

PLUMAGE VARIATION, MORPHOLOGY AND IDENTIFICATION OF COLLARED *PTERODROMA BREVIPES* AND GOULD'S *P. LEUCOPTERA* PETRELS

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ABSTRACT

PORTELLI, D.J. 2017. Plumage variation, morphology and identification of Collared *Pterodroma brevipes* and Gould's *P. leucoptera* petrels. *Marine Ornithology* 45: 59–65.

Collared Petrel *Pterodroma brevipes* and Gould's Petrel *P. leucoptera* are two closely related gadfly petrels that breed on islands in the Pacific Ocean. Pale individuals of the polymorphic Collared Petrel are remarkably similar to Gould's Petrel, so it is unsurprising that published descriptions of differences between the two species are incomplete or misleading. Museum specimens of both species and live Gould's Petrels were examined to identify diagnostic plumage characteristics. Pale Collared Petrels were most reliably distinguished from Gould's Petrels by their proportionally longer and tapered tail and by a clear contrast between the grey primaries and white primary coverts on the underwing. Pale Collared Petrels also exhibited a different pigment pattern on the side of the head; a subtle contrast between the breast sides and crown, which is absent in Gould's Petrel; a thicker dark trailing edge on the underwing; and a usually diffuse, rather than abrupt (as in Gould's Petrel), posterior edge of the breast patch. The presence of a collar across the upper breast was not diagnostic of intermediate Collared Petrels. Additional characteristics that may facilitate identification of some Gould's Petrels include a thinner dark ulnar-carpal bar on the underwing, prominent white blotches within the dark ulnar-carpal bar, and conspicuous white sides to the spread tail.

Key words: White-winged Petrel, Procellariidae, polymorphism, seabird identification, taxonomy

INTRODUCTION

The Collared Petrel *Pterodroma brevipes* and Gould's Petrel *P. leucoptera* are small gadfly petrels distributed in the tropical and subtropical Pacific Ocean (Brooke 2004) and, in the latter species, also into the Indian Ocean south of Australia and adjacent Southern Ocean (Priddel *et al.* 2014). The two species were previously considered conspecific (e.g., Jouanin & Mougin 1979, Marchant & Higgins 1990, Dickinson 2003), and are readily distinguishable from other *Pterodroma* species by their small size and sooty black crown that extends onto the cheek, nape, upper mantle, sides of the neck and breast, creating a distinct hooded appearance (Onley & Scofield 2007). Collared Petrels have been recorded breeding on at least nine islands in Fiji, Vanuatu, and Raratonga, but extant populations have been confirmed only on Gau, Kadavu, Erromango, Tanna, and Vanua Lava (Tennyson *et al.* 2012). The species probably also breeds on Moorea and Tahiti (Anonymous 2010). Gould's Petrel breeds on several islands off the coast of New South Wales, Australia (primarily Cabbage Tree Island; Priddel & Carlile 2007) and on Grand Terre in New Caledonia (Naurois 1978). The two populations have been designated as subspecies—*P. l. leucoptera* and *P. l. caledonica*, respectively (Imber & Jenkins 1981)—but a comprehensive investigation of plumage variation concluded the original diagnosis of *P. l. caledonica* was not valid and the species should be treated as monotypic (Portelli 2016). Petrels have also been recorded on Raivavae in the Austral Islands, but breeding has not been confirmed (Seitre & Seitre 1991, Raust 2007). The specific identity of these birds has been treated as uncertain (Seitre & Seitre 1991, Raust 2007), with most authors considering them to be Collared Petrels (Onley & Scofield 2007, Tennyson *et al.* 2012, Raust 2015). However, examination of photographs of

four individuals (taken by Alain Guillemont in February 1993) unequivocally identified them as Gould's Petrels (Portelli 2016).

The Collared Petrel is polymorphic: individuals vary along a continuum of wholly white breast, belly, flanks, and undertail coverts to wholly grey underparts except for a white chin and throat (Murphy 1929, Harrison 1983, Watling 1986). Intermediate birds have a partial or complete speckled grey band (collar) across the upper breast, which progresses in more heavily pigmented individuals to a completely grey breast with grey flecking extending onto the flanks and belly. The extent of grey on the underwing of Collared Petrels increases from pale to dark birds, except for the small inner wing coverts, median wing coverts, and axillaries, which remain white (Bretagnolle & Shirihai 2010). The proportions of pale, intermediate, and dark individuals vary among breeding colonies in Fiji and Vanuatu (Watling 1986, Tennyson *et al.* 2012). Recently, Bretagnolle & Shirihai (2010) recognised Collared Petrels as polytypic, describing a new subspecies, *P. b. magnificens*, from waters off the Banks islands. This taxon was designated on the basis of apparent monomorphism of the population (all birds purportedly had extensively or completely dark grey underparts), smaller size, and differing breeding phenology. However, the validity of this subspecies has been questioned, because paler individuals also occur in the breeding colony and reported differences in size and breeding phenology may be spurious (Tennyson *et al.* 2012). Phylogenetic analyses indicate that the relationships among Collared Petrels from different breeding colonies are complex and remain unresolved (Gangloff 2010).

Intermediate and dark Collared Petrels are readily distinguished from Gould's Petrels by the extensive grey pigmentation on

the underparts, but pale individuals are remarkably similar and identification of individuals seen at sea is difficult (Harrison 1987, Roberson & Bailey 1991a, Spear *et al.* 1992, Onley & Scofield 2007). Indeed, the occurrence of Gould's Petrel at sea near Fiji may have been underestimated because of a lack of knowledge in distinguishing pale Collared Petrels from this species (Shirihai *et al.* 2009). Some diagnostic characteristics have been proposed to distinguish pale Collared and Gould's petrels, but a thorough examination of interspecific differences has not been published. Moreover, some published accounts omit or poorly describe important diagnostic characteristics (e.g., Roberson & Bailey 1991a, Brooke 2004) or include errors (e.g., Harrison 1983).

The aim of this paper is to determine diagnostic characteristics for both species that facilitate their identification, by examining museum specimens and photographs of both species, observing live Gould's Petrels in the hand, and reviewing published descriptions (Murphy 1929, Harrison 1983, Harrison 1987, Roberson & Bailey 1991a, Spear *et al.* 1992, Enticott & Tipling 1997, Brooke 2004, Onley & Scofield 2007).

METHODS

Museum specimens of pale and intermediate Collared Petrel ($n = 16$) and Gould's Petrel ($n = 61$) (see Appendix 1, available on the website) were examined by the author in person (Australian Museum, Australian National Wildlife Collection, Queensland Museum) or from photographs supplied by museum staff (American Museum of Natural History, Museum of New Zealand Te Papa Tongarewa, Paris Museum of Natural History, US National Museum of Natural History). Skins of five Collared Petrels and 18 Gould's Petrels had been prepared with one or both wings partially spread, or with one wing removed and fully spread. The plumage of an additional 188 live Gould's Petrels was examined in the hand during annual population surveys on Cabbage Tree Island (see Priddel & Carlile 2007). Published photographs of Collared Petrels in Watling (1986), Carter *et al.* (2009), Enticott & Tipling (1997), Bretagnolle & Shirihai (2010) and in volumes 69, 71, 75 and 82 of *Te Manu* (Bulletin of the Société d'Ornithologie de Polynésie) were also consulted. Intraspecific and interspecific variation in plumage was examined for the frons, fore-crown, cheek, neck, breast, lower mantle to upper back, underwing, and tail.

Comparison of photographs of museum specimens is complicated by differences in the lighting conditions under which specimens were photographed. To minimise this, specimens were photographed alongside either a card with colour control patches or a pure white square. This permitted an adjustment of the white balance of images using Adobe Photoshop (version 7.0) and an assessment of colour distortion. Multiple specimens were sometimes included in the same photograph to permit an accurate comparison of plumage colouration.

RESULTS AND DISCUSSION

Plumage

Frons and fore-crown

The frons and fore-crown of both species were largely white with black speckling—a result of white fringes on the otherwise sooty black feathers—which becomes less pronounced and narrows

towards the bill. Examination of live Gould's Petrels revealed that the extent of white on the frons and fore-crown diminished considerably as the white fringes of the feathers became worn, but also varied among individuals independent of wear. Carter *et al.* (2009) suggested that the extent of white on the frons and fore-crown is reduced in Collared Petrels, appearing as a narrower white band across the frons; however, no consistent difference was discernible between Collared and Gould's petrel museum specimens (Fig. 1).

Cheek and neck

In Gould's Petrel, the demarcation between sooty black and white feathers on the side of the head typically ran diagonally across the cheek (but see Fig. 2), whereas in the Collared Petrel it was more horizontal and formed an angle (indentation) between the suborbital patch and breast sides (Fig. 1; Carter *et al.* 2009). Moreover, in some Collared Petrels this extended to form a slight crescent at the indentation (Fig. 1; Onley & Scofield 2007). The appearance of the indentation was affected by the positioning of the neck, such that a distinct angle was sometimes apparent in Gould's Petrels, as revealed through close examination of live individuals. When the neck is straightened, as in flight, the indentation persists in Collared Petrel but, if present, usually forms a straight line in Gould's Petrel (Carter *et al.* 2009). As a result, Collared Petrels generally appear to have a dark cap rather than a dark hood as in Gould's Petrel, which is accentuated by differences in the breast sides (see Breast, below). Although the pattern of pigmentation on the cheek and neck can facilitate identification, it is not an infallible diagnostic feature as the indentation can be pronounced in some Gould's Petrels (Fig. 2).

Breast

Examination of museum specimens revealed a hitherto undescribed difference between the two species. In Collared Petrels, the sides of the breast were slightly paler than the darker crown and

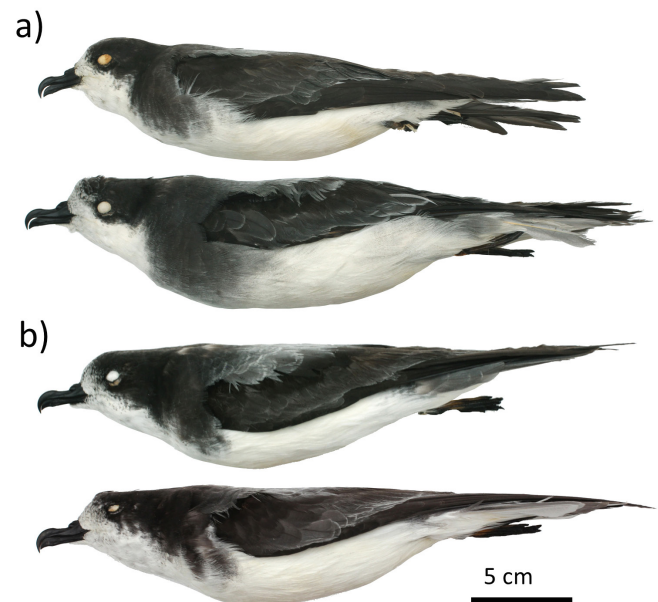


Fig. 1. Lateral profiles of (a) Collared Petrel (top to bottom: pale bird USNM 497721 and intermediate bird USNM 497160) and (b) Gould's Petrel (top to bottom: USNM 597197 and USNM 597198).

face, resulting in a weak contrast between the two areas. Such a contrast was absent in Gould's Petrel museum specimens and live individuals; the two areas were of similar colour (Figs. 1, 2). Additionally, the demarcation of the dark patch on the side of the breast appeared to be diffuse posteriorly in most Collared Petrels, whereas it was relatively abrupt in most Gould's Petrels (Figs. 1, 2). However, this was difficult to assess in museum specimens because the feathers did not always lie in a natural position.

About one-third of live Gould's Petrels had a speckled or mottled grey band (collar) connecting the dark patches on either side of the breast across the foreneck, but the collar was usually thin and indistinct. In contrast, the collar of intermediate Collared Petrels was positioned slightly more posteriorly, across the upper breast. Gould's Petrels viewed in flight from the side or from

slightly above can sometimes appear to have a complete collar, even when they lack pigment in the centre of the breast. The most heavily pigmented Gould's Petrel was found on Cabbage Tree Island and was superficially similar to an intermediate Collared Petrel (characteristics of the underwing and rectrices, see below, confirmed the bird was not a Collared Petrel). The bird had a thick collar across the foreneck and upper breast, which was mottled in the centre and continued as heavy grey speckling along the flanks.

Dorsal plumage

Feather wear, observed over the course of the breeding season, had a strong darkening effect on the dorsal plumage of Gould's Petrel (see also Roberson & Bailey 1991b, Miskelly 2001), which may confound comparisons of museum specimens. Consequently, a

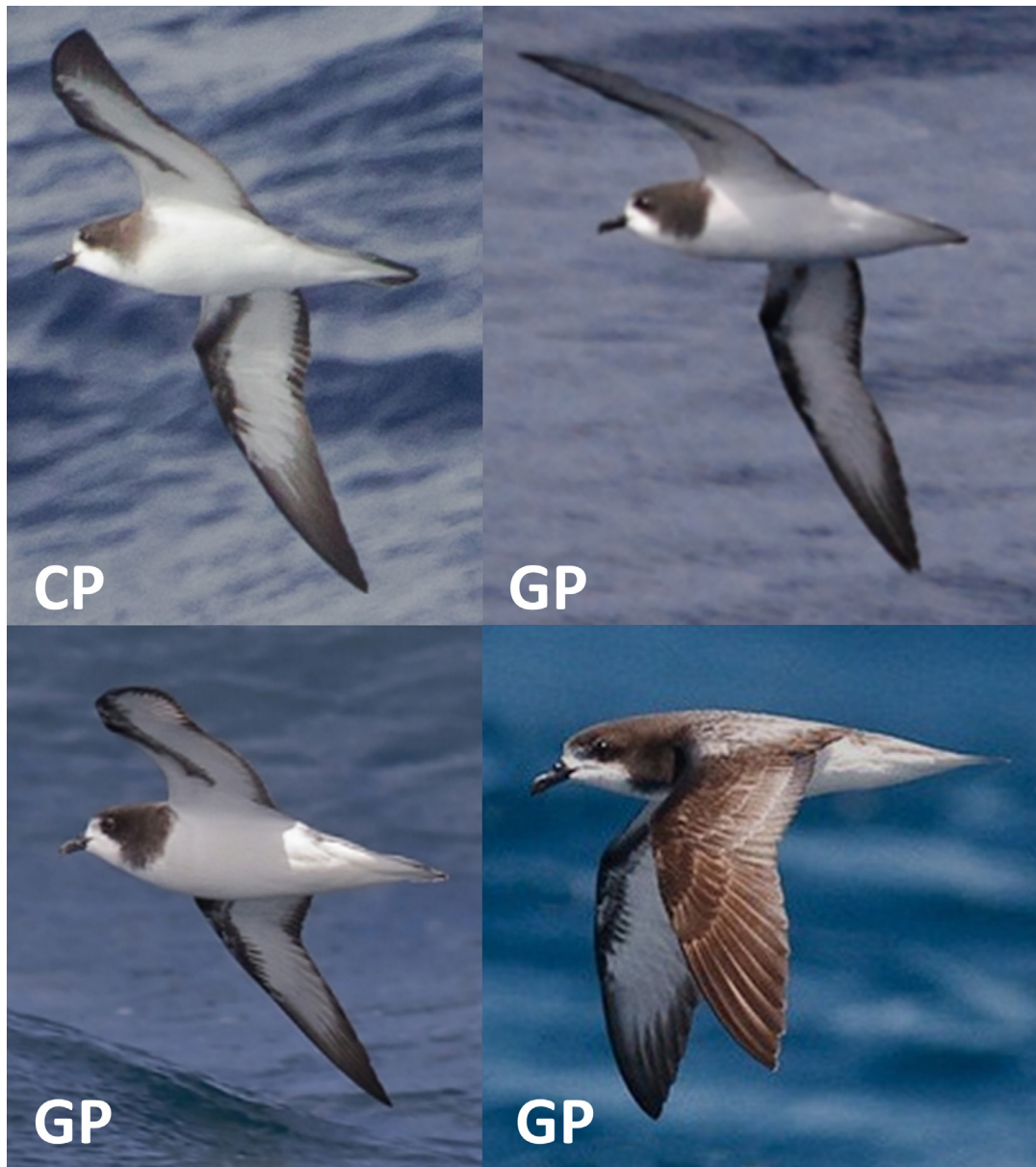


Fig. 2. Pale Collared Petrel (CP) and Gould's Petrels (GP) in flight. Note the following: demarcation line and indentation on the cheek, thickness of the dark trailing edge on the underwing, colour of the bases of the primaries, and relative tail length and shape. Photos (clockwise from top left) taken by T A. Blackman, N. Voaden, G. Jones, and R. Stephenson.

robust examination of the differences between pale Collared Petrels and Gould's Petrels was not possible because too few specimens of both species with comparable states of plumage wear were available for examination under similar lighting conditions. For example, most specimens of both species in the US National Museum of Natural History were collected in October–November, but the breeding phenology, and hence moult phenology, of the two species differs: Collared Petrel breeds ~3–4 months later than Gould's Petrel (Watling 1986, Tennyson *et al.* 2012, Priddel *et al.* 2014). Published descriptions of differences between Collared and Gould's petrels are contradictory. Enticott & Tipling (1997: 50) described the “mantle and back medium grey, lighter than on Gould's Petrel” and Harrison (1983: 247) similarly stated that the “upperparts [are] paler grey” in Collared Petrel. In contrast, Spear *et al.* (1992) suggested the opposite is the case, but noted there was considerable intraspecific variation. Differences observed between Collared and Gould's petrel museum specimens collected at equivalent stages of plumage wear (Fig. 3) included (1) a marginally darker lower mantle to upper back in Collared Petrel, and (2) a clear bluish hue to the grey mantle and back feathers in Gould's Petrel (Fig. 3). However, these differences require confirmation from further study.

Underwing

The bases of the primaries of Gould's Petrels had a white “wedge” on the inner vane that blended into the white greater

primary coverts. In contrast, in Collared Petrels the primary bases were off-white to light grey in pale birds, light to mid-grey in intermediate birds, and uniform grey in darker birds (Fig. 4; Murphy 1929, Spear *et al.* 1992, Enticott & Tipling 1997). As a result, the extent of white on the underwing of pale Collared Petrels was more restricted than in Gould's Petrel, and there was a readily discernible contrast between the greater coverts and primaries (Figs. 2, 4; Spear *et al.* 1992; Enticott & Tipling 1997). Pigmented regions of the underwing of Collared Petrels may be slightly reflective under some lighting conditions and wing angles (Bretagnolle & Shirihai 2010), which could lead to difficulties in observing this plumage feature in the field. The secondaries were also entirely or almost entirely grey in Collared Petrels, while those in Gould's Petrel had partially white inner vanes (Fig. 4). Consequently, the dark trailing edge of the underwing was slightly thicker in pale Collared Petrels (Figs. 2, 4; Onley & Scofield 2007).

In general, the sooty black ulnar-carpal bar of Collared Petrels was thicker than in Gould's Petrel, and widened in progressively darker birds (Fig. 4; Spear *et al.* 1992, Enticott & Tipling 1997, Brooke 2004, Onley & Scofield 2007). However, inter-individual variation occurred in both species, leading to overlap in the thickness of the ulnar-carpal bar of pale Collared Petrels and more heavily pigmented Gould's Petrels (Fig. 4; see also Fig. 4 in Bretagnolle & Shirihai 2010). Most Gould's Petrels had some partially white

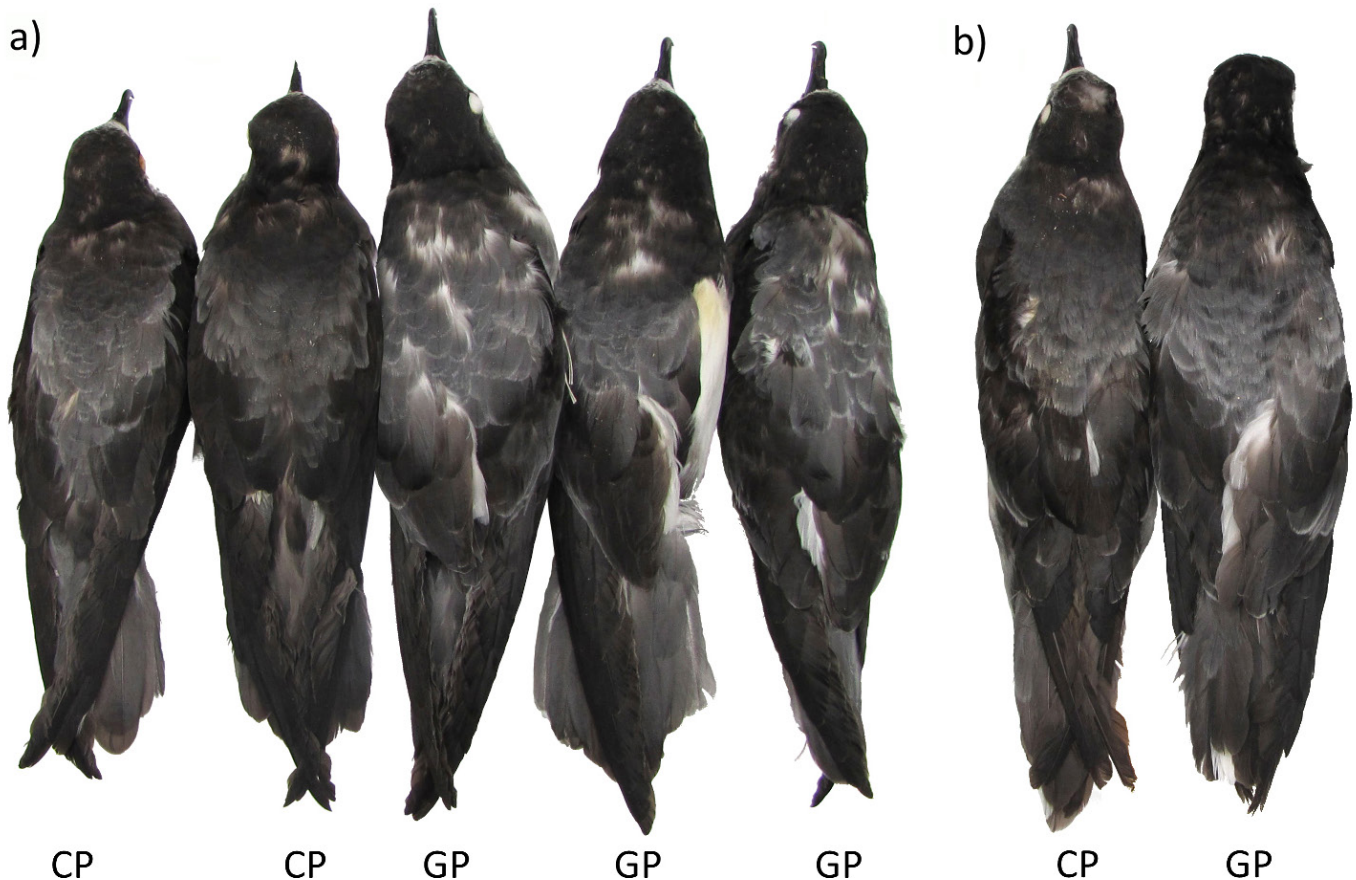


Fig. 3. Comparison of the dorsal plumages of Collared Petrel (CP) and Gould's Petrel (GP) in equivalent stages of plumage wear: (a) two Collared Petrels collected in January–February (left: USNM 497721 and USNM 497722) and three Gould's Petrels collected in October–November (right: USNM 608709, USNM 597198, and USNM 607574), and (b) Collared Petrel collected in August (left: USNM 497160) and Gould's Petrel collected in May (right: USNM 615079). Specimens were photographed together in a single image.

feathers on the underside of the manus, which in the extreme case formed conspicuous, small white blotches (Fig. 4). This latter feature has not been described for Collared Petrels. Of the five underwings of pale and intermediate Collared Petrel museum skins examined, several marginal coverts on the underside of the manus were fringed or freckled white in two individuals (Fig. 4), and about one quarter of these feathers were partially white in another (USNM 497162). Marginal coverts with white or whitish fringes are also evident in a pale individual photographed by Dick Watling (see appendix in Carter *et al.* 2009), and a small whitish blotch is evident in the pale individual in Fig. 4 of Bretagnolle & Shirihai (2010). Thus, a solid black ulnar-carpal bar or the presence of white or partially white feathers is not diagnostic of either species, but the presence of large white blotches may distinguish some Gould's Petrels from pale Collared Petrels.

Rectrices

The central rectrices of Collared Petrels were about one-third longer than the outer rectrices, whereas they were only about one-fifth longer in Gould's Petrel, resulting in a substantially more graduated and proportionally longer tail, which tapered to a point, in Collared Petrels (Fig. 5; see also Spear *et al.* 1992, Enticott & Tipling 1997, Onley & Scofield 2007). The dorsal surface of the inner vane of the outer rectrices of Gould's Petrel ranged from wholly white through mottled grey to predominantly grey (Imber & Jenkins 1981). In contrast, none of the Collared Petrel museum specimens examined had wholly or primarily white inner vanes of the outer rectrix. The palest individuals had extensive grey speckling on a white background (contra Roberson & Bailey 1991a, Onley & Scofield 2007), resembling some Gould's Petrels,

while darker individuals tended to have almost wholly grey feathers. This suggests that, unlike some Gould's Petrels, the sides of the spread tail of Collared Petrels never appear primarily white. However, this is a tentative conclusion because the number of pale individuals examined was small.

Morphology

Size

Overall, Collared Petrels are smaller than Gould's Petrels, with the notable exception of tail length (Murphy 1929), which is 5.6% longer than Gould's Petrel (Bretagnolle & Shirihai 2010; measurements for each species averaged across sampled populations). The bill is 5.8% shorter, 12.2% slimmer, and 9.0% narrower, and the wing and tarsus lengths are 3.8% and 10.5% shorter, respectively (Bretagnolle & Shirihai 2010). Mean body mass of four Collared Petrels caught at sea in the eastern tropical Pacific Ocean was 17% less than mean mass of 127 Gould's Petrels caught at the same location (Spear *et al.* 1992), but the time of year that measurements were made was not reported. The mean body mass of four Collared Petrels caught on Gau (during the breeding season) was 25.9% less than that of Gould's Petrels caught on Cabbage Tree Island during the late incubation–early nestling period (Marchant & Higgins 1990).

Legs

No direct comparisons of the leg colouration of Collared and Gould's petrels have been made. Watling (1986) described the legs of Collared Petrels as varying from a very light grey to an intense blue, which was repeated by Enticott & Tipling

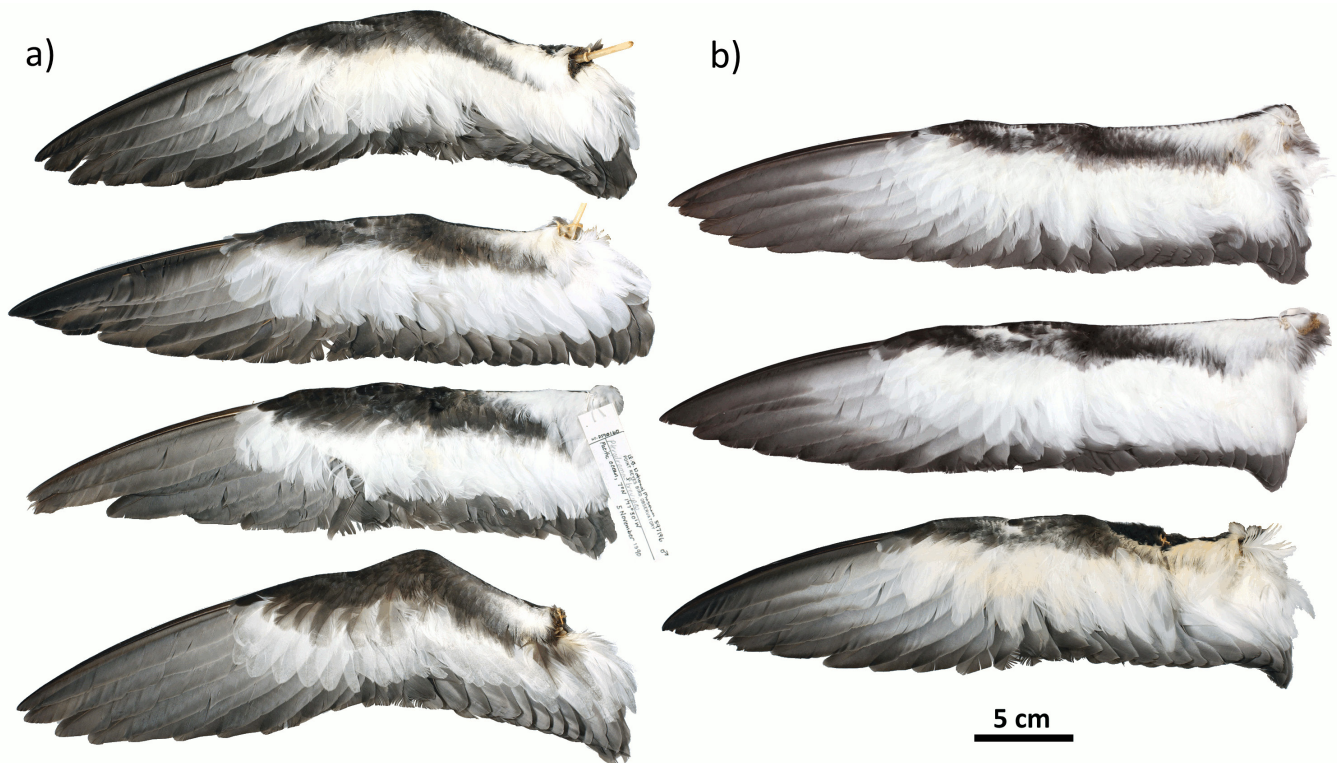


Fig. 4. Underwings of (a) Collared Petrel (top to bottom: pale bird USNM 497164; intermediate birds USNM 497166 and USNM 597196; and near-dark bird USNM 497167) and (b) Gould's Petrel (top to bottom: USNM 597197, USNM 597198, and USNM 497197).

(1997) with an additional description of bluish-pink. The legs of Gould's Petrel have been variously described as whitish or flesh-coloured (Murphy 1929), flesh-coloured (Fullagar 1976), off-white (Enticott & Tipling 1997), and greyish blue (Serventy *et al.* 1971). Brooke (2004) described the legs of both species as bluish-pink. The legs of live Gould's Petrels examined were mostly off-white to pinkish with a variable blue wash, and a few individuals had distinctly bluish legs. Whether the species differ in leg colouration is thus unresolved.

CONCLUSIONS

Two diagnostic characteristics readily distinguish pale Collared Petrels from Gould's Petrels: a proportionally longer and tapered tail resulting from strongly graduated rectrices, and a clear contrast in the underwing between the white greater coverts and the grey bases to the primaries. The two species also typically differ in the angle of the demarcation between white and blackish feathers on the side of the head, which gives the

Collared Petrel a more dark-capped, rather than dark-hooded, appearance. However, this difference may not be an infallible diagnostic characteristic. Several subtle differences that may aid distinguishing pale Collared Petrels from Gould's Petrel include (1) a weak contrast between the breast sides and darker crown, (2) a usually diffuse posterior edge to the breast patch, (3) a thicker dark trailing edge to the underwing, (4) possibly a slightly darker and duller lower mantle and upper back (relative to the stage of plumage wear), and (5) a smaller overall size of Collared Petrels. The presence of a collar across the upper breast is not diagnostic of intermediate Collared Petrels, since some Gould's Petrels exhibit this plumage character. However, the collar, when present, is positioned slightly more anteriorly in the latter species. Additional characteristics that may facilitate identification of some Gould's Petrels, but are not in themselves diagnostic of this species, include (1) a thinner dark ulnar-carpal bar, (2) prominent white blotches within the dark ulnar-carpal bar, and (3) conspicuous white sides to the spread tail, resulting from predominantly white inner vanes to the outer rectrices.

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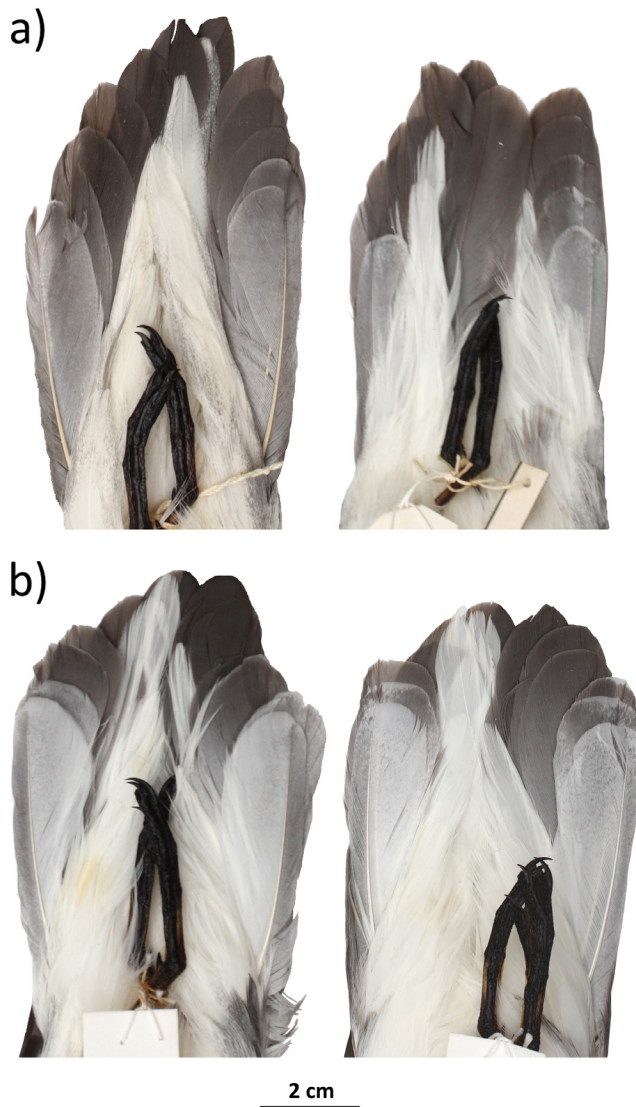


Fig. 5. Ventral aspect of the rectrices of (a) Collared Petrel (USNM 497722 and USNM 497162) and (b) Gould's Petrel (USNM 597198 and USNM 597197).

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