



Phylogenetic affinities of the *Fregetta* storm-petrels are not black and white [☆]



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ABSTRACT

The *Fregetta* storm-petrels generally are regarded to comprise two species: black-bellied storm-petrels *F. tropica* (monotypic) breed at Antarctic and sub-Antarctic islands (46–63°S), and white-bellied storm-petrels *F. grallaria* breed at south temperate islands (28–37°S), with four recognized subspecies. Confusion surrounds the status of birds at Gough Island (40°S), central South Atlantic, which have been attributed usually to a white-bellied form of black-bellied storm-petrel *F. t. melanoleuca*. We use cytochrome *b* and nuclear β -fibrinogen gene sequences to show that *F. t. melanoleuca* are present during the breeding season at Gough and islands in the nearby Tristan da Cunha archipelago (37°S), exhibiting limited divergence from *F. t. tropica*. We also show that there is greater diversity among *F. grallaria* populations, with eastern South Pacific *F. g. segethi* and *F. g. titan* differing by *c.* 0.011, and both differing from western South Pacific nominate *F. g. grallaria* by *c.* 0.059. The Tristan archipelago supports a population of *F. grallaria* closely allied to the nominate form, as well as a distinct form identified as *F. g. leucogaster*. Further research is needed to assess how *F. grallaria* and *F. tropica* segregate in sympatry at Tristan and Gough, and why this is the only location where both species have white-bellies.

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1. Introduction

The storm-petrels of the Southern Hemisphere genus *Fregetta* Bonaparte (sub-family Oceanitinae) traditionally contains two species (e.g. Jouanin and Mougín, 1979); the black-bellied storm-petrel, *F. tropica* (Gould, 1844) that breeds in the Antarctic and sub-Antarctic; and the temperate-breeding white-bellied storm-petrel, *F. grallaria* (Vieillot, 1818). The taxonomy of the *Fregetta* storm-petrels has been debated vigorously over the last 100 years (e.g. Salvadori, 1908; Mathews, 1933; Murphy and Snyder, 1952), with various sub-specific designations proposed and revised (Mathews, 1933; Murphy and Snyder, 1952), and confusion remains as to whether a white-bellied form of *F. tropica* exists on

Gough Island (40°S, 10°W) in the mid-South Atlantic (Clancey, 1981; Brooke, 2004; Ryan, 2007). Robertson et al. (2011) showed using phylogenetic analyses that the New Zealand storm-petrel (*Oceanites maorianus*) is not an *Oceanites*, but is better placed with *F. grallaria* and *F. tropica* in the genus *Fregetta*, and suggested the name *Fregetta maoriana*. Recently, Cibois et al. (2015) clarified the identity of an unusual ‘pealea’ specimen (American Museum of Natural History 194110) collected off the Marquesas Islands, concluding that it was closely related to the *F. grallaria* clade but that its exact placement was uncertain. They also suggested that *F. grallaria* was not monophyletic, based on a short cytochrome *b* sequence from a Natural History Museum, London, specimen (1953.55.101) collected on Gough Island and assigned to *F. g. leucogaster*.

Fregetta taxonomy has been based on various morphological characters (Marchant and Higgins, 1990; Stephenson et al., 2008) including chin and throat feather coloration (bases white in

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F. tropica, not in *F. grallaria*; but see Stephenson et al., 2008); toe projection beyond the tail tip in flight (absent in *F. grallaria*; but see Howell, 2010); tarsal scale pattern (holothecal in *F. tropica*, scutellated in *F. grallaria*); morphometrics (bill, tarsus, toes longer in *F. tropica*; wings relatively longer in *F. grallaria*); and toe morphology and symmetry (Marchant and Higgins, 1990; Stephenson et al., 2008). Various combinations of these characters have been used in revisions of *Fregetta* taxonomy (Salvadori, 1908; Kinghorn and Cayley, 1922; Mathews, 1932a, 1933; Murphy and Snyder, 1952). However, many of the early taxonomic revisions were based on the examination of single specimens of unknown breeding provenance (Murphy, 1936; Murphy and Snyder, 1952).

Recently several researchers have called for a revision of *F. grallaria*, suggesting that some subspecies might warrant full species status due to plumage and morphological differences (e.g. Stephenson et al., 2008; Howell, 2014). Currently, four subspecies are recognized for *F. grallaria* (nominate *grallaria*, *titan*, *segethi* and *leucogaster*) and one or two subspecies for *F. tropica* (nominate *tropica* and *melanoleuca*), depending on the status of the Gough population (cf. Marchant and Higgins, 1990; Brooke, 2004; Onley and Scofield, 2007; Dickinson and Remsen, 2013). *F. g. grallaria* breeds on the Lord Howe islands (32°S, 159°E) in the Tasman Sea, and the

Kermadec Islands (29°S, 178°W) north of New Zealand (Fig. 1). The nominate form is unusual in being polymorphic, with some black-bellied forms at Lord Howe islands (Fig. 2; Marchant and Higgins, 1990) and a less extensive degree of polymorphism at the Kermadec Islands (Tennyson and Taylor, 1990). *F. g. titan* of Rapa Island (28°S, 144°W) in the Austral Islands, French Polynesia, was defined on size, being larger than *F. g. segethi* from the Juan Fernandez Islands (34°S, 81°W) in the eastern South Pacific (Murphy, 1924, 1928). Finally, *F. g. leucogaster* breeds at the Tristan da Cunha group (37°S, 12°W) and perhaps Gough Island (Brooke, 2004) in the central South Atlantic, and a tiny relict population breeds at St Paul Island (39°S, 77°E) in the southern Indian Ocean (Tollu, 1984; Worthy and Jouventin, 1999). This form probably also bred at nearby Amsterdam Island (38°S, 77°E) prior to the arrival of rats and other introduced mammals (Worthy and Jouventin, 1999). *F. t. tropica* breeds in three regions further south than *F. grallaria* (Brooke, 2004): at sub-Antarctic islands south of New Zealand (Auckland, Antipodes and Campbell, 49–52°S) and in the southwest Indian Ocean (Kerguelen, Crozets and the Prince Edwards, 46–50°S), and at peri-Antarctic islands in the South Atlantic and Scotia Sea area (South Georgia, South Orkneys, South Shetlands, Bouvet and probably the South Sandwich Islands, 54–63°S).

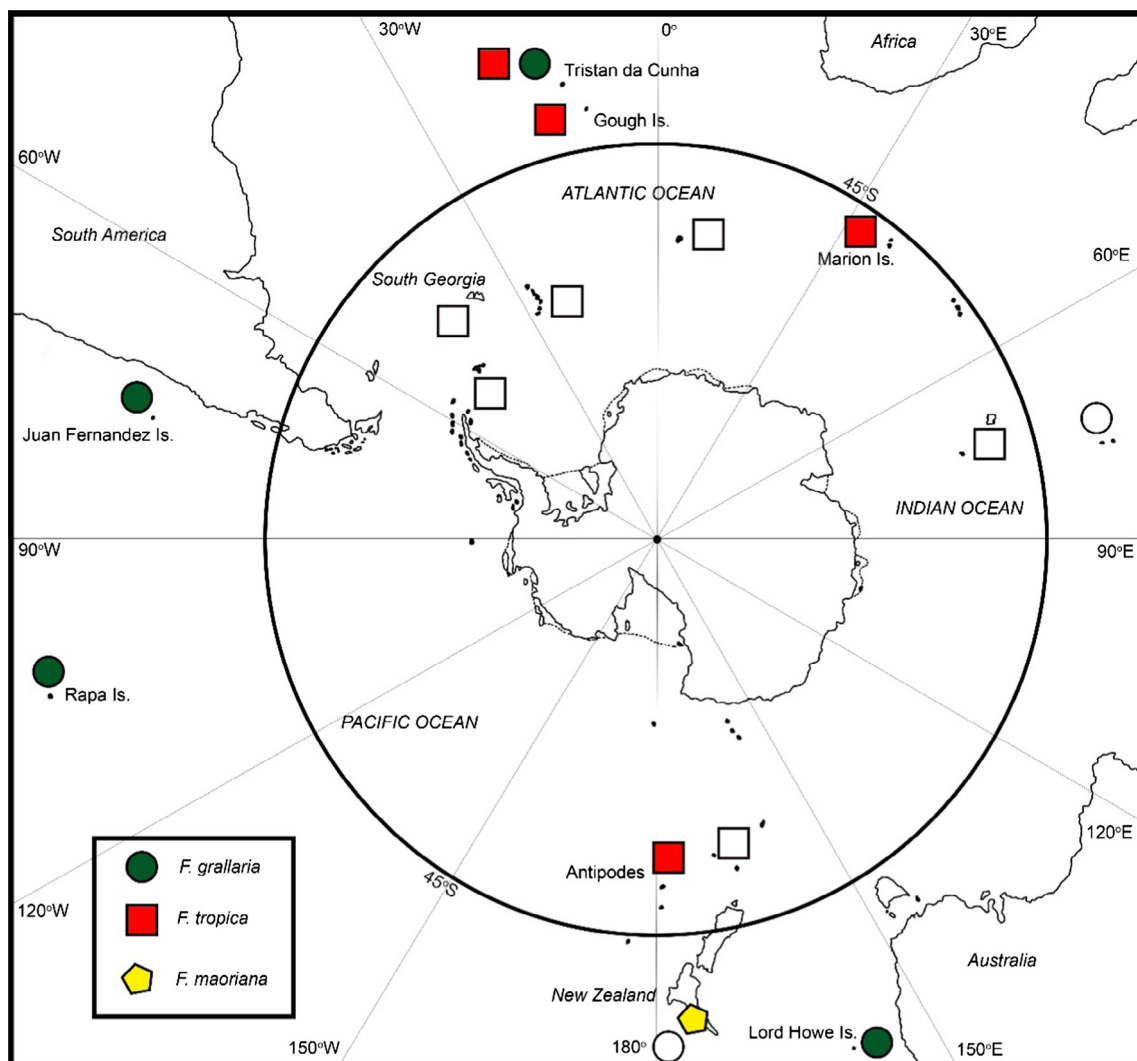


Fig. 1. Sampling locations of the New Zealand storm-petrel *Fregetta maoriana* (pentagon), white-bellied storm-petrels *F. grallaria* (circle) and black-bellied storm-petrels *F. tropica* (square) used in the analysis. Open symbols are breeding locations not sampled in this study.

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