New Zealand Journal of Zoology, 2015
http://dx.doi.org/10.1080/03014223.2014.995107

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FORUM

Proceedings of the 9th Oamaru Penguin Symposium 2014

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(*Received 1 October 2014; accepted 2 December 2014*)

This paper records the abstracts of the presentations given at the 9th Oamaru Penguin Symposium, held at the Opera House, Oamaru, New Zealand, 10 and 11 July 2014.

Department of Conservation's Fiordland crested penguin recovery strategy—how useful will a single species plan be in protecting tawaki?

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At the 2008 Oamaru Penguin Symposium, the Department of Conservation (DOC) asked symposium participants to help identify strategic direction for the Fiordland crested penguin (*Eudyptes pachyrhynchus*; tawaki). In 2012, the population trend for tawaki, as indicated by nest counts over time and by modelling-detected estimated demographic rates, and recent research, monitoring and management efforts were reported at the symposium. Two years on, DOC now has three initiatives working at different scales aimed at achieving improved conservation of the Fiordland crested penguin: (1) a single-species recovery strategy, (2) a nation-wide optimised ecosystem level protection system and (3) a single threat abatement group, i.e. the marine-focused Conservation Services Programme team. The recovery strategy sets out long-term conservation goals and a prioritised list of actions to be undertaken, which address all the potential and actual threats, and key knowledge gaps. Actions are ranked as high, medium or low priority. In the optimised ecosystems programme, a sufficient number of every ecosystem type known in New Zealand has been identified and the management actions needed to restore the site to full function have been identified and costed. Many of the sites where tawaki breed are optimised ecosystem sites, and the species should benefit from the required island biosecurity actions and/or the pest control actions. DOC's Conservation Services Programme team focuses on understanding and reducing the threats from the various fisheries to marine life. The proposed increased observer coverage of the set-net fishing fleets off the southern South Island during 2014/15 should improve understanding of the risk of this fishery to tawaki. Despite currently having multiple approaches to conserving biodiversity in New Zealand, it is still considered beneficial for some species, such as the nationally endangered tawaki, to have their own recovery strategy, despite the considerable time and effort that is needed to draft and agree on one.

Eastern rockhopper penguins work harder for less gain from higher trophic level prey

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Diet quality is a key determinant of population dynamics. An optimal quality diet maximises net energy gain per unit of time. In the early 1940s the world's largest population of eastern rockhopper penguins (*Eudyptes filholi*) bred on subantarctic Campbell Island, New Zealand, but the species' conservation status is now 'Nationally Critical'. The dominant hypothesis for the population's dramatic decline of 94.7% through the latter part of the century is that a climate-induced shift to a lower quality diet resulted in adults and chicks of insufficient body mass for successful reproduction and survival. In the 2011 and 2012 breeding seasons we investigated whether stable nitrogen ($\delta^{15}N$) and carbon ($\delta^{13}C$) isotope values of blood from adults and chicks were related to their body masses. We concurrently assessed foraging effort using an automated gateway to measure incubation foraging and chick provisioning trip durations of passive integrated transponder (PIT)-tagged males and females and related the latter to chick masses. Heavier males consumed a lower trophic level diet at each stage in 2011 and 2012, significantly during incubation in 2011, and average chick mass was heavier in 2011 when chicks were fed a more zooplankton-based, pelagic/offshore diet than in 2012. Adults made incubation and foraging trip durations of longer duration in 2012 than 2011, and had lower body masses and provisioned chicks less frequently. Chick mass at 30 days of age was strongly positively related to their rate of being fed in both years. Contrary to the suggested importance of a fish-based diet, our results support the alternative hypothesis that rockhopper penguin populations are likely to be most successful when abundant zooplankton prey are available.

Climate change and a super-sized iceberg impact Adélie penguin (*Pygoscelis adeliae*) numbers in Commonwealth Bay, Antarctica

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The Australasian Antarctic Expedition 1911–14 made observations on Adélie penguins (*Pygoscelis adeliae*) at Cape Denison and the nearby Mackeller Islets, Commonwealth Bay, Antarctica. Subsequent observations indicate that penguin numbers and distributions changed little between 1913 and 1931, with many more penguins on the Mackeller Islets than at Cape Denison. Since 1974, numbers at Cape Denison have increased, whereas numbers on the Mackeller Islets, and the Commonwealth Bay meta-population, have declined. In 2009 the giant iceberg B09B stranded offshore from Commonwealth Bay and fast ice formed behind the iceberg, so now the penguins must commute about 65 km over solid ice to reach open water. In this presentation we discuss how numbers and distribution of Adélie penguins in Commonwealth Bay changed and relate these to changes in climate and pack ice, and the impact of the B09B iceberg. Since the 1970s, wind strength has declined and sea-ice density has apparently increased in this part of Antarctica, limiting foraging opportunities close to these colonies. Since B09B stranded off Commonwealth Bay, penguin numbers have declined and a high percentage of breeding attempts have failed. Recruitment of young birds into the Commonwealth Bay meta-population seems unlikely while the iceberg remains in place.

Identifying 'super-breeders' in yellow-eyed penguins

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Breeding success in penguins is principally a product of parent quality: factors that contribute to parent quality and hence to reproductive success include nest site selection, nest attendance patterns, foraging success and senescence. Regular monitoring over 30 years of reproductive success in endangered yellow-eyed penguins (*Megadyptes antipodes*) at one study site in New Zealand has shown that there exists a small proportion of breeders (5.4% of breeding pairs) that consistently produce offspring which exhibit higher rates of survival, and which in turn give rise to more healthy chicks in subsequent generations. These high-quality parents ('super-breeders') contribute more to the population than ordinary breeders but currently can be identified only at the end of their lives by viewing all the breeding records of the pair and their offspring. Focusing conservation efforts on these 'super-breeders' could benefit the species. Oxidative stress is emerging as an important factor underlying reproductive performance and aging in birds. Oxidative stress accumulates and represents a lifetime of immune challenges: levels of antioxidants and oxidative stress have been used as a measure of condition, and could be indicators of quality earlier in penguins' lives. We hypothesise that the reduced oxidative stress experienced by the healthier 'super-breeders' during their lifetimes enables them to produce healthy young. In addition, we hope to establish senescence trends in yellow-eyed penguins using breeding records from the database, and explore relationships between breeding success and oxidative stress in individuals of different ages. A potential external indicator of fitness could be the brightness of the unique yellow-pigmented feathers of the post-ocular stripe, which can be quantified by measuring the reflectance of the feathers using spectrophotometric analysis. Variations in the brightness of the post-ocular feathers will be examined in relation to individual quality and senescence.

Increase in yellow-eyed penguins through intensive management at Moeraki, North Otago

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Yellow-eyed penguin (*Megadyptes antipodes*) nest numbers at Moeraki, North Otago, New Zealand, increased from seven in 1984 to 58 in 2013 at an average annual increase of 8% through 30 years. In contrast, total nest numbers from the other six North Otago breeding locations decreased from 34 in 1984 to 12 in 2013 at an average annual decrease of 1.5%. The sustained increase in nest numbers at Moeraki is attributed to intensive management implemented primarily by Janice and Bob Jones up to 2002 and subsequently by Rosalie Goldsworthy. The initial terrestrial habitat at Moeraki was grazed farm grassland, some with public access. The key management methods have been the control of terrestrial mammals to mitigate predation of chicks and the deployment of nest boxes to provide nest sites. Other methods have included re-forestation to provide nesting habitat; continual mowing of rank grass to provide penguins with access to nest sites and open areas for socialising; prohibition of dogs and restrictions on access by people to mitigate harassment; fostering of eggs and chicks to enhance breeding success; and rehabilitation of injured or emaciated penguins to enhance survival rate. The most significant outcome has been the creation of a new breeding colony instigated by rehabilitated penguins, with an increase in nest numbers from two in 1991 to 31 in 2013.

Pododermatitis; causes and treatments

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Pododermatitis, or bumblefoot, is a common affliction seen in captive and rehabilitated birds, especially penguins, other sea birds, waterfowl and raptors. It begins with a flattening or thinning of the ventral surface of the foot, followed by cellulitis, a thickening of the dermis and, as the condition progresses, formation of abscesses. If left untreated the abscesses can rupture leading to inflammation and infection of the tendons, ligaments and joints, further leading to septicaemia and osteomyelitis. A grading system is used to determine the severity of the condition based on clinical signs. From this a prognosis and treatment plan is formulated that may involve further diagnostics such as radiographs and haematology. Treatment ranges from addressing and changing the husbandry issues to surgical debridement and maintenance of an open wound through frequent bandage changes. This condition is caused by many factors, often working together to compound the issue, such as obesity, poor substrate and a lengthened time spent on land. Prevention is always preferable to treatment and this presentation is focused not only on the causes and treatment of bumblefoot, but on the measures successfully used to prevent this from happening to those we care for.

An overview of oiled wildlife rehabilitation: intake, stabilisation, cleaning, conditioning and release

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Oiled wildlife rehabilitation is a key component of an oil spill response. Rehabilitation of wildlife is the process of removing from the wild and caring for injured, orphaned, oiled or sick wild animals. The goal of wildlife rehabilitation is to provide food, housing and medical care for these animals, and release them back to the wild once the habitat is able to receive them. There needs to be a clear path in the process of treating these animals. Consistency is the key and skilled personnel are required at every step. The oiled wildlife rehabilitation pathway is: (1) intake, including triage and a full veterinary examination; (2) stabilisation, including provision of fluids, thermoregulatory and nutritional support, and superficial decontamination; (3) cleaning, using the appropriate techniques and products for a successful outcome; (4) conditioning, including provision of opportunities for exercise and waterproofing activities; and (5) release back to a cleaned environment. All species, marine mammals, marine reptiles and marine birds will follow this process with individual nuances depending on the species. This presentation does not deal with the challenges faced during this process, but will summarise the requirements for each step to give an overview of why consistency, skilled personnel and care are needed throughout.

Post-release survival and productivity of oiled little blue penguins rehabilitated after the C/V *Rena* oil spill

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There is contentious debate regarding the conservation value of rehabilitating oiled wildlife. One way to evaluate the effectiveness of such rehabilitation is to conduct post-release monitoring of oil-rehabilitated animals to determine whether these animals survive the transition to the wild, and thereafter have survival and reproductive rates equivalent to control animals. We have been monitoring the survival and productivity of little blue penguins (*Eudyptula minor*) oiled and subsequently rehabilitated after the 2011 C/V *Rena* oil spill in Tauranga, New Zealand. Post-release survival of oil-rehabilitated penguins (that were micro-chipped pre-release) was similar to the survival of control birds (that were not oiled but were micro-chipped during the oil spill response). There was, however, a reproductive impact. Hatching success (proportion of chicks hatched from eggs laid) in the year after the spill was significantly reduced in breeding pairs containing at least one rehabilitated adult (rehabilitated pairs) compared with pairs containing no rehabilitated adults. Fledging success (proportion of chicks fledged from chicks hatched) and overall egg success (proportion of chicks fledged from eggs laid) were also reduced but not significantly so. Despite these reductions, hatching, fledging and egg success rates for rehabilitated pairs were higher than or within the ranges reported for other little blue penguin colonies in Australia and New Zealand. Survival monitoring surveys are on-going and data collected from the second post-spill breeding season will be analysed to determine whether reduced hatching success is a transient effect lasting one breeding season or if the effect of oil contamination persists in the medium term.

From fish to fowl: a comparison using stable isotope analysis of the little blue penguin (*Eudyptula minor*) in captive and wild populations

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The stable carbon and nitrogen isotope compositions of penguin tissues and the penguins' diet are compared in a captive colony (i.e. controlled diet) at the International Antarctic Centre, Christchurch, New Zealand. The data from the captive penguin study will be compared with similar isotopic data sets determined for three geographically separated natural populations at (1) Oamaru, Otago; (2) Flea Bay, Banks Peninsula; and (3) Wellington Harbour's Matiu/Somes Island. The stable isotope ratios of carbon and nitrogen in animal tissues change (i.e. fractionate) because metabolic processes preferentially incorporate lighter atoms into solid tissue. The stable isotopes of carbon and nitrogen fractionate as they move through biological systems. Measurement of the shifts in relative abundance of the light and heavy isotopes can be used to track these changes at different points in the process in question, be it within and between individual birds or between whole colonies. The stable isotopes of the major biological elements H, C, N, O and S are the most useful, there being well-studied fractionations between light and heavy isotopes. Stable isotope ratios can be used to map trophic levels within an ecological system. From the ratios between trophic levels in one species, we can then further develop the 'ratio map' with added layers of complexity with different mixes of prey species. Trophic level mapping of the food chain can provide information on the surrounding ecosystem. Using the stable isotope ratios of carbon and nitrogen, we can track, trace and record changes in penguin feeding behaviour and/or metabolism. This may help us to predict what could occur, especially in different circumstances such as geographic location or seasonal food availability. Documenting the manner and magnitude of changes in C and N isotope ratios in feathers and egg material will provide a better understanding of specific species and set a baseline for measuring any response to environmental pressures.

Little penguin study on Matiu/Somes Island: status and findings

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Representatives from the little penguin (*Eudyptula minor*) project on Matiu/Somes have provided previous Oamaru Penguin Symposia with updates on progress. This report to the 2014 symposium will conclude these updates. The little penguin project on Matiu/Somes, Mākaro/Ward and Mokopuna islands has been conducted in stages:

- Stage One (2007–2011) focused on assessing whether flipper bands were impacting on the ability of the birds to forage. The initial findings from this study will be covered in the symposium presentation.
- Stage Two (2012–2014) is looking at nest-related activities, particularly nesting success. A progress report will be included in the symposium presentation.

The presentation will include observations about the health and size of the colony, the addition of a large number of new nest boxes, and the role of the island as a nesting colony for the wider Wellington region. It will report on a substantial increase in the loss of chicks on Matiu/Somes Island during the 2013 nesting season. The project provided assistance to a study undertaken by a PhD student during 2012 into the foraging and ranging habits of Matiu/Somes little penguins. A summary of the study findings will be included in the presentation. With the infrastructure now in place, this island is an ideal site for future research on the little penguin.

Corticosterone and responses of penguins to changes in their environment

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Penguins, like other birds, live in complex environments that can change at any time. When changes in the immediate environment are potentially harmful then birds can secrete a hormone called corticosterone. The increased secretion of corticosterone is known as a stress response, with corticosterone acting to increase blood glucose levels, promote changes in behaviour and help the bird to adjust to the situation. We have studied corticosterone responses in Adélie and emperor penguins, and are currently investigating corticosterone responses in little penguins. Corticosterone responses of little penguins at Oamaru are greater than responses of the other species. Responses of individual little penguins vary markedly, with peak concentrations 15 times higher in some birds than others. The mean response of little penguins at Oamaru was identical in birds sampled at the same time of year in 2012 and 2013, and responses of individual birds sampled in both years were similar. Little penguins breed around the coasts of the North and South Islands, Stewart Island, and the Chatham Islands, and it will be valuable to compare corticosterone responses of little penguins at different locations throughout New Zealand, and to compare the responses of New Zealand and Australian little penguins.

Spatial variability in population genetic structuring of *Eudyptula minor*

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Due to the high rates of mortality in juveniles during their most dispersive years and a lack of search effort throughout most of their range there are few records of movement between colonies for *Eudyptula minor*. Records of gene flow—individuals observed breeding at a non-natal colony—are extremely rare. Neutral genetic markers can be used to estimate movement between, and genetic relatedness among, colonies of *E. minor*. A previous study of *E. minor* in southeast Australia documented low spatial structuring of genetic variation with the exception of colonies at the western limit of sampling, and their distinction was attributed to an intervening oceanographic feature or differences in breeding phenology. Here we conducted sampling across the entire Australian range, employing additional markers (12 microsatellites and mitochondrial DNA, 697 individuals, 17 colonies). The zone of elevated genetic structuring previously observed actually represents the eastern half of a contact zone between two groups, within which allele frequencies vary clinally over much shorter spatial scales than elsewhere. Colonies separated by as little as 27 km in this zone are genetically distinguishable, whereas outside the zone, homogeneity cannot be rejected at scales of up to 1400 km. This study highlights the importance of sampling scale to detect the genetic variability that may occur across short distances, and also illustrates how historical factors such as secondary contact may produce elevated genetic structuring that might otherwise be interpreted solely in terms of barriers to contemporary gene flow.

Population genetics of little blue penguins, *Eudyptula minor*

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The little blue penguin, *Eudyptula minor*, is the smallest extant penguin species and inhabits the coasts of New Zealand and southern Australia. Recent studies on mitochondrial DNA (mtDNA) discovered a phylogenetic split of *E. minor* into two highly divergent groups, suggesting the possible existence of two species of little blue penguin, one Australian (but interestingly also including birds from New Zealand's Otago region) and one from New Zealand. Although vocalisation data similarly suggest that these groupings may be biologically distinct, confirmation of this distinction from the nuclear genome has been lacking. In this study we use mtDNA, together with 20 nuclear microsatellite loci and a nuclear intron marker, to examine the population structure of little blue penguins across their whole distributional range. Our analyses confirm the presence of two major genetic lineages, with little evidence of hybridisation, suggesting that they do indeed represent distinct biological taxa. We also analyse ancient DNA from bones found in archaeological middens to test the timeframe of the Australian lineage's arrival in Otago. In contrast to previous analyses, our preliminary ancient-DNA data support a recent (post-human) timeframe for this intriguing colonisation event.

Pairing patterns in mixed-clade colonies of little blue penguins

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The little blue penguin (*Eudyptula minor*) can be divided into two deeply divergent clades: the Australia and southeast New Zealand clade and the New Zealand-only clade. Individuals of both clades can be found in colonies on the east and southeast coast of New Zealand's South Island. Given the deep genetic divergence of these clades within this species, we are exploring mate choice in mixed-clade colonies to determine whether pairing between clade members is random or whether individuals show patterns of assortative or disassortative mating. Clade membership in little blue penguins is cryptic and can be determined only through molecular methods. In addition, little blue penguins cannot be definitively sexed through visual inspection or morphological measurements. Consequently, we used genetic methods to explore pairing patterns. We collected DNA from focal individuals at two mixed-clade colonies in Oamaru, New Zealand. Our initial sample of 100 pairs resulted in too few New Zealand-only individuals (13 of 200) to allow statistical analyses. Consequently, we are continuing to collect additional DNA samples at the Oamaru colonies.

The blue in little 'blue' penguins: quantifying colour by sex and clade

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Many birds can visualise parts of the ultraviolet (UV) range; consequently, the diversity of colours observed by birds is generally greater than humans can perceive. The colouration of feathers is diverse both between and within bird species. Feather colour can result from either pigments or structure—i.e. when light refracts off of the physical structure of the feather—or a combination of both. In the little penguin (*Eudyptula minor*), also known as the little blue penguin, non-iridescent (β-keratin) nanostructures result in their characteristic blue colour. As little penguins are categorised into two clades (i.e. Australia/southeast New Zealand clade and the New Zealand-only clade), we compared different colour characteristics of feathers by sex and clade. Using a recently designed spectrometry instrument to reliably quantify structural colours, we analysed two to three feathers from each individual. We also used feather-based DNA to determine sex and clade for each individual. Preliminarily results suggest that less than 30% of feathers analysed have a characteristic UV/Blue hue (300–510 nm) whereas over 70% were considered simply shiny (hue approx. 700 nm). Of those individuals demonstrating peaks in the UV/Blue range in any of their feathers sampled (124 of 259 birds), we found a significant difference between clades for UV chroma (proportion of brightness in UV range), blue chroma (proportion of brightness in blue range), and hue (wavelength of maximum reflectance peak). We detected no difference between sex for UV chroma, blue chroma, or hue, but we did detect a significant difference between male and female feather maximum brightness (area under the maximum spectral curve). These differences may be related to sexual dimorphism and clade differentiation within the species, but the biological significance of these differences is unclear. We are expanding this study to include feather samples from more birds of both clades as well as analysing the colour pattern on the dorsal side of the flipper, which may also vary by sex and clade.