

Welcome to the 12th Oamaru Penguin Symposium

**6-7 May 2021
Oamaru Opera House**



Programme

Day One: Thursday, 6th May

08:45 – 09:20	Registration – Ink Box Room, Oamaru Opera House	
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09:50 – 10:10	From conflict to coexistence: Sex-specific risk of human-wildlife conflict in the “pesky” brown skua <i>Hendrik Schultz</i>	Page 6
10:10 – 10:30	Beyond the field: policy and engagement to facilitate conservation of hoiho <i>Trudi Webster</i>	Page 7
10:30 – 11:10	Morning tea	
11:10 – 11:30	Outcomes of yellow-eyed penguins (<i>Megadyptes antipodes</i>) presented to wildlife hospitals for marine predator attacks <i>Kathryn Johnson</i>	Page 8
11:30 – 11:50	Rescue strategy at Moeraki, guidelines and an example <i>Rosalie Goldsworthy</i>	Page 9
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13:30 – 13:50	Investigating locally adapted foraging strategies of discrete breeding colonies of Rakiura Hoiho <i>Thor Elley</i>	Page 12
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12:20 – 12:40	Penguins connect children to nature, conservation and ecology <i>Lucy Waller</i>	Page 27
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13:40 – 14:00	Impacts of terrestrial heat waves on survival of moulting adult little penguins <i>Lauren Tworowski</i>	Page 28
14:00 – 14:20	Best of the West: A good season's foraging for West Coast kororā <i>Richard Seed</i>	Page 29
14:20 – 14:40	Investigating drivers of early egg-laying by little penguins at Oamaru <i>Philippa Agnew</i>	Page 30
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Fit parents and fat chicks? Linking foraging and breeding success in Adélie penguins

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³ Manaaki Whenua Landcare Research, Lincoln

Adélie penguins (*Pygoscelis adeliae*) are one of the most widely spread and abundant penguin species in the world, with a circumpolar distribution. While clumsy on land, they are agile marine predators, with their diet primarily consisting of small fish and krill. Because of these factors, and a well-documented relationship between the condition of the Antarctic pack-ice and population viability, Adélie penguins are considered an indicator species for the health of the Antarctic marine environment. Given the recent designation of the Ross Sea, off the coast of West Antarctica, as a Marine Protected Area (MPA), research on local Adélie penguin populations can provide an excellent source of information to predict the outcomes of different management decisions and provide advice to stakeholders. Unlike other MPAs, the protection status of the Ross Sea has a sunset provision of 35 years, meaning that its status and extent will be under review. This research on an established indicator species like the Adélie penguin could, therefore, inform whether such protection should be modified or withdrawn. This presentation will discuss current work describing the at-sea movements of Adélie penguin breeding at Cape Bird in relation to relevant local environmental conditions. Additionally, focus will also be given to the application of mechanistic modelling to link this movement to reproductive outcomes such as fledging success and chick mass, which has applications for the wider movement ecology field.

From conflict to coexistence: Sex-specific risk of human-wildlife conflict in the “pesky” brown skua

Hendrik Schultz¹, Kevin Chang¹, Sarah J. Bury², Anne C. Gaskett¹, Todd E. Dennis³, Stefanie M. H. Ismar-Rebitz^{1,4}, Ian Southey⁵, Rebecca J. Hohnhold¹, Craig D. Millar¹

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Overlap between humans and wildlife frequently results in conflict. Importantly, sexual differences in foraging behaviour are often not considered when studying such human-wildlife conflicts. However, these differences can have important implications for the conservation and management of a species. In this study, we investigated the foraging behaviour of the predatory brown skua (*Catharacta antarctica lonnbergi*) breeding on the Chatham Islands, New Zealand in an agricultural context. Skuas here are subject to culling by farmers, when perceived as a threat to livestock. Using high-resolution Global Positioning System (GPS) devices, we studied the space-use of foraging brown skuas during three consecutive breeding seasons (2014-16). We also analysed stable isotopes of carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) from modern and archived blood samples to investigate possible changes in diet over the past ~30 years. Analysis of 100 GPS tracks from 64 individuals demonstrated that males and females consistently visited different habitats. Males spent most of their time close to their breeding territory and females frequently visited nearby farmland. Consistent with this finding, we show that male and female skuas differed markedly in their diets: males specialised on small seabirds (94%) with only a small proportion of sheep remains (*Ovis aries*; 6%) contributing to their diet. In contrast, female diet comprised 54% small seabirds and 46% sheep remains. Further, stable isotope analysis of archived blood samples suggest that this male / female difference in diet has persisted over a ~30-year period. Because females spent more time on farmland and fed to a large extent on sheep remains, they may be at a heightened risk of being culled by local farmers.

Beyond the field: policy and engagement to facilitate conservation of hoiho

Trudi Webster

Yellow-eyed Penguin Trust, Dunedin

Yellow-eyed penguin / hoiho have been subject to a rapid decline (70% over the last 12 years), at least for the Northern population (mainland NZ and Rakiura). Management is increasing in intensity with each successive breeding season and the Northern population are becoming increasingly conservation dependent. The field monitoring, rehabilitation and hospital work that takes place on the mainland is absolutely critical, now more than ever. This mainstay of conservation management is well reported in regular fortnightly updates, social media posts, at the Annual Yellow-eyed Penguin Symposium and at pre- and post-season meetings with stakeholders.

Less visible and under-reported is the work that occurs behind the scenes. A fairly logical step from field monitoring is the analysis of data, the provision of support and advice for rangers to ensure that quick and informed decisions can be made, and the coordination and response to disease and other events. Several large planning projects have recently been undertaken, including a survey of Rakiura, and establishing a rehab facility and increasing intervention efforts on Rakiura and Whenua Hou. Setting strategic priorities and helping to shape conservation policy are another critical aspect to achieving conservation work for local and national Government. Strategy is the long-term planning designed to achieve goals and objectives, and policy provides the guidelines to achieve those goals. Providing constructive feedback through submissions or other forums are key to ensure hoiho and the impacts facing them get the recognition and resources they deserve, and are included in wider efforts to address impacts. There is ongoing work to plan, prioritise, fund and undertake work through Te Kaweka Takohaka mo Te Hoiho (strategy) and Te Mahere Rima Tau (5 year action plan) to progress the actions to achieve hoiho conservation. Engagement with mana whenua is an essential component of hoiho conservation enabling them to exercise kaitiakitanga (guardianship) and maintain cultural identity. Consultation and collaboration with other stakeholders including local Government and fisheries is necessary to progress effective conservation measures. Informed decisions, identification of priorities and measuring effectiveness are just some of the ways that research can be used to aid conservation of hoiho. All of these ingredients are necessary to ensure that decision makers, policy makers, funders and managers fully comprehend the issues, have the tools that they need to respond to them, and ultimately to ensure the ongoing survival of hoiho.

Outcomes of yellow-eyed penguins (*Megadyptes antipodes*) presented to wildlife hospitals for marine predator attacks.

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Marine predator injuries from sharks, New Zealand sea lions (*Phocarctos hookeri*) and potentially barracouta (*Thyrsites atun*) are one of the main reasons that yellow-eyed penguins (*Megadyptes antipodes*) are admitted to wildlife hospitals in New Zealand for veterinary treatment. With their numbers on the New Zealand mainland rapidly declining due to a range of threats, every individual is considered important for the conservation of this species. As the mainland population is individually microchipped and monitored each year with nesting surveys, we are in a unique position to be able to follow the outcomes of hospitalised birds post-release. In addition, through the Wildlife Pathology service at Massey University, we've reviewed hospitalised and non-hospitalised yellow-eyed penguins that died as a result of marine predation injuries, to understand whether either the severity of the original injury or secondary complications of hospitalisation, may have contributed to the animal's death. It is hoped with this information we can gain a better understanding of the role that wildlife veterinary hospitals can serve in the conservation of this species.

Rescue strategy at Moeraki, guidelines and an example

Rosalie Goldsworthy

Penguin Rescue, Katiki Point

The rehabilitation of sick, injured and starving penguins began in the 1980s at Moeraki, North Otago by Janice Jones and continues to this day. The conservation charity Penguin Rescue provides sanctuary for penguins by optimising habitat, maximising survival and breeding, minimising disturbance, enhancing management through science, advocating for penguin conservation and managing the risk of disease. This sustainable and conservative strategy is illustrated by the care and rehabilitation of a breeding yellow-eyed penguin (*Megadyptes antipodes*) female. Her nest site shaded with open ground, undisturbed by humans and concealed (optimised habitat, minimised disturbance). In the 2019 season this female raised one chick as a three-year old but got entangled in Muehlenbeckia vines during the moult resulting in compromised left flipper feather coverage. She was rehabilitated for her injury, treated for Avian Malaria and released (maximised survival). Trail camera footage throughout winter 2020 confirmed that she was in good condition and socialising normally after release. She returned to breed in the 2020 season and raised one chick but was returned to rehab after losing weight when the chick was about two months old (maximised survival, breeding and managing disease). She was rehabilitated and released prior to the annual moult but re-admitted to rehabilitation to complete the moult. Her compromised left flipper moulted normally and has again full feather coverage with only two small featherless patches.

"Miracle Jo"- a YEP in lockdown

Thomas Stracke

Christchurch Penguin Rehabilitation, Christchurch

A severely dehydrated yellow-eyed penguin was admitted to Christchurch Penguin Rehabilitation from Kaikoura during the 2020 level 4 lockdown. At 2700g it was unlikely to survive and there was no way of getting it to Massey or Dunedin Wildlife Hospital. It turned out to be a micro-chipped juvenile from Katiki Point, which had been adopted by a sponsor. So for the first time we experienced the complex challenge of saving Jo's life, involving drips and trying to avoid a re-feeding syndrome. But slowly the bird got better and could be transferred to an outdoor enclosure. After 32 days in rehab, it could be transferred to Penguin Place for soft release. Jo was re-sighted during moult several months later.

Penguins, poo and probiotics (oh my!); a study using probiotic bacteria to aid Hoiho rehabilitation

Abby Clarke, Yolanda van Heezik, Phillip Seddon, John Tagg, Melanie Young

University of Otago, Dunedin

Probiotics are live microorganisms which when administered in an adequate amount confer a health benefit to the host. BLIS K12TM, an oral probiotic which has been shown to interfere with the growth of some disease-causing bacteria, has potentially important health benefits for hoiho. In lab studies it has been shown to inhibit the growth of *Corynebacterium*, the bacteria responsible for diphtheria in hoiho chicks. A previous field study found that chicks treated with the probiotic were up to 574g heavier at 90 days old. Interestingly however the probiotic appeared not to colonise the buccal cavity of the treated chicks.

The aim of the current project was to investigate if administration of the probiotic can increase weight gain over time in adult and juvenile hoiho in rehabilitation facilities. It also aimed to investigate if the probiotic colonises the gut, rather than the buccal cavity, thereby explaining any weight gain effect observed. The findings indicate there may be little to no effect of BLIS K12 on weight gain in adult and juvenile penguins, there was also no evidence of gut colonisation. I now propose to investigate further the reason for apparent absence of weight gain and K12 colonisation in the older hoiho. Additionally, I propose to isolate from samples of the penguin gut microbiota candidate probiotic strains having *in vitro* inhibitory activity against *Corynebacterium* for potential future development as penguin-specific natural probiotics.

Investigating locally adapted foraging strategies of discrete breeding colonies of Rakiura Hoiho

Thor Elley

University of Otago, Dunedin

The foraging ecology of Hoiho (*Megadyptes antipodes*) breeding on Rakiura/Stewart Island has been investigated since the late 1980s, with research focusing on areas of high penguin prevalence. The present study examined locally adapted foraging behaviours at two previously studied colonies (Paterson Inlet & Whenua Hou) and presents data from one previously data deficient colony (Port Pegasus). During the 2020/21 season Hoiho breeding from Port Pegasus ($n = 7$), Paterson Inlet ($n = 6$), and Whenua Hou ($n = 6$) were fitted with time-depth recorder-GPS units for an average of six days to track their at-sea movements and diving behaviours. Birds reached greater maximum depths, spent longer periods at the seafloor, and performed longer overall dives at Port Pegasus compared to birds foraging from Paterson Inlet and Whenua Hou. Home range sizes and total trip lengths were smallest at Port Pegasus where birds foraged within a small, well defined inshore area, and largest at Whenua Hou, where birds ranged north-east into Foveaux Strait or south toward Mason Bay. GPS tracks suggest that foraging Hoiho are limited by the local bathymetry directly adjacent to their colonies. Breeding Hoiho showed rigid individual and intra-site consistency in the location of their foraging bouts, however greater plasticity in benthic foraging behaviours appear when inter-site behaviours are examined.

Marine distribution of yellow-eyed penguins (*Megadyptes antipodes*): presence and preference

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The relationship between environmental predictors and the distribution of a species is a crucial indicator of ecosystem resilience under the pressure of environmental change. As central place foragers, penguins depend on the ocean to obtain food and the land for nesting. Understanding which environmental factors determine or limit foraging sites is important for conservation planning. We first determined if sex, season, dive type, or breeding site influenced yellow-eyed penguin (*Megadyptes antipodes*; hoiho) marine home range size. We then employed spatial distribution models (Maxent) to identify climatic, environmental, and anthropogenic factors that affect their marine distribution off mainland New Zealand using environmental spatial data and GPS foraging data from penguins breeding on Banks Peninsula, Otago, the Catlins, and Stewart Island. By determining the range and environmental conditions that yellow-eyed penguins require for foraging, we are able to highlight marine hotspot areas that are critical to population persistence and vulnerable to anthropogenic activities (fishing, mineral exploitation) and future environmental change.

Yellow-eye spy: Using trail cameras to validate hoiho breeding behaviours on Motu Ihupuku/Campbell Island

Mel Young

Department of Conservation, Dunedin

Systematic observations of wildlife are difficult to collate for species with secretive nesting habits, nocturnal behaviours, or remote distributions. For species that are sensitive to human disturbance, determining passive methods for observation that are robust, affordable, and that provide meaningful results need to be validated. We used trail cameras deployed at nests and landing sites to determine patterns of nest attendance and breeding phenology of hoiho (*Megadyptes antipodes*) on Motu Ihupuku/Campbell Island in November 2019 during Operation Endurance. The aim of this research was to determine arrivals, departures, proxy foraging trip duration, and nest attendance, to validate other counting methods. The timing of hatching events, chick provisioning behaviours, and any observed threats to hoiho productivity were also able to be determined. Trail cameras can provide quantitative data that are useful for determining behaviours and trends, which can inform research and future conservation management for this endangered species, while at the same time minimising nest disturbance.

Breath-taking insights from recent camera deployments on New Zealand penguins

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Since decades researchers study penguin marine ecology using ever smaller and better GPS dive data loggers to understand their at-sea behaviour and foraging hotspots. Yet without behavioural observations, interpreting the resulting complex dive data can be difficult. Diet analysis required stomach flushing to reveal half-digested prey along with the older sometimes eroded fish ear bones/otoliths and squid beaks that, when measured, allow estimating original size of prey items. Only very recently, technology advanced sufficiently to allow the first back-mounted camera deployments that enable us to look over a penguin's shoulder during a foraging trip. First camera models had a limited field of view, poor video quality and light sensitivity, so that we decided to develop our own camera loggers, which use a full high-definition video camera equipped with wide-angle lens in a rugged dive case to allow recording penguin foraging behaviour to >120m depths. Battery life currently enables the recording of up to three hours of full HD footage. The PenguCam is programmable with a delayed start and duty cycling to record videos during the most interesting times of a penguin's foraging trip. We will share some of the at times surprising footage we obtained from camera deployments on Fiordland penguins/tawaki and Yellow-eyed penguins/hoiho during the 2020-21 breeding season. In tawaki, we observed benthic foraging along the vertical cliff walls of the Milford Sound/Piopiotahi Marine Reserve as well as pelagic foraging behaviour targeting different prey. Hoiho from Stewart Island/Rakiura proved to be almost exclusive benthic foragers with a diverse range of benthic habitat and prey preferences. We will showcase how, despite the differing predator evasion tactics of their chosen prey and associated energetic consequences, individual hoiho successfully employ contrasting foraging strategies. Animal-borne cameras enable unique insights into the foraging ecology of penguins well beyond prey species and size. Individual behaviour, habitat preferences and foraging strategies along with additional collateral data obtained from camera footage paint an intriguing picture of the diverse and productive marine habitats that support penguins in New Zealand.

Tawaki population surveys on Stewart Island/Rakiura

Robin Long, Simon Litchwark

West Coast Penguin Trust

Stewart Island/Rakiura was surveyed for Fiordland penguins/tawaki, *Eudyptes pachyrhynchus*, in late July and early August 1993 as part of the McLean *et al.* attempt to census the entire tawaki population. This survey was carried out from a boat and only 32 tawaki were counted around the coast of mainland Rakiura. The resulting conclusion that the mainland Rakiura population was very low has been contradicted by recent reports of tawaki breeding in caves along the coastal cliffs. For this reason, a ground survey of tawaki breeding between Lee Bay and White Rock Point in northeastern Rakiura was carried out from 1–6 September 2019. A total of 128 nests was found along the ~40 km of coast, 107 of which were located in caves on the cliffy shoreline, rather than in the forest as is typical of South Westland breeding areas. Access along this coast is often difficult; however, the confinement of most nests to caves allows for a more accurate search than in forest colonies such as those in South Westland and Milford Sound. Port Pegasus was also searched, using a double sit-on-top kayak, between 28 August and 7 September 2020. Another 54 nests were found occupying most available caves in the outer, rougher parts of the Port. None were found in the more sheltered areas further from the open sea. The results of these two surveys indicate that a significant tawaki breeding population of 800-900 pairs may be present on mainland Stewart Island and needs to be considered in future management plans for the species. Additional surveys of the remaining coastline should be conducted to obtain a more robust population estimate.

Beyond the horizon – a closer look at the tawaki winter dispersal

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⁶ Department of Conservation, Auckland

In the 9-10 weeks between the end of the breeding season (December) and annual moult (February), Tawaki/Fiordland penguins travel up to 2,500 km away from the NZ mainland and cover extraordinary distances of up to 6,800 km, a feat that has earned them the title of “Marathon penguins”. Once the birds have completed the moult (late February/early March), they leave on significantly longer journeys that last around five months, a time span which would allow them to travel even further afield. Over the course of three years (2018), we conducted a comprehensive study of the winter dispersal of tawaki using geolocators (first year) and satellite transmitters (subsequent years). We compared the travel patterns of tawaki from the species’ main breeding regions (i.e., Southwestland, Fiordland, and the Foveaux Strait region, 2018-2019), and investigated whether migratory behaviour differs in tawaki that completed the moult along the Otago coast as well as in rehabilitation centres. In all three years, penguins from all groups targeted the Subantarctic and Polar Fronts to the Southwest of New Zealand ranging up to 5,000 km away from their departure location, often covering distances well beyond 10,000 km over the course of the winter. Tawaki that moulted within the species’ breeding range departed along south-westerly trajectories; penguins that started their winter dispersal on the Otago coast followed a parallel trajectory that was offset by roughly the width of the South Island, resulting in little spatial overlap between penguins from the west and east coasts during the first months of their journeys. General trip characteristics (e.g., range, trip distance) between all examined groups are comparable, except for tawaki that moulted in rehabilitation centres which tended to travel further afield and stay at sea longer. It appears as if the significantly heavier body mass at departure of rehabilitated birds may alter their dispersal behaviour resulting in longer journeys and later return to the mainland. However, results at this stage are still preliminary and data requires further analysis.

The dive behaviour of Tawaki in Milford Sound: A tale of two colonies

Myrene Otis

University of Otago, Dunedin

The Fiordland crested penguin (*Eudyptes pachyrhynchus*), also known by the Maori name of Tawaki, are distributed throughout New Zealand's southwestern coast and southern islands. However, little is known about the marine ecology of Tawaki breeding within fiords. This study presents the first comparison of guard stage dive behaviour between two Tawaki colonies from different locations within Milford Sound. Through the attachment of GPS/dive data loggers, dive parameters were examined to determine behavioural differences between the inner fiord colony (Harrison Cove) and the outer fiord colony (Moraine) over the years of 2019 and 2020. Moraine birds almost exclusively foraged outside the fiord in both years while Harrison Cove birds primarily foraged within the fiord in 2020 but not in 2019. Tawaki from Harrison Cove and Moraine also displayed contrasting dive behaviour across years, either adopting a strategy of deeper, longer dives with fast velocities or shallower, shorter dives with slower velocities. Foraging efficiencies for both colonies appeared to be greater in the year 2020 than 2019 although birds foraged differently to achieve this – Harrison Cove birds dived primarily to depths of 0-20m while Moraine birds switched between shallower dives at this depth and longer dives in the deeper 60-120m of the water column. Changes in dive behaviour across years and between colonies are likely due to differential foraging habitats and environmental factors affecting prey availability.

Tangaroa Tohu Mana, Tangaroa Tohu Mauri – Marine Cultural Health Programme

Te Kaha Hawaikirangi

Napier Port, Napier

The Marine Cultural Health Programme (Programme) is a kaupapa (initiative), developed in partnership between mana whenua hapū (Māori tribes) of Ahuriri (Napier) and the Napier Port, to monitor and protect the health of the Ahuriri marine environment. The Programme is based around a Cultural Monitoring Framework (CMF) and Māori based marine monitoring programme; recognising that spiritual, sensible and energy worlds are connected and that Māori share common ancestry with the environment and all living things. The CMF embodies Kaitiakitanga or guardianship, an obligation to care for the environment and maintain it for future generations. It also acknowledges the marine environment of Ahuriri which contains taonga (species of importance) of deep cultural significance to the mana whenua hapū of Ahuriri through the sea maiden Pānia and her son Moremore. The Programme is an Aotearoa New Zealand first, the Programme provides a real-time state of health of the marine environment and aims to help lay the foundation for the future restoration and enhancement of this environment. The Marine Cultural Health Programme officially launched on Wednesday 14 April at Te Ara o Tāwhaki Marae, Eastern Institute of Technology (EIT).

Ascertaining distribution and abundance of little penguins (*Eudyptula minor*) using a protected species detection dog

Alastair Judkins

Kaikoura Ocean Research Institute, Kaikoura

Little penguin fledging success in kaikōura before and after a protective fencing project

Jody Weir

Kaikoura Ocean Research Institute, Kaikoura

Penguins at Napier Port

Paul Rose

Napier Port, Napier

Napier Port has developed the first on-port penguin sanctuary of its kind in New Zealand to protect kororā (little blue penguin) that nest in and around the sea walls at the port. Designed with the help of kororā expert of 30 years, Professor John Cockrem of Massey University, the sanctuary will become a protected breeding, monitoring and research hub for the kororā population, an at-risk and declining species. The sanctuary is part of a wider Avian Management Plan the port has developed with mana whenua hapū, as kaitiaki of the area, the Department of Conservation (DOC) and the Hawke's Bay Regional Council to protect birdlife during the construction of its 6 Wharf project. With the help of a DOC-certified conservation dog named Rua and GIS-mapping technology, 180 penguins have been located in the revetment wall where the new wharf is being built and safely moved into purpose-built nesting boxes located in the sanctuary. As part of a wider education campaign, Napier Port teamed up with the local community, including Napier Central School, mana whenua, and Napier Port employees and families to construct and paint the 48 nesting box kits that form the basis of the sanctuary. Nesting boxes have greater breeding success rates than natural burrows. Despite being an industrial area, the port provides a safe space for penguins as it is free from threats such as dogs, cats and humans. Longer-term the port team believe the sanctuary will help to boost the local population and contribute to the international body of knowledge on the species.

The national kororā monitoring programme and NZ Penguin Database

Richard Seed, Thomas Mattern

NZ Penguin Initiative, Dunedin

While extensive research on little penguins/ kororā (*Eudyptula minor*) has been conducted in Australia, we have little robust population data for most of New Zealand. In much of their range, kororā populations appear to have declined but evidence is anecdotal or based on sporadic surveys, providing insufficient data to reliably assess population trends or implement conservation management actions. Monitoring mostly relies on efforts of community groups often working in isolation, using different methods which makes comparison between regions difficult. The NZ Penguin Initiative is driving a national monitoring programme aiming at coordinating and standardising efforts of community groups. A holistic approach is essential to understand factors driving kororā population changes, and to develop management actions required to improve the species' conservation in different parts of New Zealand. Here, we demonstrate the core aspects of the programme; (1) the three-tiered monitoring protocols that deliver a consistent methodology, (2) the NZ Penguin Database that serves to centralise data and make it available for conservation through the Creative Commons (CC) while ensuring data ownership remains with the community groups, (3) the use of a mobile database application facilitating data entry in the field and near-real time reporting of breeding outcomes.

Horomaka Kororā 2020

Averil Parthonnaud

Pohatu Penguins, Banks Peninsula

Following Covid and knowing that tourism was going to be low in the coming year, we started to think about environmental actions that we could be taking over the coming months and extend our conservation, and the first one that popped in mind was reproducing the first Little penguin survey of the whole of Banks Peninsula that was led by the Department of Conservation in the years 2000 and 2001. Twenty years on, and with many conservation projects that have been happening, and even more due to the announcement of Pest Free Banks Peninsula we were very keen on working on a data baseline of penguin population health around the peninsula. And so, the massive project started, a project led by Pohatu Penguins, but supported by so many organisations, businesses, NGOs and volunteers which without who, this project wouldn't be possible. The community support has been uplifting.

Don't count me twice: double-marking prevents double-counting of little penguins (*Eudyptula minor*) at Takiharuru / Pilots Beach, Otago

Hiltrun Ratz

Blue Penguins Pukekura, Dunedin

Little penguins (*Eudyptula minor*) at Takiharuru / Pilot Beach, Otago Peninsula, New Zealand, are dual fitted with a micro-chip (Allflex PIT tags) inserted in the neck and web tags on the outside webbing of the right foot. In the 2020 season 597 penguins were identified and 443 were dual-marked for more than 365 days and could be examined for both. The total number of years since the initial marking was calculated from the date of fitting to the last day of checking. Of these 388 (87.6%) had a web tags and working micro-chips (1169 total penguin years), 45 (10.2%) had a web tag but had the micro-chip replaced (138 total penguin years), eight (1.8%) had the web tag replaced but a working micro-chip (23 total penguin years), and two penguins (0.5%) had both replaced (eight total penguin years). The average annual loss of micro-chips was 3.5% and the average loss of web-tags was 0.7%. Micro-chip loss was further examined to determine the length of time elapsed between the fitting of the first and the replacement micro-chip. Micro-chips of 16 adults didn't read within two weeks of fitting, and micro-chips of 23 chicks only read prior to fledging. It is possible that they were either lodged in the feathers to be lost when the penguin went to sea or fell out of the insertion hole, indicating installation failure. Only six micro-chips (three adults and three chicks) initially read and then didn't after a minimum of two years indicating that these stopped working rather than being lost. Double-marking avoids counting individuals twice that lose a single marker which can result in over-estimating mortality of adults and chicks and under-estimating chick recruitment. Empty boxes should be examined with a reader to find lost micro-chips that have become "ghosts". A total of six ghost micro-chips were discovered in the 353 nest boxes at Takiharuru / Pilots Beach in the 2020 season.

Tests, trials, and tribulations in developing electronic burrow monitoring

Elise Smith

Ngā Motu Marine Reserve Society, Taranaki

The Ngā Motu Marine Reserve Society has been involved in the surveying and study the marine life of the Taranaki coast since 1997. The importance of penguins was first recognised when the baches at Nga Motu Beach were removed, and kororā residents were noticed to become homeless. Since then, we have led a succession of projects to monitor Taranaki penguins and their activities, with campaigns to improve public awareness. This has included constructing artificial burrows, monitoring the birds with a “penguin cam” and using electronic devices to improve our knowledge of the life patterns of Taranaki kororā. ‘Project Hotspot’ and ‘Finding Little Blue’ have been successful education programmes with a focus on kororā. Now with Lotteries funding, a Department of Conservation permit and assistance from the New Zealand Penguin Initiative, we are well placed to monitor a known colony for recruitment and survival.

Penguins connect children to nature, conservation and ecology

Lucy Waller

West Coast Penguin Trust

Penguin education has been a cornerstone of the West Coast Penguin Trust's work since the Trust was formed in 2006. Having delivered occasional classroom and beach activities for children, the Trust wanted to reach more children and developed and published an educational resource, "Blue Penguins and other Seabirds: Activities for exploration and action for schools and community groups", in 2014. The aim was to support teachers and other youth and environmental education leaders to present activities for children to learn about penguins and the local coastal habitat, linked to the NZ curriculum. The resource book includes activities that both enable a voyage of discovery for children in the classroom and on field trips, and encourage them to take action. It was developed in consultation with local teachers and was provided both digitally and as an A4 56 page publication. Initial workshops with teachers to introduce the resource supported its launch, and demand for the Trust's Education Ranger to work with new teachers and schools has grown ever since. The Trust has worked closely with 21 schools across the West Coast so far who are committed to a long term investment in this programme. Teachers and students are empowered through encouragement, guidance, classroom sessions and field trips. They gain the confidence to embark on penguin and seabird focussed projects across English, science, social sciences, arts, technology, maths & statistics and health & physical education. Penguins open doors to conversations about nature, conservation and the environment and those messages reach communities through the children.

Impacts of terrestrial heat waves on survival of moulting adult little penguins

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Continued warming of the Earth's atmosphere is having a range of ecological, behavioural and physiological impacts on seabirds. The effects of changes in sea surface temperatures on seabirds are well-documented, but the effects of high ambient temperatures on land are not. Like all penguins, moult in Little Penguins is 'catastrophic', with all feathers shed and replaced in ~18 days. As they do not have adequate insulation and waterproofing to forage at sea, they are constrained to land in some of the hottest parts of the year. Long-term survival analysis suggests that adult mortality is greatest in years when high ambient temperatures are paired with low humidity during moult. Given current climate projections, successful management of Little Penguins requires a better understanding of the physiological processes and habitat features that influence mortality events. In this study we aimed to identify which birds are most at risk of heat stress during moult, and why. Using a novel approach to field respirometry, we investigated thermoregulatory costs of moulting birds in response to ambient temperature and humidity. Our results predicted that penguins in early stages of moult would be most affected by heat exposure, as they displayed a significant increase in metabolic rate at higher temperatures compared to mid and late moult birds. During a heat wave in 2019, the largest adult Little Penguin mortality event on record occurred during moult at Phillip Island in south-eastern Australia. As predicted, all recorded deaths were birds in early stages of moult. We are currently quantifying the microclimates of burrows and vegetation types and investigating how birds are using structural habitat during extreme weather events. Results will help determine how birds are currently coping with extreme temperatures on land, and identify adaptation options most likely to reduce negative climate change impacts for the species across their distribution.

Best of the West: A good season's foraging for West Coast kororā

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Land-based monitoring of penguin colonies is an essential tool to assess population trends. But to understand the mechanisms driving these trends we must look to the sea. The West Coast Penguin Trust (WCPT) have been monitoring the breeding success of the kororā population in Charleston, Buller Region since 2013 and, with support from NZPI, began establishing a marked population in the 2020/21 season to capture more detailed population data. We also initiated a complementary, long-term GPS dive tracking study that will support this terrestrial monitoring. During October 2020 we deployed GPS dive trackers on breeding adults during the guard (n=7) and post-guard stage (n=4). Birds showed consistent foraging routes between guard and post-guard with the latter group opting for two-day foraging trips and performing shorter, shallower dives at a higher frequency. Unusually short nest attendances required an intensive surveillance effort to intercept birds for logger deployment and retrieval. Good body condition and successful chick rearing was evidence of an abundant food supply throughout the season. Over the coming seasons, additional data will be recorded allowing comparison of foraging effort and success between years and the examination of how reproductive outcome, survival rates and population dynamics are shaped by the marine environment. Here we frame the dive tracking data from the first year in the context of marine environmental conditions and potential fisheries interactions. This project also serves as a pilot as we look to facilitate similar kororā tracking projects in all regions of New Zealand in the medium to long-term. This will provide a holistic view of the vastly different foraging conditions observed around New Zealand's coast and deliver ancillary data to significantly enhance our understanding of kororā population developments throughout NZ.

Investigating drivers of early egg-laying by little penguins at Oamaru

Philippa Agnew

Oamaru Blue Penguin Colony, Oamaru

Double-brooding and the laying of replacement clutches has increased the breeding success of little penguins (*Eudyptula minor*) at Oamaru by as much as 75% in a season. Across all 27 years of penguin monitoring, the addition of chicks from such broods increased the fledglings per female from 1.43 to 1.89. During the most productive seasons, as many as 70% of females produced a double brood and some fledged chicks from three separate broods. Double brooding is determined by how early during the season the penguins lay eggs and previous research at Oamaru found the timing of egg laying to be related to concentrations of Chlorophyll-*a* during the period January through April prior to the breeding season. The current study aimed to further investigate this relationship by examining foraging behaviour during the months immediately prior to egg-laying. Penguins were tracked during May 2018 and May 2019, no tracking was carried out during 2020 because of the impacts of Covid-19, and then tracking resumed in April 2021. While there were subtle differences between the Chlorophyll-*a* concentrations, foraging behaviour and lay dates, generally 2018 and 2019 were similar overall, with 29% and 31% of females double brooding. Tracking during these seasons showed surprising results; birds spent their time foraging on average 7km from the colony and carried out single-day foraging trips. Research into diving behaviour and pre-breeding body mass is continuing.

The impact of human disturbance on breeding success of Little Blue Penguins (*Eudyptula minor*) in Oamaru, New Zealand

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Little blue penguins (*Eudyptula minor*) are a significant attraction for ecotourism as they are an attractive, charismatic species that are found in relative abundance, although numbers are declining at many sites. The Oamaru Blue Penguin Colony (OBPC) is home to one of the largest colonies of blue penguins in New Zealand. While penguins nesting inside the colony are infrequently exposed to humans beyond weekly monitoring and evening viewings, many penguins nest outside of the protected area. These penguins are frequently exposed to disturbance by cars, animals such as cats and dogs, loud noises, bright lights, and by humans wishing to view little blue penguins for free. In various penguin species, human disturbance has been seen to elicit a number of behavioural and physiological responses, including impairments to reproduction. However, it has not yet been studied if disturbance affects breeding success in little blue penguins. To investigate this, chicks were weighed weekly until fledging at three sites of varying disturbance across the 2019/20 and 2020/21 breeding seasons. No significant differences in fledging weights nor growth rates were found between any of the sites for either breeding season, and high fledging weights were observed at all three sites. This suggests that little blue penguin breeding success is not significantly influenced by human disturbance and indicates that the species may be able to habituate to human presence, a phenomenon that has been observed in several other penguin species. While this has significant management implications for the species, it is important that little blue penguin management be colony- and site-specific, and generalisations should be avoided.