WING-MOLT PHENOLOGY IN WILSON'S, FUEGIAN, AND PINCOYA STORM PETRELS, THE SOUTHERN-BREEDING *OCEANITES OCEANICUS* COMPLEX

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ABSTRACT

HOWELL, S.N.G. 2024. Wing-molt phenology in Wilson's, Fuegian, and Pincoya Storm Petrels, the Southern-breeding *Oceanites oceanicus* complex. *Marine Ornithology* 52: 229–233.

Information on wing-molt timing is summarized for three southern-breeding taxa of *Oceanites* storm petrels: Wilson's Storm Petrel *O. [o.] oceanicus*, Fuegian Storm Petrel *O. [o.] chilensis*, and Pincoya Storm Petrel *O. [o.] pincoyae*. Timing of molt in seabirds is often poorly known for breeding adults and differs in relation to migration distance, starting sooner in shorter-distance migrants. The trans-equatorial migrant Wilson's Storm Petrel has a novel, complete wing molt added into its first cycle, something lacking in the shorter-distance migrant and more sedentary Fuegian and Pincoya storm petrels. More data are needed to establish wing-molt timings with respect to age and breeding status in Pincoya and different populations of Fuegian Storm Petrels, which may help elucidate taxonomic relationships.

Key words: *Oceanites* storm petrels, phenology, taxonomy, wing molt

INTRODUCTION

Species-level taxonomy of numerous storm petrels (families Oceanitidae and Hydrobatidae) remains vexed, as exemplified by southern populations of the Wilson's Storm Petrel *Oceanites oceanicus* complex, within which three or four taxa are usually recognized. The larger nominate *oceanicus* breeds on subantarctic islands and around Antarctica, while the smaller *chilensis* breeds in Chile, and presumably also in the Falkland Islands (Murphy 1936). The latter has been treated provisionally as a separate species, Fuegian Storm Petrel (Howell & Zufelt 2019). Birds around the Antarctic continent are sometimes treated as the subspecies *exasperatus*, which averages slightly larger than birds breeding on subantarctic islands but is poorly defined and not recognized by recent authors (Shirihai 2007, Pyle 2008). Hereafter, Wilson's refers to nominate *oceanicus* (including *exasperatus*) and Fuegian refers to *chilensis*.

Recently, birds from the vicinity of Chiloe Island, in southern Chile, have been described as a new species, Pincoya Storm Petrel *O. pincoyae* (Harrison *et al*. 2013). However, most of the "unique" specific features attributed to this taxon (behavior, foraging ecology, molt timing) are either spurious or uncertain, and the diagnosability of Pincoya appears to rest on the extent of white plumage markings on the wings and belly—although even those may overlap with presumed Fuegian (Howell & Schmitt 2016). Without explanation, Flood *et al*. (2024, their Fig. 4) included a photo they label as Pincoya of a bird showing characteristics of classic Fuegian Storm Petrel (dark belly, limited white on underwing) and well outside the range of plumage attributed to Pincoya by Harrison *et al*. (2013). Although the taxonomic status of *pincoyae* remains unresolved, we use the name here for birds with extensively white plumage, as defined by Harrison *et al*. (2013).

Ideally, any study of wing-molt timing in storm petrels should be built around the timing of breeding and known fledging dates, but these are poorly known or unknown for Fuegian and Pincoya. In some cases, it may be possible to infer breeding periods by back-tracking from molting birds of known age and from newly fledged juveniles. It is important to recognize, however, that first-year birds and other non-breeding individuals can differ in wing-molt timing from breeding adults. Moreover, inter-annual variation in breeding schedules may be appreciable, reflecting factors such as food supply and weather (e.g., snow or ice cover, and associated rock falls, may make nest sites inaccessible and delay breeding).

As with most smaller tubenoses, adult storm petrels need to be fully winged to forage effectively when raising young and thus undergo wing molt in their non-breeding period. Breeding adults usually start wing molt around or soon after their chick fledges, or they may delay wing molt until their arrival in non-breeding areas. First-year birds, which are not breeding and which have slightly poorer quality feathers than adults, start wing molt earlier than breeding adults, synchronizing with the adult schedule over the next year or two (Pyle 2008, Howell 2010). Here I summarize details of wing-molt timing in Wilson's, Fuegian, and 'Pincoya' Storm Petrels with the hope of elucidating areas where more data are needed to help better understand this poorly understood complex of oceanic birds.

METHODS

This note was prompted by opportunistic observations and photos from shelf and shelf-slope waters of southern Chile (37–46°S) during mid-January to mid-March, 2016–2024. On a number of cruises through this area, I and other observers found hundreds of Fuegian/Pincoya Storm Petrels, many in obvious wing molt (total birds photographed in parentheses): 11 March 2016, around 44°S, S. Howell & F. Schmitt (n = 39); 16–18 February 2017, 38–46°S, S. Howell & F. Schmitt (n = 33); 13 March 2018, 37°S, S. Howell & F. Schmitt (n = 6); 15–16 February 2019, 42°S, S. Howell & F. Schmitt (n = 3); 04–05 February 2020, 37–46°S, S. Howell

& L. Seitz (n = 20); and 18 January 2024, 44°S, S. Howell & L. Seitz (n = 110). Photos of Fuegian/Pincoya in the Macaulay Library (ML; through January 2024) were also checked, although they were heavily biased to periods when birders are present (in austral spring–summer). There were few or no photos during May–September, a number of photos were misidentified or equivocal as to taxon, and such images were not used. I also conducted extensive specimen examination to elucidate molt in Wilson's, as summarized by Pyle (2008) and Howell (2012).

Primaries are numbered from innermost (p1) to outermost (p10). Frequently, the inner few primaries (p1–p3/p4) are shed in quick succession, creating a big gap that may wrongly suggest that outer secondaries have also been shed; the middle primaries (p5–p7/p8) and outer primaries (p8–p10) molt more gradually; and the outermost two primaries (p9–p10) often molt concurrently. Juvenile plumage is considered as first-basic plumage, and molt terminology follows that of Howell *et al*. (2003) and Pyle (2008).

For Table 1, birds were grouped into five molt categories: Old = no wing molt, but primaries (pp) not fresh; Inner = inner 1–4 pp shed/growing, outer 4–6 pp old; Middle = middle pp shed/growing, outer 1–3 pp old; Outers G = outer 1–2 pp growing; Fresh = wing molt completed recently (includes fresh juveniles, often not easily told at sea or in photos from older birds that have recently completed molt).

OBSERVATIONS AND DISCUSSION

Wilson's Storm Petrel

This is the best-known and most widespread taxon. Eggs are laid mainly from mid-December through January, with peak hatching in February and fledging mainly in April (Marchant & Higgins 1990). Wilson's is a trans-equatorial migrant, moving to waters of the North Atlantic and North Pacific in the austral winter/boreal summer. Adults reach the Northern Hemisphere in April–May and return south during September–October, arriving back around the breeding grounds in November (Marchant & Higgins 1990). First-year birds, not constrained by breeding, migrate later and may linger in northern and tropical regions into December–January or later. Interestingly, there are no confirmed records of Wilson's from the Humboldt Current region, where all specimens are referrable to Fuegian. Migrant Wilson's appear to transit over offshore oceanic waters (Spear & Ainley 2007).

TABLE 1
Molt progression in Fuegian/Pincoya Storm Petrels *Oceanites [oceanicus] chilensis/pincoyae* off south-central Chile (see Methods for explanation of molt stages)[a]

	Old	Inner	Middle	Outers G	Fresh
18 January 2024, 44°S					
Fuegian (44)	-	6	35	3	-
Fuegian/Pincoya (64)	-	26	33	3	2
Pincoya (2)	-	2	-	-	-
16/18 February 2017, 38–47°S					
Fuegian (11)	-	4	6	1	-
Fuegian/Pincoya (12)	-	4	6	2	-
Pincoya (11)	-	2	6	2	1[b]
11 March 2016, 46°S					
Fuegian (27)	-	1	9	16	1[b]
Fuegian/Pincoya (3)	-	-	1	2	-
Pincoya (7)	-	-	-	2	5[b]

[a] As noted by Howell & Schmitt (2016), given poorly known plumage variation, it is often unclear where Fuegian ends and Pincoya begins; the Fuegian/Pincoya category includes such birds, as well as others where photos were insufficient to determine taxon but could be used to evaluate molt (*cf.* Fig. 1).

[b] Some or all possibly juveniles

Molt

Adult wing molt is relatively rapid, starting mid-April to early June, completing mid-August to late September (Howell 2012). Wilson's Storm Petrel is unusual among storm petrels in adding an 'extra' (preformative) wing molt into its first cycle. This extra wing molt is found in other aerial-feeding, long-distance migrants, such as pratincoles (Glareolidae), jaegers (Stercorariidae), and swallows (Hirundinidae), suggesting it developed as a consequence of prolonged exposure to strong sunlight courtesy of long migrations across hemispheres (Howell 2010). Thus, first-year Wilson's that fledged in April start wing molt during mid-July to early September, and they complete wing molt from late October into December, perhaps later; this is followed by second and subsequent prebasic molt timings similar to the adult cycle (Pyle 2008, Howell 2012).

Fuegian Storm Petrel

This taxon appears to comprise three populations (Falklands, southern Chile, central Chile), although undiscovered colonies may exist in the remote southern Andes and fjords of Chile. No specific breeding data exist for the Falklands (presumed *chilensis*), where the breeding season "probably extends from December to April" (Woods & Woods 1997), a span perhaps based on the timing for Wilson's. *Oceanites* (Wilson's and Fuegian combined) are present in Falkland waters year-round but in very low numbers between June and September (Woods & Woods 2006), when local breeders may range into the cool Falkland Current northward to Brazil; others perhaps reach as far as the cool Benguela Current off western Africa, north to the Gulf of Guinea (Flood *et al*. 2024).

In southernmost Chile (54–56°S), eggs (unknown when laid) have been reported in December and early January (Murphy 1936), but fledging dates are unknown. Based on a cycle similar to Wilson's, fledging could be expected in April, perhaps averaging earlier than Wilson's given the smaller body size of Fuegian. Birds appear to be rare or absent around southern Chile in austral winter (eBird data, www.ebird.org) and presumably migrate north at this season. Some may move into the same areas as presumed for Falkland birds while others may range north in Humboldt Current waters to Peru, rarely to the Gulf of Panama (Spear & Ainley 2007, Howell & Zufelt 2019).

In central Chile (31–35°S), where birds considered Fuegian nest in the high Andes, egg laying appears to be in November–December, with fledglings recorded from early March into May (Barros 2017). Additionally, a juvenile (of unknown origin) was collected at sea off Concepción (around 38°S) on 01 March (Murphy 1936), and ML549052681 from Valparaíso (around 33°S) on 12 February shows a fresh-plumaged bird that may be a juvenile. Thus, some

Fuegians may fledge in February, similar to Pincoya. Fuegians are present year-round off central Chile (eBird data, www.ebird.org; SNGH pers. obs.), but whether these are local breeders, migrants from southern Chile, or a mix of both, is unknown.

Molt

Based on the above information, breeding adult Fuegians would undergo wing molt sometime between March and September, the non-breeding season. Murphy (1936) reported that Peruvian specimens in May–June were "undergoing moult of the quills." Howell & Zufelt (2019:252) proposed for Fuegian: "Adult and subadult wing molt mainly Feb–Jul; imm. wing molt may span Dec–Apr; study needed."

From the South Atlantic region, Flood *et al*. (2024) found eight molting presumed Fuegians in the Gulf of Guinea, late June 2023: five birds had two to four old outer primaries remaining, while three had the two outermost primaries growing. Thus, wing molt on these would likely complete in June–August, slightly later than proposed for adults by Howell & Zufelt (2019).

In Falkland waters, ML photos (none for March–September) show no wing molt for 36+ Wilson's/Fuegian during 22 October–23 February, and one bird on 07 January with mid-primary molt (ML613743024). In southern Chile (52–56°S), ML photos (none for April–September) show no wing molt during 20 October–11 February (n = 10 birds), but wing molt is evident 15 February–11 March (n = 10+ birds). On 15 February 2019, many of 500+ birds in the Magellan Strait were molting inner to middle primaries (ML141581001) on a schedule similar to Fuegian/Pincoya in south-central Chile, but the age and breeding status of such birds are unknown.

In central Chile (32–35°S), ML photos of 30+ birds from 08 August (fresh) to 02 February (worn) show no wing molt. Birds from mid-February into March are a mix of worn and molting presumed adults (e.g., mid-primary molt on 15 February, ML88102931) and fresh-plumaged birds, some probably juveniles (earliest 12 February, ML549052681), timings much like those of Pincoya (see below). Photos from May (6+ birds) are all of fresh birds, probably juveniles, and June–July photos show nine birds having no wing molt, ages unknown. Off Peru, ML photos of migrant Fuegian span 30 May–07 October (n = 11+ birds, none certainly in molt); of these, three May–July birds appear to be slightly worn juveniles, and one bird on 03 August may have p10 growing (photo ambiguous). One photo taken on 21 September is an adult in fairly fresh plumage.

For south-central Chile (37–46°S), Table 1 shows molt progression for the three periods having the largest samples of presumed Fuegians that I and others have observed, 2016–2024. Observations from other trips and from ML in this region also fall within these parameters. Given these data, the second-prebasic molt of Fuegian likely starts in November/December (about 7–8 mo after fledging) and completes in February/April, thus starting slightly earlier than proposed by Howell & Zufelt (2019). Third and subsequent prebasic molts would then synchronize with the adult cycle. This offset in molt schedule between ages is typical of shorter-distance migrant storm petrels, but it is unlike that of the long-distance migrant Wilson's, which has an added wing molt in the first cycle (starting only 3–5 mo after fledging).

The large numbers of molting birds in south-central Chile during mid-January to mid-March may comprise mainly first-year birds and other non-breeders. Small numbers of classic Pincoya types are often mixed with them, while many birds are not readily placed with either taxon given field views (Fig. 1). At times, rafts of many hundreds can be found in this region, which lies between the two known breeding areas of Fuegian in Chile. Whether birds from one or both populations may gather there for molt is unknown. These molt aggregations recall those of some other storm petrels, such as Fork-tailed Storm Petrels *Hydrobates furcatus* in the northeast Pacific—rafts of up to a few thousand molting, non-breeding birds can be found in late summer/fall off the coast of central California (around 38°N), well south of the main breeding grounds (Howell 2012). The same is true for Ashy Storm Petrel *H. homochroa*—rafts that may contain the entire population of several thousand birds have been encountered (Ford *et al*. 2021).

Pincoya Storm Petrel

This enigmatic taxon apparently has a breeding range that lies between northern and southern breeding populations of Fuegian,

Fig. 1. A small part of aggregations totaling hundreds of molting Fuegian/Pincoya Storm Petrels *Oceanites [oceanicus] chilensis/pincoyae* off south-central Chile, 43°S 75°W, 18 January 2024. (Photo credit: Steve N.G. Howell).

but no nest has been found. Fresh juveniles have been reported mid–February to mid-March (Harrison *et al*. 2013, Howell & Schmitt 2016, ML images). On the basis of limited observations to date, Pincoya ranges from around 37°S to 46°S in Humboldt Current waters and in adjacent fjords (Howell & Schmitt 2016, SNGH pers. obs.). It is not limited to "shallow, sheltered bays of the Chilean fjord system," *contra* Harrison *et al*. (2013). Some Pincoyas appear to be present year-round in the core of their range (Harrison *et al*. 2023, ML photos), but the extent of non-breeding movements remains to be elucidated. A recent May record of presumed Pincoya from South Africa indicates significant potential for dispersal (Jamie & Keogh 2024).

Molt

During 17–21 February 2011, Harrison *et al*. (2013) reported that "most adult *O. pincoyae* observed ... were in active wing molt, with the inner primaries growing out or missing" (i.e., starting wing molt) but gave no molt data for birds seen in July. To what extent those February "adult" *pincoyae* were breeders rather than non-breeding subadults is unknown (see below, and under Fuegian). No molt data were provided for the type specimen (an adult female collected 19 February), which may imply it was not in wing molt (Harrison *et al*. 2013). Howell & Zufelt (2019) suggested for Pincoya: "Wing molt timing probably similar to northern-breeding Fuegian," which they proposed as February–July for adults and subadults.

As noted by Howell & Schmitt (2016) and confirmed here (Table 1), wing-molt timing overlaps broadly for some Pincoya and presumed Fuegian Storm Petrels (e.g., Fig. 2). The limited data provided in Table 1 suggest that Pincoya may average earlier wing molt than Fuegian, but samples are small and age and breeding status of birds involved are unknown. The most advanced molting Pincoya are presumably immature birds completing wing molt in February/March, and not breeding adults. Given fledging of Pincoya in mid-February to March (and later?) *versus* early March (or earlier?) to early May in northern Fuegian, a strong difference in adult molt schedules would not be expected, except perhaps for Fuegians that might delay wing molt until after migration.

SUMMARY AND FUTURE QUESTIONS

Breeding of northern Fuegian appears to start earlier and is more protracted than for Wilson's, which has a shorter, more-synchronized cycle. Such is typical of species breeding at higher latitudes and migrating long distances. Breeding of Pincoya may average earlier than for northern Fuegian, but more data are needed on both. Wing-molt timing appears to be broadly similar in some Fuegian and Pincoya, perhaps averaging earlier in the latter, although determining possible differences in timing is compounded by uncertainty concerning the age of birds observed molting.

Although Harrison *et al*. (2013:188) noted that "Within the southern *Oceanites*, *O. pincoyae* are unique in that they molt at the end of or immediately after their breeding attempt," this claim is presumably based on comparison with the long-distance migrant Wilson's and not with Fuegian, whose life history cycle is more similar to Pincoya. Indeed, differences in first-cycle molt strategy between Wilson's and Fuegian may be added to differences in plumage, size, and ecology, providing further support for treating Fuegian as specifically distinct from Wilson's.

Numerous questions about Fuegian/Pincoya Storm Petrels remain. For example, what are the breeding and normal non-breeding ranges for Pincoya and each of the three populations of presumed Fuegian? How much inter-annual variation is there in breeding schedules? What is the initiation span—and duration—for wing molt of breeding adults? To what extent might different populations of Fuegian delay wing molt until after post-breeding dispersion/migration? Are there differences in morphology and phenology between southern and northern Chilean populations of Fuegian? Are Falkland birds really attributable to Fuegian? And perhaps most importantly—as highlighted by Howell & Schmitt (2016)—is there any reliable way to distinguish poorly marked Pincoya from strongly marked Fuegian, and *vice versa*? If Fuegian and Pincoya cannot be reliably identified at sea (e.g., if Pincoya is sometimes indistinguishable from classic Fuegian, as suggested by Flood *et al*. 2024), then any discussions of their distribution (as made by Flood *et al*. 2024) and molt (as here) are potentially compromised. Indeed, this raises the question of whether Pincoya is even a taxon distinct

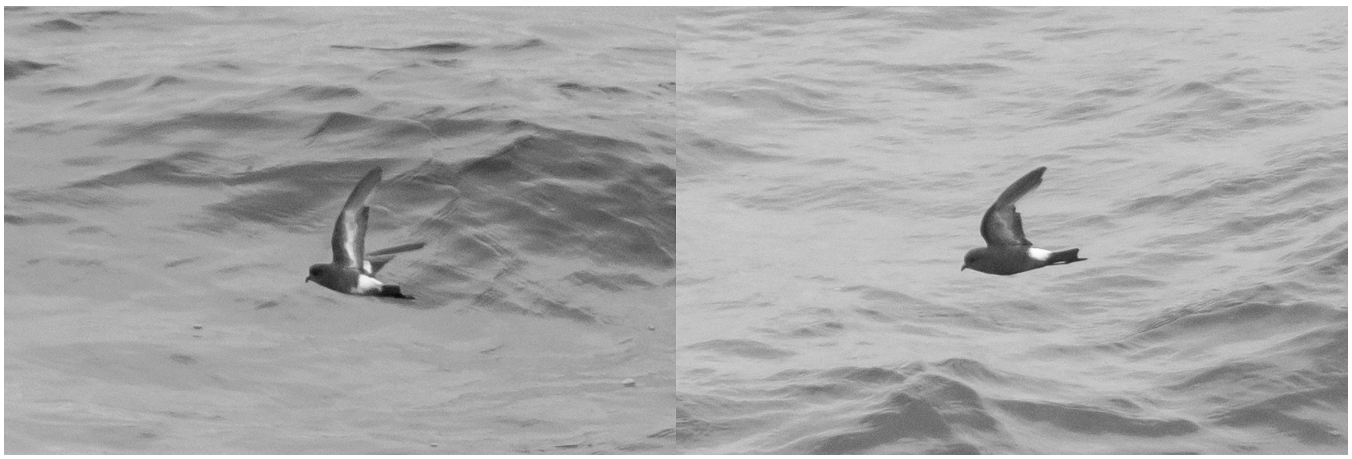

Fig. 2. Presumed Pincoya Storm Petrel *Oceanites [oceanicus] pincoyae* (left) and presumed Fuegian Storm Petrel *Oceanites [oceanicus] chilensis* (right) photographed within the same minute off south-central Chile, 43°S 75°W, 18 January 2024. (Photo credit: Steve N.G. Howell). These individuals show classic plumage features ascribed to each taxon; note the comparable stage of wing molt on both birds.

from northern Fuegian or simply a 'white morph,' as occurs in other austral taxa, as with Southern Giant Petrel *Macronectes giganteus* or Peregrine Falcon *Falco peregrinus* (the striking 'Pallid Falcon' was long considered a distinct species, *F. kreyenborgi*, until it was shown conclusively to be a 'white morph' of Peregrine restricted to southern Patagonia; Ellis & Garat 1983). We hope that observers now primed with these questions can start to provide answers that will shed more light on these fascinating birds.

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