

Endemic breeding birds of Juan Fernández archipelago, Chile

Hadoram Shirihai, Hernán A Díaz, Javier E Huichalaf & Vincent Bretagnolle

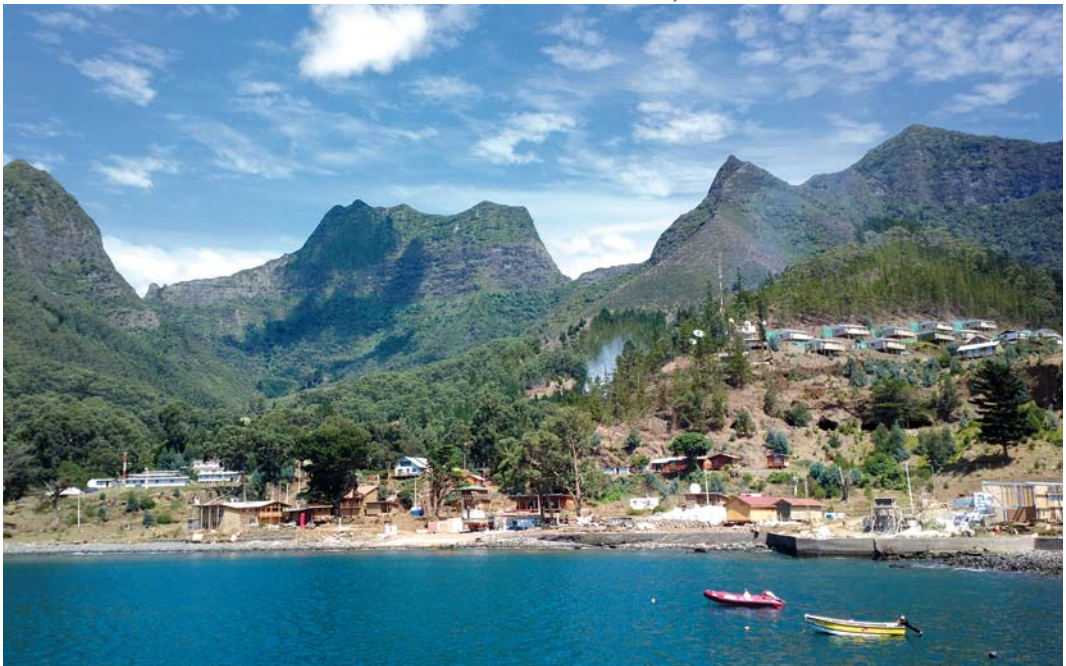
This paper details the special avifauna of Juan Fernández archipelago, off Chile. We visited the archipelago from 3 to 15 March 2013, mainly to study the local gadfly petrels *Pterodroma* at sea, namely Juan Fernández Petrel *P externa*, Stejneger's Petrel *P longirostris* and De Filippi's Petrel *P defilippiana*. While on land, we focused on the endemic landbird taxa of the archipelago, including three full species. This expedition was undertaken by Hadoram Shirihai as part of the Tubenoses Project & Extreme Gadfly Petrel Expeditions for the forthcoming book *Albatrosses, petrels and shearwaters of the world* (Shirihai & Bretagnolle in prep). Special interests included documenting plumage variation, pelagic distribution and population numbers, and feeding techniques and species associations. In addition, we studied the petrels' island-return strategy of a number of species that breed in 'petrel-capital' Masafuera.

As far as we know, our pelagic 'mass chumming' expedition was the first of this type around Juan Fernández archipelago since the Brewster-Sanford Expedition in December 1913 and Rollo Beck's visit in January 1914 (Murphy 1936). Bill Bourne (pers comm; see also Bourne 1983ab, in press) also visited the archipelago in May 1983 recording seabirds.

Methods

To view petrels at sea, it is essential to perform chumming sessions. During the c 1800 km (950 nautical miles) voyage by vessel, we did 12 of these for a total of 42.5 hours (for locations see figure 1), with sessions lasting two to six hours. We used c 1 ton of 'frozen chum-blocks', with 70 blocks in total. Each block consisted of 10-15 kg of fish cuts. We also used a good amount of very dense fish oil. The blocks were stored on board in

1 Robinson Crusoe Island, Juan Fernández archipelago, Chile, 7 March 2013
(Hadoram Shirihai/©Tubenoses Project)





2 Masafuera, Juan Fernández archipelago, Chile, 10 March 2013 (*Hadoram Shirihi*/©*Tubenoses Project*). Bizarre impression of melting ragged huge chocolate cake in middle of ocean, with summit nearly always to some degree covered by thick cloud.

freezers at -20°C . With frozen blocks, the bait floats longer permitting petrels to take food before it sinks. Gadfly petrels are more easily attracted to floating material of a certain size, permitting prolonged and closer views.

HS chose the chumming locations based on lessons learned from previous similar work carried out elsewhere on the world's oceans (eg, Shirihi et al 2009, 2014). Chumming locations were chosen based on the islands' structure, eg, in relation to suitable summits with forest, with constant cloud cover, and with the direction of the islands' deep valleys (where such petrels are likely to congregate on the way to their colonies). In addition, the 'land-mass effect' of the islands was used to determine the most likely distance between the island and the locations where the petrels are suspected to gather (mainly to feed). Chumming locations also took

into account underwater topography (along contour lines and over seamounts). There was almost constant observation en route between 'hotspots'.

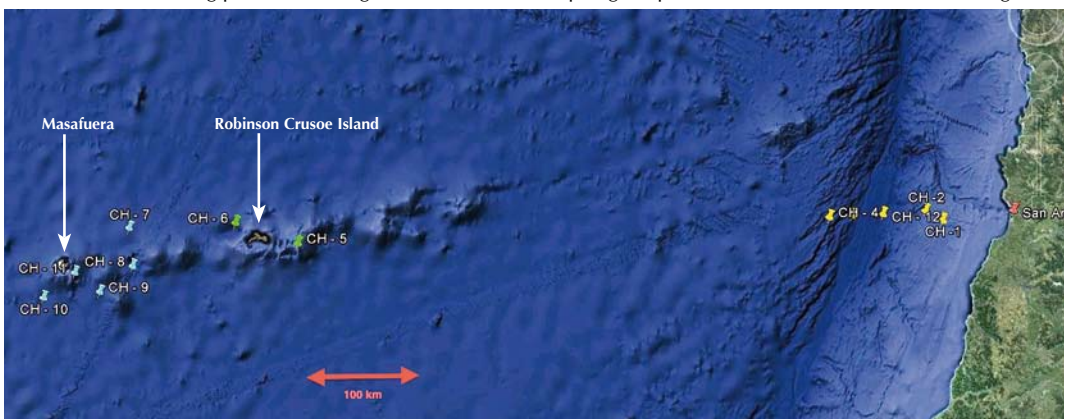
Photographs were made with a Canon 1DX camera with ImageStabiliser 300 and 500 mm lenses.

Characteristics of Juan Fernández archipelago

Geology and geography

Juan Fernández archipelago lies c 700 km west from the central coast of Chile. The archipelago consists of three main islands, with several smaller ones. In this paper, we use the names Masafuera, Robinson Crusoe Island and Santa Clara Island for the larger three islands. However, other names have been in use for the former two islands. Masafuera (meaning 'farther away') is also often

FIGURE 1 Juan Fernández archipelago off central coast of Chile, with Robinson Crusoe Island and Masafuera. CH1-11: chumming positions during Juan Fernández archipelago expedition (see main text) (© 2014 Google)



referred to as Alexander (or Alejandro) Selkirk Island, while Masatierra (meaning 'closer to mainland') has been used for Robinson Crusoe. We only visited Masafuera and Robinson Crusoe so we will not detail Santa Clara further.

Robinson Crusoe was the first island of the group to be discovered by the Spanish sailor Juan Fernández in November 1574. Today, the human population is c 600 people during winter, mostly living in the main village of San Juan Bautista. The population can dramatically grow during the austral summer with the arrival of tourists and local students. The island has a volcanic origin and the short geological time since formation makes the soil vulnerable for wind and water erosion. More than the 70% of the island, especially the west, looks like desert landscape. Forests and green vegetation are found only higher up, mostly in the extreme east, close to the village in Cumberland Bay. The endemic flora and fauna are of great interest but are almost only present near the nearly vertical wall at the top of El Yunque Mount, the highest site of the island at 916 m above sea level. The wall and its forests allow water condensation and provide the only sources for fresh water above the village. In 2010, following a strong earthquake, a tsunami hit the island in the middle of the night. Almost all of the houses close to the coast were destroyed, killing a number of people.

From a distance, Masafuera looks like a large cake in the middle of the sea. Approaching from the east, big foothills can be seen descending from the top of one of the hills down to the coast, which is a narrow belt at this side of the island. From the west side, the island looks imposing; a big V-shape gorge marks the southwest side of the island which, as a whole, appears like a big and massive piece of volcanic rock elevating to the clouds. Only the last 300 metres or so show some green vegetation. The rest of the island is covered by yellow thatch, which is the product of almost 500 years since the first goats were left here for food by sailors (see below). Masafuera is not permanently inhabited. Fishermen live on the island from September to May-June, when the fishing season ends. They follow the tradition of their ancestors, catching lobsters at the same sites inherited from their parents.

Conservation issues

Juan Fernández archipelago fights a battle against extinction, both on land and at sea. The top of the islands is covered by clouds which allow the growth of a particular habitat dominated by mid-to large-sized tree fern forests. Here, the soil is sufficiently soft for petrels to dig burrows to give pro-

tection from non-native predators. However, because goats roam the islands ever since they were introduced by the sailor Juan Fernández himself, it is impossible to know how much of the islands used to be covered with such vegetation. Today, not only the grazing by goats but also by cattle and rabbits results in erosion and degradation of the natural vegetation. This results in problems for the endemic landbirds (Colwell 1989, Hahn & Römer 2002). Furthermore, also introduced plant species cause havoc on the natural ecosystem of the islands. Exotic invasive plant species radically changed the original natural forest conditions and the landscape of the archipelago. The changed habitat supports the presence of highly destructive animals, like rats, cats and Coatis *Nasua nasua*, which readily adapted to the modified ecological conditions. Examples of invasive plants include *Acaeria argentea*, *Aristotelia chilensis*, *Rubus ulmifolius* and *Ugni molinae* (Dirnböck et al 2003). The presence of blackberry *Rubus* furthermore facilitated a successful colonization of Austral Thrush *Turdus falcklandii* to first Robinson Crusoe and then to Masafuera. The thrush is suspected to raid nests of endemic landbird species (Hahn et al 2011b). Furthermore, with the thrush, blackberry and other invasive plant species can also spread to Masafuera (Smith-Ramírez et al 2013).

Not only the endemic landbirds suffer, however, but also the petrels (Hahn & Römer 2002). For these, the main danger apparently comes from predation by rats and cats as well as by the ongoing decrease of breeding habitat linked to the increase in erosion caused by feral goats. For instance, not long ago, Juan Fernández Petrel may have bred at much lower elevations. Only in recent times it has been forced to breed closer to the summit where it is relatively safe for the pressures by goats and cats. The breeding population of Juan Fernández consequently seems to be lower than it used to be. Being the smaller of the two, the problem for Stejneger's Petrel may be even more urgent, as this species may be the favoured prey by rats, mice and cats in the mixed-species colonies that it forms with the larger Juan Fernández (Brooke 1987b). The colony habitat also suffers from landslides and fires, although the effects of these on the species are not clear.

The National Forestry Corporation (CONAF) and the Service for Agriculture and Cattle (SAG) of Chile started a determined combat against these problems, as evidenced by a concerted effort for forest restoration during the last decade. Worryingly, however, there have been only limited efforts to eradicate non-native predators from Masafuera.



3 Juan Fernández Firecrown / Juan-Fernándezkolibri *Sephanoides fernandensis*, male, Robinson Crusoe Island, Chile, 7 March 2013 (Hadoram Shirihai/©Tubenoses Project). Typical hanging upside-down feeding behaviour.



4 Juan Fernández Firecrown / Juan-Fernándezkolibri *Sephanoides fernandensis*, male, Robinson Crusoe Island, Chile, 7 March 2013 (Hadoram Shirihai/©Tubenoses Project).

Masafuera is one of the most important sites for breeding petrels in the eastern Pacific and, despite being a World Heritage Site, we have little hope for the two endemic petrels without eradication of the introduced fauna (rats, mice, cats and goats) from the island. Furthermore, permanent or regular monitoring of the populations is lacking.

Problems also occur at sea. The depletion of food resources caused by industrial overfishing can have a tremendous impact. Both humans and Juan Fernández Fur Seal *Arctocephalus philippii* depend on the marine resources, as do the petrels. The endemic fur seal was feared extinct until 1967, when Nibaldo Bahamonde rediscovered it at Masafuera. Another threatened animal is Juan Fernández Lobster *Jasus frontalis*, which has been the core of economic sustainability for the archipelago since it was colonized. Now decidedly scarcer compared with previous decades, lobster catch has been reduced by two-thirds during the last 50 years. Overexploitation and inadequate regulation of the resources have forced fishermen to face up to the future in a more visionary and planned manner. Many projects are underway

with new catching methods and alternative marine products. Even so, lobsters will continue to be the main economic driver, at least for a while.

Endemic landbirds of Juan Fernández archipelago

Introduction

Three landbird species are endemic to Juan Fernández archipelago: Juan Fernández Firecrown *Sephanoides fernandensis* and Juan Fernández Tityrant *Anairetes fernandezianus* on Robinson Crusoe, and Masafuera Rayadito *Aphrastura masafuerae* on Masafuera. Furthermore, on Masafuera, endemic subspecies of Red-backed Hawk *Buteo polyosoma exsul* and Grey-flanked Cinclodes *Cinclodes (oustaleti) baeckstroemii* occur (Jiménez 1995, Farquhar 1998, Hahn et al 2005). Both are candidates to be split as full species. The islands also have the endemic subspecies of American Kestrel *Falco sparverius fernandensis* but this is not a candidate for full species status and will not be featured here.

We were able to visit the specific habitats of the landbirds thanks to the help by the staff of CONAF. Most of these people were born on the islands and thus know the terrain and where to find the birds.

Juan Fernández Firecrown

Despite several reports suggesting that this species is in decline, we found it to be numerous, present in almost every corner near Cumberland Bay on Robinson Crusoe. It has gone extinct, however, on Masafuera (Brooke 1987a, Colwell 1989, Roy et al 1998). We found main concentrations in gardens and parks of the village, where the air was filled with the strange and energetic buzzy vocalizations of the hummingbirds flying from bush to bush, competing over the nectar of the flowers. Both males and females showed this behaviour. While foraging, they frequently perch on flowers in a typical upside-down manner (plate 3). *Abutilon pictum* seemed to be a favourite with large numbers of males visiting the flowers: some large bushes supported over 20 males. Numbers of Juan Fernández Firecrown have recently been estimat-

ed at 2000-3000 individuals (<http://oikonos.org/juan-fernandez-firecrown>) and, based on the number of birds we saw in our expedition, we agree with these figures. This seems to indicate an increase from the 250-400 individuals that were estimated by Roy et al (1998) but is similar to the estimate of 1980 individuals in 2009 (Hahn et al 2011a).

Juan Fernandez Firecrown shows extreme sexual dimorphism, which even resulted in both sexes being described as separate species (Colwell 1989, Roy et al 1998). The species shares or competes for resources with the non-endemic Green-backed Firecrown *S. sephaniodes* that is a relative newcomer to the islands (Colwell 1989, Roy et al 1998). Both species compete mainly for the nectar of introduced species like *Abutilon* or *Eucalyptus* which abound in the surroundings of the village. Although the flowers of at least 12 endemic plant species are equally suitable, most of these, like *Dendroseris litoralis*, *Raphithamnus venustus* and *Sophora fernandeziana*, are now endangered (Colwell 1989).

5 Juan Fernández Firecrown / Juan-Fernándezkolibrie *Sephanoides fernandensis*, male, Robinson Crusoe Island, Chile, 7 March 2013 (Hadoram Shirihai/©Tubenoses Project) 6 Juan Fernández Firecrown / Juan-Fernándezkolibrie *Sephanoides fernandensis*, female, Robinson Crusoe Island, Chile, 7 March 2013 (Hadoram Shirihai/©Tubenoses Project). Note that high degree of sexual dimorphism, although with still distinctly attractive and colorful female plumage in its own way, is reason why this species was initially mistakenly described as two species!





7 Green-backed Firecrown / Vuurkroonkolibrie *Sephanoides sephaniodes*, female, Robinson Crusoe Island, Chile, 7 March 2013 (Hadoram Shirihai/©Tubenoses Project) 8 Green-backed Firecrown / Vuurkroonkolibrie *Sephanoides sephaniodes*, male, Robinson Crusoe Island, Chile, 7 March 2013 (Hadoram Shirihai/©Tubenoses Project). Other hummingbird species on Robinson Crusoe. 9 Juan Fernández Tit-Tyrant / Juan-Fernándezmeestiran *Anairetes fernandezianus*, Robinson Crusoe Island, Chile, 7 March 2013 (Hadoram Shirihai/©Tubenoses Project)



Juan Fernández Tit-tyrant

We first encountered one bird of this species at the plantation at the edge of the town. We did not see good numbers, however, until we reached the forest recovery site of Plazoleta El Yungue at the base of El Yunque Mount, the highest mountain on Robinson Crusoe. We located and photographed six pairs.

This small passerine is unmistakable, especially due to its pointed crest that can be raised. These crown-feathers resulted in the local names for the species: cachitoro, little horns (cachudito), and little bull (torito). The upperparts are dark ash-grey and the underparts and basal chest are white with black stripes. The 'raised' crest-feathers are shorter in the female. The tit-tyrants may be solitary, or found in pairs or family groups. It is a very active bird continuously moving among the leaves and branches looking for insects. It is very curious, approaching and sometimes temporarily following human observers before continuing foraging (Hahn 2005), although others may be shier. Its population was estimated at 1550 birds in 2009 (Hahn et al 2011a).

Masafuera Rayadito

In order to find this endemic species, one has to

climb to the higher elevations of Masafuera. We first tried to locate the species at Refugio La Cuchara, close to Cordón Atravesado. Here, we found ourselves in appropriate habitat on the extremely steep vertical valleys where dense ferns *Lophosoria quadripinnata* grow (Brooke 1988). We found and photographed one bird very briefly in the morning of 12 March but could not relocate it during almost two hours of search. We then descended to c 1000 m at the even steeper Cordón Atravesado in El Guatón gorge, where we found at least four pairs giving alarm calls. We managed to attract one pair with a juvenile, and took very good photographs. We then had to ascend back to 1200 m (in dense cloud cover and rain for much of the time), to reach Refugio La Cuchara again before we could finally descend to the village, that was reached after nearly five more hours.

The population of Masafuera Rayadito is very small. During the austral breeding season, mainly between December and February, it is 'easiest' to find them as they fly on and off from their nest which itself is very difficult to locate (Hahn et al 2011b). Only by observing these birds over several days, they will reveal their tiny nest entrance in the rock, located 4-5 m above the ground (Hahn et al 2004, Tomasevic et al 2010). Interestingly, Toma-

10 Masafuera Rayadito / Masafuerarayadito *Aphrastura masafuerae*, Masafuera, Chile, 11 March 2013
(Hadoram Shirihai/©Tubenoses Project)



Endemic breeding birds of Juan Fernández archipelago, Chile



11 Masafuera Rayadito / Masafuerarayadito *Aphrastura masafuerae*, Masafuera, Chile, 11 March 2013 (*Hadoram Shirihai/©Tubenoses Project*) **12** Red-backed Hawk / Roodrugbuiserd *Buteo polyosoma exsul*, Masafuera, Chile, 11 March 2013 (*Hadoram Shirihai/©Tubenoses Project*) **13** Habitat of Red-backed Hawk *Buteo polyosoma exsul*, Masafuera, Chile, March 2013 (*Hadoram Shirihai/©Tubenoses Project*) **14** Red-backed Hawk / Roodrugbuiserd *Buteo polyosoma exsul*, Masafuera, Chile, 11 March 2013 (*Hadoram Shirihai/©Tubenoses Project*)





15 Red-backed Hawk / Roodrugbuizerd *Buteo polyosoma exsul*, Masafuera, Chile, 11 March 2013
(Hadoram Shirihai/©Tubenoses Project)

sevic et al (2010) successfully placed nest boxes for this species.

The species is highly territorial and utters a strong buzzy-like *chirp*. It adopts a larger posture by puffing up body-feathers and partially spreading the wings (plate 10). Birds are restless and often change locations, seemingly to avoid detection by the local Red-backed Hawk, which is the only known indigenous predator of the species (Hahn et al 2004). The rayadito prefers to move under fern cover, and the need to move farther from the nest makes them vulnerable to foraging hawks (Hernán Díaz pers obs).

Most recently, Tomasevic et al (2010) estimated the population at c 500 individuals. It is considered nationally endangered (Schlatter 1987, Glade 1993).

Red-backed Hawk

The local subspecies *exsul* differs from the continental birds in occurring in only one morph, that furthermore only occurs in *exsul* (Farquhar 1998). The population is estimated at 250 individuals and is classified as endangered.

We encountered the species everywhere between the shore and the summit of Masafuera; at least 25 individuals were seen. Non-adult Red-backed Hawks are common in small groups close to the village. They are accustomed to people and may approach you very closely. Adults are commoner at higher altitudes, usually seen in pairs flying over their territories, resting and foraging intermittently. They construct their nest mainly with branches and feathers on cliffs or in cypress-pines and eucalyptus. They feed mainly on petrels which

are abundant at early morning and twilight but have also been seen stalking rayadito nests. During the fur seal breeding season, birds permanently patrol the fur seal colony and have been seen eating placenta.

Grey-flanked Cinclodes

The population of Grey-flanked Cinclodes on Masafuera was most recently estimated at c 1500 individuals (Hahn et al 2005, Hahn 2006) and is considered endangered. This subspecies is a potential split, because of its differences in morphology and vocalizations from the continental taxa (Hahn 2006). Birds occur throughout the whole altitude range of the island but prefer to be close to freshwater streams (Hahn 2006). They may also be seen on rocky beaches in the vicinity of waterfalls. We only located three birds in the morning of 12 March.

Breeding gadfly petrels at Juan Fernández archipelago

Introduction

For three species, Juan Fernández archipelago, and particularly Masafuera, is an important breeding ground or even the only one in the world: Juan Fernández Petrel, Stejneger's Petrel and De Filippi's Petrel. A fourth species, Kermadec Petrel *P neglecta juana* has only a small population of 200 pairs in Juan Fernández archipelago (Brooke 2004). March is outside its breeding season, and we only saw three birds around the archipelago (plate 29).

Many 1000s of petrels nest on the tops of

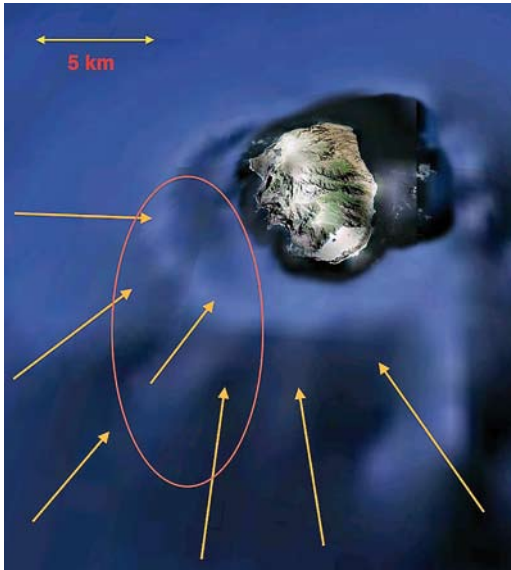


FIGURE 2 Masafuera, Chile. Petrels (mostly Juan Fernández Petrel *Pterodroma externa*, see main text) come from all directions, with main influx in evening. Incoming petrels into Masafuera shown as yellow arrows; red circle indicates main gatherings area (© 2014 Google)

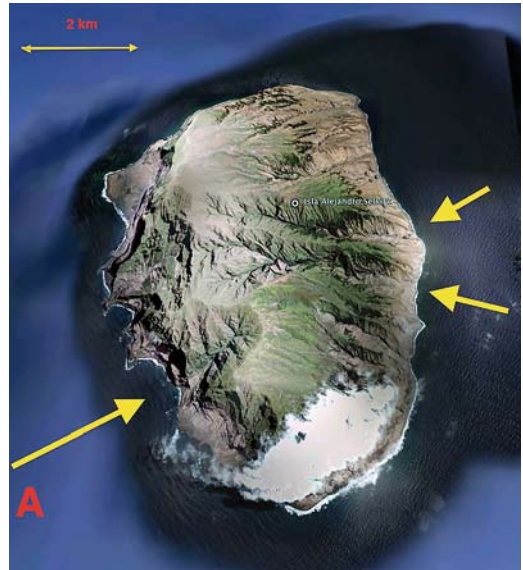


FIGURE 3 Masafuera, Chile. Yellow arrows show main directions of evening penetration of petrels (mostly Juan Fernández Petrel *Pterodroma externa*, see main text) into Masafuera; El Tongo valley (A) is possibly main flyway valley (© 2014 Google)

Masafuera, especially in the soft terrain and fresh grass carpets. Most of the burrows are hidden in the middle of tree fern forests. Every early morning, one bird of the pair leaves the nest to go to sea to feed. The other one of the pair will spend all day incubating the egg or rearing the chick. Birds gather around the island at twilight, waiting for almost total darkness before flying back to the nest. Because the nests are very difficult to find in the dark, acoustic communication between partners is important. Therefore, a loud cacophony of petrel vocalization starts to inundate the night air together as darkness falls.

We tried to locate petrels at sea during nine chumming sessions around Robinson Crusoe and Masafuera, mostly working off the eastern, southern and south-western sides of the islands.

Juan Fernández Petrel

Population size and numbers recorded at sea

Juan Fernández Petrel is an endemic breeder of Masafuera. Brooke (1987b) estimated the population in 1986 at one million pairs (which indicates a world population of at least three million birds). We counted c 85 000 individuals.

Distribution at sea

With such numbers, it was not surprising that birds were encountered around both Robinson Crusoe and Masafuera, although the bulk was seen around Masafuera. There, birds rested or fed during daytime or waited in the evening for their return to the islands. Other significant numbers were found on the oceanic ridge c 65 km east of Masafuera, which often involved many birds resting or feeding during the day.

We found three main feeding grounds. One stretched almost 100 km (c 400-500 km east from Masafuera), between the coordinates 33°35'S; 76°13'W to 33°38'S; 74°54'W (yellow circle in figure 4). On 14 March, we counted 17 000 birds there. A second feeding area was located around the western edge of the Continental Shelf (33°39'S; 73°25'W) where a deep canyon leads westward. On 4 March, we sailed through 200 Juan Fernández Petrels around that area that fed in association with six Sei Whales *Balaenoptera borealis*. The third major feeding concentration was located around the oceanic ridge between Robinson Crusoe and Masafuera at around 33°5'S; 80°6'W (c 65 km east from Masafuera; yellow circle in figure 5). Counts on 8 March alone produced 12 000 birds between 09:00 and 12:00.



FIGURE 4 Juan Fernández archipelago, with Robinson Crusoe Island (1) and Masafuera (2). Main feeding grounds of petrels (yellow circle) stretch for almost 100 km (at roughly 400-500 km east from Masafuera); another one was located around western edge of Continental Shelf (right red arrow; see main text) (© 2014 Google)

We were surprised to see this species feeding far east over the Humboldt Current. The crossings over the Humboldt waters produced in total 531 birds, with most around the Continental Shelf (110-165 km off the coast; see figure 4). This total includes 31 birds recorded as far east as 63 and 80 km off the coast on 3 March.

Feeding behaviour at sea

Juan Fernández Petrel is a social feeder: we hardly saw birds feeding singly under natural feeding conditions (ie, not involving chumming). They formed spirals of birds following or briefly hanging above food sources, and dramatic aerial forma-

tions, including tight group arching (plate 16). The main natural prey is flying fish and squid, and other small fish that jump above the surface. They follow shoals of larger predator fish (like tuna) that chase and panic these small creatures into leaping above the surface in huge numbers – the petrels collect them in the air, and are able to do this due to their incredibly fast flight. We do not exaggerate with our estimate that the speed of flight is 200 km/h in strong wind conditions, similar to Peregrine Falcon *Falco peregrinus*. Under artificial feeding conditions (ie, chumming), Juan Fernández Petrel collects small floating food items from the surface while flying (before the item sinks). If the food is

FIGURE 5 Location of oceanic ridge between Robinson Crusoe Island (right) and Masafuera (left) where major feeding concentration was located (yellow circle; mostly Juan Fernández Petrels *Pterodroma externa*, see main text) (© 2014 Google)





16 Juan Fernández Petrels / Witnekstormvogels *Pterodroma externa*, off Masafuera, Chile, 12 March 2013 (Hadoram Shirihai/©Tubenoses Project). Feeding flock during chumming session.

composed of large pieces, they often rest on the surface for a few seconds (at most 50) with open wings and peck at it. They often formed feeding frenzies and dropped down to the frozen chum blocks to eat from them, or to collect small pieces while in flight, mainly when a shark was scavenging from the chum block and breaking it into small pieces. Again, Juan Fernández Petrel feeding behaviour is thus in association with larger predator fish. Diving or other means of collecting food below the surface was not recorded.

Returning behaviour to colonies

During the day, many flocks gathered involving 10s or 100s of birds, with many resting, or even performing feeding frenzies related to tuna shoals. Other birds were just hanging around in front of the island waiting for evening. However, from c 17:00, an increasing number of birds came from all directions but especially from the south and west of the island, and headed to the western side (where we made counts from about position CH-10 or when moving/sailing eastward toward the island until dark, 9 March). From c 19:30 (but most intensely from 20:00 to 21:00), a sudden influx of petrels happened, with many flocks forming streams of many kilometres long, totaling 50 000 individuals on 9 March, heading straight or moving in circles. Our impression was that gatherings mainly occurred west of the island with birds coming from all directions but with much higher concentrations toward the huge El Tongo valley (see figure 2 and 'A' in figure 3 showing these movements).

There was a similar gathering (but with smaller numbers) on the eastern side of the island, with petrels seemingly heading toward the Las Casas

and Las Vacas valleys. Indeed, it was phenomenal to see this sudden influx of petrels coming toward the island!

On 10 March, we climbed the ridge bordering Las Casas valley, and mostly from dusk to almost 23:00. Along the edges of many of the steep and deep ravines, we could hear and see with a spotlight the massive wave of petrels that funneled upward toward the island. The peak movement (c 500 m height) was about one hour after dark, most likely involving breeders that headed straight to their nests. After 23:00, a sudden drop of these movements occurred. However, in the night of 11 March, HS was at the coastal village at the entrance of Las Casas valley and observed and heard 10s of petrels all night long, coming from the ocean to investigate the entrance of Las Casas valley, and to display there. These birds apparently concerned non-breeding immature birds. People in the village also confirmed that similar gatherings of petrels occur at night in Las Vacas valley.

Stejneger's Petrel

Population size and numbers recorded at sea

Stejneger's Petrel is an endemic breeder of Masafuera. [Carboneras \(1992\)](#) estimated the population at 131 000 pairs, although [Hodum & Wainstein \(2003, 2004\)](#) indicated that lower numbers were involved, suggesting a decline. On 6-13 March, we counted a total of 1925 individuals (see below); on 9 March we estimated that the influx of incoming flocks of petrels toward Masafuera involved one Stejneger's for every 50 Juan Fernández Petrels, which could give a hint on their relative population sizes.



17 Juan Fernández Petrels / Witnekstormvogels *Pterodroma externa*, off Masafuera, Chile, 8 March 2013 (*Hadoram Shirihai*/©*Tubenoses Project*) **18** Juan Fernández Petrel / Witnekstormvogel *Pterodroma externa*, off Masafuera, Chile, 12 March 2013 (*Hadoram Shirihai*/©*Tubenoses Project*) **19** Stejneger's Petrel / Stejnegers Stormvogel *Pterodroma longirostris* (above) and Juan Fernández Petrel / Witnekstormvogel *P externa* (below), off Masafuera, Chile, 12 March 2013 (*Hadoram Shirihai*/©*Tubenoses Project*). The two gadfly petrels endemic to Juan Fernández archipelago.





20 Juan Fernández Petrels / Witnekstormvogels *Pterodroma externa*, off Masafuera, Chile, 12 March 2013
(Hadoram Shirihai/©Tubenoses Project)

21 Juan Fernández Petrel / Witnekstormvogel *Pterodroma externa*, off Masafuera, Chile, 4 March 2013
(Hadoram Shirihai/©Tubenoses Project)





22-23 Stejneger's Petrel / Stejnegers Stormvogel *Pterodroma longirostris*, off Masafuera, Chile, 12 March 2013 (Hadoram Shirihai/©Tubenoses Project) **24** Stejneger's Petrel / Stejnegers Stormvogel *Pterodroma longirostris*, off Masafuera, Chile, 8 March 2013 (Hadoram Shirihai/©Tubenoses Project) **25** Stejneger's Petrel / Stejnegers Stormvogel *Pterodroma longirostris*, off Masafuera, Chile, 10 March 2013 (Hadoram Shirihai/©Tubenoses Project)



Endemic breeding birds of Juan Fernández archipelago, Chile

Distribution at sea

We encountered Stejneger's Petrel primarily around Masafuera in relation to an 'en masse' return to the colonies (from a generally southern direction). Gatherings mostly took place south and south-west off Masafuera, at c 34°4'S; 81°1'W (CH-10, figure 1), which is c 42 km south-west off the centre of the island. On 9 March, a bulk of c 1000 birds was counted between 19:30 and 21:30. Other significant numbers were found around the oceanic ridge c 65 km east of Masafuera between 09:00 and 12:00 on 8 March (250 birds), and 'en route' to position CH-9 at 34°3'S; 80°27'W, where we chummed between 10:00 and 13:00 (210 birds) on 9 March. On 12 March, when chumming at position CH-11 (33°53'S; 80°41'W) c 15 km south-east off Masafuera, 300 Stejneger's were counted between 13:30 and 17:30.

The fact that we primarily saw them when they were returning to the colonies suggests that foraging areas are far from the island. This accords with the very few found between the archipelago and the continent of South America. Based on our observations, this species does not feed in the Humboldt Current around the latitudes 33°S, ie, straight east of Juan Fernández archipelago, at this time of the year. In fact, one of us (HS) happened to discover a specific feeding ground of this petrel in and around off Concepción just off Chile (where the continental shelf starts dropping, and mostly around coordinates 36°41'S; 73°34'W and 36°38'S;

73°45'W, which is c 37 and 61 km off the coast-line, respectively). It thus seems to have a very specific feeding ground mostly in the colder waters of the southern part of the Humboldt Current, south-east of Juan Fernández archipelago.

Feeding behaviour at sea

Despite that Stejneger's Petrel is often seen with Juan Fernández Petrel, Stejneger's tends to segregate from the larger and more aggressive scavenger Juan Fernández on the chum slick. Also, under natural feeding conditions (not when attracted to chum), Stejneger's never joins the feeding frenzies of Juan Fernández. Thus, the two species have a completely different diet and feeding behaviour and technique, that of Stejneger's being typical of *Cookilaria* petrels, collecting small scraps of floating offal or surfaced marine organisms. Stejneger's forms at most only small and dispersed groups in one area, usually being a solitary feeder. Also, Stejneger's only very briefly and hesitatingly visited the chum slicks or the small moving boat.

Returning behaviour to colonies

Stejneger's Petrel does not hang around Masafuera during the day. Most birds seem to come from long distance feeding grounds south of the island, with most approaching Masafuera in the last daylight hour, in one main influx just 30 minutes before dusk. In such moments, up to 30 birds could be seen in one area at the time, and mostly from the

26 De Filippi's Petrel / Juan-Fernándezstormvogel *Pterodroma defilippiana*, between Robinson Crusoe Island and Masafuera, Chile, 4 March 2013 (*Hadoram Shirihai*/©*Tubenoses Project*)





27 De Filippi's Petrel / Juan-Fernándezstormvogel *Pterodroma defilippiana*, 'en route' to Juan Fernández Archipelago, Chile, 15 March 2013 (*Hadoram Shirihai/©Tubenoses Project*). Winter breeder that we did not expect to see in such large numbers as we did in March, raising questions about their origin. **28** De Filippi's Petrel / Juan-Fernándezstormvogel *Pterodroma defilippiana*, between Robinson Crusoe Island and Masafuera, Chile, 8 March 2013 (*Hadoram Shirihai/©Tubenoses Project*)

direction of position CH-9, 10 and 11 (see figure 1), where there was the impression of a corridor flight-path.

De Filippi's Petrel

Population size and numbers recorded at sea

Unlike Juan Fernández Petrel and Stejneger's Petrel, De Filippi's Petrel is not an endemic breeder to Juan Fernández archipelago. There, probably a few 100s pairs breed on Santa Clara and islets off Robinson Crusoe. At least 1000 pairs breed on San Ambrosio, Desventuradas Islands (c 800 km north of Juan Fernández archipelago), with a few 10s of pairs on San Félix, although the world population was recently estimated at 6000-15 000 individuals (BirdLife International 2015). It breeds in the austral winter and spring, which means that the species returns to the colony in May-June, and lays in August-September, with fledglings appearing by January. We did thus not expect to see this species in March 2013 as it should be much further north in the eastern Pacific. However, we counted 604 birds, including 200 (09:00-21:00) on 14 March, roughly between 33°35.15'S; 76°13'W and 33°38'S; 74°54'W, while moving east to San Antonio. On 15 March, we counted 340 birds (08:00-15:00), roughly between 33°35'S; 73°24'W and 33°37'S; 72°54'W.

Distribution at sea

We were surprised to encounter a fair number all along the stretch between the Humboldt Current to Juan Fernández archipelago, and even on some

chumming sessions off Masafuera. During the crossings of the Humboldt Current, we saw 34 birds, with most being juveniles of the recent fledgling period (December-January), although two birds concerned adults in moult. The fact that we found this species in small but uniform numbers across the areas of the expedition shows that the species does not leave the area 'en masse'.

Feeding behaviour at sea

De Filippi's Petrel behaves very differently at sea compared with both Juan Fernández Petrel and Stejneger's Petrel. First, this small gadfly petrel is a boat follower, with the same individuals following a boat for quite some time, and keeping up with its speed, typically by circling or hovering. When feeding, it never occurs in flocks larger than six birds, and quite frequently only two or three birds are seen feeding together at one spot. The maximum number of birds observed in one view was up to 25.

De Filippi's Petrel is quite often attracted to (and then following) the feeding frenzies of Juan Fernández Petrel. However, in mixed flocks, it remains on the side and at the rear, seemingly collecting smaller food scraps at the back. Picking up food only occurs in a low, flapping, often hovering flight.

Reasons for out-of-season occurrence off Chile (including Juan Fernández archipelago)

De Filippi's Petrel is among the least known gadfly petrels. For both the breeding and non-breeding season, little information is available, nor on its



29 Kermadec Petrel / Kermadecstormvogel *Pterodroma neglecta juana*, between Robinson Crusoe Island and Masafuera, Chile, 14 March 2013 (Hadoram Shirihai/©Tubenoses Project)

movements and its seasonality. De Filippi's disperses from the breeding islands northward into the Humboldt and Peruvian Currents. Indeed, good numbers were found in the latter waters in September 2003 (see www.oceanwanderers.com/PetrelCocktail.html). Carboneras (1992) also mentions it being 'absent from sea around breeding grounds, March-January' as well as its northward dispersal up to the Peruvian Current. With current knowledge, it is thus impossible to relate our observations to any particular known colony. Our birds were rather pale, regardless of age. They involved mostly evenly fresh juveniles but some were adult/immature at the end of primary moult. We noted the following characters: relatively limited black wing tip area (with extensive white inner web thongs penetrating the black wing tip); narrower/shorter and often broken dark diagonal bar of the underwing-coverts; seemingly whiter face (with extensive and cleaner white forehead connecting to the white supercilium, thus leaving rather narrow and more pointed black eye-mask); and with whiter and cleaner outer tail-feathers. The bill seemed also rather narrow but longish.

Could these birds represent an unknown summer breeding population of Juan Fernández archipelago? Are these birds breeders from other islands, of which we by chance crossed the feeding grounds? Brooke (2004) mentioned that De Filippi's Petrel is 'fairly sedentary' but contrarily also stated that it 'may move north during the non-breeding season, perhaps even north of the equator'. The presence of birds of this appearance at this time of year thus raises the question if De Filippi's varies

geographically and if perhaps more than one taxon is involved. A complication for future research may be that the type specimen of De Filippi's was collected at sea off northern Chile (Giglioli & Salvadori 1869). It may be impossible to relate this type and its morphological characteristics to any of the known populations without extensive study.

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Samenvatting

ENDEMISCHE BROEDVOGELS VAN JUAN FERNÁNDEZ-ARCHIPEL, CHILI In dit artikel wordt de bijzondere avifauna besproken van de Juan Fernández-archipel, op c 700 km af

stand van het vasteland van Chili. De grootste eilanden van de archipel zijn Masafuera, Robinson Crusoe en Santa Clara. In de inleiding worden de telmethoden op zee besproken, evenals de geologie en geografie van de eilandengroep, en wordt ingegaan op de beschermings-situatie. Zowel op zee als op land staan de endemische broedvogels onder druk, bijvoorbeeld door geïntroduceerde zoogdieren en planten.

De auteurs bezochten de archipel in maart 2013, met name om *Pterodroma*-stormvogels op zee te bestuderen. Er broeden twee endemische soorten, Witnekstormvogel *P. externa* en Stejnegers Stormvogel *P. longirostris*; Juan-Fernándezstormvogel *P. defilippiana* is bijna-endemisch en broedt ook op andere eilanden in de regio. Speciale aandacht werd besteed aan het documenteren van kleedvariatie, de pelagische verspreiding en aantallen, foerageertechnieken, associatie met andere soorten en de routes waarlangs vogels van zee terugkeerden naar de broedlocaties. Het was voor het eerst sinds 1914 dat in deze wateren een uitgebreide pelagische studie werd verricht. In totaal werd gedurende 42.5 uur aan 'chumming sessions' gedaan, tijdens een zeereis van 1800 km. Van de drie behandelde *Pterodroma*'s is Witnekstormvogel het talrijkst, met een populatieschatting (in 1986) van 3 miljoen exemplaren (1 miljoen broedparen); de auteurs telden in maart 2013 c. 85 000 exemplaren. Deze soort foerageerde op zee in groepen van enkele 10-tallen tot 1000en. Van Stejnegers Stormvogel werd de populatie in 1992 op 131 000 broedparen geschat. De auteurs telden in totaal 1925 exemplaren; de verhouding tussen Witnekstormvogels en Stejnegers op zee was naar schatting 1:50. Witnekstormvogel en Stejnegers werden vaak samen in grote groepen waargenomen, waarbij Witnekstormvogel dominant gedrag vertoonde. Juan-Fernándezstormvogel is op wereldschaal de zeldzaamste soort van de drie, met een wereldpopulatie van 6000-15 000 vogels. De auteurs telden in totaal 604 exemplaren, wat verrassend was omdat de soort geacht werd in deze tijd van het jaar verder noordelijk te verblijven. In tegenstelling tot de andere twee volgde deze soort schepen en de groeps-grootte was steeds klein, tot maximaal zes. De vogels verbleven altijd aan de rand van grote groepen stormvogels. Omdat onduidelijk is van welke kolonie(s) de waargenomen vogels afkomstig waren en omdat de auteurs enkele morfologische bijzonderheden noteerden wordt de vraag opgeworpen of ze een tot nu toe onbeschreven taxon zouden kunnen vertegenwoordigen.

Van de landvogels zijn drie soorten endemisch: Juan-Fernándezkolibrie *Sephanoides fernandensis* (daarnaast komt de niet-endemische Vuurkroonkolibrie *S. sephanioides* voor) en Juan-Fernández-meestiran *Anairetes fernandezianus* op Robinson Crusoe en Masafuerarayadito *Aphrastura masafuerae* op Masafuera. Twee andere endemische taxa op Masafuera, Roodrugbuizerd *Buteo polyosoma exsul* en Grijsflankwipstaart *Cinclodes oustaleti baeckstroemii*, verdienen mogelijk eveneens soortstatus maar worden (nog) als ondersoorten beschouwd. De endemische ondersoort van Amerikaanse Torenvalk *Falco sparverius fernandensis* wordt niet als potentiële

'split' beschouwd. De populatie van Juan-Fernándezkolibrie bedraagt naar schatting 2000-3000 exemplaren en vertoont mogelijk een opwaartse trend. Opmerkelijk bij deze soort is het grote verschil in uiterlijk tussen mannetjes en vrouwtjes. De populatie van Juan-Fernándezmeestiran werd in 2009 op 1550 vogels geschat. Madafuerarayadito is de zeldzaamste endemische landvogel, met een geschatte populatie van c. 500. De lokale populaties van Roodrugbuizerd en Grijsflankwipstaart bedragen respectievelijk c. 250 en c. 1500 exemplaren.

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- Hadoram Shirihai, Emek Aylon 4, 6080001 Shoham, Israel (albatross_shirihai@hotmail.com)
- Hernán A Díaz, Laboratorio de Ecología y Biodiversidad, Facultad de Química y Biología, Universidad de Santiago de Chile, Avenida Libertador Bernardo O'Higgins 3363, Estación Central, 9170022 Santiago de Chile, Chile (hernan.diaz@usach.cl)
- Javier E Huichalaf, Pasaje Maravillar 1330 Santa Inés, Viña del Mar, Valparaíso, Chile
- Vincent Bretagnolle, CEBC CNRS, 79360 Beauvoir sur Niort, France (breta@cebc.cnrs.fr)