

SHORT NOTE

First record of a petrel species killed by penguins: outcome of competition for artificial nesting boxes

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Seabirds include some of the most endangered species of birds in the world; 28% are listed as globally threatened and 5% are critically endangered (Croxall *et al.* 2012). New Zealand is a global seabird hotspot with potentially more breeding species than anywhere else in the world (Taylor 2000; Forest & Bird 2014). One of the main threats to seabirds while on land is predation by invasive mammals (Burger & Gochfeld 1994). As a result, many seabird restoration projects have included programs to remove or control invasive mammalian predators. For species that nest in burrows (*e.g.*, petrels), the use of artificial nesting boxes to entice individuals to predator-free sites has been successful for a range of seabirds (Bolton *et al.* 2004; Priddel *et al.* 2006), including penguins (Sherley *et al.* 2012; Sutherland *et al.* 2014).

Amongst burrow-nesting seabirds, competition for burrow sites is not uncommon (Bolton *et al.* 2004). Inter- and intraspecific competition for nest burrows has been recorded, particularly amongst Procellariiformes (Imber 1976; Ramos *et al.* 1997; Sullivan & Wilson 2001). In some other species, the

rapid uptake and high use of artificial nest boxes indicates a low availability of suitable natural nest sites (Rohrbaugh Jr & Yahner 1997). Additionally, the choice of particular burrow locations may be a result of environmental factors that managers cannot always identify (*e.g.*, temperature, slope). While competition for nesting sites often results in displacement, and occasionally injury or death of one party, these typically involve individuals of the same species, situations where one species is more aggressive, or where juveniles are targeted. For example, chicks of the endangered Chatham petrel (*Pterodroma axillaris*), face threats from the abundant broad-billed prion (*Pachyptila vittata*), which nests sympatrically and engages in burrow competition with Chatham petrels (Sullivan & Wilson 2001; Kennedy 1994). However, broad-billed prions were not more attracted to Chatham petrel nesting sites in preference to their own sites (Sullivan *et al.* 2000) indicating that competition between the 2 species is based on lack of habitat rather than seeking more preferable sites.

While intraspecific competition for nest sites is relatively common amongst Procellariiformes, competition between this group and penguins (Sphenisciformes) has been rarely recorded.

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Sandager (1890) noted in his account of the Mokohinau Islands that penguin “nests are occasionally found at a couple of hundred feet above the water, but only, I think, when suitable places cannot be found at a lower level. On one occasion I witnessed a fight between [a penguin] and a *Procellaria* [*Pterodroma gouldi*] about a burrow. Leaving them to settle the question, and visiting the spot again a few days later, I found the penguin dead outside the burrow, and the *Procellaria* in possession”. It is interesting to note that reports from South East Island, Chatham Islands, found that little penguins (*Eudyptula minor*) were outcompeted for burrows by the smaller, broad-billed prion (~200 g; Was *et al.* 2000). Here we report the first incidence of little penguin apparently killing a pair of grey-faced petrels (*Pterodroma gouldi*) in competition for a nest site.

We made our observations at Tawharanui Regional Park (-36.365350, 174.857987), a mainland open sanctuary north of Auckland on the Hauraki Gulf. Following the installation of a pest-proof fence, mammalian pests within the park were eradicated in spring 2004 using 2 aerial applications of brodifacoum (Pestoff 20R) toxic baits supported by trapping, hunting, poisoning at bait stations, and detection dogs. Ten species of pest mammals were targeted for eradication including brushtail possum (*Trichosurus vulpecula*), cat (*Felis catus*), ferret (*Mustela furo*), stoat (*M. erminea*), weasel (*M. nivalis*), ship rat (*Rattus rattus*), Norway rat (*R. norvegicus*), house mouse (*Mus musculus*), European rabbit (*Oryctolagus cuniculus*), and European hedgehog (*Erinaceus europaeus*). Seven of the 10 species were eradicated but house mice, rabbits, and hedgehogs persisted although hedgehogs are now at zero density, and rabbits are subject to a sustained control programme. The site is monitored extensively for signs of pests and all incursions by rats, cats, mustelids and possums that have been detected have been successfully controlled through trapping, shooting and baits (Maitland 2011). The sanctuary is managed in partnership by Auckland Council and Tawharanui Open Sanctuary Society Inc.

Surveys in 2009 discovered a small population of grey-faced petrels breeding at Ngaio Bay, which was either a remnant population or newly established since the eradication. Subsequent surveys identified additional natural grey-faced petrel burrows in the same vicinity (Gaskin 2012). Seven of the burrows discovered at Ngaio Bay were within 30 m of the shoreline. Little penguins have been observed using burrows in this area, including successful breeding, and surveys in 2010 indicated that there were 4 penguin burrows at this location. Little penguin chicks have been observed in the vicinity of the grey-faced petrel burrows, and surveys in 2010 confirmed a number of penguin burrows in



Fig. 1. A) Grey-faced petrel found dead outside of nest box as a result of competition from little penguins on 13 May 2015 at Tawharanui Regional Park (Photo: Kerry McGee). B) Second grey-faced petrel found dead inside nest box tunnel Novacoil entrance as a result of competition with little penguins on 19 May 2015 at Tawharanui Regional Park (Photo: James Ross).

this area. Several burrows were also known to have been used by both petrels and penguins in different seasons.

The absence of mammalian predators at Tawharanui, the existing small population of grey-faced petrel and its proximity to the outer Hauraki Gulf, made the sanctuary an ideal candidate for seabird restoration including the use of sound attraction systems (Gaskin 2012). Three systems were installed at 3 sites in 2011, and 16 nest boxes were installed for grey-faced petrels in 2013 including 12 at Ngaio Bay. The location of the nest boxes was chosen to be close to existing natural grey-faced petrel burrows (*i.e.*, close to the shore), although most of the new boxes were clustered around one of the sound attraction systems. The use of artificial nesting boxes coupled with acoustic attraction has been successful in attracting grey-faced petrels, with 3 chicks fledged in boxes during the 2014 breeding season and 2 chicks during the 2015 season.



Fig. 2. Pair of little penguins with their egg, inhabiting the artificial burrow subject to competition with grey-faced petrels (photo: Megan Friesen).

On 7 May 2015, a pair of little penguins was found in one of the nest boxes positioned near the shore. This nest box had been occupied by a grey-faced petrel pair in 2013 and the same pair also fledged a chick in the same box 2014. When the box was checked a week later (13 May 2015), a dead grey-faced petrel adult was found at the nest box tunnel entrance. The bird was lying on its chest and facing the burrow entrance. Trauma to the eye socket, skull, and back of the bill was evident (Fig. 1). The bird's band confirmed that this adult was one of the pair that successfully fledged a chick from this nest box in 2014. Following the discovery of the dead petrel, tracking cards were deployed and additional baits added to nearby traps to check for possible mammalian predators. No evidence of mammalian predators was found (note that weka are not present at Tawharanui, and no other avian predators present are known to burrow).

Less than a week later, on 19 May 2015, a second dead grey-faced petrel was found at the same nest box. This adult was not banded and was found partly within the tunnel, with large wounds on the neck (potentially indicating it had been dragged into the tunnel, Fig. 1). Fewer abrasions to the face were found compared to the first dead petrel. The second dead grey-faced petrel was autopsied (Massey University, Accession No. 52080) and the cause of the injuries were found to be 'likely avian aggression' with substantial evidence against mustelid predation. A dog trained to indicate on mustelids also showed no reaction to this dead petrel. A trail camera (KeepGuard 12MP 720P Infrared) placed facing the burrow entrance recorded considerable penguin activity over the following 2 weeks.

The pair of little penguins remained in the nest box and a single egg was laid in mid-July (Fig. 2).

The egg was incubated until 1 October 2015 but proved to be infertile. At this point the pair moved to an empty adjacent nest box where they laid a second egg. This egg hatched on 20 November and the chick fledged.

Grey-faced petrels at this site close to the shore were likely a small remnant colony that overlapped with little penguin habitat. While competition for nest sites could be expected the deadly aggression by little penguins towards grey-faced petrels was not anticipated. While little penguins are known to be aggressive (Waas 1990) and highly territorial (Mouterde *et al.* 2012), their ability to outcompete and kill a large gadfly petrel (~550 g) has not been previously recorded.

At least 2 other penguin nests with chicks and 3 successful grey-faced petrel burrows were located within 30 m of the usurped nest box during the 2015 breeding season. With the numbers of both grey-faced petrel and little penguin at Tawharanui increasing (from unpublished data collected during routine surveys), further conflict between petrels and penguins cannot be discounted.

The implications for seabird restoration programs of such conflict are most severe at the establishment and early recovery phase when losses of individuals will have a greater proportional impact. As recovery proceeds then the loss of individuals as a result of conflict or competition, while unfortunate, will be of less significance for population recovery. Consequently, initial restoration plans for burrow-nesting petrels that co-occur with little penguins should consider the placement of artificial burrows to avoid aggressive interactions of this type. The chance of overlap may increase as populations grow, but conflict at this stage should be less detrimental to seabird restoration. While the placement of nest boxes in this instance was partly determined by the location of a small remnant population close to the shore, installing nest boxes in a cliff-top environment could decrease incidences of competitive encounters. Further investigation is required to determine if the use of nest boxes elicits natural behaviour in burrow residents. It is possible that breeding individuals in artificial boxes are young or new breeders that could be exhibiting unusual levels of aggression. For example, Cory's shearwaters (*Calonectris borealis*) nesting in artificial burrows were found to lay smaller eggs, indicative of younger nesters, than pairs nesting in natural burrows (Ramos *et al.* 1997). While this project shows the risks of mortality from interspecific interactions, the use of artificial nest boxes to increase nest sites remains a valid and successful tool for seabird restoration.

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LITERATURE CITED

- Bolton, M.; Medeiros, R.; Hothersall, B.; Campos, A. 2004. The use of artificial breeding chambers as a conservation measure for cavity-nesting procellariiform seabirds: case study of the Madeiran storm petrel (*Oceanodroma castro*). *Biological Conservation* 116: 73-80.
- Braidwood, J.; Kunz, J.; Wilson, K.-J. 2011. Effect of habitat features on breeding success of the blue penguin (*Eudyptula minor*) on the West Coast of New Zealand. *New Zealand Journal of Zoology* 38: 131-141.
- Burger, J.; Gochfeld, M. 1994. Predation and effects of humans on island-nesting seabirds. In Nettleship, D.N.; Burger, J.; Gochfeld, M. (Eds.) *Seabirds on islands, threats, case studies and action plans*. Proceedings of the Seabird Specialist Group Workshop held at the World Conference of the International Council for Bird Preservation, University of Waikato, Hamilton, New Zealand, 19-20 November 1990. *Birdlife Conservation Series*, 1. Birdlife International: Cambridge. 39-67 pp.
- Croxall, J.P.; Butchart, S.H.M.; Lascelles, B.; Stattersfield, A.J.; Sullivan, B.; Symes, A.; Taylor, P. 2012. Seabird conservation status, threats and priority actions: a global assessment. *Bird Conservation International* 22: 1-34.
- Forest & Bird 2014. *New Zealand seabirds: Important bird areas and conservation*. Wellington, New Zealand: Royal Forest & Bird Protection Society of New Zealand. 72 pp.
- Gaskin, C.P. 2012. *Seabird restoration plan for Tawharanui Open Sanctuary*. Report for Auckland Council and Tawharanui Open Sanctuary Society Inc.
- Imber, M. J. 1976. Breeding biology of the grey-faced petrel (*Pterodroma macroptera gouldi*). *Ibis* 118, 1: 51-64.
- Kennedy, E. 1994. *Chatham petrel recovery plan*. Department of Conservation, Canterbury Conservancy. Christchurch, New Zealand.
- Maitland, M. 2011. Tawharanui Open Sanctuary—detection and removal of pest incursions. In Veitch, C.R.; Clout, M.N.; Towns, D.R. (Eds.) *Island invasives: eradication and management*. Gland, Switzerland: IUCN. 441-444 pp.
- Mouterde, S.C.; Duganzich, D.M.; Molles, L.E.; Helps, S.; Helps, F.; Waas, J.R. 2012. Triumph displays inform eavesdropping little blue penguins of new dominance asymmetries. *Animal Behaviour* 83: 605-611.
- Priddel, D.; Carlile, N.; Wheeler, R. 2006. Establishment of a new breeding colony of Gould's petrel (*Pterodroma leucoptera leucoptera*) through the creation of artificial nesting habitat and the translocation of nestlings. *Biological Conservation* 128: 553-563.
- Ramos, J.A.; Monteiro, L.R.; Sola, E.; Moniz, Z. 1997. Characteristics and competition for nest cavities in burrowing Procellariiformes. *Condor* 99: 634-641.
- Rohrbaugh Jr, R.W.; Yahner, R.H. 1997. Effects of macrohabitat and microhabitat on nest-box use and nesting success of American kestrels. *Wilson Bulletin* 109: 410-423.
- Sandager, A.F.S. 1890. Observations in the Mokohinau Islands and the birds which visit them. *Transactions of the New Zealand Institute* 22: 286-294.
- Sherley, R.B.; Barham, B.J.; Barham, P.J.; Leshoro, T.M.; Underhill, L.G. 2012. Artificial nests enhance the breeding productivity of African penguins (*Spheniscus demersus*) on Robben Island, South Africa. *Emu* 112: 97-106.
- Sullivan, W.; Wilson, K.; Paterson, A. 2000. Influence of artificial burrows and microhabitat on burrow competition between Chatham petrels *Pterodroma axillaris* and broad-billed prions *Pachyptila vittata*. *Emu* 100: 329-333.
- Sullivan, W.; Wilson, K. 2001. Differences in habitat selection between Chatham petrels (*Pterodroma axillaris*) and broad-billed prions (*Pachyptila vittata*): implications for management of burrow competition. *New Zealand Journal of Ecology* 25: 65-69.
- Sutherland, D.R.; Dann, P.; Jessop, R.E. 2014. Evaluation of artificial nest sites for long-term conservation of a burrow-nesting seabird. *Journal of Wildlife Management* 78: 1415-1424.
- Taylor, G.A. 2000. *Action plan for seabird conservation in New Zealand*. Biodiversity Recovery Unit, Department of Conservation.
- Waas, J.R. 1990. Intraspecific variation in social repertoires: evidence from cave-and burrow-dwelling little blue penguins. *Behaviour* 115: 63-99.
- Was, N.W.; Sullivan, W.J.; Wilson, K.-J. 2000. *Burrow competition between broad-billed prions (Pachyptila vittata) and the endangered Chatham petrel (Pterodroma axillaris)*. New Zealand Department of Conservation.

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