Indigenous Protected Area planning in Torres Strait. New institutional initiatives such as the Australian Institute of Marine Sciences *Indigenous Partnerships Plan* aim to create solid foundations for substantive research collaborations. Across Australia, novel relationships grounded in culturally assured, holistically integrated approaches to island governance and caring for country involving Traditional Owners and island resource users / managers are creating equity in livelihoods and stronger wellbeing. Australia's innovative sea country collaborations, with priorities initiated and lead by island Traditional Owners themselves, carry real value for sustained island conservation and provide positive inspirations for global humanity in the accelerating Anthropocene.

Conservation entrepreneurship for offshore island enterprises: a perspective

Derek Ball[1]

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Conservation entrepreneurship is based on the notion that it is possible to build a business system around a conservation challenge, and in doing so create a targeted and adequate resourcing mechanism to support interventions, over adequate time frames. Constructing business models is not something that is usually at the forefront of a conservation practitioner's agenda, nor often within their capacity. This talk takes the reader through the process of building such models using structures and terminologies that are commonplace in the business world, but perhaps not so much so in the conservation sector. In addition, this business model approach is presented in context of the 'collective impact' framework, which involves centralised infrastructure, dedicated management, and a structure ensuring development of a common agenda, shared measurement systems (i.e. of what success looks like), continuous communication, and mutually reinforcing activities amongst all those involved.

Island partnerships building collective impact

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Conservation relies on people and on populated islands community partnerships are the lynchpin to conservation success. Local knowledge, intellectual capital and community support not only saves island managers invaluable time and money, it embeds ownership and longevity into conservation initiatives well beyond their planning timeframe. But island communities are driven by a range of motivations and if we are to build the collective impact needed to achieve conservation at scale we must better understand and embed these key drivers into program design and delivery. We present four contemporary case studies on populated islands in Australia (Bruny Is Tas, Kangaroo Is SA, Phillip Is Vic and Lord Howe Is NSW) where community initiative and collaboration has underpinned conservation success or failure. They contain learnings based on social motivations, inclusion and empowerment to help guide island conservation planning in the future.

Assessing and adapting island biodiversity to the risks of climate change

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Climate change will drive pervasive changes to island ecosystems, component biota and ecological processes. How island managers identify and assess risks, and where possible assist in adaptation of natural systems to change, may significantly influence the future state of island landscapes. However, there is currently no comprehensive framework to guide managers through this process. We provide an initial structure of a decision support system to assist based on; one, an existing climate change adaptation approach (for settlements and infrastructure), and two, categories of adaptation measures. We do not assert that this system is complete, comprehensive nor correct, but propose that it forms a starting point for one that could be. We contend that identification and assessment of climate change risks should be considered routinely by conservation practitioners in designing interventions to conserve biodiversity on islands. In doing so we can identify what island biodiversity we are likely to be able to conserve in the face of climate change, and how that might be best approached. Importantly, we also put forward the pragmatic proposal that conservation triage must be enacted and will dictate that we need to accept the loss of some biodiversity values on islands. However, we also propose that if we have the courage to embrace more radical and innovative approaches, such losses might at least in part be compensated for.

Lessons from the first national database of threatened species on Australian islands: towards a national island solutions platform

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Islands are some of Earth's most precious, rich and unique natural environments, yet islands across the Planet are facing challenges. These include both challenges to nature and to people, such as declining biodiversity, extinctions, invasive species, climate change and threatened sustainable resource use. While the task of protecting islands and their unique communities is vast, many island communities have already developed creative and working solutions to address environmental challenges. Ambitious projects, including the removal of exotic species from large islands, have achieved significant conservation wins for diverse island landscapes and stakeholder groups. Because different islands often share similar challenges, national legislation and frameworks to support collaborations to address both human and biodiversity needs, joint research, and information sharing across islands becomes an important opportunity to address the diverse and often complex environmental challenges facing islands and their people. Frameworks that can be applied across the nation are required, and include knowledge, data and experience sharing to ensure that pan-State and Territory coordination can disseminate the lessons learned from island projects to island stakeholders across Australia. To address this requirement, we propose a need for a platform in Australia that provides a multi-disciplinary platform for island solutions. This organisation will aim to bring together island managers, communities and researchers working on environmental island solutions across diverse and complementary spheres along the continuum from people to biodiversity to natural ecosystems, and drawing together policy makers, Indigenous communities, and natural and social scientists to lead innovative collaborations and novel partnerships. Such a platform will create, evaluate, deliver and share innovative solutions for jointly addressing environmental challenges facing people and biodiversity on islands nationally, and share solutions for islands globally in the face of global change.

How do we drive a renaissance for national island conservation in Australia?

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We propose a role description and an organisational model for an effective national island alliance that champions conservation action, prioritises investments aligned to risks, and connects partners at a national level. This is because a nationally coordinated approach to strategically manage Australia's offshore islands is lacking. The creation of an 'Australian Islands Alliance' can form a collective of conservation practitioners across Australia's States and Territories, partnering with island communities, and with representation across a wide spectrum of island contexts. A national alliance offers important opportunity to assess threats and report on condition. Four key foundations underpin a national alliance dedicated to champion island care and expert management: (i) management informed by evidence, (ii) sound return on investment, (iii) national coordination in partnership with States and Territories, and (iv) community participation inclusive of Aboriginal peoples' and Torres Strait Islanders' custodial rights and interests. These shared learnings collectively demonstrate the time is now for Australia to move forward with a respectful and unified direction to progress successful and sustainable island conservation and restoration.

The climate crisis and the need for immediate on-ground action: an example from Millowl (Phillip Island)

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Little penguins are well adapted to temperate climates and have a low tolerance to prolonged high temperatures. In southeastern Australia, where the largest Little penguin colonies are found, we see increasing maximum temperatures and longer terrestrial heatwaves due to the climate crisis. In March 2019, a significant heatwave on Millowl (Phillip Island) saw over 100 penguins succumb to heat stress. From this event, it was clear that immediate action was required to create resilience in the Millowl Little penguin colony in the face of increasing land temperatures. Training programs for staff and volunteers to quickly respond to heat-stressed penguins have been implemented, high-risk areas are being identified, and mitigation measures are being put in place; from covering artificial nest boxes with vegetation to modifying the habitat. Given that the climate crisis and high temperatures will continue and likely increase in severity in the future, with these measures in place we can reduce further mass mortality of Little penguins.

Catastrophic decline in a super colony of Little penguins

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Little penguins, *Eudyptula minor*, are a locally abundant seabird breeding in complex habitats on islands around southern Australia, yet their population trends are largely unknown because population estimates for about 60% of colonies are data deficient. Such assessments are vital at a time when marine environments in south-eastern Australia have been identified as a global warming hotspot, driving changes which are expected to affect penguin colonies.

We developed distance surface models (DSM) combining distance sampling surveys with spatial covariates from Geographic Information System datasets to estimate the detectability and density of active burrows in large colonies. We validated the generalisability of the model to provide rapid population assessments requiring minimal fieldwork and applied it at one of the largest Little penguin colonies in the world, Gabo Island in far eastern Victoria, in 2012 and 2021.

Results indicate the colony has suffered a catastrophic decline over nine years from 26,200 (95% CI: 22,400 – 30,800) active burrows in 2012 to 1770 (1170 – 2700) active burrows in 2021; less than 7% of the colony remaining. We explore the environmental conditions that may have driven the colony decline including rising sea-surface temperatures, habitat degradation and predation. We also describe the utility and potential biases of the DSM approach to allow rapid assessments of penguin colony size at other colonies in the region which are data deficient and whose population trends are unknown.

A life spent saving critically endangered species of French Polynesia

Caroline Blanvillain[1]

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Dr Caroline Blanvillain has spent 16 years fighting to save the birds of French Polynesia. Foremost is the Tahiti Monarch (Pomarea nigra), almost extinct with just 12 birds when Caroline initiated recovery as a volunteer in 1998. Introduced invasive species like Indian Mynahs, Red-fronted Bulbuls and Black Rats were harassing nesting females and killing nestlings, and pest plants were out-competing native species. With the rats controlled, Caroline collaborated with 30 families in the Monarchs' valleys, training them to humanely trap and euthanise Mynahs and Bulbuls, reducing pressure on the Monarchs. Mynahs and Bulbuls are no longer threats and the Tahiti Monarch population has now passed 125.

Similarly, when Little Fire Ants were detected on Tahiti Island in 2014, severely threatening the Monarchs; they were successfully eradicated from houses and nearby forest, including drone treatment of an inaccessible cliff face colony.

Local people are critical to the recovery program's success. Almost 5,000 children have participated in school and community events since 2012. To make a little black bird sexy a "monarch love story" was published – very popular on Tahiti and aligning with some monarchs pairing for life.

Other species in French Polynesia have benefitted from Caroline's dedication - the last viable population of Polynesian Ground Dove protected, inter-island translocation of Marquesan Imperial Pigeon; four islands protected against black rats using the region's first rat detector dogs; and a recovery plan written for the Ultramarine Lorikeet.

These successes have required overcoming significant challenges. Foremost is no access to many large international grants due to French Polynesia being a French colony and France's wealthy country listing. Caroline responded through securing grants totaling over USD.600,000 to protect threatened native species and control invasive species. From a zero-knowledge base, she has led research on diseases in wild birds across the islands.

Eradicating a rare endemic bird to protect a common ubiquitous seabird

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Weka, a flightless bird, are declining on the main New Zealand islands, and the Stewart Island sub-species (*Gallirallus australis scotti*) is nationally vulnerable. It occurs naturally on Stewart Island and on many of the smaller islands within about 1 km of the main island – the birds are good swimmers. It has been introduced to other southern islands including the 930-ha Taukihepa (Big South Cape) Island – 1500 m off Stewart Island. Weka predate native animals, sometimes leading to their extinction on islands. They also predate the eggs and chicks of sooty shearwaters (titi). This species is one of the most common seabirds in the world and the chicks form an important cultural harvest for Maori (and Aborigines in Tasmania). The numbers of shearwaters nesting on Taukihepa are declining and the island's owners are debating options to either eradicate or harvest the weka to enhance their main harvest of titi – and to restore the wider natural biodiversity of their island. Some questions in the debate are whether weka can be eradicated and if they can be used to repopulate Stewart Island? Weka have been eradicated from five islands and I explore the methods and effort taken in two of the larger precedents – Macquarie and Whenua Hou (Codfish) islands both with the Stewart Island subspecies as introductions. Birds from Codfish were translocated back to Stewart Island but did not establish. In summary, the Taukihepa weka can be technically eradicated but the ability to successfully translocate birds back to Stewart Island may require the planned eradication or intensive control of cats and rats on Stewart Island before eradication of an endangered (but out of place) bird to protect a common bird is socially palatable.

The foraging ecology of an endangered ecosystem engineer translocated beyond its historical range

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Species declines and extinctions result in the loss of biodiversity and ecological function from ecosystems. Direct conservation actions such as threatened species translocations offer a way to re-establish self-sustaining populations and restore degraded ecosystems but require ongoing monitoring and evaluation. As an animal's diet provides an important insight into its ecology, identifying and quantifying diet can assist in threatened species management. This study investigated the diet of two populations of eastern barred bandicoots (Perameles gunnii) introduced to fox-free islands (Churchill Island and Phillip Island) thought to be outside of the species' historical range. Microscopic scat analysis revealed bandicoots to exhibit an omnivorous diet, consuming a broad range of invertebrate, plant and fungal material. Invertebrate taxa commonly identified in the diet included earthworms, beetle adults and larvae, ants, cockroaches, spiders and caterpillars. Notably, crabs were also found in bandicoot diet, indicating the species' ability to adapt to novel environments. Seasonality appeared to be the main factor driving variation in diet at Churchill Island, suggesting that the species is likely to feed opportunistically on seasonally abundant food items, making it a good candidate species for translocations. As no difference was detected between population diets, knowledge of the diet of one population can likely aid in predicting bandicoot foraging ecology at other translocation sites. The results of this study can help inform the conservation and management of eastern barred bandicoots, including future translocations, to ensure the species' long-term survival. It may also provide a case study for conservation translocations of other threatened species beyond their own historical distributions.

Communities and threatened species conservation: a Phillip Island case study

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Phillip Island (Millowl) was officially declared fox-free in 2017, becoming the largest populated island in the world achieve this extraordinary feat. After the successful establishment of Eastern Barred Bandicoots, the Nature Parks are looking to reintroduce a number of locally extinct threatened species to the Island, including Bush Stone-curlews. Community support is integral to the success of threatened species recovery, and the Nature Parks is involving the local community at every step of the way – including structured decision making to select the priority species for reintroduction, the involvement of local schools in project planning, creating engaging visitor experiences, and volunteering with the species on the ground. Alongside the local and visitor community, we are one step closer to our aspiration to be a safe haven for the protection of native threatened flora and fauna.

Better home ranges and gardens: using home range analyses to investigate how habitat restoration can improve territory quality for a critically endangered island owl

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By 1986, the population of Norfolk Island moreporks had declined to just one female. This was most likely as a result of many contributing factors including habitat loss, secondary poisoning and low genetic diversity. Two male New Zealand moreporks were subsequently introduced onto Norfolk Island. One of these disappeared and the other successfully bred with the female. 35 years later, the population consists of only 20-35 individuals, and monitoring demonstrates a decrease in breeding success. To assist the population, management interventions may be necessary to restore habitat and increase the carrying capacity of the island. This study aims to investigate how habitat type influences the territory size of Norfolk Island moreporks and inform vegetation management on the island. Between 2019 – 2021, nine owls were radio-tracked with some repeat captures during Spring and Autumn. GPS fixes were recorded at 30-minute intervals each night for 14 – 28 days for each owl. We used high-resolution spatial data to generate vegetation density, canopy height, elevation, patch size and vegetation class data. Owls were more likely to be found in larger patches of vegetation than smaller patches, and vegetation type had little impact their distribution. Here we use territory mapping as well as vegetation structure, topography and land-use type to suggest how land management can optimise the number of territories available for moreporks in the Norfolk Island group.

Protecting a threatened petrel improves a seabird community… A story from the *other* Phillip Island

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Phillip Island, located 6km off the coast of Norfolk Island, is a seabird-lovers paradise. This small, uninhabited island, devoid of feral predators provides significant breeding habitat for numerous ground nesting seabird species including sooty tern, red-tailed tropicbird, white-necked and black winged petrels, and the EPBC listed, Kermadec petrel.

Researchers from the Department of Planning and Environment (NSW) have been formally surveying seabirds on Phillip Island since January 2017. Despite many years of community-based reports suggesting self-introduced purple swamphens ("tarler birds") were having an impact on seabird breeding, this was the first opportunity to measure their impact quantitatively. Unequivocal evidence showed that tarler birds were the primary cause of nest failure for the surface nesting Kermadec petrels.

With funding from the DPE and DITRDC, staff from the Norfolk Island National Park and local community volunteers commenced a concerted tarler bird control program in 2019.

The results have been stark. Annual Kermadec petrel breeding success (laid eggs that produce fledged chicks) measured 23% at June 2018 and 2019. Trained shooters removed more than 60 tarler birds from the island in both 2019 and 2020. In 2020, the petrels breeding success rose to 28% and by mid-2021 this had doubled to 56%. There has been a significant growth in the number of pairs attempting to breed, from 26 to now 50 pairs annually. Among other species to benefit are the burrow-nesting black winged petrels, with breeding success improving from 50% in 2017 to almost 70% in 2021. Sooty terns, a species that almost abandoned breeding attempts here, have seen a dramatic increase in breeding colonies on the island to levels not witnessed for decades.

This is a fantastic example of a collaborative program involving three large government agencies, and a small group of dedicated local volunteers, working together to achieve desirable environmental outcomes.

The visual ecology of light attraction in Hawaiian seabirds

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Seabirds are one of the most endangered groups of birds globally. Artificial lights cause high mortality in Procellariiformes, particularly of fledglings, due to attraction and subsequent grounding of night-flying birds. These birds are of concern to Hawai'i, particularly the island of Kaua'i, which has severely declining populations of the endangered Hawaiian petrel, *Pterodroma sandwichensis*, the threatened Newell's shearwater (*Puffinus newelli*) and the Wedge-tail shearwater (*Ardenna pacifica*). All three of these species are susceptible to grounding due to attraction to artificial lights, although *P. newelli* fledglings are the most susceptible, suggesting differences in behaviour and/or vision between fledglings and adults as well as between species. Efforts to conserve these birds include the manipulation of the colour of anthropogenic light. While some lights have been shown to be slightly less attractive to seabirds than others, no true solution has been found and lighting systems must be redesigned to prevent lethal juvenile light attraction. To design a seabird friendly lighting system, we must first understand how these seabirds see the world. While certain characteristics of vision are highly conserved in birds, there are well documented differences in vision between closely related species, usually related to their natural history. This talk will focus on the importance of understanding the visual ecology of seabird species when targeting conservation efforts and highlight preliminary results of my dissertation work demonstrating how ecology shapes differing perceptions of light between seabirds in Hawaii.

The national light pollution guidelines for wildlife – protecting the (d)ark for wildlife

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Islands can provide important refuge sites for many threatened and migratory species, keeping islands naturally dark can be vital for maintaining suitable habitat for the recovery and maintenance of these species. Artificial light at night can disrupt critical behaviours in wildlife. Where this occurs in threatened species, artificial light has the potential to stall the recovery of a population. Where it occurs in migratory species, the impact of light may compromise an animal's ability to undertake long distance migrations integral to their life cycle. For example, hatchling marine turtles may not be able to find the ocean when beaches are lit, and fledgling seabirds may not take their first flight if their nesting habitat never becomes dark. Wallabies exposed to artificial light have been shown to delay reproduction and clownfish eggs incubated under constant light do not hatch.

To address this conservation challenge, the Australian Government developed the National Light Pollution Guidelines for Wildlife (Light Pollution Guidelines). The Light Pollution Guidelines raise awareness about the impacts of artificial light on wildlife, provide a framework for assessing and adaptively managing these impacts and provide six best practice principles for reducing and managing light pollution. The guidelines also provide species specific considerations, mitigation technologies and techniques for marine turtles, seabirds, migratory shorebirds and will soon include bats and terrestrial mammals.
Since finalising the Light Pollution Guidelines, the Australian Government has received wide support from members of the public, councils, and environmental organisations. The Light Pollution Guidelines were endorsed by the 132 countries that are Party to the *Convention on the Conservation of Migratory Species of Wild Animals* (CMS). Notably, CMS has chosen light pollution as the theme for the 2022 World Migratory Bird Day.

Dark Sky Ark....

Marnie Ogg[1]

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In 2016 Australia's First Dark Sky Place was designated in the Warrumbungle National Park, NSW. At the time, there were 76 dark sky places listed around the world. Fast forward six years, and there are three dark-sky designated places in Australia and over 180 around the world. So, what's the big deal? Why become a dark sky place, what are the benefits, and why should Phillip Island join this fast-growing conservation movement?

Deen Maar – rabbit eradication on an island of great cultural significance

TBC

Eastern Maar Aboriginal Corporation and Gunditj Mirring Traditional Owner Aboriginal Corporation hold joint Registered Aboriginal Party (RAP) status for Deen Maar and are partnering with are the Department of Environment, Land, Water and Planning and Parks Victoria on the eradication project.

Deen Maar Island is a significant place of both tangible and intangible cultural value to Gunditjmara and Eastern Maar.

Deen Maar is a small (144 hectare) island that is ~9km offshore in western Victoria. It is of volcanic origin and is characterised by 30m high cliffs on all sides, with a relatively flat plateau on top.

Deen Maar Island supports significant breeding populations of seabirds including Short-tailed Shearwaters, Common Diving Petrels, Fairy Prions and Little Penguins, and also hosts Australia's largest breeding colony of Australian Fur Seals. There are no other mammals or amphibians that inhabit Deen Maar Island, and the only terrestrial vertebrate on the island is a reptile - White's skink.

Rabbits were originally introduced onto Deen Maar Island in the mid-1800s to provide a possible food source for shipwreck survivors. Rabbits have a significant negative impact on the nesting habitat for ground-nesting seabirds by altering the vegetation cover and species structure, causing erosion, and by competition for burrow sites. Rabbits will typically target the most palatable vegetation first, which encourages the growth of weedy and non-palatable vegetation, therefore changing the vegetation structure overall. Eradicating rabbits on Deen Maar would lead to a significant breeding benefit for the seabirds that nest on the island, by removing the negative impacts caused by the resident rabbit population.

Traditional Owners will ensure that cultural safe practices are implemented prior to any works occurring on Deen Maar Island. The site is also within an area under federal consideration as a Sea Country Indigenous Protected area with both TO groups working together on planning for management of Sea Country in 2022-23.

Successful eradication of feral pig population on Quail Island, Victoria: restoring ecological values within a Ramsar area

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Quail Island Nature Conservation Reserve is a low tide accessible island covering 700 Ha in the north of Western Port Bay. The island has extremely high ecological values for both flora and fauna and is included within the Western Port Ramsar site. In 2008, Feral Pigs *Sus scrofa* were released onto Quail Island with subsequent releases in 2010 and 2012. In the years following the population grew and illegal activities such as hunting with firearms and dogs were reported. The Feral Pig population decimated vegetation assemblages including saltmarsh communities and competed with threatened fauna such as Southern Brown Bandicoot *Isoodon obesulus*. Parks Victoria's response included a variety of tools including poison baiting, trapping, stalking as well as aerial and ground shooting. Monitoring was undertaken during the control operations including conventional and 4G trail cameras, thermal drone counts as well as ground observations. Additional actions included community engagement, gazettal of the Island, installation of signage and regular site visits. In December 2019, two feral pigs were shot, and no further detections have been made over the subsequent 29 months. Given the size and detectability of feral pigs, we are confident that the population was eradicated at this time. Importantly, the ecological condition of the island has since made a dramatic recovery. Ongoing monitoring continues regularly along with other invasive species control works to reduce their impacts on this pig-free paradise.

Island pest and weed management or integrated island management and restoration.

Not kitten around. The feral cat free French Island project.

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A decade of extensive control effort on French Island paired with a community-driven sterilisation program for owned cats has set the scene for eradication of the feral cat population on Victoria's largest island. Over 1100 feral cats have been removed over this period and all of the owned cats currently on the island are sterilised. At the same time, Zoos Victoria invested in a significant community engagement effort as part of a proposal to translocate a threatened species onto the island.

The preliminary control effort was conducted by members of the local community which prepared a solid foundation for the eradication project to build on amongst residents and Crown land managers on the island. Revisions to legislation facilitated use of additional removal tools that are anticipated to greatly improve the prospect of eradication success.

However, the path from legislative change to the initiation of on-ground works has been surprisingly challenging in relation to obtaining support by regulatory agencies. This presents a concern with respect to meeting the obligate rules for island restoration projects but also has implications for management programs for invasive species more broadly across the state.

Our presentation will summarise the preparatory work undertaken to scale the existing feral cat removal program from a control to an eradication objective and present the preliminary results from the first few months of operation.

Kangaroo Island feral cat eradication, community support for advanced technologies; implications for other programs

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The eradication of feral cats from Kangaroo Island is an ambitious undertaking. It is a very large island (440,500 ha), access in many areas is limited and feral cats are notoriously difficult to detect at low densities. Here we outline the advantages of wide scale community support and the deployment of new technologies to dramatically reduce staff time in the field and office and to increase efficiencies both in feral cat detection and capture success. We demonstrate how these technologies are being deployed for a large-scale, real-world application, namely the eradication of feral cats from the 38,400 ha Dudley Peninsula on the eastern end of Kangaroo Island.

Improving invasive rodent management with above-ground monitoring and control

Alexandra H. Nance[1,2], Melinda Wilson[2], Phoebe Burns[3], Carly Cook[1] & Rohan H. Clarke[1]

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Invasive rodents pose a significant threat to biodiversity worldwide. The heightened extinction risk for island endemic species means that invasive rodent management is a top conservation priority in these systems. An often-overlooked aspect of invasive rodent biology that may have implications for control is their arboreal - or tree-dwelling - behaviour. Quantifying the extent of aboveground activity and determining monitoring methods that perform well in an arboreal setting will thus provide insight into how to monitor and control invasive rodents most effectively. Using Norfolk Island as a model system, we deployed three common rodent monitoring tools - camera traps, chew cards and tracking tunnels - at the ground, mid-storey and canopy of three forest types. We subsequently deployed lethal non-toxic rodent traps (Goodnature® A24) across these vertical strata at a subset of sites. We detected considerable rodent activity across all strata, with levels of activity varying largely by forest type. Black rats were the dominant arboreal species, while Pacific rats were most common on the ground. Chew cards exhibited the highest detection rate (90% accuracy) and were most effective aboveground. Camera traps and tracking tunnels both exhibited a lower rodent detection rate (75% accuracy), with ground-level camera traps performing better than ground-based cameras. Lethal A24 traps deployed in the canopy killed significantly more rats than those deployed at the mid-storey or ground level. Our results demonstrate that monitoring aboveground rodent activity is feasible and may provide a more comprehensive assessment of rodent activity in a system. Further, deploying aboveground control mechanisms may result in improved control outcomes. These findings are particularly relevant to long-term ground-based control programs that are exhibiting reduced effectiveness over time. Our study highlights the need for practitioners to consider arboreal rodent behaviour for the development of ecologically informed management.

Act for the best, prepare for the worst - will cat removal in isolation lead to improved outcomes for birds in a multi-invaded island ecosystem?

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Eradicating invasive species is critical for threatened species recovery. In multi-invaded ecosystems, removing one or some of several invasive species' present may be the only feasible management option. However, by leaving threats remaining, single species eradication outcomes can fall short, or if threats shift, outcomes can be uncertain and potentially adverse. To improve the likelihood of success, well-informed and closely evaluated objectives are required that are coupled with explicit plans for contingent or adaptive management if things start to go south. On Christmas Island, we assessed the potential outcomes of an apex predator (feral cat; *Felis catus*) eradication that will leave an invasive mesopredator (Black rats; *Rattus rattus*) remaining, using population viability analyses informed by field data. We investigated whether 1) removing feral cats in isolation would allow a threatened seabird species (red-tailed tropicbird; *Phaethon rubicaudra westralis*) to recover; and 2) found the nest predation threshold for black rats that should trigger complementary targeted rat control. Our models found that the tropicbird population would recover quickly and that the current rates of rat predation, or modest increases to that rate, would be insufficient to cause tropicbird declines. The critical rat impact thresholds generated for this ecosystem can now be used to inform cat eradication decision-making as well as monitoring and decision triggers if things change for the worse. This approach will help to optimise the conservation benefit of removing feral cats from the Christmas Island ecosystem while also supporting transparent communication with concerned community and stakeholders.

Testing the efficacy of 'Curiosity' feral cat baiting in woodland on Kangaroo Island, South Australia

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A feral cat eradication is underway on the Dudley Peninsula of Kangaroo Island. Effectively controlling feral cats in woodland habitats on the island and elsewhere remains a challenge. Traditional control methods such as shooting and cage trapping require road access, therefore feral cat baiting may be one of the few tools available to control cats in remote woodland pockets of Kangaroo Island. In this study we tested the efficacy of the feral cat bait 'Curiosity™' in woodland habitats of the Dudley Peninsula. The density of cats was monitored using camera traps set up across the treatment and control site to achieve a before-after control-impact design. Feral cat density was calculated using a spatially-explicit capture–recapture framework. To monitor direct mortality resulting from baiting, 14 feral cats were also GPS collared at the treatment site. After baiting, feral cat density at the treatment site fell from 1.18 to 0.58 cats km^{-2}. Of the 14 feral cats that were GPS collared, eight were within the baited zone directly prior to baiting, and of those eight, six died as a result of consuming a bait. After baiting, a new individual was detected in the zone within ten days, and four new individuals were detected within twenty days. Detections of cats on cameras was highest on roads both before and after baiting, suggesting roads may act as avenues for new individuals to enter a baited zone. Overall Curiosity baiting is likely to be a tool that can effectively reduce the density of feral cats in woodland habitats on Kangaroo Island. Future baiting programs would benefit from incorporating additional follow-up control, particularly along roads.

Tasmania – the Australian refuge for beach-nesting shorebirds

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Surveys around Tasmania's coast over the last 28 years have shown that Tasmania supports at least half the global populations of Hooded Plovers, Pied and Sooty Oystercatchers. These species are present elsewhere in Australia, but populations of all three species are decreasing rapidly on the mainland in the absence of intervention (such as beach closures).

With fewer people in Tasmania, the pressures on coastal areas and the shorebirds dependent on this habitat are lower than on the mainland. However, the Tasmanian Government is unwilling to undertake active conservation measures to protect beach-nesting shorebirds and terns. Pre-COVID, Tasmania currently received c. 1.5M human visitors annually, three times the resident population, and the coastal areas of Tasmania feature in advertising efforts.

Unless coastal shorebird and tern values are explicitly recognised and protected, Tasmania's shorebirds and terns will experience greater pressures in the near future, threatening the survival of these species' populations in Tasmania. As mainland populations of these (and potentially other species of shorebird) decrease, Tasmania's role as a refuge for shorebirds and small terns, and its contribution to global biodiversity conservation will increase rapidly.

Changing trans-equatorial migration of short-tailed shearwaters

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Islands are critically important to the *Procellariformes* - utilizing islands for breeding colonies and spending the majority of their lives in the most extreme marine environments. Short-tailed shearwaters (STSW) are Australia's most abundant seabird playing a key ecological role as marine predators. Breeding almost exclusively on south-east Australian islands they are trans-equatorial migrants who utilise the northern Pacific Ocean for feeding during the Austral winter. Global climate changes which impacts upon marine resources in these areas will impact aversely upon the STSW. The summer time extent of Arctic sea ice has declined rapidly over the past decade profoundly changing marine resources in the northern Pacific Ocean and in the Arctic Ocean. In 2019 a significant mortality event was recorded affecting STSW and other marine birds. The return of STSW to the Australian colonies was several weeks late, a significant delay for this usually very punctual species. Data from geolocators deployed and recovered from birds on Phillip Island showed that at least half of STSW delayed their departure from the northern hemisphere moving instead north through the Bering Strait and into the Arctic Ocean prior to returning late to the southern hemisphere. Future changes in marine resource availability in the northern hemisphere are likely to have profound impacts on STSW and their annual migration and breeding patterns.

Changes in short-tailed shearwater distribution in Alaska and the influence of environmental conditions

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Short-tailed shearwaters (*Ardenna tenuirostris*) make an annual migration from breeding sites in Australia to rich foraging grounds in Alaska. The Alaska portion of this ~ 30,000 km round trip occurs from May to early October. We tracked migration patterns using >250,000 km of at-sea surveys in Alaska (2007-2019) and examined shearwater abundance relative to environmental drivers. Shearwaters reach the Gulf of Alaska by late April/early May, and by mid-May they aggregate in Aleutian Island passes. In late June they move northward into the Bering Sea and by late July they funnel through Bering Strait into the Arctic waters of the Chukchi Sea, as far as 74.5° North. Peak abundance in the Chukchi Sea occurs from mid-August to mid-September, thereafter, decreasing until early October, when most birds have returned south. In Alaska, shearwaters feed on small fish, squid, and krill (euphausiids), and can comprise > 50% of total seabirds encountered offshore. We documented a northward shift in distribution, with greater numbers of shearwaters in the Chukchi Sea in recent years, especially during the warm years of 2017-2019. The shearwater's northward advance corresponds to an increase in open water (less sea ice, spatially and temporally), and higher biomass of zooplankton during late summer. Shearwater abundance in the Chukchi Sea in August was most strongly associated with environmental conditions in winter (January-March), specifically the amount of volume, heat, and freshwater transport through Bering Strait, which was driven by intensity of southerly winds. We suggest that sub-Arctic winter conditions set the stage for the availability of the shearwater's primary prey, euphausiids. Climate change impacts in the Bering and Chukchi seas could thus require greater use of Arctic waters, resulting in more energy expenditure by shearwaters to access areas with high prey abundance at the northern extent of their migratory route.

Impacts of marine heatwaves may be mediated by seabirds' life history strategies

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Marine heatwaves (MHWs) are periods of anomalously warm water associated with changes in ocean structure, based on the horizontal advection of water masses and atmospheric exchange of heat. The longest MHWs persist for many months and dramatic effects on marine life have been reported from around the world. As top-order predators, seabirds are particularly sensitive to MHWs, with high levels of mortality associated with some events, but not with others. Thus, prediction of impacts is not straight forward, as mortality is not linearly related to simple measures of MHW intensity, persistence, and areal coverage. We describe biological responses expected for seabirds, based on demographic parameters, and the geographic proximity and phenological timing of MHWs with respect to seabirds. The expected interactions between seabirds and MHWs will be complex (with some responses likely to be unpredictable) and extend over broad spatial and temporal scales. The spatial proximity of anomalous marine conditions to breeding colonies, their overlap with foraging areas, and the degree to which MHWs coincide with pre-breeding and breeding seasons presently generate the greatest pressures on seabird populations. We posit that area-restricted seabird species, in terms of movement and breeding strategies, are at greater risk from MHWs, but that non-linear effects complicate prediction. The impacts of MHWs on seabirds may be mediated by their life history strategies.

POSTER

Reconstructing land cover changes between 1778-2020 on Norfolk Island: From historical maps to remote sensing

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Abstract

Norfolk Island hosts the largest numbers of endemic and threatened species compared to other Australian islands. However, many of these species are threatened due to the island's relatively long and diverse settlement history. We aimed to understand the land cover changes over the past 250 years and the impacts of European settlement on Norfolk Island, which also holds a Commonwealth Park and UNESCO World Heritage Site. We collated and examined an extensive range of historical maps and historical aerial photos to reconstruct the key changes in vegetation on Norfolk Island. Altogether, we collated 120 historical maps and aerial photos from diverse sources, such as digital and physical libraries and archives, of which we georeferenced ~75. We used supervised classification and manual digitisation to extract land cover information on vegetation cover from 10 historical maps and datasets. While the classification and symbology used to represent vegetation on the maps varied over time, we were able to track changes in land cover on the island. We found that non-agricultural vegetation cover was at its lowest during the 1940s and has substantially expanded in the past century. We also found high persistence of land cover patterns on the island since 1840 onwards, which we explain by the relative remoteness of the island and its low population density. We suggest that historical maps have an important value to better understand the processes shaping the present landscape and can assist in identifying trends in landscape dynamics and conservation actions.

POSTER

Conservation of coastal values on truwana/Cape Barren Island, Tasmania

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A collaborative effort amongst the Aboriginal Land Council of Tasmania (ALCT), BirdLife Tasmania and the truwana Rangers is providing new data on the coastal bird values on truwana/Cape Barren Island. GPS mapping surveys of beach-nesting shorebirds and seabirds undertaken by BirdLife Tasmania at the invitation of the indigenous community have identified key breeding sites around the island and previously unknown internationally significant breeding populations of resident shorebirds, and nationally significant populations of migratory shorebirds.

Visits in 2019 - 2022 surveyed foreshores on the island; focal species for the surveys were Hooded Plovers, Pied Oystercatchers and Fairy Terns. All breeding sites mapped *in situ*, and all data on species' numbers, distribution and breeding status are shared with the indigenous community. Ongoing annual surveys are planned to provide further data on population trends. The results will contribute to improved management of sensitive coastal areas on truwana/Cape Barren Island by the indigenous community.

POSTER

Cost-effective portfolio allocation across quarantine, surveillance and eradication using info-gap theory

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Invasive species can lead to community-level damage to the invaded ecosystem and extinction of native species. Ecological systems, and the species within, are highly complex and variable. Uncertainties need to be considered in bio-economic modelling to assist in decision making and evaluate the robustness of designed policy. In our research, info-gap decision theory (IGDT) is applied to model and manage such uncertainty.

IGDT is a non-probabilistic theory to enable robust decision making. Such robust decision-making methods are often desirable in ecological systems characterized by Knightian uncertainty, without considering the probability or frequency of policy outcomes. This research provides a novel method for applying IGDT to determine the robust population threshold estimate and the allocation of funds in a biosecurity context, in particular the cost of pre-border prevention versus post-border surveillance and eradication.

We use the risk of incursion of the Asian house gecko, *Hemidactylus frenatus* Duméril and Bibron, 1836 onto Barrow Island as a case study.

Our work provides guidance for decision makers to balance the robustness against parameter estimate errors and specific total budget limit. We demonstrate that, allocating budget to both quarantine and surveillance results in a more robust option, irrespective of the risk of incursion. Increasing investment in either quarantine or surveillance increases the annual budget, but also decreases the total budget limit (i.e., the maximum total budget that decision makers may allocate to all three biosecurity activities). Budget allocated to quarantine should outweigh that to surveillance. A higher estimated population threshold for post-border surveillance detection could increase robustness against unacceptable total management costs. The method outlined here can be used to assist in robust portfolio allocation of limited budget to manage invasive species in a wider context, and to better tackle uncertainty in protection of biodiversity and native species in a cost-effective manner.

WORKSHOPS

Planning for a national island platform in Australia

Australia's approach to managing and conserving its offshore islands needs urgent review. Join this workshop to discuss a range of models, key stakeholders, role descriptions and parameters for creating a national Australian Islands Alliance that can champion island conservation action, prioritise investments aligned to risks, and connect partners at a strategic level nationally.

Island sustainability and community action: developing foundational principles

Perfecting the partnership - Kia tika, kia pono, kia pūmau (Follow a path that is true and correct, is honest and in good faith, is enduring and long lasting).

Join this workshop to learn how to empower communities in island conservation through partnerships and how to develop foundational principles in planning conservation initiatives on populated islands.

Collaborating with communities works best when we learn from each other rather than books or science papers. Collaboration and partnerships have subtle differences depending on who the people are, where the project is located and what the project is. They are enriched by having an open door to anyone who is interested and involving people from the start. Involving Traditional Owners provides an additional richness through understanding traditional ways and connections to the environment and how we can inspirate these to make projects better.

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