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First records of Herald Petrel *Pterodroma heraldica* on Phillip Island (Norfolk Island Group)

Emily Mowat[1]*, Genevieve Kyi[2], Terry O'Dwyer[3], Lachlan Wilmott[4] and Nicholas Carlile[5]

[1]BirdLife Australia, Suite 2–05, 60 Leicester Street, Carlton VIC 3053, Australia
[2]Local Land Services, P.O. Box 4515, Westfield, Penrith NSW 2750, Australia
[3]34 Ashford Street, Shorncliffe QLD 4017, Australia
[4]NSW Department of Planning and Environment, 84 Crown Street, Wollongong NSW 2500, Australia
[5]NSW Department of Planning and Environment, 12 Darcy Street, Parramatta NSW 2150, Australia
*Corresponding author. Email: Emily.Mowat@birdlife.org.au

Abstract. The Herald Petrel *Pterodroma heraldica* is a medium-sized gadfly petrel that breeds primarily on islands across the tropical and subtropical South Pacific Ocean. Its only confirmed breeding site in the Australasian region is Raine Island off North Queensland, where it occurs in very small numbers. Here we report on the presence of a Herald Petrel ashore on Phillip Island (Norfolk Island Group) in June 2021, and subsequent sightings in May and June 2022. On most occasions that a Herald Petrel was observed on the ground, it was seen under a shrub, behaviour which is consistent with prospecting for a nest site in this surface-nesting species. These sightings make Phillip Island one of just four locations in Australian territory at which the Herald Petrel has been recorded ashore away from Raine Island. Our new records reinforce the importance of active island restoration and the value of long-term intensive monitoring efforts. Future observations will confirm whether the species attempts to establish on Phillip Island, a location free from introduced predators and with ample suitable habitat.

Introduction

The Herald Petrel *Pterodroma heraldica* is a medium-sized gadfly petrel that occurs primarily in tropical and subtropical pelagic waters of the South Pacific Ocean (Marchant & Higgins 1990). The species predominantly breeds on islands, atolls, cays, and rocky islets between approximately 8° and 27°S in the central and west South Pacific Ocean (Stewart *et al*. 2021), although breeding also occurs on Round Island (Mauritius) in the western Indian Ocean (Brown *et al*. 2011). Current known breeding sites for the species are listed in Table 1.

Hunga Tonga and Hunga Ha'apai, Tonga, were also known to be breeding sites for the species (Jenkins 1980), but both islands were largely destroyed by a volcanic eruption in January 2022 (Global Volcanism Program 2022). Herald Petrels may still breed on Oeno Island, Pitcairn Islands, from where they were collected during a 1922 expedition (Murphy & Pennoyer 1952); five individuals were seen ashore there in 1991, although there was no evidence of breeding (Brooke 1995). Herald Petrels were also collected during an expedition to Chesterfield Reefs, New Caledonia, in 1859, but there have been no breeding records at this location since this time (Bourne *et al.* 2005).

Breeding in the Australasian region has been confirmed only on Raine Island, Queensland, a 27-ha low-lying outer cay of the northern Great Barrier Reef (Batianoff & Cornelius 2005). Herald Petrels were first recorded at Raine Island in February 1959 (Warham 1959), but breeding was not confirmed until July 1982 (King 1984). Only a few pairs are generally found on any visit to Raine Island, and breeding has been recorded irregularly since their initial discovery (Threatened Species Scientific Committee 2015).

The current Australian population estimate for the Herald Petrel is fewer than 50 mature individuals (Stewart 2019). The species is listed as Critically Endangered in Australia under the federal *Environment Protection and Biodiversity Conservation Act 1999* because of its restricted area of

Table 1. Current breeding sites of the Herald Petrel.

Location	*Country*	*References*
Raine Island	Australia	King (1984, 1996)
Île Hunter	New Caledonia (France)	Spaggiari *et al.* (2006)
'Ata	Tonga	Rinke (1991)
Rarotonga	Cook Islands	Turbott (1977); McCormack (2007)
Ta'u	American Samoa (United States of America)	Pyle *et al*. (1990)
Ua Pou & Tahuata (Marquesas Islands)	French Polynesia (France)	Thibault & Cibois (2017); Flood *et al.* (2022)
Gambier Islands	French Polynesia (France)	Thibault & Bretagnolle (1999)
Henderson and Ducie Islands	Pitcairn Islands (United Kingdom)	Brooke (1995); Brooke & Rowe (2008)
Motu Nui	Easter Island/Rapa Nui (Chile)	Jaramillo *et al.* (2008); Plaza *et al.* (2020)
Round Island	Mauritius	Brown *et al.* (2011)

occupancy and extremely low population size in Australian territory. A 2022 assessment determined the Herald Petrel to be one of the Australian vertebrates at greatest risk of extinction (Garnett *et al*. 2022). At a global level, however, the species is listed as Least Concern on the IUCN Red List (BirdLife International 2022) because of its wide distribution and large global population (estimated to number around 150,000 individuals: Brooke 2004). Although the Herald Petrel's global population is suspected to be in decline because of predation by invasive species at some breeding sites (particularly by Pacific Rats *Rattus exulans* on Henderson Island in the Pitcairn Island Group, which has 20% of the global population: Kirwan & Pyle 2022), the decline is not considered to be sufficiently rapid to meet the threshold for listing as Vulnerable under the IUCN Red List (BirdLife International 2022).

Observations at sea suggest that the species mainly occurs south of the equator, from northern Queensland, Australia, to the vicinity of Easter Island, Chile, but may range north to 39° North in the central Pacific (Gould 1983). The species has been recorded to approximately 39° South in the Atlantic Ocean off the coast of northern Argentina (Carboneras 1992) and to 43° South in the Tasman Sea, including several offshore from New South Wales (Norris 1965; Izzard & Watson 1980; McBride & Hobcroft 1985) and Tasmania (BARC 2001), Australia.

Most at-sea tracking data for the Herald Petrel comes from solar geolocation studies conducted on Round Island, Mauritius (e.g. Nicoll *et al.* 2017; Franklin *et al.* 2022). In 2018–2019, the non-breeding season movements of 18 Herald Petrels from Raine Island were tracked for the first time using geolocation (see Stewart 2019). All individuals remained within the Pacific Ocean but travelled in three different patterns – south along the east coast of Australia, north of New Guinea, and east to the central Pacific. These data have not yet been published and no tracking has been conducted during the breeding season on Raine Island.

Information on the breeding biology of the Herald Petrel is sparse, because of the remote nature of its breeding sites. The species nests in a rock crevice or a surface scrape under trees or low vegetation, from near sea level up to an elevation of 1000 m (Stewart *et al*. 2021). On Raine Island, the Herald Petrel mainly nests on the ground on a low sand ridge, under a mat of dense shrubs, creepers, and grass (King 1984, 1996; King & Reimer 1991), although in 2017 one individual was found nesting in a crevice on a cliff (Dunstan & Robertson 2018). As in other *Pterodroma* species, a single egg is incubated by both adults, which also share chick provisioning (Warham 1990).

The timing of the Herald Petrel's breeding season varies with location. The Australian population on Raine Island is present from February to October, with eggs generally laid in late June to early July, chicks observed in late July and August and one near-fledged juvenile observed in late October (King 1984; Dunstan & Robertson 2018). A period of post-breeding dispersal and foraging at sea by adults and juveniles follows, with birds absent from Raine Island from November to January (King 1984). In other parts of the Pacific, however, a year-round presence at breeding colonies is reported (Murphy & Pennoyer 1952; Jenkins 1980). Age of first breeding, survivorship and recruitment rates for the species are unknown (Baker *et al.* 2002).

There are just two previously recorded instances of Herald Petrels on land in Australian territory away from Raine Island. In April 1986, three birds identified as Herald Petrels were observed flying around and calling before dusk on North Keeling Island in the Cocos (Keeling) Islands (Stokes & Goh 1987). In June that same year, at least 10 individuals were seen flying back and forth and calling at the same location. One bird was captured after dark as it appeared to emerge from under a layer of fallen palm fronds. A thorough search was not conducted at that time to avoid disturbance of any potential nests, but in September a potential empty nest site was located under palm fronds in the same area (Stokes & Goh 1987). Breeding on North Keeling Island has never been confirmed and there have been no subsequent records from the locality. There is some uncertainty about the identification of these birds; it was later suggested that they might have been Trindade Petrels *P. arminjoniana* (Garnett & Crowley 2000; DEH 2005).

A single live Herald Petrel was also found ashore at Christmas Island in August 2006, where it was taken into care and later released (BARC 2006). The individual had an active brood patch suggesting that it was breeding at the time (James & McAllan 2014), although there are no confirmed Herald Petrel breeding sites in the eastern Indian Ocean. The pale lores on this bird were considered characteristic of the Herald Petrel (BARC 2006).

In addition to these two records of birds found ashore, a single Herald Petrel was observed in the air in a circling display flight over Varanus Island (Lowendal Islands Group) off Western Australia in May 1992. The bird was thought to be possibly prospecting for a nest site; unfortunately, the following day it was killed when it flew into the rotor blades of a helicopter (Johnstone *et al*. 2013).

Here we document the first records of the Herald Petrel for Phillip Island (Norfolk Island Group). We describe the habitat where the birds were observed and discuss the potential for the establishment of a future breeding site.

Study area

The Norfolk Island Group (29°02′S, 167°57′E) comprises Norfolk Island (3455 ha), Phillip Island (190 ha), Nepean Island (10 ha), and several smaller islets. It is situated in the south-western Pacific Ocean ~1670 km north-east of Sydney, Australia, and a ~1070 km north-west of Auckland, New Zealand. Figure 1 shows the location of Phillip Island in relation to the global distribution of breeding sites for the Herald Petrel.

Phillip Island lies 6 km south of Norfolk Island and has a maximum height of 280 m above sea level. It is subject to severe erosion following a long history of grazing by Goats *Capra hircus* and European Rabbits *Oryctolagus cuniculus*, which were introduced around 1820 (Coyne 2010). Feral Pigs *Sus scrofa,* which were introduced in 1793, preyed upon the island's seabirds and caused extensive soil damage (Coyne 2009). Goats died out naturally between 1848 and 1915, and pigs were shot out by 1848 (Coyne 2009), but rabbits remained until they were removed in an eradication program between 1981 and 1988 (Hermes *et al.* 1986; Coyne 2010). By this time, the island was largely denuded of vegetation (Green 1994), with several

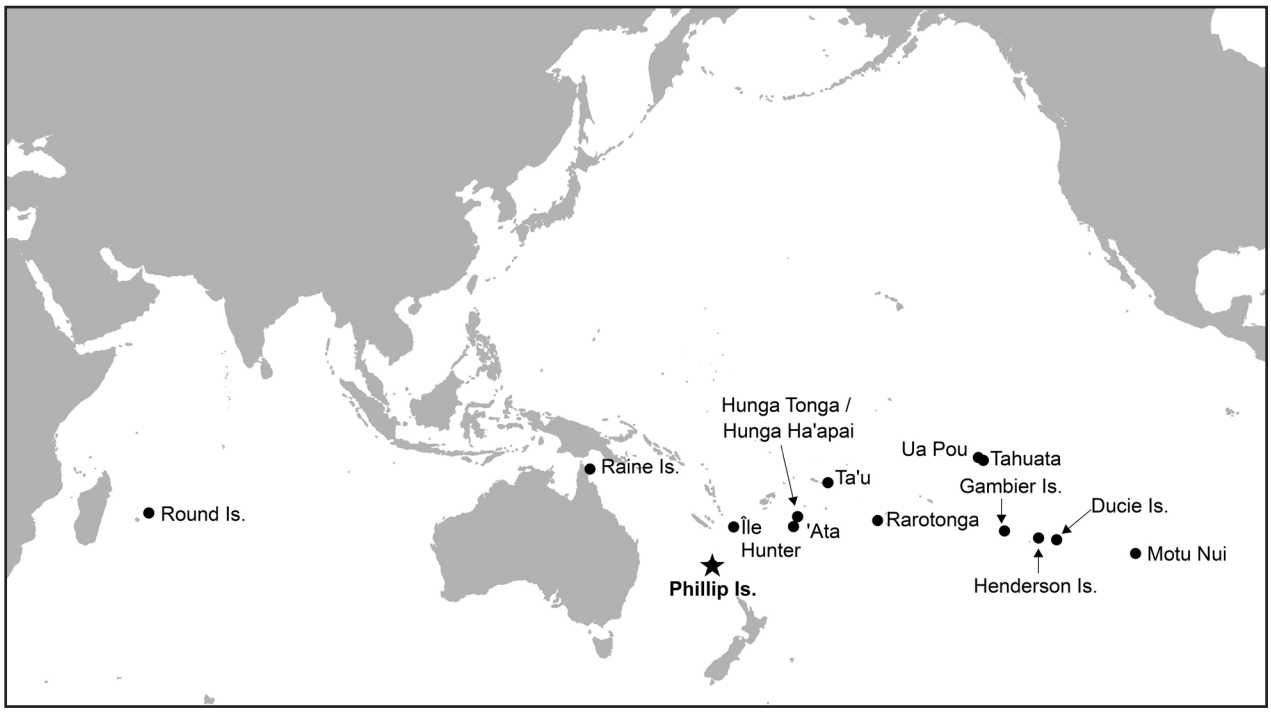

Figure 1. Location of Phillip Island in relation to known breeding sites for the Herald Petrel. Note that the January 2022 eruption at Hunga Tonga/Hunga Ha'apai largely destroyed these two islands.

metres of topsoil and subsoil lost (Director of National Parks 2010). The remaining soils were very unstable and continued to erode at an average rate of 42 mm per year (Coyne 2010), meaning that there was little available habitat for either burrowing or surface-nesting seabirds. Unlike neighbouring Norfolk Island, rodents and cats have never been present on Phillip Island (Coyne 2009).

In the four decades since rabbits were eradicated from Phillip Island, a significant amount of regeneration has taken place, and revegetation programs have also been implemented (Coyne 2010). The original vegetation communities of the island are largely unknown, but today the vegetation comprises a mixture of regenerated or planted native species and large numbers of exotic species (Mills 2009). Large areas of the island — particularly those with exposed tuff soils — remain devoid of topsoil or any vegetation (Coyne 2010).

The island has been recolonised by a range of seabird species, which have gradually become established as habitat has stabilised and vegetation re-established. The island now provides breeding habitat for four species of *Pterodroma* petrels: Black-winged *P. nigripennis,* Providence *P. solandri*, Kermadec (western Pacific subspecies) *P. neglecta neglecta* and White-necked *P. cervicalis*. These species have recolonised at differing rates since eradication of the feral species (or, in the case of the Providence Petrel, might have survived the introduction of feral species because of their very deep burrows: Priddel *et al.* 2010). Another nine species of breeding seabirds are also present (see Priddel *et al.* 2010). The island is today part of Norfolk Island National Park, managed by Parks Australia (Director of National Parks 2010). It is uninhabited, but a Parks Australia hut and a second hut used by local fishers are both intermittently occupied.

When the observations described here occurred, we were on the island carrying out field research for an ongoing study of the breeding biology and spatial ecology of the Kermadec Petrel through the New South Wales Department of Planning and Environment (DPE) (see Carlile & O'Dwyer 2023). This study, which began in 2017, includes listening surveys and active searching during both day and night to locate nest sites for monitoring and geolocator tracking of Kermadec Petrel breeding pairs.

Observations

June 2021 sighting

The first Herald Petrel observations occurred when EM and GK were present on the island between 11 and 18 June 2021. The location of the sighting was on a prominent ridge line at ~200 m above sea level, with extensive views to the island's east, south and west. The vegetation at this location is dominated by stands of wind-sheared African Olive *Olea europa* subsp. *cuspidata* 1.5–2.5 m high, with scattered stunted native White Oak *Lagunaria patersonia* and New Zealand Flax *Phormium tenax*. These stands are interspersed with open grassland dominated by introduced Red-leg Grass *Bothriochloa macra* and areas of bare ground. The immediate area forms part of a study colony of Kermadec Petrels, with >20 known nesting sites marked and regularly monitored (Carlile & O'Dwyer 2023).

During one of the dusk surveys for Kermadec Petrels on 14 June 2021 at 1830 GMT+11 h, an unfamiliar rapid, high-pitched call was heard from underneath a low, wind-sheared African Olive shrub. As the bird moved towards one side of the shrub, we captured it to be photographed and measured for identification. The bird was then released

Figure 2. The Herald Petrel photographed in daytime on the second consecutive day that it was observed in June 2021. Photo: Emily Mowat

Table 2. Measurements (mm) of the Herald Petrels from Phillip Island, Norfolk Island Group, in this study compared with published morphometrics for Herald, Kermadec and Trindade Petrels. References: # = Andrews & Skerrett (2012) (one live individual; Seychelles); ^ = V. Bretagnolle (pers. comm). (from 141 museum skins; throughout range); * = Murphy & Pennoyer (1952) (from museum skins; throughout range); ~ = Plaza *et al*. (2020) (30 live individuals, Rapa Nui); x = Marchant & Higgins (1990) (7 live individuals; Macauley Island, New Zealand); + = Luigi *et al*. (2009) (496 live individuals and museum skins; Trindade Island, Brazil). N/A = not available.

Measurement	*Head–bill*	*Culmen*	*Bill depth*	*Tarsus*	*Wing chord*	*Mass (g)*
Phillip Island bird 1 (unbanded)	71.6	27.9	10.3	N/A	265	310
Phillip Island bird 2 (band no. 071-87402)	73.2	27.7	9.8	34.0	278	300
Published morphometrics for Herald Petrel	70.1#	24.0–29.3^	8.0*–11.8^	30.8*–42.0^	260^–300*	260–430~
Published morphometrics for Kermadec Petrel (western Pacific subspecies)	N/A	28.5–32.5*	8.8–10.0*	33.2–40.9*	274–309*	370–590x
Published morphometrics for Trindade Petrel	68.0–81.3+	26.0–32.9+	8.7–10.4*	31.3–42.3+	207–309+	300–475+

back under the shrub, and we left the area to avoid further disturbance.

The bird was still present under the same shrub at 1500 h on 15 June. It was photographed *in situ* (Figure 2) but not handled. When we returned at 1600 h it was heard calling from what seemed to be the same position. We recorded its call at this time but did not approach the shrub. At sunset (1657 h), the bird was observed to emerge and it began to overfly the area, vocalising and being chased by Providence Petrels. The following morning (16 June) it could not be located.

The bird was identified in the field as a Herald Petrel based on plumage characteristics, measurements, and the colour and structure of the bill, legs, and feet. The vocalisation was also distinctive and diagnostic of Herald Petrel. This record was submitted to the BirdLife Australia Rarities Committee (BARC) and accepted on 21 October 2021 (BARC 2021). Measurements (see Table 2), photographs (Figure 3), and call recordings were provided for appraisal.

Other similar species could be eliminated based on appearance, measurements, and vocalisation. Kermadec

Figure 3. Two of the photographs used to identify the Herald Petrel ashore, June 2021. Photos: Emily Mowat

Petrel was ruled out by the individual's very different vocalisation, smaller and slimmer body, more slender legs, narrower wings, smaller head, finer bill, and lack of white primary shafts on the upperwing. The weight of the bird was also below the published range for Kermadec Petrel. Although the measurements for Herald and Trindade Petrels overlap considerably, the individual in question could be ruled out as a Trindade Petrel by the different vocalisation, paler lores, slimmer body and lack of white median panel on the underwing.

May 2022 sightings

Subsequent observations of Herald Petrel on Phillip Island occurred between 1 and 4 May 2022 by NC and LW. The first sighting was on 2 May, ~70 m from the location of the 2021 sighting and ~20 m lower in elevation. This area has the highest nesting density of Kermadec Petrels on Phillip Island (see Carlile & O'Dwyer 2023). A suspected Herald Petrel was observed at 1715 GMT + 11 h (sunset 1713 GMT + 11 h) landing directly into a stand of African Olives and settling within 2.5 m of two incubating Kermadec Petrels. The individual was captured and measured, and its morphological and plumage characteristics examined, which allowed confirmation of its identification as a Herald Petrel (see Table 2 for measurements). It was fitted with an Australian Bird and Bat Banding Scheme band before being released. The bird called several times during the following 2 hours of observations; NC recorded these vocalisations, which proved to be identical to those recorded by EM and GK in June 2021.

When the site was next observed, at 1000 h on 3 May, the Herald Petrel was absent. That evening, it was heard at 1700 h vocalising near the previous site of capture but was not visually observed. A dark-morph Kermadec Petrel was observed in the exact location within the African Olive stand used by the Herald Petrel on the previous day. During a final visit to the site on the morning of 4 May, no Herald Petrels were observed.

June 2022 sightings

The third period during which the species was detected on Phillip Island was 17–22 June 2022. During an initial visit on 17 June to the exposed ridge by NC and TO at 1712 GMT + 11 h (sunset 1657 GMT + 11 h), three Herald Petrels were observed overflying together and vocalising; their distinctive calls were recognised by NC from the previous month's sighting. The Herald Petrels were sharing the airspace with five to six Kermadec Petrels, which were also calling. At 1740 h, a single Herald Petrel landed in an open area adjacent to the stand of African Olives where the May 2022 sighting occurred; the other two observed Herald Petrels had by this time departed from the area without landing.

The Herald Petrel on the ground called in response to, and solicited responses from, an adult Kermadec Petrel attending a chick at a nest ~6 m away. The Herald Petrel was also observed to associate with a Kermadec Petrel chick from one of the two active nests noted in May 2022. At 1830 h, it was captured, and its band number revealed that it was the same individual seen in May. On examination, it was found to have neither a vascularised brood patch nor swollen cloaca, indicating that it was not currently breeding. The bird was still present and vocalising at 2200 h when observations ended.

On 18 June at 1030 h, the main Kermadec Petrel breeding area was revisited, and the banded Herald Petrel was noted to be associating with a Kermadec Petrel chick in the same shrub complex where the adult Kermadec Petrel had vocalised on the previous evening. Upon returning to the site at 1620 h, the banded Herald Petrel was observed in the air with eight to ten Kermadec Petrels, which it was occasionally chasing or being chased by. Pursuits by the Herald Petrel occurred only with light-morph Kermadec Petrels. At 1700 h, a Swamp Harrier *Circus approximans* was observed in the area, and both Kermadec Petrels and the single Herald Petrel chased and harassed the Harrier until it was >500 m distant from the ridge. The pursuing birds then returned and were observed overflying the

ridgeline until the end of civil twilight. The Herald Petrel had not attempted to land again when observations ceased at 2020 h.

On 21 June 2022, observations commenced at the ridge site at 1650 h, with a Herald Petrel seen in the air with six Kermadec Petrels, evenly split between light- and dark-morph birds. Over the following 30 minutes, the Herald Petrel again only engaged in pursuits with light-morph Kermadec Petrels (n = 4 observations). At 1715 h, the Herald Petrel briefly alighted at the same location as during the 17 June observations and was observed to be the same banded individual. It then continued overflying and calling occasionally until observations were no longer possible at the end of civil twilight. During a final visit to the site, on the morning of 22 June, no Herald Petrels were located.

Discussion

Before our observations reported here, there had been only two recorded instances of Herald Petrels on land in Australian territory away from Raine Island. Both previous sightings are from the Australian Indian Ocean Territories (North Keeling and Christmas Islands).

Since our observations were made, several Herald Petrels have also been located at Central Diamond Islet at the Tregrosse Reefs in the Coral Sea (17°27′11″S, 150°56′38″E), 984 km north-east of Raine Island. In mid July 2021, staff from the Queensland Parks and Wildlife Service observed three apparent pairs of Herald Petrels at this site. However, no active nests were located, so breeding activity could not be confirmed (Chapman *et al.* 2022). It is not known how long the species might have been present, as Central Diamond Islet has previously been surveyed only in early winter and summer. It has long been suspected that Herald Petrels could breed on small Coral Sea cays within Australian territory (King 1984 1996; Marchant & Higgins 1990; King & Reimer 1991; Garnett & Crowley 2000); however, visitation to these sites is infrequent because of challenging logistics, limited resources, and difficult weather conditions (Chapman *et al.* 2022).

Phillip Island is located 3148 km south-east of Raine Island. The closest known Herald Petrel breeding site to Phillip Island is Île Hunter, New Caledonia, 855 km to the north-east. However, it is difficult to postulate where the Phillip Island birds might have originated, as the species is known to be wide-ranging across oceans and has even been recorded switching breeding sites. For example, a Herald Petrel found on Round Island with a chick in April 2006 was originally banded on Raine Island in July 1984, where it had bred in subsequent years through to 1987 with the same mate (King & Reimer 1991; Booth Jones *et al.* 2017). This bird was recorded breeding on Round Island again in October 2008 and May 2012.

The Herald Petrel is considered highly pelagic, rarely approaching land except at breeding colonies (BirdLife International 2022). Given that the species was present on Phillip Island in two consecutive years, with multiple birds observed on the third observation, it is unlikely that they ended up ashore by chance. In addition, the weather before all three occasions was characterised by fine conditions and light–moderate winds, so their presence cannot be explained by their being blown ashore during storm conditions.

The timing of the records of these birds suggests that they could have been prospecting for breeding sites, because all three sightings were made during the time of year that Herald Petrels are present at their breeding site on Raine Island. Breeding on Raine Island occurs from about June to September, but birds may be present from as early as February (King 1984). On most occasions that we observed a Herald Petrel on the ground, it was seen under a shrub during the night or day. This behaviour is considered consistent with prospecting for a nest site in this surface-nesting species (Carlile & O'Dwyer 2023).

Phillip Island contains potentially suitable breeding habitat for the Herald Petrel, with extensive areas of low, dense vegetation, treed areas, rocky ridges and cliff ledges, all of which are utilised by the species elsewhere for breeding sites (Jenkins 1980; Holyoak & Thibault 1984; King 1984). The available habitat on the island is far from being at capacity, with seabird populations still in the process of recovery and only a relatively small breeding colony of Kermadec Petrels present. Kermadec Petrels are also surface-nesters and are present on the island year-round. However, on Phillip Island, lower numbers of Kermadec Petrels breed in winter compared with summer, so there are lower numbers present at the time of year when the Herald Petrels were observed (Carlile & O'Dwyer 2023). The other *Pterodroma* species on Phillip Island are generally burrow-nesting so would not compete with Herald Petrels for nesting habitat.

Herald Petrels breed in sympatry with other surface-nesting petrel species, including Kermadec Petrels, at some breeding locations. For example, the small breeding population of Herald Petrels at Round Island off Mauritius, in the western Indian Ocean, makes up ~10% of the island's total petrel population. Kermadec Petrels make up another 10%, with the remaining 80% being Trindade Petrels (Brown *et al*. 2011). The Herald Petrel is known to hybridise with both the Kermadec Petrel and Trindade Petrel within this mixed population, with genetic evidence that some of these hybrids have also reached other locations and bred there (Booth Jones *et al*. 2017). Hybridisation between sympatric Herald and Kermadec Petrels on Motu Nui (off Easter Island) is also suggested by the work of Plaza *et al.* (2023). Herald Petrels also breed sympatrically with Kermadec Petrels on Henderson and Ducie Islands in the Pitcairn Group (Brooke 1995).

Based on the availability of suitable habitat, the species' known co-occurrence with other surface-nesting petrels at breeding sites elsewhere, and the repeated sightings ashore during the breeding season, it is possible that the Herald Petrel could establish a breeding site on Phillip Island. Subsequent follow-up observations will determine whether any additional individuals are present and whether any nest sites have been established. Banding any additional birds found ashore would be beneficial to determine how many different individuals are present between years and to keep track of any future colony establishment.

Of note are the *Pterodroma* fossil remains recorded on Norfolk Island by Meredith (1991); in addition to remains of Providence and Pycroft's Petrel *P. pycrofti* (the latter

is no longer extant in the Norfolk Group), there were also remains of a third species of intermediate size. The wing and leg-bone measurements for this unknown *Pterodroma* were similar to those of both Kermadec and Herald Petrel, neither of which is known to have bred historically in the Norfolk Group (Kermadec Petrel having first been recorded on Phillip Island in the late 1980s: Woods 1988). An analysis by Holdaway & Anderson (2001) concluded that these remains were more likely to be Kermadec Petrel based on the species' present breeding range, but the similarity of the two species makes differentiation of fossil remains difficult. It could therefore be possible that Herald Petrels bred on Norfolk Island in the past.

A review by Garnett *et al*. (2013) ranked the Herald Petrel as the Australian bird species second most sensitive to climate change. It is one of eight Australian bird taxa considered to be highly exposed to rise in sea level, because of the low elevation of its only known Australian breeding site on Raine Island. However, sea level rise may not be an imminent threat as more sediment was built up than was lost on Raine Island in the 40 years to 2007 (Dawson & Smithers 2010).

The review also listed the Herald Petrel as one of the top 12 Australian marine bird taxa most exposed to changes in inshore marine productivity resulting from climate change. This is because the greatest declines in marine productivity under future climate change are predicted to occur off eastern Australia, including parts of the Great Barrier Reef (Garnett *et al*. 2013). Rises in sea-surface temperatures within 200 nautical miles of Raine Island are predicted to lead to a decrease in ocean productivity of 16% by 2100 (Garnett & Franklin 2014). This would likely affect the Herald Petrel because this species is expected to forage within these waters whilst provisioning young.

At a latitude of 29°S, Phillip Island is further south than any other known Herald Petrel breeding locality (all of which occur between 8°S and 27°S). Availability of lower-latitude islands, especially those free of exotic mammals, could become increasingly important in the future as many seabird species are expected to undergo poleward range shifts in response to climate change (Krüger *et al.* 2018).

Given the potential threats to the persistence of Herald Petrels on Raine Island, colonisation of new islands would be beneficial for the species' Australian population. Phillip Island has suitable breeding habitat for the species at sufficiently high elevation to avoid the threat of rising sea levels (from ~180–230 m above sea level). It would also be beneficial on a global scale for the Herald Petrel to establish additional breeding sites. Although the species is listed as Least Concern under the IUCN criteria (BirdLife International 2022), most of the global population breeds in the Pitcairn Islands. Because of predation of the Henderson Island population by rats, the majority now breed on Ducie Island, from which rats were eradicated in 1997 (Kirwan & Pyle 2022). However, Ducie Island is <6 m above sea level, and it is thought that the Herald Petrel's breeding habitat there could be significantly affected by future rise in sea level (Kirwan & Pyle 2022).

Our sightings reinforce the importance of active island restoration. As Phillip Island continues to recover from centuries of damage by introduced rabbits, goats and pigs, numerous species of seabirds have colonised or recolonised the newly available habitat (Priddel *et al*. 2010). This process of recovery has been aided by active revegetation programs (Coyne 2010). Since 2019, Parks Australia has also implemented an intensive control program on Phillip Island for the self-introduced Purple Swamphen *Porphyrio porphyrio* (Parks Australia 2021), which preys upon seabird chicks and eggs (Carlile *et al*. 2021). This has seen substantial improvements in both breeding effort and success for the Kermadec Petrel and other seabirds (Carlile & O'Dwyer 2023). Reduced predation pressure may facilitate prospecting and establishment by new species such as the Herald Petrel, as its surface-nesting habit would have previously made it particularly vulnerable. Long-term intensive monitoring efforts are important for documenting such changes in seabird assemblages following the implementation of island restoration measures.

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