Gastrointestinal helminths of two Storm Petrel species, Oceanites oceanicus and Fregetta tropica, from Antarctica

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Research Article

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Abstract

Although knowledge about parasitic diseases in Antarctic birds is scarce, an increasing number of studies are currently being carried out in this area. The importance of the host-parasite relationship in Antarctic seabirds is key to understanding trophic ecology and epidemiology of infection diseases, especially in those birds with extensive migratory routes that can act as reservoirs and distributors of diseases. This study aims to provide information on helminths of two Storm Petrel species, the Wilson’s storm-petrel Oceanites oceanicus and the Black-bellied storm-petrel Fregetta tropica. Twenty individuals were analysed: 18 O. oceanicus (8 adults, 10 chicks) and 2 F. tropica (adults); 89% of the O. oceanicus were parasitized with the nematode Stegophorus macronectes, whereas 100% of F. tropica was parasitized by at least one of three parasite species identified: S. macronectes, Seuratiasp., and Tetrabothrius sp. The low richness of parasites observed is associated with a stenophagic diet. However, a clear difference is observed between both species related to a higher fish ingestion by F. tropica, unlike O. oceanicus with a higher ingestion of krill.

Introduction

In the last century, human disturbance with degradation or loss of nesting habitat has been a significant factor in seabird population declines (Phillips et al. 2016). The petrels (Procellariformes), in particular, have specific physiological responses that make them very susceptible to environmental changes, such as delayed sexual maturity, low fecundity, laying single-egg clutches (Warham, 1990). For this reason, they are valuable and useful indicators of the ecosystem's health they inhabit (Thibault et al. 2019; Velarde et al. 2019). Procellariformes are oceanic and pelagic birds that spend very limited time on land, except during nesting or breeding season, are present throughout the world, but there is a clear predominance of species in the Southern hemisphere (Padilla 2015).

Storm-petrels (Hydrobatidae) along with other seabirds represent the main top predators, acting as important indicators of the health of the aquatic ecosystem, maintaining the structure of marine food web (Lascelles et al. 2012; Paleczny et al. 2015; Braun et al. 2021; Pande and Sivakumar 2022). Storm-petrels are small, delicate birds with relatively large heads that are found in all oceans and may congregate in very large numbers (Beck and Brown 1972). This pelagic family includes roughly 20 species distributed in seven genera, although the taxonomy is being constantly revised and debated (Piro et al. 2019). The Austral or Southern storm-petrels classified into Oceanitinae include the genera Oceanites, Garrodia, Pelagodroma, Fregetta, and Nesofregetta, whereas the Northern representatives are grouped into Hydrobatinae with the genus Hydrobates (Carboneras and Bonan 2018).

Among the Austral storm-petrels, the Wilson’s storm petrel Oceanites oceanicus Kuhl and the Black-bellied storm petrel Fregetta tropica (Gould) breed in ice-free areas in natural cavity beneath rock, during the austral summer (December to March) migrating north with a different distribution during the austral winter (Fig. 1) (Gladbach et al. 2007; Pacyna et al. 2019). Both species feed in the sea, however while the Black-bellied storm petrel take fish and crustaceans in equal proportions (Hahn 1998), the Wilson’s...
storm petrel take mainly crustaceans (80–90% of its diet) (Quillfeldt 2002, 2017). Both petrel species are often predated by other birds (Padilla 2015).

Global changes, such as those related to climate and habitat alterations, which are more pronounced in the Polar regions, are affecting many biological processes, including animal migrations (Cotton 2003; Hurlbert and Liang 2012; Altizer et al. 2013). This situation directly or indirectly influence the distribution of parasites, with gastrointestinal infections being a direct response to trophic habits (Hoberg 1996; Daszak et al. 2000). The Antarctic Peninsula together with their surrounding islands represent areas with rapid environmental changes (Klimpel et al., 2017) as a result of multiple stressors originated by anthropogenic disturbances. These actions could directly affect the diet, causing changes in the parasitic diversity of birds (Vidal et al. 2012; Diaz et al. 2017) generating poor body conditions which directly affect their migration (Klasssen et al., 2012). In Antarctica, parasitological researches are relatively recent. Inevitably, reports and descriptions of parasites appear after the host’s biology studies. Therefore, it is not surprising that there are so few published reports on parasites of Antarctic organisms since the middle of the twentieth century (Mackenzie 2017; Fusaro et al. 2018). Even though pathogens have the potential to cause rapid declines in vulnerable vertebrate populations, less is known about the threat that small petrels face from infectious disease. Notably, no helminth were found parasitizing small petrels in the Antarctic region at day, and only one nematode species was reported from Sub-Antarctic region (i.e., Stegophorus herardi form O. oceanicus) (Barbosa and Palacios, 2009).

The aim of this study is to know the helminth community of the Wilson's storm petrel O. oceanicus and the Black-bellied storm petrel F. tropica in their reproductive areas on Antarctic Peninsula and neighboring islands during the Southern Hemisphere summer.

**Materials And Methods**

We studied two storm-petrel species, O. oceanicus and F. tropica in their breeding colonies located in the Potter Peninsula (62°14′S, 58°40′W), 25 de Mayo (King George) Island, South Shetland Islands, and Cape Geddes (60°41´S, 44°34´W), Lauri Island, South Orkney Islands. Additionally, one adult specimen found at Barry Islet (68°07′S, 67°06′W), Caleta Sanaviron, Bahia Margarita was added. Eighteen Wilson’s storm petrel and two Black-bellied storm petrels, freshly dead were collected during the summers of 2017 to 2022 (Fig 2). The causes of death were unknown although we can exclude predation. The samples were placed in plastic bags and frozen at – 20 °C until evisceration was carried out. In the laboratory, digestive tracts were removed and preserved in 96% ethanol for parasitological examination.

Viscera was separated into esophagus, stomach (glandular proventriculus and muscular gizzard), intestine, cloaca, heart, liver, kidneys, and lungs. Body cavities were also analysed. Helminths were removed under a stereomicroscope, fixed in 5% formalin, and preserved in 70% ethanol. Parasites were cleared in 25% glycerine alcohol and observed using a light microscope. The terms prevalence (P), mean intensity (MI), and community were interpreted and calculated according to Bush et al. (1997). Specimens were determined following keys and specific bibliography (Chabaud 1974; Khalil 1994; Vidal et al. 2016)
and deposited in the Helminthological Collection of the Museo de La Plata (MLP) XXX, La Plata, Argentina. The skeletons of the birds were deposited in the collection of the Azara Natural History Foundation.

Results

A total of 191 helminths were recovered from all analysed hosts. Three adult parasite species were identified: *Stegophorus macronectes* (Johnston & Mawson, 1942) (Nematoda, Acuariidae) parasitizing the stomach of the two host species, *Seuratia* sp. (Nematoda, Acuariidae) found in the lumen of the stomach only of *F. tropica*, and one immature cestode specimen identified as *Tetrabothrius* sp. (Tetrabothridae) recovered from the intestine of Black-bellied storm petrel from Lauri Island. Of the total storm-petrels examined, 18 were parasitized (85%) by at least one of the species identified (MI = 9.6). Sixteen *O. oceanicus* were parasitized (89%), while both *F. tropica* were parasitized (100%). Composition and ecological parameters by locality and host are show in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Potter Peninsula 62°14'S; 58°39'W</th>
<th>Cape Geddes 60°41'S; 44°34'W</th>
<th>Barry Islet 68°07'S; 67°06'W</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>O. oceanicus</em></td>
<td>11 (82; 14,6)</td>
<td>6 (83; 3,4)</td>
<td>1 (100; 24)</td>
</tr>
<tr>
<td><em>F. tropica</em></td>
<td>1 (100; 8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Stegophorus macronectes</em> (P; MI)</td>
<td>82; 14,6</td>
<td>100; 4</td>
<td>100; 6</td>
</tr>
<tr>
<td><em>Seuratia</em> sp. (P; MI)</td>
<td>100; 4</td>
<td>100; 1</td>
<td></td>
</tr>
<tr>
<td><em>Tetrabothrius</em> sp. (P; MI)</td>
<td>100; 1</td>
<td></td>
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</tr>
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</table>

Table 1
Parasite composition and ecological parameters of Storm-petrels *Oceanicus oceanites* and *Fregetta tropica* by locality.

*Stegophorus macronectes* were the most common parasites in the studied community (P = 85%; MI = 9.1). This species was diagnosed by the morphology of ornamental cephalic structures, cephalic collar and deirids, position of the vulva in females, number and distribution of papillae and shape of spicules in males (see Vidal et al. 2016).

The nematode *Seuratia* sp. was present in both *F. tropica* analysed, and identified by the presence of an indented cap, large trident deirids, position of the vulva in females, number and distribution of papillae, and shape of spicules in males. Taking into account the low number and poor preservation of the specimens, they could not be identified at a specific level. However, the absence of longitudinal rows of spines suggests the presence of a new species.
The specific identification of *Tetrabothrius* sp. was not possible since the single specimen found in one *F. tropica* was immature.

**Discussion**

This work enlarges the knowledge about the parasites of the Wilson’s storm petrels in Antarctica, being the first one in which the parasite fauna of the Black-bellied storm petrel is explored.

Most Wilson’s storm-petrels and Black-bellied storm petrels were collected at Tres Hermanos colony on Potter Peninsula, 25 de Mayo Island (King George Island) during the breeding season. According with Quillfeldt (2002) adult Wilson’s storm-petrels from this colony fed mainly on crustaceans (80–90%), being krill the most important prey, whereas samples at nests (mainly regurgitates from chicks) contained a higher fish content. It is known that *S. macronectes* use krill as intermediate host (Diaz et al. 2017).

Despite the low number of birds examined, we did not observe differences in the parasitic fauna between adults and nestlings, with *S. macronectes* being the only helminth species parasitizing Wilson’s storm petrels. Unlike them, the Black-bellied storm petrel presented a greater richness, three helminth species (i.e., *S. macronectes*, *Seuratia* sp. and *Tetrabothrius* sp.) were found in only two analysed specimens.

Spirurid nematodes occur in the oesophagus and stomach of seabirds and are one of the most abundant components in the helminth communities of Antarctic and sub-Antarctic birds (Barbosa and Palacios, 2009) mainly penguins (Diaz et al. 2017). Among them, *S. macronectes* is one of the most representative and has been reported in the three Pygoscelid species, also were found in emperor penguin *Aptenodytes forsteri* (Gray), rockhopper penguin *Eudyptes chrysocome* (Forster), and macaroni penguin *Eudyptes crysolophus* (Brandt) (Diaz et al. 2017; Fusaro et al. 2018). It was also reported in the giant petrel *Macronectes giganteus* (Gemelin), the sheathbill *Chionis alba* (Gemelin) (Barbosa and Palacios, 2009), and recently it was found in the snow petrel *Pagodroma nivea* (Foster) and the polar and brown skuas *Catharacta maccormicki* (Saunders) and *Catharacta antarcticus lonnbergi* (Mathews) (Fusaro et al. unpub. data). While the prevalence of this parasite species in Pygoscelid penguins has always been high (e.g., P = 78% in chicks of *P. antarctica*; P = 30% in chicks of *P. adelia*, and P = 48.6% in both chicks and adults of *P. papua*) and it is markedly low in *A. forsteri* (P = 10% in chicks) (Vidal et al. 2012; Diaz et al. 2013, 2016; Fusaro et al. 2018), we observed a higher prevalence in storm petrels, reaching 85%. Based on the difference in size between penguins and storm petrels, we could attribute this high value to a greater host specificity of *S. macronectes*, being petrels its preferred hosts.

Adult Black-bellied storm petrels from the same locality fed on fish and crustaceans in equal proportions (Hahn 1998). However, Quillfeldt (2017) found krill only in 21% of analysed samples of the latter species. Lower krill intake by Black-bellied storm petrels is consistent with a lower prevalence of *S. macronectes*. In other hand, it is important to highlight the finding of *Seuratia* sp. in both Black-bellied storm petrel specimens and its absence in the 20 Wilson's storm-petrels analysed. This would indicate that *Seuratia* sp. use a different intermediate host that *S. macronectes* (e.g., a fish or another crustacean), and/or that *Seuratia* sp. has also a higher host specificity than *S. macronectes*. The presence of *Tethrabothrius* sp. in
the Black-bellied storm petrels and its absence in the Wilson's storm petrels supports the idea of a higher fish ingest by the former.

Present results confirm the low richness of parasitic species in Antarctic birds, in agreement with the lower diversities of intermediate hosts and the extreme climatic conditions that hinders the development of parasitic forms. Additionally, the stenophagic diet of many bird species reduces the chance of acquiring parasites.

The changing climatic conditions that have been occurring in the Antarctic Peninsula and surrounding areas, with the consequent alterations in the distribution of different taxonomic groups, affect the trophic web from bottom to top and cause a significant reduction in the primary production of the food web (Montes-Hugo et al. 2009; Klimpel et al. 2017). These modifications can lead to changes in the parasite diversity, producing host population alterations and even its disappearance.

Currently, seabirds have received more attention due to their condition as reservoirs and disseminators of parasites and pathogens taking into account their longevity and great mobility (Altizer et al. 2013). The large migratory scales together with the interaction between different species along these routes, as well as their conglomerations of reproductive colonies, make them key environmental indicators to understand the parasites and pathogens circulation (McCoy et al. 2016). Well-known example of this is the global circulation of avian influenza A viruses that travel with their bird reservoirs during spring and fall migrations (Olsen et al. 2006). Also, Lymmen disease which is transmitted by ticks is another example of how birds can spread pathogens along their migratory routes (Ogden et al. 2008); the presence of *Babesia* sp. in chinstrap penguins in Antarctica is another example of how ticks act as vectors of parasites (Barbosa et al. 2011; Montero et al. 2016). In the case of helminths, understanding these variations is more complex due to variations in food webs as well as bird migrations. The difficulty in being able to determine the diet during non-reproductive periods increases the difficulty in understanding the variability of helminth richness.

In this way, Antarctic seabirds constitute a particularly interesting group to study trophic variations through the hosts - parasites relationship, due to their role as top predators and their long migratory distances that expose them to many more parasites compared to other groups (Boulinier et al. 2016).

## Declarations

### Acknowledgements

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### Author contributions
BF and JID conceived and designed research. BF, EL, GP, VF, LF analysed host. BF and JID determined parasites. BF and JID analysed data. BF and JID wrote the manuscript. JID, ML and MA supervised sampling and provide financial support. All authors read and approved the manuscript.

**Data Availability Statement**

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

**Conflict of interest**

The authors declare that no conflicts of interest exist.

**Declaration of funding**

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**Ethical Standards**

All samples were taken in compliance with all appropriate research permissions given by the Environmental Management and Tourism Program of the Dirección Nacional del Antártico (DNA), Argentina.

**References**


27. In: Klampel S, Kuhn T, Mehlhorn H (eds) Biodiversity and Evolution


Figures
Figure 1

Distribution of the Wilson's storm-petrel *Oceanites oceanicus* and Black-bellied storm-petrel *Fregetta tropica* showing reproductive areas and sampling zone (BirdLife Internatinonal and handbook of the birds of the world 2017).
Figure 2

Localities sampled. 1. Potter Peninsula, 25 de Mayo/King George Island, South Shetland Islands. 2. Cape Geddes, Lauri Island, South Orkney Islands. 3. Barry Islet, Caleta Sanaviron, Bahia Margarita.