Rottnest Island, Western Australia

11-15th February 2019

The Island Arks Symposium organising committee and delegates would like to acknowledge the Whadjuk Noongar people as the traditional owners of the islands off the coast of Fremantle including Rottnest Island or Wadjemup as it is known in the Noongar language. In doing so the Island Arks Symposium organising committee and delegates pay their deepest respects to Whadjuk Elders past, present and future and to the ancient and continuing connection Whadjuk people have with Wadjemup.

Welcome message from the organising committee

The Organising Committee extends a warm welcome to delegates attending Island Arks VI, the sixth symposium on island conservation, tourism and management, being held on Rottnest Island, Western Australia 11-15 Feb 2019.

Since the first meeting in 2009 held on the Great Barrier Reef, the Island Arks Symposium has grown considerably to now include Oceania. To extend our geographic coverage even further, we encourage our neighbours working to conserve islands in south-east Asia and the Indian Ocean to join us.

Our chosen theme for 2019, *Finding the Balance*, reflects the many biodiversity, economic and social values of islands, and the work we do to sustainably use and conserve our islands' resources. Our conference venue is a paragon of this theme. Rottnest Island is an A-Class Nature Reserve, recognised for its unique biodiversity, and is well known for its photogenic quokkas. It is also an island with a rich and significant cultural heritage, and arguably one of our favourite holiday destinations.

We have compiled an exciting program for Island Arks VI. The symposium will allow island practitioners to explore current and future research directions, and learn about new solutions to conservation and management problems on islands. The opportunity exists to reflect upon and celebrate past accomplishments, renew friendships and extend our networks.

We look forward to meeting you so we can learn from each other as we work to conserve islands as important assets.

Dorian Moro

Chair

Our Sponsors

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Department of **Biodiversity, Conservation and Attractions**

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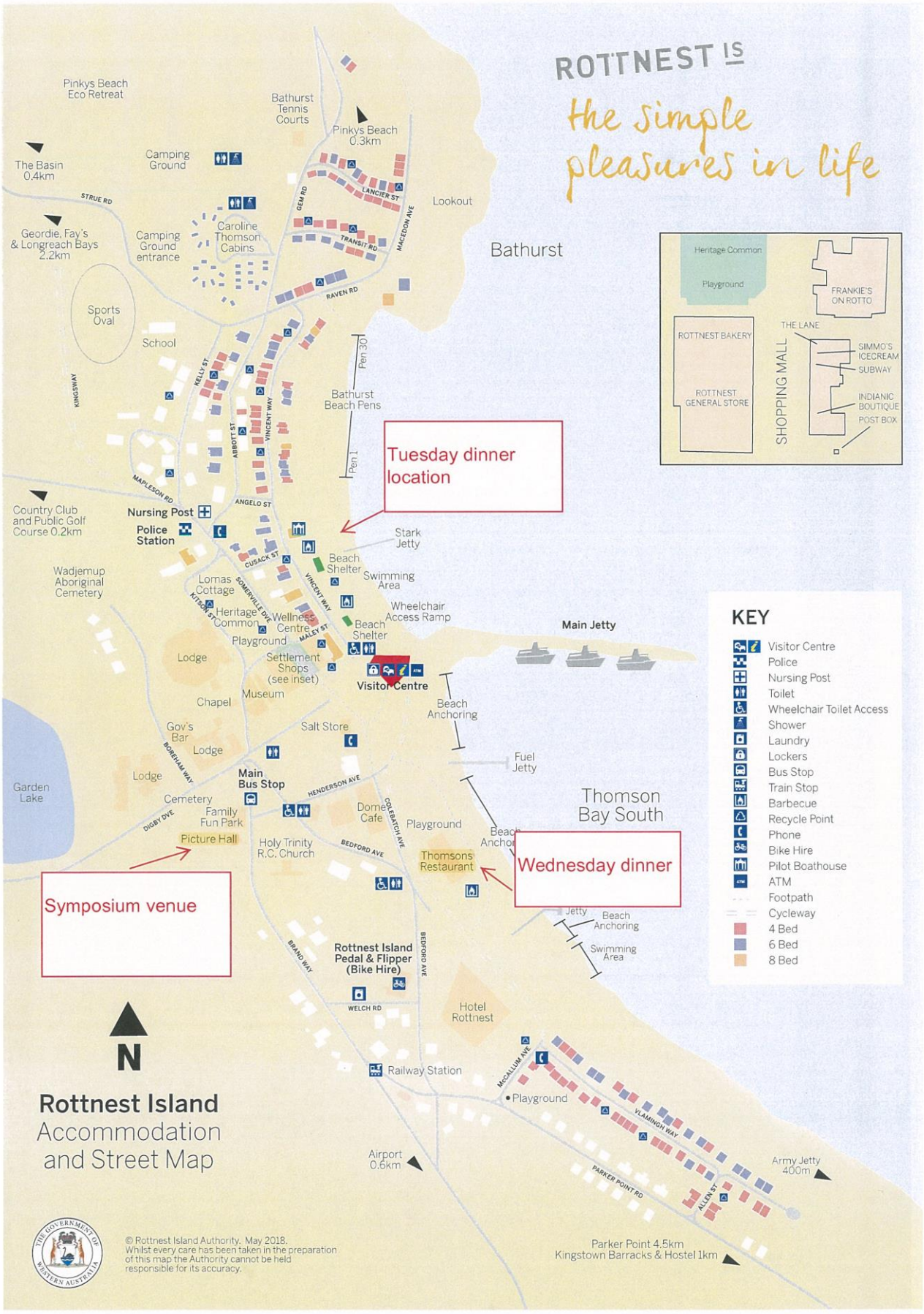
The Western Australian Biodiversity Science Institute

About Rottnest

Located 19km off the coast of Western Australia, the Island is just 25 minutes from Perth's city and feels a million miles from everything. Rediscover life's simple pleasures as you follow a sandy track, run barefoot through the waves or discover intriguing wildlife along the Wadjemup Bidi; a series of picturesque walk trails. As an A-Class Nature Reserve surrounded by sparkling Indian Ocean; Rottnest is home to 63 beaches and 20 secluded bays and you'll also meet our resident quokka; the marsupial that the Island is world-famous for. Relax beach-side or snorkel through vibrant coral reefs protected by marine sanctuary zones, dive among shipwrecks, or climb a lighthouse. The island is essentially a car-free zone, with bicycles the most common mode of transport. Scenic joy rides of the Island can by enjoyed by air, eco boat or a hop-on, hop-off bus service that tours the perimeter of the Island.

Rottnest Island is a Class A Reserve. All flora, fauna and landforms are protected for both purposes of conservation and recreation. This protection zone includes the Island itself, and its surrounding marine environment. This covers a land area of 1,859 hectares and 3,800 hectares of Marine Reserve. The Island has a myriad of natural values that are of importance for biodiversity conservation, and are an integral part of the Island amenity and attraction for visitors. Protection of the Rottnest Island Reserve to maintain a healthy environment is critical to ensure ecosystem function today and in the future, with minimal human intervention. Biodiversity conservation planning is used to identify the natural values of the Rottnest Island Reserve, determine current and desired health, consider threatening processes, and identify priority conservation actions to enable resources to be directed where most needed.




ROTTNEST IS
the simple pleasures in life
Pinkys Beach Eco Retreat
Bathurst Tennis Courts
Pinkys Beach 0.3km
The Basin 0.4km
Camping Ground
Lookout
Bathurst
Geordie, Fay's & Longreach Bays 2.2km
Camping Ground entrance
Caroline Thomson Cabins
Sports Oval
School
Bathurst Beach Pens
Pen 30
Pen 1
Tuesday dinner location
Country Club and Public Golf Course 0.2km
Nursing Post
Police Station
Stark Jetty
Beach Shelter
Swimming Area
Wadjemup Aboriginal Cemetery
Lomas Cottage
Heritage Common
Wellness Centre
Playground
Wheelchair Access Ramp
Beach Shelter
Main Jetty
Lodge
Settlement Shops (see inset)
Visitor Centre
Museum
Chapel
Beach Anchoring
Gov's Bar
Salt Store
Lodge
Fuel Jetty
Garden Lake
Main Bus Stop
Cemetery
Family Fun Park
Dome Cafe
Playground
Thomson Bay South
Picture Hall
Holy Trinity R.C. Church
Thomsons Restaurant
Wednesday dinner
Symposium venue
Jetty
Beach Anchoring
Swimming Area
Rottnest Island Pedal & Flipper (Bike Hire)
Hotel Rottnest
N
Railway Station
Playground
Airport 0.6km
Army Jetty 400m
Parker Point 4.5km
Kingstown Barracks & Hostel 1km
Rottnest Island
Accommodation and Street Map
Heritage Common
Playground
FRANKIE'S ON ROTTO
ROTTNEST BAKERY
THE LANE
SIMMO'S ICECREAM
SUBWAY
ROTTNEST GENERAL STORE
SHOPPING MALL
INDIANIC BOUTIQUE
POST BOX
KEY
Visitor Centre
Police
Nursing Post
Toilet
Wheelchair Toilet Access
Shower
Laundry
Lockers
Bus Stop
Train Stop
Barbecue
Recycle Point
Phone
Bike Hire
Pilot Boathouse
ATM
Footpath
Cycleway
4 Bed
6 Bed
8 Bed
© Rottnest Island Authority, May 2018.
Whilst every care has been taken in the preparation of this map the Authority cannot be held responsible for its accuracy.

About the Island Arks Symposium

The Island Arks Symposium is a long standing, high level meeting for islanders, island managers, conservation ecologists and island eco-tourism operators. The Symposium provides an invaluable forum for knowledge sharing, and as a platform for developing collaborations and partnerships amongst island people. Now in its 6th iteration, Island Arks VI promises to be a wonderful opportunity for those involved in, or with an interest in island management.

Western Australia Organising Committee

- Dorian Moro **(Chair)** (Western Australian Department of Biodiversity, Conservation and Attractions)
- Keith Morris (Western Australian Department of Biodiversity, Conservation and Attractions)
- Lesley Gibson (Western Australian Biodiversity Science Institute)
- Shane Kearney and Cassyanna Gray (Western Australian Department of Biodiversity, Conservation and Attractions)
- Cheryl Lohr (Western Australian Department of Biodiversity, Conservation and Attractions)

National & International Committee

- Derek Ball – CEO Wild Mob, Australia
- Sally Bryant – Tasmanian Land Conservancy, Australia
- Jo Ritchie – Natural Logic Environmental Management New Zealand
- Duncan Sutherland – Deputy Research Director, Philip Island Nature Parks, Australia

Program

Island Arks VI 2019

Spoken presentations	Monday 11/2/19	Tuesday 12/2/19	Wednesday 13/2/19	Thursday 14/2/19	Friday 15/2/22
early morning (0700-0745)			Tours	Tours	Tours
0900-0940		Keynote Sally Box	Keynote Ed Chignell	Keynote Karl Campbell	
0940-1000		Integrated island management and restoration Dirk Hartog Island National Park Ecological Restoration Chair: Keith Morris R. John Asher Return to 1616 – the ecological restoration of Dirk Hartog Island	Phillip Island Chair: Jo Ritchie Ben Thomas Iconic holiday destination to emerging conservation ark: The Phillip Island story	Community conservation Chair: Sally Bryant Sue Neureuter Contemporary conservation challenges for islands and associated marine habitats in the Hauraki Gulf: Community taking the lead	
10.00-10.30		Morning tea	Morning tea	Morning tea	
10.30-10.50		Dave Algar Feral Cat Eradication on Dirk Hartog Island, Western Australia	Duncan R. Sutherland Saving a species from extinction and paving the way for rewilding Phillip Island	Jo Ritchie Walking the tightrope – Balancing community expectations with the realities of doing the work on the ground	
10.50-11.10		Shane M. Heriot *Return to 1616* – sheep and goat eradication on Dirk Hartog Island	Richard Faulkner 'Working together' for effective environmental decision making and prioritising threatened species conservation on Phillip Island	Junior Novera 'Backyard Conservation' on Bougainville	
11.10-11.30		Richard J van Dongen Monitoring vegetation cover using high temporal frequency Landsat imagery on Dirk Hartog Island	Peter Dann Victoria's islands as conservation arks	Christy Martin Saving Hawaii's forest birds	
11.30-11.50		Saul Cowen Wirruwana's wallabies – translocations of banded and rufous hare-wallabies to Dirk Hartog Island, Western Australia	Pest eradications Chair: Karl Campbell Nic Dunlop Rat Island recovery-twenty-eight years after feral predator eradication	Sally L Bryant Protecting the Golden Goose and the growth of tourism on Tasmania's Bruny Island	
11.50-12.10		Deanne von Senger Return to 1616 – engaging with the community	John Parkes Trophic position of feral cats on two Tasmanian islands: implications for eradication and biodiversity benefits	Cherie W. Morris Social and economic outcomes in a changing fishery: case study of the Vanua Navakavu, Fiji	

12.10-1.10		Lunch	Lunch	Lunch
1.10-1.30	Long tours of island (1300-1500 hr)	Islands as Arks for conservation Chair: Sally Box Derek Ball Island Arks Australia – Can it guide a renaissance in Australian island conservation?	David C. Duffy Cats, dogs and mongoose: the good, the bad and the ugly	Monitoring and modelling Chair: Lesley Gibson Robert Blok Middle Island – Finding the Balance
1.30-1.50		Allan H. Burbidge Judging success in translocations of birds to islands	Jo Ritchie Keteparaha – a toolbox for community pest control	Kelly Rayner Predictive modelling during planning: a retrospective case study of two species translocated to Doole Island in the Exmouth Gulf of Western Australia.
1.50-2.10		Sarah Comer Blazing arks, potential refugia and management of threatened species on Mondrain Island	Keith Morris The 'eradication' of black rats on Direction Island, Cocos Keeling group.	Roy Teale Monitoring of Golden Bandicoots and Burrowing Bettongs: a case study in adaptive management on Australia's Island Ark
2.10-2.30		Tony Friend Trial translocations to Middle Island, Recherche Archipelago, provide positive assessment of habitat suitability for the world's rarest marsupial, Gilbert's potoroo	Alan Saunders 'Pride and predators'; social drivers of pest management in New Zealand	Stewart Ford Distance sampling as a tool for monitoring on Barrow Island
2.30-2.50		Kate Brown Restoring critical seabird habitat on Penguin Island	Sue Robinson Partnerships and persistence: Big Green Island successfully cleared of rats	Elsie Kinnaird Invertebrate surveillance techniques and considerations: the Barrow Island example

2.50-3.20	Registrations	Afternoon tea	Afternoon tea	Afternoon tea
3.20-3.40		Salit Kark Saving Species on Australian Islands	Indigenous Protected Areas Chair: Cheryl Lohr Ellie Bock Regaining Balance - Managing Islands as Indigenous Protected Areas	Janine. M. Buist Identifying indicators to monitor terrestrial island ecosystem change in the Torres Strait and develop future management strategies
3.40-4.00		Rottnest Island Chair: Duncan Sutherland Shane Kearney Sustainable Tourism – Practices and Challenges on Rottnest Island	Leah E. Dann The use of historical maps and aerial images to examine long term vegetation dynamics and inform conservation actions on Norfolk Island	Mark Cowan Variation in the Herpetofauna on islands of the Houtman Abrolhos archipelago, Western Australia
4.00-4.20		Suzanne H. Mather Summer migrants-the importance of Rottnest Island habitat for transequatorial bird species.	Subantarctic islands Chair: Dorian Moro Jennie Whinam Heard Island – The balance between conservation management, science and tourism	Formal Symposium Close
4.20-4.40	430-445pm -Welcome (housekeeping) -Welcome To Country -Formal Symposium Opening	Cassyanna Gray Conservation Action Planning – Adaptive Biodiversity Management on Rottnest Island	Justine Shaw Sub-Antarctic Islands: conservation lessons and sentinels of global change	end of day
4.40-5.00	445-530pm Keynote Ric How		Melissa Houghton Invertebrates as indicators of ecosystem change on sub-Antarctic islands	
5.00-5.30		end of day	end of day	
	530-730pm Welcome Reception			
6.00		Social BBQ Thomsons Bay (BYO drinks)	Symposium dinner (Thomsons Restaurant)	Free evening

KEYNOTE SPEAKERS

Island biogeography and evolution in the eastern Indian Ocean

Ric A. How[1, 2]
[1] Department of Terrestrial Zoology, Western Australian Museum, Locked Bag 49, Welshpool DC, WA 6986
[2] School of Human Sciences, The University of Western Australia, Crawley WA 6009, Australia

Islands in the eastern Indian Ocean have been the focus of major biogeographic and evolutionary ideas, beginning with Alfred Wallace's biological collections and seminal writings from the Dutch East Indies in the late 1850s. The biogeographic boundary between the Asian and Australasian regions, aptly named Wallace's Line, occurs within these islands that are of either of continental shelf origin or volcanically derived. The impact of numerous Pleistocene sea-level changes on island connectivity, as well as recent anthropogenic activity, provide insights into present regional relationships of their faunas and evolutionary processes within several taxonomic groups. The results of the Western Australian Museum's survey of snakes and mammals across 125 locations on 28 islands in eastern Indonesia between 1987 and 1993 will be presented and the outcomes that morphological and molecular research provide on species biogeographic and systematic status evaluated.

Over 3600 islands occur on the Australian continental shelf off Western Australia, the majority having been isolated from the mainland for around 7000 years following sea-level rise since the last Pleistocene glacial maxima. Many islands act as refugia for populations isolated from conspecifics on the mainland and thus allow research opportunities into morphological and genetic changes in remnant populations during the Holocene. Species research of populations on over 40 islands off the Kimberley coast has shown that morphological and demographic differences are evident and that genetic heterozygosity declines with distance from mainland and decreasing island size, but connectivity of island populations is also related to difficulty of ocean passage. Island populations of mammals and reptiles off the Pilbara and West coasts, including the Houtman Abrolhos, illustrate the essential role continental islands play in retaining species and population variation that is essential to effective conservation and management as well as predicting the inherent extinction debt of fauna in habitat isolates on the mainland.

Australia's Threatened Species Strategy and the role of island safe havens

Sally Box
Threatened Species Commissioner, Department of the Environment and Energy, GPO Box 787, Canberra ACT 2601, Australia

Australia's Threatened Species Commissioner leads the implementation of the Threatened Species Strategy, a new national approach to recovering threatened species delivered in partnership with conservation organisations, governments, community and the private sector. The Threatened Species Strategy sets out a five-year plan which highlights how an approach of science, action and partnership can be used to achieve the long-term goal of reversing species declines and supporting species recovery. The Threatened Species Strategy includes ambitious targets to tackle the threat of feral cats including eradication of feral cats across five islands by 2020. This talk will provide an overview of the importance of islands and other safe havens in the Australian Government's approach to recovering threatened species. I will discuss the successes and challenges to date, and the role of community and robust partnerships in driving successful island eradications and threatened species recovery.

Return to life

Ed Chignell
Predator Free 2050 Limited, PO Box 106040, Auckland City 1143, New Zealand

Invasive mammals have had a devastating impact on New Zealand's unique indigenous biota. Nearly a quarter of native bird species have been lost and only a fifth are safe from extinction. Predator Free 2050 Limited facilitates co-funding to enable large landscape predator control and eradication operations and breakthrough scientific research. The company's first tranche of around seven projects will enable over $100 million of predator control and eradication operations. These projects will be implemented in rural provincial landscapes, major cities, inhabited islands and forests. The company is required to attract co-funding at a ratio of 2:1. It has exceeded this target, in large part through the support of regional councils, which have embraced the Predator Free 2050 mission, and philanthropic trusts. The national goal is stimulating research and innovation in predator control methodologies. Rural projects are utilising remote wireless monitoring of traps to reduce labour costs. In remote back country areas, emphasis is on 100% removal of predators through aerial toxins and improved surveillance techniques to protect against reinvasion. In urban areas like Wellington very high rates of public acceptance and involvement in ground-based control is a key to success. The city aims to be the world's first predator-free capital and return the New Zealand national emblem, the kiwi, to its suburbs.

Predator Free 2050 Limited's research strategy focusses on improving the effectiveness of current tools (traps, toxins and surveillance), the potential of new tools (focusing initially on the genetics field), societal attitudes to the pathways that would enable predator eradication, and the potential of modelling and other computer applications. The company, the Department of Conservation and other partners are focussed on 2025 targets: to increase predator suppression to an additional one million hectares, eradicate predators from at least 20,000 ha without the use of fences, eradicate predators from all offshore nature reserves, and achieve a science solution capable of eradicating at least one small mammalian predator from the mainland.

Alternative pest management strategies and working for communities on islands

Karl J. Campbell
Island Conservation, Puerto Ayora, Galapagos Islands, Ecuador

Invasive rodents have significant negative impacts on island biodiversity. Inhabitants of islands are negatively impacted by rodents as vectors of disease, and through agricultural and infrastructure damage. Inhabited islands with children, livestock, agriculture and pets present significant challenges because eradication is currently limited by a lack of species-specific methods, animal welfare issues, high fixed costs, and socio-political opposition. Current tools restrict eradication efforts to fewer than 15% of islands with critically endangered or endangered species threatened by invasive rodents. Innovative breakthroughs are needed to overcome current barriers. Three innovations will be discussed:

1. On Floreana Island in the Galapagos, a conflict transformation process has been underway since 2012. Positively centered processes have built a strong foundation based on trust. The partnership is implementing a shared vision, including eradicating invasive predators, within which Island Conservation takes a position of working for the community and other partners to implement their sustainable development project;

2. Rodenticide bait application utilizing drones is being explored, with a potential trial in the Galapagos in January 2019. Drones have the potential to facilitate aerial bait application on small islands in the short-term. As adoption continues, and technology advances, drones will provide an alternative to helicopters on baiting operations at larger scales;

3. The use of gene drives is being explored in mice within the Genetic Biocontrol of Invasive Rodents partnership (www.geneticbiocontrol.org/). Technological approaches currently being investigated include the production of multiple strains of *Mus musculus* with a modified form of the native t-complex, and a CRISPR gene drive, carrying genes or mechanisms that determine sex. These systems have the potential to bias the sex ratio of offspring towards a single-sex, resulting in population collapse. Complimentary aspects of the program include stakeholder and regulatory engagement, modelling, ecologically-based risk assessments, ethics evaluation and development of gene drive control mechanisms.

Speakers

Tuesday

Integrated island management and restoration: Dirk Hartog Island National Park Ecological Restoration

Return to 1616 – the ecological restoration of Dirk Hartog Island

R. John Asher[1] and Deanne M. von Senger[2]
[1] Biodiversity and Conservation Science, Department of Biodiversity, Conservation and Attractions, PO Box 1693, Bunbury WA 6230, Australia
[2] Biodiversity and Conservation Science, Department of Biodiversity, Conservation and Attractions, PO Box 72, Geraldton WA 6531, Australia

The Dirk Hartog Island (DHI) National Park Ecological Restoration Project (*Return to 1616*) is an integrated, long-term project that aims to restore the major ecological values of Western Australia's largest island (63,000 ha) to what they were 400 years ago when Dirk Hartog landed on the island in 1616. DHI formerly supported at least 13 species of native terrestrial mammals, of which only three persist following the introduction of cats, mice, sheep and goats over the last 150 years. In the 1800s the island was used as a base for whaling, guano collection, pearling and since the 1860s it has been a pastoral lease. More recently it has been subject to extensive recreational use. In 2009, most of the island became a national park.

Return to 1616 is being implemented over two stages and will take up to 20 years or more to achieve its objectives. Stage 1 (2011-2018) involved the eradication of sheep, goats and feral cats allowing for Stage 2 (2018-2030) to re-establish 10 species of mostly medium-sized threatened mammals on the island and one native bird species. Two additional mammal species, which may have previously inhabited the island, will also be introduced for conservation purposes. Once completed, the terrestrial mammal fauna will be increased to 15 species, the most diverse of any Western Australian island. Concurrently with the planned fauna re-establishment, several other activities, including weed and fire management, native vegetation reconstruction, community engagement and quarantine management, will continue to be implemented to return the island's biodiversity as near as possible to its 1616 state.

The project is substantially funded by the Gorgon Barrow Island Net Conservation Benefits Fund and implemented by the Western Australian Department of Biodiversity, Conservation and Attractions.

Feral cat eradication on Dirk Hartog Island, Western Australia

Dave Algar[1], Mike Johnston[1], Cam Tiller[1], Jason Fletcher[1], Mike Onus[1], Gary Desmond[1], Neil Hamilton[1] and Peter Speldewinde[2]
[1] Biodiversity and Conservation Science, Department of Biodiversity, Conservation and Attractions, Locked Bag 104, Bentley Delivery Centre, WA 6983, Australia
[2] Centre of Excellence in Natural Resource Management, University of Western Australia, Albany WA 6330, Australia

There is extensive evidence that the introduction of domestic cats to both offshore and oceanic islands around the world can have serious detrimental impacts on land vertebrates and breeding bird populations. Feral cats have been known to drive numerous extinctions of endemic species on islands. Also, predation by feral cats currently threatens many species listed as critically endangered. Insular faunas that have evolved for long periods in the absence of predators are particularly susceptible to cat predation. Dirk Hartog Island, the largest island off the Western Australian coast, is no exception with 10 of 13 native terrestrial mammal species that previously occurred on the island now locally extinct. Predation by cats has been implicated in these extinctions. Since the 1860s, Dirk Hartog Island has been managed as a pastoral lease grazed by sheep and goats. More recently, tourism has been the main commercial activity on the island. Cats were probably introduced by early pastoralists and became feral during the late 19th century. The island was established as a National Park in November 2009, which has provided the opportunity to eradicate feral cats and reconstruct the native mammal fauna. Dirk Hartog Island could potentially support one of the most diverse mammal assemblages in Australia and contribute significantly to the long-term conservation of several threatened species. Successful eradication of feral cats would be a necessary precursor to any mammal reintroductions. Globally, the Dirk Hartog project is the largest feral cat eradication campaign attempted on an island. In this presentation, we outline the strategy and techniques used in the eradication campaign.

The eradication of sheep and goats on Dirk Hartog Island

Shane M. Heriot[1] and R. John Asher[2]
[1] Biodiversity and Conservation Science, Department of Biodiversity, Conservation and Attractions, Denham WA 6537, Australia
[2] Biodiversity and Conservation Science, Department of Biodiversity, Conservation and Attractions, Bunbury WA 6230, Australia

Dirk Hartog Island (DHI) is the largest island off the Western Australian coastline with an area of approximately 63,000 ha. The island has a history of sheep pastoralism from the 1860s until 2009 when the island became a national park. At its peak it was estimated that there were up to 20,000 sheep (*Ovis aries)* and goats (*Capra hircus*) on the island. In 2005 the lessee began destocking through mustering and removing sheep and some goats from the island and ground shooting remaining goats. In 2008 the then Department of Environment and Conservation began ground shooting and in 2010 commenced a regular and methodical aerial shooting program.

In 2011 the DHI National Park Ecological Restoration Project (*Return to 1616*) commenced, substantially funded through the Gorgon Barrow Island Net Conservation Benefits program and managed by the Department of Biodiversity, Conservation and Attractions. This provided reliable ongoing management and funds to achieve eradication of the sheep and goats. The use of radio collared adult female 'Judas' goats was implemented to assist the aerial shooting program. From 2005 to November 2017 a total of 5,185 sheep and 11,194 goats were removed from DHI through mustering and ground and aerial shooting, achieving a combined total of 16,379 sheep and goats removed. In June 2016 sheep were declared eradicated and goats in November 2017, when the last 'Judas' goat was removed.

Dirk Hartog Island is now the largest island in the world where domestic sheep have been eradicated and the fourth largest island in the world where goats have been successfully eradicated. Vegetation monitoring by the project using satellite imagery has shown a significant increase in vegetation cover and reduction in the size and rate of spread of sand dunes following sheep and goat removal.

Monitoring vegetation cover using high temporal frequency Landsat imagery on Dirk Hartog Island, Western Australia

Richard J van Dongen, Bart G Huntley and Greg J Keighery
Biodiversity and Conservation Science, Department of Biodiversity, Conservation and Attractions, Locked Bag 104, Bentley Delivery Centre, WA 6983, Australia

Dirk Hartog Island is the largest island off the Western Australian coast. Since the 1860s the Island was managed as a pastoral lease. In 2009 the Island was gazetted as a National Park and the process to remove introduced animals and enable a suite of 12 native mammal species and one bird species to be re-established on the island began. With the removal of more than 16,000 sheep and goats came questions about the ability of the Island's native vegetation to recover and concerns regarding the proliferation of weed species (which would no longer be grazed). A monitoring program was developed which integrated detailed floristic surveys, repeated site photography and Landsat time series data to provide a comprehensive picture of how the Islands vegetation cover has changed since destocking.

The integration of the ecological and satellite data has allowed present day observations to be put into context with the historical Landsat imagery. Statistical analysis of Landsat time series imagery at monitoring points identified those at which vegetation cover has increased because of destocking. Field observations were then used to identify the species responsible for increases in cover. These data sources, when analysed together, allow managers to have greater confidence that, following destocking, the native vegetation cover is increasing at a rapid rate. Also, while introduced species, such as the highly invasive buffel grass (*Cenchrus ciliaris*), has increased in density, there is no evidence that it has increased in extent. Rather it appears that with the reduction in grazing by sheep and goats, native plant species are out-competing buffel grass. This result provides managers with confidence that vegetation condition in the Island is improving, that active revegetation programs are not required and that future mammal reintroduction programs have the best chance of success.

Wirruwana's wallabies – translocations of banded and rufous hare-wallabies to Dirk Hartog Island, Western Australia

Saul Cowen, Colleen Sims, John Angus, Sean Garretson, Kelly Rayner and Keith Morris
Biodiversity and Conservation Science, Department of Biodiversity, Conservation and Attractions, Locked Bag 104, Bentley Delivery Centre, WA 6983, Australia

Dirk Hartog Island (or Wirruwana) in the Shark Bay World Heritage Area is Western Australia's largest island and is the site of one of the world's largest ecological restoration programs. Since the Dutch explorer Dirk Hartog first landed on the island in 1616, 10 species of native mammal and one bird species are known to have become locally extinct. The Dirk Hartog Island National Park Ecological Restoration Project, or 'Return to 1616', seeks to return the island to its pre-European ecological state. This includes the eradication of the introduced sheep, goats and feral cats, followed by the re-establishment of the former native fauna, many of which are threatened or conservation dependent. In addition to the previously known assemblage, two other mammal species that may have occurred on the island will also be translocated to improve their conservation status: banded hare-wallaby (*Lagostrophus fasciatus*) and rufous hare-wallaby (*Lagorchestes hirsutus*).

All the sheep and feral goats were removed from the island between 2007 and 2017, and the island was declared feral-cat free in September 2018, after four years of cat baiting, trapping and monitoring. In August 2017, a trial introduction of the two hare-wallaby species was undertaken with the release of 12 of each species from nearby Bernier and Dorre Islands. These animals were monitored closely for 13 weeks post-release and less intensively for a further 6 months to assess survivorship, movement patterns and reproductive activity. Survivorship was high with 100% of banded and 92% of rufous hare-wallabies still alive after the first nine months. Some hare-wallabies moved large distances (up to 15km) in the first few months, others remained near their release locations. Reproductive activity was also encouraging, with a minimum of six banded and 10 rufous joeys recorded during the monitoring period. Given the success of this trial, translocations of larger numbers of the two hare-wallaby species were undertaken in September 2018 and the results of these will be presented. These represent the first of many such releases of native fauna over the next 12 years to help return Dirk Hartog Island to its former natural state and improve the conservation status of at least eight threatened mammal species.

Return to 1616 – Engaging with the community

Deanne von Senger
Department of Biodiversity, Conservation and Attractions, Geraldton WA 6531, Australia

Important to the continued success of the Dirk Hartog Island National Park Ecological Restoration Project *Return to 1616* is support from the local community and visitors to the island, particularly in relation to biosecurity. An ongoing campaign to raise awareness of, and support for, the project and island biosecurity measures is therefore necessary. To this end, the *Return to 1616* project has a community engagement strategy, employs a community engagement officer to implement it in Shark Bay, and utilises the Department of Biodiversity, Conservation and Attractions Public Information and Corporate Affairs unit to raise awareness and appreciation of the project.

Since 2013, annual community engagement events have taken different forms in a quest to reach as much of the Shark Bay community as possible. Events have ranged from sausage sizzles to weaving workshops and an art exhibition and have included a *Return to 1616* children's activity and made use of Shark Bay community Facebook pages. Regular project updates are provided in the local Inscription Post and in project newsletters and photobooks. Alongside this are media releases and posts on the Parks and Wildlife Service Facebook page.

The *Return to 1616* children's activity is also run at Monkey Mia during school holiday programs and was recently updated to reflect the project's progression from feral animal eradication to the translocation of native species.

The community engagement strategy and activities are regularly reviewed and adapted to reach the community and reflect changes in the project.

Island Arks Australia – Can it guide a renaissance in Australian island conservation?

Derek Ball[1], Sally Bryant[2] and Dorian Moro[3]
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Island Arks Australia (IAA) was conceived about 10 years ago with the explicit intent to foster knowledge sharing and collaboration in Australian island conservation. Unlike other conservation strategies, IAA intended to embrace and improve understanding of the social, cultural and economic imperatives that are almost invariably intertwined with conservation initiatives on Australian islands. The first Island Arks Symposium was held in the Whitsundays (north Queensland) in 2009 and since then has extended its outreach globally, offering outstanding opportunities for learning and collaboration with other island nations. However, the Symposium is merely the 'tip of the iceberg' and numerous initiatives have occurred along the way from a collective of practitioners focused on raising the profile of islands, their biodiversity value and priority for protection. The key strengths of this collective are their credibility, documentation of a strong evidence base, a multidisciplinary approach, and their resolve as island 'champions'. We propose that the next evolution for IAA is to enlist and formalise this collective to guide a renaissance in Australian island conservation. This would involve development of negotiated governance structures, stakeholder networks, terms of reference and well thought out strategies. We believe IAA should be non-political, non-adversarial, embrace innovation and science to drive island projects, and comprise a team of 'can-do' people from every sector of the island community. We invite discussion and support for this evolution at this sixth IAA on Rottnest Island.

Judging success in translocations of birds to islands

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Translocation success is usually described in terms of commencement of breeding, followed by persistence of the population. For example, noisy scrub-birds on Bald Island continued to increase in numbers for more than two decades after the introduction of 11 birds in the early 1990s, and have persisted for more than 25 years. In contrast, spinifexbirds and a black-and-white subspecies of white-winged fairy-wrens showed substantial increases in numbers during the five years following translocation to Hermite Island in 2010-11, but then decreased significantly. However, natural populations of both black-and-white subspecies of the white-winged fairy-wren on Dirk Hartog and Barrow Islands vary markedly from year to year, apparently in response to variation in rainfall. Translocated populations in environments like this are not likely to be viable until they can withstand at least halving of their population size, and consequently recover, without detrimental genetic impacts. The magnitude of these genetic impacts may partly depend on the size of the founder group in the initial translocation, which in these cases was relatively small, potentially exacerbating the vulnerability of the new population. Such stochastic variation needs to be taken into account when setting criteria for assessment of long-term success.

Blazing arks, potential refugia and management of threatened species on Mondrain Island

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At 880 ha Mondrain Island is one of the largest islands on the south coast of Western Australia, and the second largest in the Recherché Archipelago. The vegetation and topography of the island have resulted in a diverse range of habitats from woodland to heath and thickets, and these areas provide refuge for the largest population of the Recherché sub-species of the black-flanked rock wallaby *Petrograle lateralis hacketti,* and significant seabird breeding colonies. In 2002 the island was in the spotlight following a lightning strike which resulted in over 85% of the vegetation burning. Monitoring plots were established to study post-fire regeneration of three of the dominant vegetation communities. Following numerous field visits the island was considered as a potential translocation site for the endangered noisy scrub-bird *Atrichornis clamosus.* Detailed habitat assessment was conducted in 2014, and the abundance of leaf litter invertebrates found to be comparable to occupied mainland sites. Although outside the known historic range of this species the island occupies the same geological formation, and preliminary modelling suggests it will remain buffered from climate change impacts. However, a lightning strike in December 2017 resulted in a fire starting on the island, and in spite of considerable efforts from local managers this also resulted in the loss of a significant area of habitat. Despite this, two small remnants deemed suitable for scrub-birds remained unburnt. In July 2018 the first phase of the experimental introduction took place, with some of the founders sourced from Bald Island which has not burnt for over 140 years. In this paper we will explore the potential for south coast islands to provide secure habitat for threatened species, and consider the challenges and considerations for operational staff in preparing for, managing, and mounting fire suppression operations on islands in an increasingly flammable ark.

Trial translocations to Middle Island, Recherche Archipelago, provide positive assessment of habitat suitability for the world's rarest marsupial, Gilbert's potoroo

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Establishing new populations through translocation is a process widely-used to improve the conservation status of threatened species. Measurement of critical habitat attributes such as food availability and abundance of shelters in potential translocation sites prior to any movement of animals can inform selection of the sites most likely to be suitable. Closely-monitored trial translocation of a few individuals, however, provides the ultimate test of prospective habitat.

Gilbert's potoroo, discovered in 1840, in the vicinity of Albany on the south coast of Western Australia, was last recorded in the 1870s and subsequently thought extinct, until 1994 when a colony of around 30 was discovered at Two Peoples Bay, 25 kilometres east of Albany. The single population of these highly fungivorous marsupials was extremely vulnerable to a possible fire event, so recovery planning gave the highest priority to the establishment of new populations.

Following an encouraging trial translocation of two potoroos for five weeks to nearby Bald Island in 2005, transfer of 10 animals in 2005-2007 has resulted in a population of 70-100 potoroos on that island. On Middle Island, where the adjacent mainland is well outside the historic range of the species, four-week trials in winter 2017 and in the following summer, each involving four animals, met the success criteria of 75% survival and loss of body weight of no more than 10%. Faecal analysis showed that the potoroos were feeding on a wide variety of hypogeal fungi. This result provided justification for a full translocation in July 2018, resulting in a founder group of ten animals on the island.

Restoring critical seabird habitat on Penguin Island

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The transition from native shrublands to weedy grasslands following establishment of large colonies of gulls has been reported for floras of small islands across the world. In addition to causing extensive trampling, guano deposition and disturbance, gulls are effective carriers of weed seed, ejected from their crops in a viable form into soil and guano deposits around nesting colonies. Around 1961 a colony of silver gulls (*Larus novaehollandiae*) became established on Penguin Island and current estimates put the population at around 4000 pairs. The gulls have had a particularly serious impact on the vegetation in north east section of the island, historically important nesting habitat for bridled terns (*Onychoprion anaethetus*). Once Rhagodia shrubland, the area is now largely a cover of weedy annual grasses and herbs in winter/spring, and bare ground in summer when terns return from Japan and Borneo to nest, lay eggs and raise young.

Studies ongoing since 2014 aim to develop effective restoration techniques for the north eastern Rhagodia shrublands on Penguin Island and to reverse the decline in critical bridled tern habitat. Trials to restore the shrublands through planting revealed silver gulls pulled out 98% of tube stock across sites while natural regeneration studies indicated seedling establishment is much more likely to occur in sites protected from silver gulls. In addition, if sites are protected under weld mesh cages from silver gulls in the initial 12 months, planting tubestock, direct seeding or brushing with fertile material are techniques that rapidly and effectively create cover of dense native shrubland. Eighteen months after removal of protection, restored native vegetation in all treatments retained cover and mapping of nest densities in 2018 indicated bridled terns are using restored vegetation. While these results are encouraging part of the solution to managing the decline in bridled tern habitat on Penguin Island probably lies in effectively managing silver gull numbers.

Saving Species on Australian Islands

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Australia has over 9,000 islands that support many hundreds of threatened species. Although islands can be important havens for biodiversity, more species extinctions have occurred on Australia's islands than on mainland Australia and when islands are invaded by invasive species the consequences to native species and ecosystems can be catastrophic. With so many islands, Australian scientists, policy makers and planners need evidence to determine and prioritise the most effective and efficient conservation actions. We will present the NESP Threatened Species Recovery hub project which, in collaboration with multiple partners and stakeholders, developed a national database for threatened species on Australian islands and has worked over the past three years with multiple partners on a range of priority case study islands. We will also provide an update of the outcomes of our work on the database and the island case studies, ranging from modelling invasion by cane toads on the Kimberley islands, Stradbroke Island fox management, and a study of Norfolk Island native and invasive birds, mammals, plants and other island arks on which we are collaborating with Parks and other stakeholders to advance their conservation and management.

Rottnest Island

Sustainable tourism – practices and challenges on Rottnest Island

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The Rottnest Island Authority (RIA) operates a major Western Australian holiday and recreational destination within a Class A Reserve in accordance with the Rottnest Island Authority Act 1987 for the purposes of protection or flora and fauna and the provision of recreational holidays services. The RIA operates a diversity of services, facilities and utilities including the production and supply of water and energy, waste management, parks and heritage management, building maintenance and transport that underpin the island's tourism services, products and experiences. Balancing the growth of visitor numbers through the provision of best-in-class tourism products, experiences and services, with the need to conserve Rottnest Island's unique environments, its flora and fauna, its varied built and cultural heritage and social values can be challenging.

In recognition that the environmental, cultural, social and economic performance (ECSE) of Rottnest Island is an important component of an island's reputation, product and sustainable tourism brand, the RIA adopted the EarthCheck sustainable tourism standard in 2011 and has been continually benchmarking and improving its ECSE performance since. The adoption of a sustainability standard has helped the RIA to develop and implement a sustainability strategy that provides a measure and structure to reach the desired objectives and targets across the destination community.

Summer migrants – The importance of the Rottnest Island habitat for trans-equatorial bird species

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Rottnest Island provides an increasingly important habitat for the austral/summer populations of trans-equatorial migratory birds. This suite of birds is showing a population decline as the foraging areas of extensive mud flats in their south-east flyway are lost to industrial development in Korea and China. In Western Australia the population of these birds has lost much of its south west habitat with increasing coastal population, urban development and farming. Results from the continuous bi-annual censuses on the Island suggest protecting habitat this population uses in a key tourist environment in Western Australia is beneficial for the species. This work will show the results of these censuses and the percentage of the Western Australian population that migrate to Rottnest Island compared with the population from diminishing available habitats in the south west.

BirdLife Australia's Western Australian Branch has been surveying this population bi-annually since 1998. The data from this work add to the national BirdLife Australia database and to the Rottnest Island Authority records. Whilst the results of this work show that some species, such as the Curlew Sandpiper (*Calidris ferruginea)* population has declined, this is commensurate with a world population decline. However, trend analysis shows that the population of Red-necked Stint (*C. ruficollis)*, a 30gm migratory species, has increased over the last ten years. This increase could be commensurate with the loss of habitat in the nearby Swan River estuary but also indicates that the Island provides a secure summer foraging area. The continued environmental management of the Island has secured this habitat by limiting and controlling tourist activity in the area and through monitoring the water quality in the lakes. Continued census helps researchers understand which habitats are important for this suite of birds and Rottnest Island shows how tourism and shorebird protection can co-exist.

Conservation action planning – adaptive biodiversity management on Rottnest Island

Cassyanna Gray and Shane Kearney
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Rottnest Island is an A-class Reserve and is a highly desirable holiday destination. The Island has a myriad of natural values that are of importance for biodiversity conservation at a local, state and national level, and are an integral part of the Island amenity and attraction for visitors. One of the most challenging aspects of biodiversity conservation management is determining where to focus the limited financial and social resources available to deliver optimal ecological, social and financial benefits.

The Rottnest Island Authority adopted the Nature Conservancy's 'Conservation Action Planning' (CAP) as its platform for biodiversity conservation planning in 2011. The methodology was chosen because it affords a strategic and adaptive approach to biodiversity conservation management. The CAP process works at a landscape scale and involves identification of natural values, determination of current and desired health, consideration and ranking of threatening processes, and identification of priority conservation actions to enable resources to be directed where most needed. The conservation goal at a landscape level is to maintain healthy, viable occurrences of targets. The Rottnest Island Terrestrial Conservation Action Plan has been developed, tested and applied with input from a variety of stakeholders, researchers and experts (and a Marine Conservation Action Plan is currently in development). Learning, adaptation and sharing are essential components of the CAP process and this presentation aims to provide an overview of biodiversity management on Rottnest Island, and share our challenges and learnings with peers.

Wednesday

Phillip Island

Iconic holiday destination to emerging conservation ark: the Phillip Island story

Ben Thomas, Peter Dann and Duncan Sutherland
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Islands are becoming increasingly useful as conservation arks, particularly as they present opportunities for reducing /eliminating threatening processes such as predation by introduced predators or habitat reduction through weed invasion. Phillip Island has a long history of introductions and translocations starting with the Victorian Acclimatisation Society in 1860 followed by Koala, Cape Barron Goose and Magpie Goose translocations in the 20th century and Eastern Barred Bandicoots in 2017.

Phillip Island is best known as home to one of the largest Little Penguin colonies but 40 years ago the population was in decline and the future of the world famous tourist attraction “the Penguin Parade” was in peril. This situation prompted a number of actions including two that provided the basis for the Island becoming a conservation ark. The first was an unprecedented program to buy back an entire 776 lot residential subdivision for the protection of Little Penguins and the second was an island-wide fox eradication program which was successfully completed in 2015. The former secured the funding of the not-for-profit committee of management, what is now known as the Phillip Island Nature Parks and independent and long-term conservation funding for the Island. There are a number of contributing factors that make Phillip Island eminently suited to biodiversity conservation. It has a long history of research-led wildlife management, a sustainable funding model, a robust volunteer network, a weed management strategy, a cat and rabbit reduction plan and a threatened species plan. These factors will enable the deliver an ever growing list of outstanding conservation outcomes on an inhabited and much visited island.

Saving a species from extinction and paving the way for rewilding Phillip Island

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Phillip Island, Victoria, Australia has been declared fox free, the largest island ever to achieve the removal of this introduced predator, despite the island being permanently inhabited by people. As a result, threatened species that cannot persist in the presence of foxes can be recovered. Large offshore islands, like Phillip Island, offer the best prospects for large-scale and sustained fox-free habitat where these species might prosper. The mainland subspecies of the Eastern Barred Bandicoot (EBB) is listed in Victoria as 'Extinct in the Wild', and their decline is attributed to their susceptibility to predation by foxes and to habitat loss. In August 2015 a trial introduction of EBBs began on Churchill Island, adjacent to Phillip Island, and demonstrated that EBBs can establish in island environments and that they have positive impacts on island ecosystems, particularly the soil conditions. It has provided the Phillip Island community the opportunity to learn about this species, see their influence on island environments, and be part of their recovery. This trial enabled the largest single release of EBBs to Phillip Island in October 2017. This release represents the best opportunity to secure and down list this taxon. However, unlike other populations that are protected in fenced reserves, it faces the threat of predation and disease from feral cats. Bringing the mainland eastern barred bandicoot back to the wild would rekindle the ecological function of one of Australia's small digging mammals, benefitting the landscape of Phillip Island, and demonstrate what is possible on islands where the threat of invasive predators can be eliminated.

‘Working together’ for effective environmental decision making and prioritising threatened species conservation on Phillip Island.

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Environmental decisions that influence a large mosaic landscape are complex, having various implications when considering the environmental, social and economic outcomes. This is no exception for Islands where these implications can often be magnified. In this presentation we demonstrate an approach whereby key community members, stakeholders, and experts cooperatively work together to guide an important environmental decision for Phillip Island. In this example, Phillip Island Nature Parks were looking to identify the most appropriate threatened animal species for translocation to Phillip Island. Using a Structured Decision Making (SDM) model, this process selected and identified a number of threatened species from the Phillip Island region which would be suitable for translocation. These species were scrutinised and scored against key objectives, all which were developed by the group of key stakeholders, external experts and Nature Parks’ professionals. The outcome of this ‘working together’ approach has produced a prioritised list of species for translocation to Phillip Island, with input from experts and a diverse range of individuals that represent Phillip Island as a whole. Importantly, this participatory decision making model facilitates ongoing collaboration and cooperation between the stakeholders to support future ongoing approaches towards environmental decisions. So, whilst playing a key role in species recovery, it helps to enhance the integrity of Phillip Island as whole; environmentally, socially and economically.

Victoria's islands as conservation arks

Peter Dann and Duncan Sutherland
Phillip Island Nature Parks, Cowes VIC 3922, Australia

Islands are becoming increasingly useful as conservation arks, particularly as they present opportunities for reducing /eliminating threatening processes such as predation by introduced predators. Threatened species in coastal areas are under increasing pressure from urbanisation, recreational activity and habitat destruction. In this presentation we examine the role of Victoria's 55 islands in conserving threatened species. We filtered these islands for suitability on the basis of size, susceptibility to sea-level rise, vegetation coverage and biosecurity. In the past there have been translocations of a variety of species to the larger islands, the most successful being those of Koalas and Cape Barren Geese. There are several threatened mammal species with remnant populations on Victorian islands and, using spatial modelling, we examine the potential for securing the viability and extending the range of two of these species: swamp antechinus *Antechinus minimus* and long-nosed potoroo *Potorous tridactylus* on Victorian islands. This presentation will be a review of the opportunities and challenges for optimising biodiversity conservation through the use of island arks in Victoria. We document the threatened species currently on Victorian islands together with potential translocations particularly for those threatened species susceptible to introduced predators.

Pest eradications

Rat Island recovery - twenty-eight years after feral predator eradication

J N (Nic) Dunlop and Elizabeth Rippey
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The large, pre-European seabird colonies on Rat Island in the Houtman-Abrolhos group (Western Australia) were extirpated by the 1930s after suffering hyper-predation from black rats and cats introduced by guano miners during the colonial period. Both introduced predators were eradicated following a rat baiting program conducted in 1991 and follow-up cat trapping program. The last cat succumbed around 2000 paving the way for the return of the breeding seabirds. The Rat Island Recovery Project has been monitoring the population dynamics of seabirds on Rat Island since 2003 and has recently attempted to eradicate house mice from the ecosystem. The project is also tracking the response of the terrestrial biota to the resumption of the marine nutrient subsidy provided by the seabird colonies.

Trophic position of feral cats on two Tasmanian islands: implications for eradication and biodiversity benefits

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Eradication of cats is being planned for 8230-ha lungtalanana (Clarke) and 35200-ha Bruny Islands. Cats are the top predator on both but relationships with native and introduced species differs between islands. On lungtalanana, cats were introduced to control rabbits which they failed to do for 50+ years but did extirpate most of the small native mammals as secondary prey. When ship rats and mice arrived on the island in the 1970s, rabbits switched from being primary to secondary prey and followed the native species to extinction. These rodents have a boom-bust life history depending on rainfall driving the abundance of their foods. This means cats are unlikely raise kittens in the bust years and so have very low population densities. On Bruny Island, cats persist at much higher densities as they have a large suite of native (small mammals, reptiles, terrestrial birds and seabirds) and exotic prey (rodents and rabbits). Secondary prey can 'hide' amongst this diversity and only a few species have become extinct or are on the brink of extinction. On lungtalanana, low densities of cats means any project is already at the 'mop-up' phase, while on Bruny the full reduction phase (on a rolling-front?) will have to be conducted before the final mop-up can begin. The biodiversity benefits for lungtalanana are in the opportunities to restore lost species, while on Bruny the benefits are likely to be the in situ increase in small native species (such as bandicoots and antechinus) and higher fledging rates among the seabird colonies.

Cats, dogs and mongoose: the good, the bad and the ugly

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Invasive predators fundamentally alter island ecosystems following their introduction. While managing these predators is straight forward on some islands around the world, others face a suite of challenges based on both social and ecological factors. Hawaii is one such location, where three introduced mammalian predators subsist on a food chain of alien rodents, amphibians, and birds, the remains of the native avifauna, and direct and indirect subsidies from humans. Mongoose is the only species that is exclusively feral and for which there is some consensus on management. Cat and dog populations are continually supplemented with "owned" animals that escape or are abandoned. Because cats and dogs have closer relationships to people, these cause social, economic, and ecological conflict over management. Consensus is most likely to emerge when we can integrate these aspects into a consistent management model across the three species. Such models have been established for cats, but not for dogs or mongoose. Given the devastating effects that these three predators have on Hawaiian ecosystems, as well as other systems around the world, such a model is greatly needed. Here we propose model options and consider challenges to their implementation.

Keteparaha – a toolbox for community pest control

Jo Ritchie
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It's the age-old problem – which tool or combination of tools to use on which animal pest species or combination of species – it's a luxury if all you have to deal with is one species! The future of conservation is not with government agencies or NGO's – it's with communities but often they need help to decide what to do and how to do it. A lot of what I do is taking an idea someone has and getting it to a project on the ground. It generally involves animal pests and working out what tools will work best. Keteparaha is my way of describing a two-dimensional toolbox (diagram below) – one is control tools related to target pests and one is tools to help communities make decisions and work together. The common denominator is the characteristics of the site. Thinking about how you might undertake an island restoration (or any restoration project) that involves animal pest control or removal in this way helps people understand that every site is different and that their knowledge of their place is the key to unlocking what combination of tools will work best. I'll use two very different projects to show how this tool works and how it could work for you:

- Predator Free Waiheke – an ambitious community led project to eradicate mustelids and rodents from a heavily populated 9200ha island

- Rakitu Island rat free – a 313ha rugged island off the east coast of Great Barrier where the Department of Conservation is undertaking an aerial baiting programme to remove rats that has had to withstand anti poison protests

The ‘eradication’ of black rats on Direction Island, Cocos Keeling group

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The Cocos – Keeling group comprises an atoll of 27 islands in the Indian Ocean. Black rats (*Rattus rattus*) were initially introduced to the islands in 1825 after a shipwreck off Direction Island. They rapidly spread to all islands in the atoll, except Horsburgh Island. In 2010, funding was received to eradicate black rats on Direction Island (32 ha). A baiting program was implemented from 2011. This included the use of ‘X-Verminator’ brodifacoum wax blocks in 595 ground and 504 tree-mounted bait stations. Bait stations that excluded the abundant hermit crabs (and protected baits from the weather) were set in a grid across the island. Additional whole-of-island rat baiting was undertaken in 2012. To stop reinvasion from adjacent islands, nearby Prison Island and the north end of Home Island were also baited for black rats. Within the first 14 days, an average of 84% of the ground baits and 68% of the tree-mounted baits were removed / totally eaten or partially eaten by rats. By day 60 there was no more evidence of bait take by rats, however hermit crabs had gained access to the bait stations by this time, and it became difficult to distinguish between rat and crab chew marks on baits. Monitoring over 2012 and 2013 using remote cameras, hair tubes, chew sticks, and track ink pads indicated that rats had been eradicated on Direction Island. Less than 12 months after the rat baiting program, white-breasted waterhens (*Amaurornis phoenicurus*) were detected for the first time on cameras and white terns (*Gygis alba*) were reported nesting on Direction Island for the first time in 70 years. Following this, Parks Australia established 10 permanent remote camera stations on Direction Island. In May 2017 black rats were detected on four of these camera stations 65 months after the baiting program commenced. Lessons from this ‘eradication’ program will be shared and suggestions for future black rat management on the Cocos atoll provided.

‘Pride and predators’; social drivers of pest management in New Zealand

Alan Saunders

Waikato Regional Council, Hamilton, New Zealand

Island restoration in New Zealand has typically involved small, uninhabited islands and has generally been undertaken by government agencies. Little attention was given to consulting with iwi or landowners, or informing and engaging other stakeholders. Recognition of mana whenua (indigenous people with traditional links to the land) and formalised partnerships and co-governance arrangements have introduced new paradigms and presented opportunities and challenges for New Zealand restoration managers. Public and political interest and institutional support for predator management, on islands and at “mainland” sites, has grown markedly with a growing array of people and organisations wanting to be involved. The emergence of community groups involving different assortments of local residents, landowners, conservation groups, iwi, donor agencies and other stakeholders is a distinctive feature of the New Zealand conservation scene today. Hundreds of groups are managing predators for conservation outcomes on islands and at “mainland” sites throughout the country. Many speak with pride of their ecological achievements, and of associated social benefits. While most groups operate largely independently and typically compete for funds, this army of committed and capable volunteers represents an enormous opportunity to collectively achieve and sustain even greater conservation achievements. Understanding what motivates these people to contribute and ensuring their needs are met will be a key to further conservation achievements on islands and at landscape scales at mainland sites.

Partnerships and persistence: Big Green Island successfully cleared of rats

Sue Robinson[1] and Wayne Dick[2]

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Big Green Island (129 ha) is 3km west of Flinders Island in Bass Strait. It was settled for food production in the early 1800s and black rats arrived during this time. Declared a Nature Reserve in 1980 to protect the Cape Barren goose, the island has a long history of sheep grazing which continues today. The island and the surrounding area support a diversity of seabirds and shorebirds, which would benefit from the removal of rats. With the assistance of over 70 volunteers, an array of 2200 bait stations was established, baited and monitored during 2016. Though a small number of rats remained after baiting, these were able to be located and removed. After two years of monitoring for further activity, the island was declared ‘rat-free’ in November 2018. Critical to the success of the program was the extraordinary volunteer support, the persistence of government staff and a strong partnership with a Tasmanian tourism operator and the island’s lessee. The use of volunteers will be considered for similar projects in the future.

Regaining Balance - Managing Islands as Indigenous Protected Areas

Ellie Bock
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Australia is unique in the world for its Indigenous Protected Area (IPA) program, enabling Aboriginal people and Torres Strait Islander people to dedicate their island and other homelands as recognised protected areas, using legal and other effective means. Sea country and island IPAs have grown in number and profile over recent decades, and Australia's Aboriginal people and Torres Strait Islander people are actively pursuing both governance and management of these spiritually unique and biodiverse places in the contemporary context. Complex tenure and political contexts also apply, as jurisdictional factors vary greatly across the Australian continent. Related negotiations with state parties in the lead up to a formal declaration or dedication of an island-centric or sea country IPA under globally applicable IUCN categories are also often onerous and lengthy, requiring considerable goodwill, effort, resources and time. Yet the benefits generated – for country, for people and for our nation – are known to be substantial and positive. IPAs – including island and/or sea country IPAs can generate a new balance – in reconnecting Aboriginal people and Torres Strait Islander people to their ancestral Homelands and in the growing of shared, "two-way" cross-cultural approaches toward threat abatement, bio-cultural resource protection and the retention of some of our nation's most special, most remote or at risk islands. One example of a ground-breaking IPA involving islands is the collaborative Girringun IPA of north-eastern Queensland, whose partners must operate within a highly complex cross-cultural and multi-jurisdictional alliance, frequently challenged by a multitude of external pressures arising for Traditional Owners. Key insights into these complexities are explored, in particular as they apply to the management of the IPA's sea country.

The use of historical maps and aerial images to examine long term vegetation dynamics and inform conservation actions on Norfolk Island

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Norfolk Island has undergone extensive land cover changes driven by the deforestation of native vegetation and the invasion of alien species since the first European settlement in 1788. This has led to the decline and extinction of multiple native species. Historical data provide a valuable source for understanding the long-term impacts of introductions, extinctions, land use changes, physical features, revegetation and management activities on island ecosystems. In this study, we used historical and recent maps, aerial photographs, as well as satellite images to investigate changes in vegetation cover and population dynamics on Norfolk and Phillip Islands, examining vegetation responses to physical and anthropogenic factors over time. We specifically studied changes in historical land cover of introduced and native plant species, with focus on the endemic Norfolk Island pine (*Araucaria heterophylla*), an iconic species of importance to native birds and to the island's culture. These pines experienced a dieback event in the past, which has been attributed to overgrazing, nutrient depletion on farmlands and competition with invasive plants. We georeferenced and digitized historical aerial photos, maps and satellite images of the islands using geographic information systems (GIS). We digitized the locations of over 30,000 Norfolk Island pines from a 2016 WV3 satellite image and compared them to previous mapping efforts of Norfolk Island pines. We examined the correspondence between invasive species and changes in distribution of the native Norfolk Island pines and evaluated the applications of this approach in informing conservation management strategies on Norfolk and Phillip Islands. This work can help prevent further destruction of unique island ecosystems by using a combination of historical information and remote sensing techniques to inform conservation management actions.

Heard Island – The balance between conservation management, science and tourism

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The sub-Antarctic Heard Island and McDonald Islands (HIMI) group are a few terrestrial specks in the vast Southern Ocean. The HIMI group covers 37,000 ha of terrestrial habitat and 658,903 ha of marine habitat. The island group was inscribed on the World Heritage list in 1997 for its outstanding natural processes, the undisturbed environment and important ecosystems, the range of landform features and their aesthetic qualities, and is managed as a strict nature reserve (IUCN Category 1a), one of the largest in the world. Heard Island contains Australia's only active volcano, glaciers that flow from the volcano caldera down to the Southern Ocean and contains an abundance of marine and terrestrial flora and fauna, including endemic species and listed threatened species, but low species diversity. *Poa annua* is the only recorded introduced plant species, with remoteness and low visitation protecting the natural values of HIMI from alien species. Relicts from over 100 voyages to the island over three decades targeting Southern Elephant Seals, *Mirounga leonine* (Linnaeus 1758) remain. The first extensive scientific studies occurred during 1947-1955 with the establishment of the Australian National Antarctic Research Station (ANARE) at Atlas Cove. Periodic research expeditions have been made, but the high cost and substantial logistic requirements required to visit HIMI have resulted in brief and infrequent visits.

Threats to HIMI include: climate change, notably substantial glacial retreat as well as major geomorphic changes; biosecurity from expeditioners, tourists, Australian Customs and fishing vessels - a risk that is likely to be accentuated by climate change; illegal fishing within the Marine Reserve; potentially increased tourism demand. Ironically, the island's remoteness presents difficulties for conservation management, such as detection of newly arrived alien species, the removal of asbestos from previous buildings now decaying in the soil and removal of substantial amounts of marine debris.

Sub-Antarctic Islands: conservation lessons and sentinels of global change

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Sub-Antarctic island conservation is rapidly advancing with the implementation of pest eradication projects on numerous islands in recent years. Based on their success, more projects are planned for several other islands. With each island eradication there is consistent carry over of logistic and operational knowledge to future projects. In contrast, monitoring of ecosystem responses to eradication is often not supported and therefore opportunity is lost to inform future projects. Monitoring of ecosystems is slow, requires investment and is not considered novel research, yet it is critical if we are to understand how successful we are at island restoration and at meeting conservation targets. Furthermore, due to economic and logistic constraints and a desire to minimise our footprint we have to rationalise when, where, what and how we monitor in the region. On sub-Antarctic Macquarie Island we are developing an optimal monitoring strategy to determine the current ecosystem state and track change into the future following invasive species eradication and under climatic change. We are quantifying if conservation targets have been achieved. In order to do this we must identify when, what and how we monitor the terrestrial ecosystem. Firstly, management objectives for the region were clearly defined. Secondly, temporally and spatially explicit historic data were located and compiled from various sources. We identified suitable as bio-indicators, with which to detect change. We are aiming to determine how monitoring can be in repeatable, low impact and cost effective into the future. Finally we assess how lessons learned from recent sub-Antarctic conservation initiatives can be applied to future island conservation initiatives in the region, and more broadly. We quantify and highlight how sub-Antarctic islands are true sentinels of global change, and how this value should be elevated globally.

Invertebrates as indicators of ecosystem change on sub-Antarctic islands

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Eradication 'success' typically refers to the removal of the target invasive species. Ecosystem recovery is often assumed to follow. Commonly, post-eradication monitoring focuses on the recovery of threatened or charismatic species rather than quantifying overall conservation benefit. Although the conservation of iconic species often drives eradication programs, these species are generally vertebrates with relatively long lifespans, such as seabirds, whose responses to environmental change are slow. Monitoring these species does not typically capture immediate and large-scale ecosystem changes. Invertebrates, on the other hand, are rarely the focus of conservation research in themselves, but are critical components of ecosystems. Their short life-cycles and rapid response to environmental change make them ideal biological indicators. Here we report on the results of invertebrate monitoring specifically designed to measure ecosystem change following a large-scale mammal eradication program. Rabbits and rodents had wide-ranging impacts on the sub-Antarctic Macquarie Island ecosystem for over 140 years and were successfully eradicated in 2013. We quantify their impacts on invertebrate community assemblages using historical data and contemporary invertebrate surveys. We established 24 island-wide sites in five different vegetation communities and used six different trapping methods over three consecutive field seasons. Preliminary results indicate an increase in spiders and moths in recovering vegetation communities, and range expansions in some non-native invertebrates. By tracking invertebrate community change across space and time, we quantify the ecosystem-level conservation benefits and the return-on-investment of this $25 million eradication program. We propose methods for efficient and effective long-term monitoring of the post-eradication ecosystem using invertebrates.

Community Conservation

Contemporary conservation challenges for islands and associated marine habitats in the Hauraki Gulf: Community taking the lead

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The Noises Islands are a collection of private islands in the inner Hauraki Gulf, New Zealand. The Noises are the only islands in the inner gulf that have not suffered historical clearing and associated island degradation. Maria Island, one of the Noises Group, was the first island globally, from which introduced rodents were eradicated. Nevertheless, significant challenges remain in conserving the natural values of the Noises, including ongoing weed control, biosecurity needs, and improved conservation of the surrounding marine habitats to maintain terrestrial – marine ecological linkages. Identified needs include resourcing for ongoing management of island habitats, continued and improved biosecurity both on the Noises and nearby islands, and introduction of no-take or limited take zones within the surrounding marine environment. Additional resourcing for island management has been provided by volunteers from the non-Government organisation Wild Mob, who is assisting in eradication of weeds from the internationally significant seabird nesting area on Maria Island. Discussions are well advanced amongst managers of adjacent islands to foster continued biosecurity efforts on all islands in the inner gulf. The marine spatial planning initiative “Sea Change” has identified through comprehensive stakeholder consultation, the need for a greatly increased area of no-take zones in the Hauraki Gulf Marine Park. These actions reflect the need for contemporary conservation interventions to include; well resourced on-ground actions, co-operative approaches amongst island and marine park managers, and sound consultation with all stakeholders in addition to Hauraki *Iwi*. Importantly, approaches taken clearly demonstrate that private citizens are well placed to provide leadership in management of internationally important conservation reserves.

Walking the tightrope – Balancing community expectations with the realities of doing the work on the ground

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Many restoration projects in New Zealand are made possible as a result of the inspirational generosity of people from all walks of life who volunteer physically on the ground or have an interest in a particular project but often multiple projects. Tikapa Moana – the Hauraki Gulf in New Zealand, contains a network of islands. Many have active conservation projects that are community partnerships with the Department of Conservation. Some are also wholly community initiatives borne out of concern for depleted natural environments and motivated by work done to change this on other islands. This presentation is a window into some of those projects – their challenges and successes:

- Predator Free Waiheke – an ambitious project to eradicate mustelids and rodents from a heavily populated 9200ha island

- Motutapu Restoration Trust – a 4000 strong volunteer project on a 1500ha DOC island with considerable natural challenges – weeds, slips, heavy storm events but a resilient and energetic core team of people

- Pakihi Island – a 110ha privately owned island where mice are about to be eradicated by a family with a 130-year history of island life

Building knowledge and understanding of how to undertake this work on the ground varies between these 4 projects according to who is involved and the scale and diversity of each project. Each involves compromise, a toolbox of techniques and a great deal of talking and learning. Collectively they all provide more threads of knowledge to weave the rich korowai (cloak) that is community restoration partnerships in Tikapa Moana.

‘Backyard Conservation’ on Bougainville

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Islands constitute extraordinary ecosystems that comprise both terrestrial and marine life. Many indigenous people in the Pacific region have depended for thousands of years on island ecosystems for a myriad of environmental, economic and sociocultural benefits. Bougainville is one such island in the East Melanesia region that is culturally and geographically part of the Solomon Archipelago and politically an Autonomous Region of Papua New Guinea. It was impacted by two important historical factors that affected its biodiversity more than five decades ago, including the establishment of Bougainville Copper Limited by Rio Tinto and a subsequent bloody civil war over a plethora of environmental, sociocultural and political claims. One of the notable damages to the environment was the permanent destruction of Jaba River with heavy metals and sediments from the Panguna copper mine. No baseline study was carried out to document the island’s biodiversity and sociocultural status of the local people prior to mining on Bougainville. Since the end of the war in 1997, little is known about the status of biodiversity. This study aims to be the first attempt to examine the current distribution patterns and conservation status of endemic mammals (rodents and bats) on Bougainville following the Panguna mine and conflict. We also examine traditional ecological knowledge and beliefs of the local people towards the cultural use and conservation of the critically endangered animals including the Bougainville monkey-faced bats and giant rats. In addition, the study documents hunting pressure and changing practices of harvesting wildlife on Bougainville. These aspects are crucial to understanding the biological and sociocultural trends for the conservation of endemic mammals on the islands. By incorporating terrestrial customary management practices with robust scientific information, long-term conservation efforts can be achieved while promoting sustainable development goals at the community, provincial, national, regional and global level.

Saving Hawaii's Forest Birds

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Hawai'i's extreme isolation made natural colonization events by plants and animals a rare occurrence, and those that were able to survive expanded into a wide variety of habitats changed over millions of years. Isolation and change over time resulted in 142 species of bird found nowhere else, including at least 41 species of Hawaiian honeycreepers. Mosquitoes were absent from Hawai'i until they were accidentally brought in conveyances in the late 1800's. Since the introduction of Culex mosquitoes and the diseases they transmit such as avian malaria (caused by the Plasmodium parasite) and avian pox (caused by strains of avipoxvirus), many native Hawaiian forest birds have gone extinct, while others are confined to upper elevation forests where it is currently too cool for these mosquitoes to flourish. At lower elevations, avian malaria continues to cycle in the environment when Culex mosquitoes bite other birds. With climate change, these mosquitoes and the avian malaria they carry, is moving into upper elevation forests, the last disease-free refuge for the majority of these remaining native Hawaiian forest birds. There would be plenty of habitat for these birds in lower elevations and possibly even urban areas if they could be protected from this and other diseases. To protect native birds from mosquito-borne diseases, agencies and non-governmental organizations are planning public engagement strategies to communicate the need and technologies including the injection of a naturally occurring bacteria into male mosquitoes which acts as a birth control, and the future potential of genetic engineering techniques that could prevent the transmission of diseases.

Protecting the Golden Goose and the growth of tourism on Tasmania's Bruny Island

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This case study explores the exponential growth in popularity of Bruny Island, Tasmania and its potential impact on the natural environment including 10 nationally endangered terrestrial species. Over the past decade Bruny Island has experienced unprecedented growth in the tourism sector. This small island now attracts over 150,000 visitors per year and with a triennial growth rate of 24.8% has become more popular than iconic destinations such as Cradle Mountain. The increase in visitor number is mirrored by a growth in permanent residents and other property owners, especially off-island investors in rental and new businesses, all encouraged by a Government stimulus in two new vehicle ferries. However, the net result is that Bruny Island is experiencing haphazard development, inadequate infrastructure and escalating pressure on limited resources especially land, power and water. In May 2018 a comprehensive survey of residents revealed the community's highest priority scored against 10 domains of liveability was the 'protection of Bruny's natural environment'. This declaration presents a unique opportunity to establish a sustainable island index which balances the needs of social, economic and environmental using benchmarks as set by the UN Sustainable Development Goals 2030. Could it be possible to develop an equitable system of island land use against the rise in business demands and protect the golden goose before it loses its uniqueness and becomes a homogeneous tourist trap?

Social and economic outcomes in a changing fishery: case study of the Vanua Navakavu, Fiji

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Fishing is central to the livelihoods of many coastal communities in Fiji. Men and women of Vanua Navakavu coastal fishing community, part of the locally managed marine area network (LMMA) in Fiji, are heavily reliant on fishing mostly for income. The high percentage of fisheries catch sold compared to that being consumed or gifted, and the high relative proportion of residents engaged in fishing is indicative of this. Over time, a combination of social and environmental changes has affected the behaviour of fishers and the marine biodiversity within their fishing ground. The community perceives management of their fishing ground as satisfactory and they expect this will continue to provide income now and in the future. This paper summarises findings of a recent and past socioeconomic surveys highlighting some changes in fishing activities and perceptions of the people of Vanua Navakavu.

Middle Island – Finding the Balance

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Middle Island is located in the middle of the Recherché Archipelago, the largest in this chain of 104 islands off the coast of Esperance. It is vested with the Conservation and Parks Commission as an A class nature reserve. The islands of the Recherché provide safe anchorages, sheltered beaches, harbour an amazing array of plants and animals, and are increasingly recognised as faunal arks for threatened species. The island has a chequered history since its discovery by Matthew Flinders in 1802. It was a base for sealers in the 1820's, and salt mining and pastoral and agricultural ventures between 1899 and 1905. With the cancellation of the pastoral lease in 1958 the island was formally incorporated into the reserve system.

The island has unique natural values with an endemic species of peacock spider recently discovered. It is also being used as a refuge for threatened species such as the Gilbert's potoroo. Lake Hillier and its bubble gum pink colour has become a key drawcard and although extremely remote and difficult to access, Middle Island is becoming a popular tourist destination for tourism attracting domestic and international visitors alike. There are concerns that an increase in visitor numbers will have an impact on the fragile island ecology, including the possibility of the lake losing its distinctive colour. If not managed responsibly the island will lose this tourist attraction including a significant wetland ecosystem. The challenge for managers is to find the balance between protecting the island's biodiversity and the expectations and demands of the tourist industry, which is an important economic consideration for the Esperance community. In this paper we detail management actions that have been put in place to ensure a balanced approach in management of this unique island.

Predictive modelling during planning: a retrospective case study of two species translocated to Doole Island in the Exmouth Gulf of Western Australia.

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Conservation agencies worldwide commonly use translocations as a tool in species' recovery and ecological restoration. Translocating species within their indigenous range is preferential but can be challenging as threats contributing to local extinction often cannot be ameliorated. Alternatively, species can be introduced outside their indigenous range, to locations where such threats do not exist and are not likely to be future issues. As closed systems, islands are popular locations for such conservation introductions particularly in Australia where translocations on the mainland often fail due to the presence or incursion of introduced predators. However, factors beyond the presence or absence of these predators must also be considered in selecting release sites for conservation introductions as there is no precedent for species survival at these locations.

One island, Doole Island, in the Exmouth Gulf of Western Australia presented an opportunity as a site for conservation introductions of threatened species. This island was free of introduced predators, easily accessible from the mainland and no mammal species or potential competitors were known from this location. Between 1993 and 2001, 223 individual Djoongari (Shark Bay mouse) *Pseudomys fieldi* were translocated to this island but ultimately failed to establish a population. Conversely, golden bandicoots *Isoodon auratus* did establish a population after just one release of 92 individuals in 2011. We present the results of retrospective predictive modelling to discuss the factors that contributed to the failure of Djoongari to establish on the island and demonstrate the importance of this tool in planning conservation introductions. As translocations of threatened species are financially and ecologically expensive, we recommend that predictive modelling in conjunction with expert knowledge be incorporated into the planning stages of fauna translocations so that animals and resources can be directed to efforts that are likely to be successful.

Monitoring of Golden Bandicoots and Burrowing Bettongs: a case study in adaptive management on Australia's Island Ark

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Australia's largest ever resource initiative has been the development of the Gorgon Gas Field and Processing Plant on Barrow Island. The Island is internationally recognised as a refuge for many vertebrate fauna species that are now threatened or extinct on mainland Australia and responses of these fauna to the development have been the focus of several extensive studies. Initially, regulators required population documentation be focused on mark-recapture studies from historically established small mammal grids, however, these proved to lack the sensitivity required to explore the impacts of development on populations and, consequently, more refined methodologies were implemented. These included distance sampling, mark-recapture and spatially explicit capture recapture (SECR) programs, that used either extended transects or much enlarged grids, to evaluate population responses to changed environmental conditions induced by the development. For two key species, the Golden Bandicoot (*Isoodon auratus*) and the Burrowing Bettong (*Bettongia leseuer*), different monitoring approaches were required given their markedly different biology. An adaptive monitoring process developed by Biota and Chevron Australia has ensured that tailored methods, driven by their markedly different life histories, are used to monitor their populations. Insights into their biology gleaned during the programs are continually informing improvements to the approaches used.

Distance sampling as a tool for monitoring on Barrow Island

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Distance sampling analysis is a robust tool used to monitor animal populations on Barrow Island as part of impact assessments associated with development of the Gorgon LNG Project. By modelling a detection function, missed observations are accounted for in sampling transects. Examination of additional covariates, such as vegetation, can improve the accuracy of population estimates derived from distance sampling. Recent extensions to distance sampling incorporating spatial modelling provide a versatile approach, monitoring not only overall population fluctuations, but also geographic distributional changes in the closed context of an island population. Spatio-temporal modelling of this type is invaluable when attempting to determine ecological or anthropogenic mechanisms for population change.

Invertebrate surveillance techniques and considerations: the Barrow Island example

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Barrow Island is a 256 km^2 island located 56 km off the north-west coast of Western Australia and classified a Class A nature reserve in 1910. The Carnarvon Basin lies north-west of Barrow Island, and contains approximately 25% of all the natural gas discovered to date in Australia which attracted interest from companies in the energy sector. In 2009, the Chevron Gorgon Project was approved and construction began to extract and process the gas. Prior to commencement of the gas project, Ministerial requirements were put in place to conserve the island's biodiversity and ecological values. In addition to that, Chevron conducted thorough baseline studies, created a comprehensive quarantine management system, and has routinely conducted monitoring surveys on the island's flora and fauna. The island was listed as a Class A nature reserve due to it being recognised as a biological haven for several species of animals and plants which had declined or become extinct on mainland Australia. With many surveys focusing on the animals and plants of the island, the invertebrate assemblage remained much less surveyed. Undertaken as part of the quarantine management system in place on Barrow Island, the invertebrate collection, to our knowledge, is one of the largest, most comprehensively identified invertebrate collections in an arid area, worldwide. It spans over nine years of consistent surveying with >100,000 specimens collected from some 60,000 traps, resulting in 3664 species identified to date.

We present some analyses of that dataset, focusing on invertebrate richness and diversity in relation to location within the island, season, extreme climatic events, trap type and trapping frequencies. Our discussion focuses on two points: (1) insights gained from this large database that may benefit studies in other areas; and (2) benefits of linking science with industry partners.

Identifying indicators to monitor terrestrial island ecosystem change in the Torres Strait and develop future management strategies

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The Torres Strait, a region comprised of over 300 islands, is located at a crossroad of two seas (Arafura and Coral seas) and two nations (Australia and Papua New Guinea (PNG). The islands are noted for their high geological diversity, including: low-lying mud islands, continental islands, coral cays, and islands of recent volcanic activity. Diverse geology and historical connectivity to mainland PNG and Australia mean that the terrestrial flora and fauna of the Torres Strait islands have exceptionally high biodiversity value. However, these islands are experiencing an unprecedented rate of ecosystem change as threats associated with climate change and anthropogenic development increase. To mitigate these threats, indicators that signal changes in the health status of terrestrial ecosystems must be identified. Furthermore, a strategy for integrating indicators into monitoring and management action plans is necessary. The Torres Strait Regional Authority (TSRA) elicited expert knowledge from rangers, managers, and scientists who have worked extensively in the Torres Strait region to better understand: 1) the current health status and threat risk level of terrestrial island ecosystems, and 2) the best indicators for monitoring ecosystem change into the future. Expert elicitation revealed that coastal areas are the most threatened terrestrial island ecosystems, and that mangrove vegetation and coastal birds can serve as effective indicators for monitoring changes in health status. To successfully incorporate these indicators into monitoring, action pathways will need to integrate traditional ecological knowledge with western science and management knowledge. Integration strategies will draw upon a range of innovative ideas such as: identifying cultural keystone species, and web-based citizen science applications for documenting biodiversity baselines and shifts. Advanced technology such as drones, remote cameras, and acoustic arrays should also be considered to maximise the efficiency of monitoring approaches on remote islands.

Variation in the herpetofauna on islands of the Houtman Abrolhos archipelago, Western Australia

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Surveys of 19 of the 170+ islands in the Houtmann Abrolhos between 2002 and 2012 documented 24 species of reptile. Using both opportunistic sampling and fenced pitfall trapping we captured three unrecorded species, while three previously recorded lizard and three frog species were not found. Overall, 55 new island records for reptiles were made over six sampling periods. Islands ranged from 0.3 - 587 ha and represented the three main geomorphic island types (aeolianite, high rock, composite). Four significantly different reptile assemblage groups were documented. Assemblages on the aeolianite East and West Wallabi, the two largest islands, formed a significantly discrete cluster, as did the assemblages on aeolianite North Island and six of the high rock islands. Four of the remaining high rock islands and the large composite Pelsaert Island formed a third group while the remaining three composite islands and the small high rock, Two Island, the fourth. The number of species was significantly correlated with island area and the number of native plant species but negatively correlated with the assessment of disturbance each island had encountered. We had samples for 13 species that allowed statistical analysis of inter-island variability. Eleven of these showed statistically significant inter-island variation in size as measured by snout-vent length. Two of these species also showed sexual dimorphism. Six of the 11 species captured on both East and West Wallabi Islands showed statistically significant size differences, with five of the six being larger on West Wallabi Island. The Abrolhos archipelago possesses diverse reptile assemblages on many islands and species show pronounced differences in assemblage structure and size that indicate strong selection pressures have modified species relationships during the nearly 7000 years of their isolation from mainland counterparts. This will be examined further by evaluating the genetic differences in island populations with ongoing study.

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