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# An unusual storm-petrel collected offshore Newfoundland and Labrador

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## Abstract

Storm-petrel taxonomy remains challenging, with ongoing discoveries and genetic insights revealing ever more diversity within the group. Between 2018 and 2022, storm-petrels were collected from a variety of offshore industrial vessels and platforms off Newfoundland and Labrador, Canada. During necropsies of a subset of these storm-petrels (N = 66), one bird distinguished itself from the rest by having low contrast greyish feathers on its rump, a feature that would not have been visible in the field and may have led to incorrect identification. Genetic and morphometric analysis confirmed it was a Leach's Storm-petrel (*Hydrobates leucorhous*), with mitochondrial DNA haplotypes previously found in both the Pacific and Atlantic populations. While the bird's origin cannot be determined, the finding highlights the need to better understand large-scale movement and connectivity in this species complex.

Resumé

La taxonomie des pétrels-tempêtes demeure complexe, alors que les découvertes continuent et que les analyses génétiques révèlent une diversité toujours plus grande au sein de ce groupe. Entre 2018 et 2022, des pétrels-tempête ont été collectés sur divers navires et plateformes industrielles en mer, au large de Terre-Neuve et Labrador, au Canada. Lors des nécropsies d'un sous-ensemble de ces individus (N = 66), un oiseau s'est distingué des autres par la présence de plumes grisâtres au niveau du croupion, un caractère qui n'aurait pas été observé sur le terrain. Les analyses génétiques et morphométriques ont confirmé qu'il s'agissait d'une Océanite cul-blanc (*Hydrobates leucorhous*), présentant des haplotypes mitochondriaux déjà observés dans des populations du Pacifique et de l'Atlantique. Bien que l'origine de cet individu ne puisse être déterminée, cette observation souligne la nécessité de mieux comprendre les déplacements à grande échelle et la connectivité au sein de ce complexe d'espèces.

**Keywords:** Hydrobatidae - haplotype

## Introduction

Understanding the taxonomy of storm-petrels (Hydrobatidae and Oceanitidae) is an exacting task to embark upon and new techniques or new discoveries often result in taxonomic revision and splitting of species, indicating the limits of our current knowledge for this group of seabirds (Bolton *et al.* 2008; Harrison *et al.* 2013; Flood *et al.* 2019; Norambuena *et al.* 2024). This is especially true in the Atlantic Ocean where cryptic species of Band-rumped Storm-petrel (*Hydrobates castro*, *sensu lato*) occur in archipelagos of Macaronesia: the Azores (*H. monteiroi*), Cape Verde (*H. jabejabe*), Canary Islands, and Madeira, in addition to Berlengas, Ascension (*H. castro ascensionis*) and St. Helena (Beard *et al.* 2023). Furthermore, the taxonomy of the widely distributed Wilson's Storm-petrel (*Oceanites oceanicus*, *sensu lato*) remains poorly known (Taylor *et al.* 2019; Harrison *et al.* 2013; Jamie & Keogh 2023).

Leach's Storm-petrels (*Hydrobates leucorhous*) breed in the north Pacific and north Atlantic Oceans and have a wide pelagic distribution (Flood & Fisher 2013; Halpin *et al.* 2018; Pollet *et al.* 2019). Although traditionally treated as a single species, substantial morphological, vocal, and genetic variation across its range (Power & Ainley 1986; Bicknell *et al.* 2012; Humphries *et al.* 2018; Pritchard *et al.* 2000) suggests the existence of multiple cryptic lineages and several sub-species have been described (Pollet *et al.* 2021), with some Pacific taxa recently elevated to species status (Ainley's

Storm-petrel, *H. cheimomnestes*; Townsend's Storm-petrel, *H. soccoroensis*; Howell *et al.* 2009). One main distinguishing characteristic among populations of Leach's Storm-petrel (*sensu lato*) is rump coloration (rump is a loose term referring to the region of the uppertail-coverts). While most Atlantic individuals have a distinctive high-contrast white rump, the presence of dark rumps in individuals in the Pacific is stepped-clinal (Ainley 1980). Nearly all northern Pacific birds *H. l. leucorhous* (breeding in Japan, Russia, Alaska, British Columbia, Washington, Oregon and northern California) have white or pale rumps, but in the California Channel Islands such as the Farallon Islands (37°42'N), 6% are dark-rumped, while 28% in the northern California Channel (34°12'N) are dark-rumped, with *H. l. chapmani* occurring as far north as the Coronado Islands (32°24'N) and being nearly all dark-rumped on the San Benito Islands (28°18'N; Taylor *et al.* 2018). Ainley's and Townsend's Storm-petrels, both breed on islets off Guadalupe Island (28°48'N), but while Ainley's Storm-petrels always have some white on their rump (Medrano *et al.* 2023), Townsend's Storm-petrels vary from having a white rump to having an entirely dark rump (Kirwan *et al.* 2023).

The situation in the North Atlantic is also complicated by the presence of vagrant Swinhoe's Storm-petrels (*H. monhoris*) which also have dark rumps. Swinhoe's Storm-petrels breed on islands off Japan, eastern Russia, China, and Korea (Carboneras *et al.* 2021), but there are several records of vagrancy in the North Atlantic (Bretagnole *et al.* 1991; Flood & Fisher 2013), including eastern North America (Howell and Patteson 2008), and a poor understanding of their at-sea distribution (Carboneras *et al.* 2021; Nakahara *et al.* 2025).

Storm-petrels are abundant in the waters off Newfoundland and Labrador, Canada. In addition to millions of breeding pairs of Leach's Storm-petrels (Pollet *et al.* 2021), Wilson's Storm-petrels are regular offshore during the northern summer (Brooke 2004). Other storm-petrel species – either with a white or a dark rump – are considered vagrants (Flood & Thomas 2007; Flood 2009). The offshore oil and gas industry in Newfoundland and Labrador is required to report any stranded birds (both live and dead) from installations and vessels and to submit any deceased storm-petrels and species listed under the Species At Risk Act (SARA) to the Canadian Wildlife Service as part of their permit conditions. While most storm-petrels found stranded through this monitoring process are juveniles (Gjerdrum *et al.* 2021), adult carcasses collected between 2018 and 2022 were sent to the National Wildlife Research Centre in Ottawa, Canada, to be part of a broader contaminants study. This sample included a specimen that caught our attention as having restricted and subdued white on its rump compared to all the others and presumably would have appeared as a dark-rumped storm-petrel in the field. Here we present the details of this investigation and discuss its significance

in the context of storm-petrel cryptic diversity, movement and long-range vagrancy, with a particular reference to eastern Pacific taxa such as Townsend's Storm-petrel, the morphologically closest species to Leach's storm-petrel with a potential dark-rump.

## Methods

### *Collection*

Storm-petrels were collected on various drillships and platforms between 2018 and 2022. A subset of those (N = 66 adults) were sent to the National Wildlife Research Centre in Ottawa, Canada, to be part of a broader contaminants study. The bird of interest was collected offshore (47°57'N 46°46'W) on 8 June 2021, on a drillship conducting activities under an offshore exploration drilling program. Upon dissection on 14 July 2022 by NP and RD-S, as part of a contaminant screening study, the bird was identified as a female with no brood patch and a subcutaneous fat score of 3 (range 0–3; Camphuysen *et al.* 2007). A muscle sample was taken during dissection for further genetic investigation.

### *Morphometrics*

Measurements of the "unidentified" storm-petrel were compared with the 65 Leach's Storm-petrels collected offshore Newfoundland and Labrador (see Collection), and Townsend's Storm-petrels from the Natural History Museum, Tring, UK. We measured wing chord (flattened, straightened) using a stopped ruler (± 1 mm), and culmen, tarsus length and total head using digital callipers (± 0.01 mm). We considered the potential 1–2% shrinkage in bill and wing measurements from museum specimens (Winker 1993) and provided actual specimen measures along with corrected measures.

### *Molecular analysis*

Total genomic DNA was isolated from breast muscle tissue of the "unidentified" storm-petrel using the QIAGEN DNA Mini Kit according to manufacturer's instructions. The mitochondrial gene cytochrome b (cytb) was amplified using primers L14993 and H16065 (Helbig & Seibold 1998). The mitochondrial control region was amplified using primers OcL61 and H521 (Smith *et al.* 2007). After electrophoresis in 1% agarose gels, bands were purified using the QIAquick Gel Extraction Kit. Eluted DNA was sequenced in both directions using the PCR primers by Source Bioscience (Cambridge). Cytb and control region sequences from all *Hydrobates* species (Table 1) were downloaded from Genbank via the NCBI nucleotide database portal (https://www.ncbi.nlm.nih.gov/). Additional control region sequences of Leach's, Townsend's and Ainley's Storm-petrels from 16 colonies sites in the Atlantic

and Pacific Oceans were obtained from supplementary data in Taylor *et al.* (2018). After trimming of low quality and primer sequences, alignments were performed in CLC Sequence Viewer and verified by eye. PHYLIP files were uploaded to PhyML online at http://www.atgc-montpellier.fr/ (Guindon *et al.* 2010) and Maximum Likelihood trees were generated using HKY85 nucleotide substitution model with aLRT SH-like branch support levels determined. The mitochondrial cytb and control region D-loop sequences were uploaded to GenBank with Accession numbers PZ513471 and PZ513472 respectively.

Table 1: Hydrobates species used for the creation of the Cytb tree

| English name | Scientific name | Breeding ocean basin |
|---|---|---|
| European Storm-petrel | *Hydrobates pelagicus* | North Atlantic |
| Ringed Storm-petrel | *H. hornbyi* | Southeast Pacific |
| Swinhoe's Storm-petrel | *H. monohoris* | West Pacific |
| Matsudaira's Storm-petrel | *H. matsudairae* | West Pacific |
| Leach's Storm-petrel | *H. leucorhous leucorhous* | North Atlantic; North Pacific |
| Leach's Storm-petrel | *H. leucorhous chapmani* | East Pacific |
| Townsend's Storm-petrel | *H. socorroensis* | East Pacific |
| Ainley's Storm-petrel | *H. cheimomnestes* | East Pacific |
| Ashy Storm-petrel | *H. homochroa* | East Pacific |
| Black Storm-petrel | *H. melania* | East Pacific |
| Markham's Storm-petrel | *H. markhami* | Southeast Pacific |
| Tristram's Storm-petrel | *H. tristrami* | West Pacific |
| Least Storm-petrel | *H. microsoma* | East Pacific |

## Results

### *Morphometrics*

During necropsy of the "unidentified" specimen, the rump and uppertail coverts were heavily worn, somewhat reducing the pale area (Figure 1). Nevertheless, light-coloured feathers were still discernible, thereby excluding dark-rumped species as potential identification for this individual. The culmen length of the "unidentified" storm-petrel was too long to be considered a Townsend's Storm-petrel, even accounting for the potential 1–2% shrinkage in museum specimens and was even long for a Leach's Storm-petrel (Table 2).


**Figure 1** A: Two of the 66 examined storm-petrels collected offshore Newfoundland and Labrador, Canada, including the "unidentified" specimen (right). B: The "unidentified" specimen collected on 8 June 2021.

Table 2: Morphometric measurements (mean ± S.D.) from the unidentified Newfoundland Storm-petrel, Leach's Storm-petrels (*Hydrobates leucorhous*) collected offshore Newfoundland and Labrador, and Townsend's Storm-petrels (*H. socorroensis*), from the Natural History Museum, Tring, UK. Adjusted values were obtained by applying a 1.5% adjustment to account for shrinkage in bill and wing measurements from museum specimens.

| | Unidentified storm-petrel | Leach's (live) N = 65 | Townsend's (museum) N = 12 | Adjusted Townsend's (museum) N= 12 |
|---|---|---|---|---|
| Wing chord (mm) | 160 | 158 ± 4.3 | 149 ± 7.8 | 151 ± 7.9 |
| Culmen (mm) | 17.41 | 16.6 ± 0.55 | 14.5 ± 1.0 | 14.7 ± 1.0 |
| Total head (mm) | 41.9 | 41.3 ± 1.0 | 39.0 ± 1.6 | 39.5 ± 1.6 |
| Tarsus (mm) | 24.7 | 24.4 ± 0.77 | 21.7 ± 1.3 | 22.0 ± 1.4 |

*Molecular analysis*

Verified 994 bp fragments of mitochondrial cytb gene and 404 bp of the D-loop of the mitochondrial control region were amplified. A trimmed alignment of 975 bp of cytb was generated comparing the "unidentified" sequence (labelled 'SW103') with multiple Storm-petrel taxa from the Atlantic and Pacific Oceans (*Hydrobates hornbyi*, *H. homochroa*, *H. tristrami*, *H. matsudairae*, *H. monohoris*, *H. leucorhous leucorhous*, *H. l. chapmani*, *H. cheimomnesetes*, *H. socorroensis*, *H. pelagicus*, *H. microsoma*, *H. melania*, *H. markhami*), and a Maximum likelihood tree generated as described in the methods section (Figure 2). Cytb analysis placed the specimen in a strongly supported clade with 99-100% identity to a clade containing Leach's Storm-petrels from the Pacific Ocean (including dark-rumped *Hydrobates leucorhous chapmani*), and the closely related (previously conspecific) Townsend's Storm-petrel *H. socorroensis*. On cytb haplotype alone, it was not possible to eliminate Townsend's Storm-petrel.

The amplified Control Region D-loop sequence was BLAST-searched at https://blast.ncbi.nlm.nih.gov/Blast.cgi (Accessed 9 January 2026) to compare with previously published molecular studies, including Pacific and Atlantic birds, and was 98.7–100% identical to haplotypes found in the Pacific breeding populations of Leach's Storm-petrel (Bicknell *et al.*, 2012), but no sequence from *H. socorroensis* was immediately available for comparison. In addition to the GenBank search, the published dataset of Taylor *et al.* (2018) (not in public Genbank) had an overlapping sequence of Control Region for multiple individuals of Pacific Leach's Storm-petrels, as well as Tristram's Storm-petrels and Ainley's Storm-petrels from Guadalupe. The "unidentified" specimen sequence was compared with their dataset and an alignment of 276 bp was produced containing 34 haplotypes with 16 variable positions, 13 of which are parsimony-informative. The "unidentified" specimen (SW103) exhibited a major haplotype found in multiple birds from both the Pacific and Atlantic Oceans, in contrast to the cytb DNA result (Figure 3), indicated a possible origin from either ocean. It was concluded that although the "unidentified" bird was a Leach's Storm-petrel, its origin could not be determined.

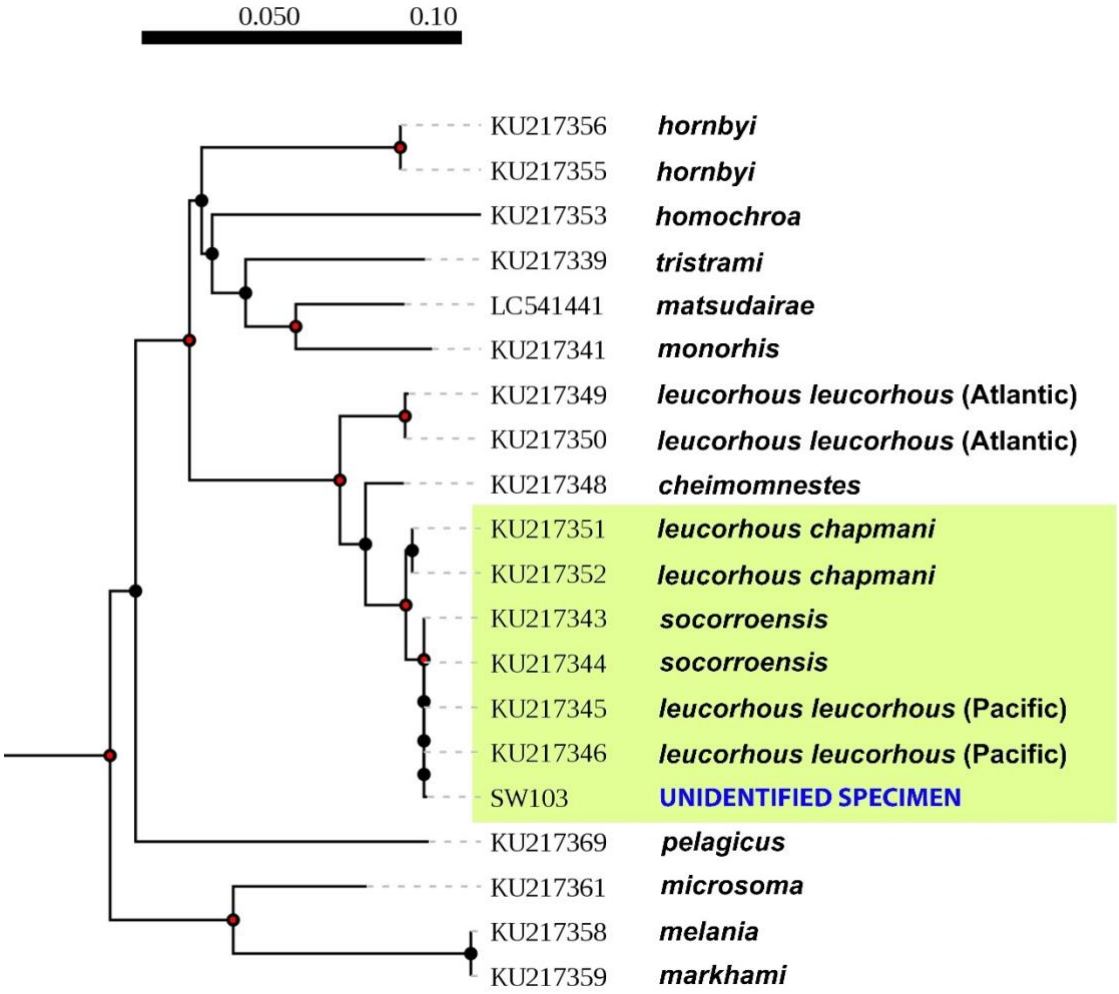


**Figure 2** Maximum Likelihood tree using cytb showing the "unidentified" storm-petrel (SW103) in relation to other storm-petrel taxa (*Hydrobates* spp) using data from GenBank. Accession numbers of previously sequenced birds are listed. Red nodes indicate >95% bootstrap support.

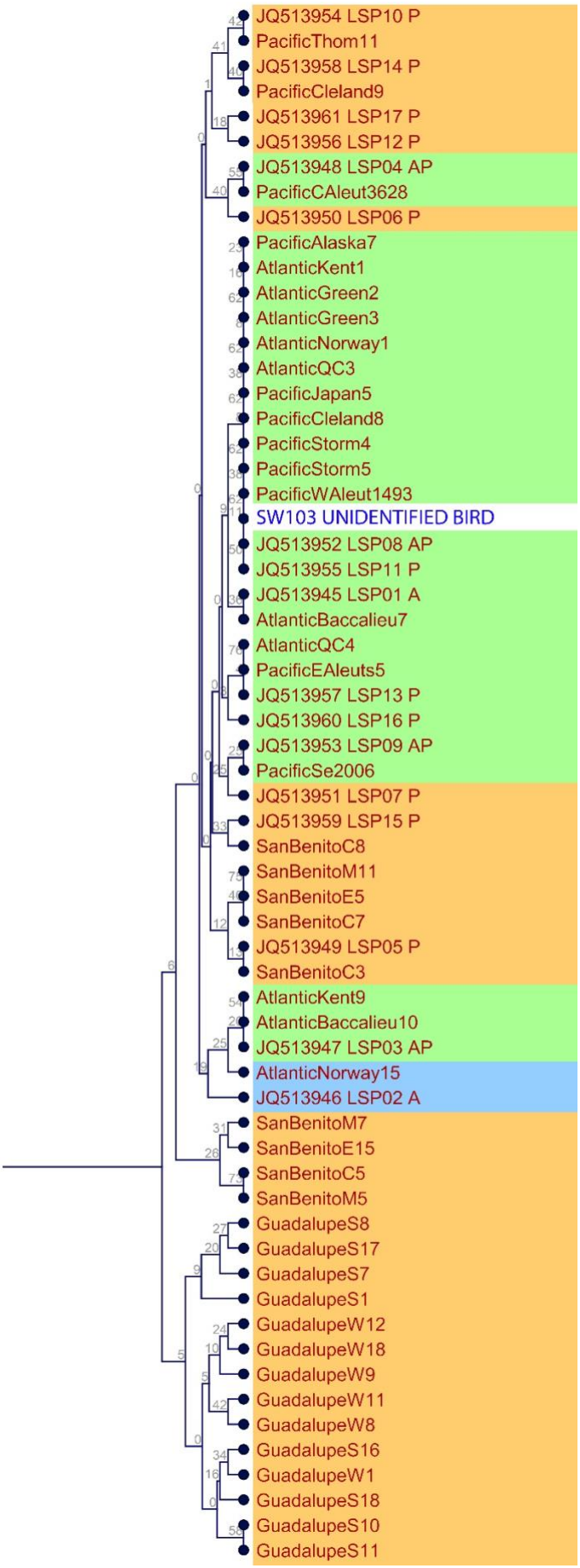
JQ513954 LSP10 P
PacificThom11
JQ513958 LSP14 P
PacificCleland9
JQ513961 LSP17 P
JQ513956 LSP12 P
JQ513948 LSP04 AP
PacificCAleut3628
JQ513950 LSP06 P
PacificAlaska7
AtlanticKent1
AtlanticGreen2
AtlanticGreen3
AtlanticNorway1
AtlanticQC3
PacificJapan5
PacificCleland8
PacificStorm4
PacificStorm5
PacificWAleut1493
SW103 UNIDENTIFIED BIRD
JQ513952 LSP08 AP
JQ513955 LSP11 P
JQ513945 LSP01 A
AtlanticBaccalieu7
AtlanticQC4
PacificEAleuts5
JQ513957 LSP13 P
JQ513960 LSP16 P
JQ513953 LSP09 AP
PacificSe2006
JQ513951 LSP07 P
JQ513959 LSP15 P
SanBenitoC8
SanBenitoM11
SanBenitoE5
SanBenitoC7
JQ513949 LSP05 P
SanBenitoC3
AtlanticKent9
AtlanticBaccalieu10
JQ513947 LSP03 AP
AtlanticNorway15
JQ513946 LSP02 A
SanBenitoM7
SanBenitoE15
SanBenitoC5
SanBenitoM5
GuadalupeS8
GuadalupeS17
GuadalupeS7
GuadalupeS1
GuadalupeW12
GuadalupeW18
GuadalupeW9
GuadalupeW11
GuadalupeW8
GuadalupeS16
GuadalupeW1
GuadalupeS18
GuadalupeS10
GuadalupeS11

**Figure 3** Unweighted Pair Group Method with Arithmetic Mean (UPGMA) tree based on a 276 bp mitochondrial control-region fragment combining haplotypes from Bicknell *et al.* (2012), representative sequences from Taylor *et al.* (2018), and the unidentified specimen (SW103). Colours indicate haplotypes reported only from the Pacific Ocean (orange), only from the Atlantic Ocean (blue), or from both ocean basins (green). See Results section for details of the combined dataset and haplotype composition.

## Discussion

Leach's Storm-petrels are highly pelagic species, capable of extensive trans-equatorial migration (Pollet *et al.* 2019), yet trans-oceanic vagrancy between Pacific and Atlantic populations has rarely been documented. Had this bird been observed in the field, it could have been mistaken for a dark-rumped storm-petrel (e.g., Townsend's, Swinhoe's or a Chapman's Leach's Storm-petrel) and categorized as a vagrant. The morphometric measurements do not identify the species or its origin with certainty but align better with Atlantic Leach's Storm-petrel than with Pacific Townsend's Storm-petrel.

The genetic data obtained firmly establish the identity of the bird as a Leach's Storm-petrel, but there is conflict between the two mitochondrial loci analysed. While cytb data strongly suggested an origin in the Pacific Ocean, analysis of the Control Region, primarily in alignment with sequences in Taylor *et al.* (2018) and Bicknell *et al.* (2012) showed that such a conclusion was not sustainable. Taylor *et al.* (2018) found that Pacific and Atlantic populations share multiple mitochondrial DNA haplotypes, likely due to ongoing gene flow. Although populations of Leach's Storm-petrel show genetic structure between Pacific and Atlantic Ocean basins (based on $F_{ST}$ comparisons), control region haplotypes are shared and coalescent analysis indicate some gene flow is probably occurring.

Despite their ubiquity in the world's oceans, storm-petrels' small size, high within-taxon variation and potential for allochronic breeding in sympatry (Thomas 2024) confounds our understanding of their distribution and movements. Advances in tracking technology (Medrano *et al.* 2024; Wilkinson *et al.* 2025) and at-sea identification (Flood 2007, Flood and Thomas 2009, Thomas 2024) have improved things considerably in the last two decades, but some populations, especially in the Pacific, remain understudied (Thomas 2024).

The fact that this bird had worn feathers in June (assuming it was collected shortly after death) suggests that it was a second calendar year bird about to replace its weak juvenile feathers. Virtually nothing is known about the at-sea movements of the first years of storm-petrels, and their dispersal strategies remain poorly understood, but trans-oceanic movements are possible (Bicknell *et al.* 2014).

Populations in the Pacific are generally more poorly known in terms of their status, trends, and movements compared to the Atlantic, though in exceptional cases, birds presumably from a north Pacific origin have attempted breeding in New Zealand (Imber & Lovegrove 1982), indicating the capacity for long-distance vagrancy. The origin of the few breeding pairs recorded in South Africa (Whittington *et al.* 1999) is unknown and could be from Atlantic populations that regularly winter in the south Atlantic (Pollet *et al.* 2019) or from Pacific birds rounding Cape Horn.

We therefore have three possibilities when it comes to the "unidentified" storm-petrel collected off Newfoundland. Molecular analysis supports the identification as a Leach's Storm-petrel, so other taxa can be discounted. The first possibility is that it originated in the Pacific and has worn rump feathers and therefore appears as "dark-rumped". Such wear and weathering would be quite significant, and though light-coloured feathers tend to wear faster than darker feathers (Bonser 1995) this would still, in our view, be extreme. The second option is that the bird is naturally with a low contrast grey-rumped and from the Pacific. The equivocal results of the molecular analysis and previous molecular work (Bicknell *et al.* 2012; Taylor *et al.* 2018) suggest, however, that there is gene flow between oceanic basins and identifying an individual to a population based on mtDNA molecular analysis alone would be imprudent. The third possibility is the "unidentified" specimen is a low-contrast grey-rumped bird from the Atlantic, despite the exceptionally low frequency of birds with such rump coloration in Atlantic breeding populations. The authors' cumulative experience of handling tens of thousands of Leach's Storm-petrels in New Brunswick, Nova Scotia, Newfoundland, and Labrador have never noted such low-contrast grey-rumped bird.

Storm-petrel individuals with a low-contrast rump, and all-dark rumped Swinhoe's Storm-petrel from the North Pacific, have been previously observed in the Atlantic Ocean (Bourne and Simmons 1997; Bretagnolle *et al.* 1991; Flood & Fisher 2013), but identification is often difficult (Ainley 1980; Morrison 1998). This specimen is a perfect example of the difficulties encountered with field identification. The *Hydrobates* complex is cryptic with many unresolved taxonomic challenges

(Birchard 2019; Pollet *et al.* 2021). There is still much to learn about the movement, migration, and vagrancies of small, elusive seabirds, such as storm-petrels.

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## Data availability

The mitochondrial cytb and control region D-loop sequences were uploaded to GenBank with Accession numbers PZ513471 and PZ513472 respectively.

## Conflict of Interest

Ingrid L Pollet serves as Editor of *Seabird*. She was not involved in the editorial process for this manuscript, including discussion with the editorial board member in charge of this manuscript, and the editorial decision. The manuscript was handled independently by the Assistant Editor.

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