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# Status of breeding birds at Observatorio and Goffré Islands, Argentina

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| **Abstract:** | Continental islands are often sites of low diversity and endemism, as well as important areas for the protection of bird populations, especially seabirds. On Isla Observatorio and the Año Nuevo Islands, in the Southwestern Atlantic, the latest assessment of avifauna dates from more than 20 years ago. In this study, we use a combination of methods to update the status of the main seabird colonies and the most abundant avian terrestrial predator at Observatorio and Goffré Islands during the breeding season. In only 4.5 km 2 , the islands would harbour ~90,000 breeding seabirds. Seabird colonies occupied different areas of the islands and varied in their population status, with Imperial shags ( Leucocarbo atriceps ) showing an increase and Southern Giant Petrels ( Macronectes giganteus ) a decrease according to the last surveys. Magellanic Penguin ( Spheniscus magellanicus ) population estimations also suggest a decrease but the last survey was based on total, and not on occupied nest sites. We recorded and assessed one new breeding species: The globally Near Threatened Striated Caracara ( Phalcoboenus australis ), which has an important breeding population of around 15 territorial pairs at Observatorio Island. These islands appear to |

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# Status of breeding birds at Observatorio and Goffré Islands, Argentina

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**Abstract**

Continental islands are often sites of low diversity and endemism, as well as important areas for the protection of bird populations, especially seabirds. On Isla Observatorio and the Año Nuevo Islands, in the Southwestern Atlantic, the latest assessment of avifauna dates from more than 20 years ago. In this study, we use a combination of methods to update the status of the main seabird colonies and the most abundant avian terrestrial predator at Observatorio and Goffré Islands during the breeding season. In only 4.5 $km^2$, the islands would harbour ~90,000 breeding seabirds. Seabird colonies occupied different areas of the islands and varied in their population status, with Imperial shags (*Leucocarbo atriceps*) showing an increase and Southern Giant Petrels (*Macronectes giganteus*) a decrease according to the last surveys. Magellanic Penguin (*Spheniscus magellanicus*) population estimations also suggest a decrease but the last survey was based on total, and not on occupied nest sites. We recorded and assessed one new breeding species: The globally Near Threatened Striated Caracara (*Phalcoboenus australis*), which has an important breeding population of around 15 territorial pairs at Observatorio Island. These islands appear to be an important regional bird site and future studies would determine their trends and threats, especially those related with invasive species.

**Keywords**

Population assessment, vegetation classification, Point-Centered Quarter Method, continental islands

## Introduction

Seabirds are the most endangered birds in the world, with over 30% of species globally threatened, and half of them declining (Croxall et al. 2012; Dias et al. 2019). Moreover, overall seabird abundance has declined 70% in the last six decades (Paleczny et al. 2015). While threats on seabirds affect them in all their life cycle (Dias et al. 2019) studies in their breeding colonies remain important to understand their status and trends, especially in poorly-known regions.

Bird studies within the Fuegian archipelago have been conducted mainly on Tierra del Fuego Main Island, Isla de los Estados, Navarino Island, and the islands and islets of the Beagle Channel (e.g., Raya Rey and Schiavini 2000; Liljesthröm et al. 2013; Raya Rey et al. 2014; Cossa et al. 2017; Benitez et al. 2019; Jara et al. 2019). However, studies on Isla Observatorio and the Año Nuevo Islands are scarce and outdated. On this area, 33 bird species have been recorded (Chebez and Bertonatti 1994; Parera et al. 1997), including important breeding colonies of Magellanic Penguin (*Spheniscus magellanicus*), Southern Giant Petrel (*Macronectes giganteus*) and Imperial Shag (*Leucocarbo atriceps*) (Frere et al. 2005; Quintana et al. 2005; Schiavini et al. 2005). Except for the Southern Giant Petrel colony of Observatorio Island, which was last assessed in 2004, the last field studies date from 1995 (Parera et al. 1997; Quintana et al. 2005). During a 2016 survey we recorded a new known breeder in the area, the Striated Caracara

*Phalcoboenus australis* Gmelin 1789, a rare Near-Threatened bird of prey strongly associated with breeding seabirds in subantarctic islands of South America (Strange 1996). In that season, we opportunistically found one nest containing one chick. The current status of these species is unknown locally and poorly-known regionally. In this study, we present an update of the main breeding seabirds and their likely most important terrestrial predator on Observatorio and Goffré Islands.

## Methods

### *Study area*

Fieldwork took place in the spring of 2016, 2019 and 2020 (October-December, breeding season) at Observatorio (4 $km^2$, 54° 39' S, 64° 08' W), and in the spring of 2020 at Goffré Island (0.5 $km^2$, 54°42' S, 64°14' W). Both are uninhabited islands north of Isla de los Estados (Staten Island), in the south-eastern tip of South America (Figure 1). Unlike Isla de los Estados, they have negligible area covered by arboreal species, as the landscape is mainly covered by tussock (*Poa flabellata*) grasslands, wetlands dominated by the rush *Marsippospermum* spp., and in Observatorio Island, prairies of *Gaultheria mucronate* with shrubs, mostly *Empetrum rubrum* and *Berberis* sp. (Parera et al. 1997). No native terrestrial mammals have been recorded on the island, while introduced species include the black rat (*Rattus rattus*) and the European rabbit (*Oryctolagus cuniculus*) (Massoia and Chebez 1993). Marine mammals comprise of a non-reproductive population of over 500 South American sea lion (*Otaria flavescens*), whose numbers are increasing both locally and regionally (Milano et al. 2020). The island is part of an Important Bird Area (Schiavini 2005; BirdLife International 2019) and it is totally protected by

the Provincial (since 1991) and the National (since 2016) Government of Tierra del Fuego Province and Argentina respectively.

### *Vegetation cover classification*

We conduct a descriptive, mesoscale classification of the vegetation cover in the study area by assigning 28 field points, each to one of the main vegetation types: grasslands, rush lands and prairies, following Parera et al. (1997) (Figure 2). To generate a land cover map of both islands we used a Sentinel-2 satellite image of February the 16th, 2017 (European Space Agency 2018). We used the Sen2Res plugin in SNAP v.8.0 (European Space Agency 2021) to enhance the resolution for the low-resolution spectral bands by parasharpening (Brodu 2017). 25 iterations with default parameters were set up to run the process. The high-resolution bands were then stacked into one multispectral image using the Semi-Automatic Classification Plugin (SCP) in QGIS 3.16.9 with GRASS 7.8.5 (QGIS Development Team 2020, Congedo 2021). The land cover supervised classification process was conducted using the Minimum Distance classification algorithm (Richards 2013) with default parameters. Finally, the r.report tool from GRASS was used to obtain the area of each land cover class.

### *Breeding bird surveys*

Due to logistic restrictions, we were not able to assess the status of all target species simultaneously. Southern Giant Petrel were assessed during the 2016 survey, Striated Caracara during the 2019 survey and both Magellanic Penguin and Imperial Shag during the 2020 survey. 2020 was the only period when we were able to conduct fieldwork in the smaller Goffré island,

and only Magellanic penguin assessment was conducted there. We used different methods to count or estimate each of the target species. The Imperial shag colonies were assessed by taking aerial photographs with an unmanned aerial vehicle (DJI, Phantom 4 pro v2.0) from a height of 50 metres. We considered a nest as active when occupied by incubating adults. Magellanic penguins occur at lower densities (around two orders of magnitude less than shags) and their burrowed nests require field inspection to assess occupancy. To estimate their numbers we used the Point-Centered Quarter Method, with random systematic points every 200 m (Krebs 1998; Mitchell 2010). This method was first developed to study forest stand density and structure and it is based on the idea that density can be estimated through distances from random points to the objects of interest. It has been used to study other sessile events such as seabird nests, especially those that are not visible from the air (Priddel et al. 2006; Rush et al. 2013). For the Observatorio Island colony, variation within quarters from single points (e.g., 20-130 m) suggested a non-random distribution of nests near the sampling points. In addition, spatial autocorrelation up to 300 m of distance precluded the use of parametric estimation (Online Resource 1) (Fletcher and Fortin 2018). Consequently, for this, we used the non-parametric estimation described in Patil et al. (1982), which produces similar mean estimates but broader confidence intervals (Mitchell 2010). In Goffré Island, we observed nests only in tussock grasslands and prairie and negligible amounts in rushland, and we used the parametric estimation described in Pollard (1971). We based our estimates on 71 and 13 systematic points at Observatorio and Goffré Islands, respectively. For scaling up into abundance, on Observatorio Island we excluded the areas recently used by nesting imperial shags, which were not occupied by penguins, as well as the rushland area in Goffré Island for the same reason (ARR pers. obs.). To assess the breeding density of the Striated Caracara population, we followed a procedure similar one that is used in

the nearby population of Franklin Bay, Isla de los Estados, which consists of walking around the island in a systematic manner and observing territorial behaviour of breeding pairs, and then looking for the nest and its content whenever possible (for details see Balza et al. 2017). Southern giant petrels breeding pairs are conspicuous and occur in relatively low numbers in the study area (Quintana et al. 2005). Therefore, we attempted to conduct a census by dividing the island into 47 plots which we surveyed systematically and completely looking for nests, eggs and/or incubating adults. The area of the plots was at most 16 ha, and were judged to be small enough to be confidently assessed by two people.

Global and country-level conservation status were obtained from BirdLife International (2021) and the Ministerio de Ambiente y Desarrollo Sustentable and Argentinas (2017), respectively. Population status from breeding pairs of Magellanic Penguins, Imperial Shags and Southern Giant Petrels are discussed by comparing our results with previous studies (Frere et al. 2005; Quintana et al. 2005; Schiavini et al. 2005).

## Results

The vegetation cover of the islands varied from tussock grasslands and prairies near the coasts and rushlands in the centre (Figure 3). The islands are estimated to harbour over 90,000 breeding seabirds, and species-specific population estimates and counts are summarized in Table 1. Magellanic Penguin density was similar in Observatorio (80.4 nests*ha$^{-1}$, 95% CI: 42.4-118.5 nests*ha$^{-1}$) and Goffré (95.0 nests*ha$^{-1}$, 95% CI: 72.4-125.0 nests*ha$^{-1}$) islands. In relation to their last study, Imperial Shag breeding pairs increased, while Magellanic Penguin and Southern Giant Petrels numbers appeared to have decrease (but see Discussion).

We found evidence suggesting association between vegetation cover types and the breeding events of some of the species assessed. More than half of the Striated Caracara nests were found on grasslands, even though this vegetation covers just 12% of the islands' surface. In contrast, 86% of Southern Giant Petrel nests were in rush land, with 42% this vegetation covering the study site (Figure 3).

## Discussion

Overall, Observatorio Island and possibly the Año Nuevo Islands archipelago as a whole stand as a very important site for breeding birds, with important colonies of at least three species of seabirds and a globally-relevant population of a Near Threatened raptor in only 4.5 $km^2$. Within the assessed breeding species on the island, we found evidence of association with different vegetation types, suggesting that the island's heterogeneity is an important factor to consider in further research and management. All other bird breeding events were found to be anecdotal and rarer, thus we are confident that our assessment represents the current status of the most important seabird colonies and of the most abundant terrestrial predator in the site. In the future, we hope to establish population trends and ecological relationships based on this first assessment.

The Magellanic Penguin colony presents the most important breeding area for the species in the Fuegian archipelago (Schiavini et al. 2005; Dee Boersma et al. 2013; Raya Rey et al. 2014). However, we noted an important difference with the last assessment of 1995 in which over 100.000 nests were estimated (Schiavini et al. 1999). In that assessment only cavity density was surveyed, with no estimation of nest occupancy. Our density estimates are 3-4 times lower, so

around a third to a quarter of nest occupancy would be necessary for our surveys to be equivalent. In the Beagle Channel colony, the mean proportion of occupied nests is 0.4 (ARR, unpublished). Therefore, we do not consider the two surveys comparable, but our differences in estimations would not represent necessarily an actual decrease in penguin numbers. Imperial shag abundance is similar to that of the entire Beagle Channel, where they are increasing in numbers (Raya Rey et al. 2014). The Southern giant petrel colony was absent in the study area during earlier surveys (Castellanos 1935, 1937), and because of its conspicuousness we can speculate that it was founded in recent times. It is one of the four colonies found in the Argentinian Patagonia and the second in numbers (Quintana et al. 2005). Individuals tracked from this colony are known to forage during the chick rearing period along the coast of Isla de los Estados, the Le Maire Strait and over the coast of Tierra del Fuego main island (Quintana et al. 2010). At other breeding grounds, populations of this species can fluctuate significantly (Dunn et al. 2016), and predation by cats and rats has been recognized as a main threat in the breeding season (Phillips et al. 2016), so more studies are required to precisely assess their status and threats. Observatorio Island is a new known breeding site for the globally Near Threatened Striated Caracara. The species is known to be present on the island for a long time, as the holotype was collected in 1775 in this site (Strange 1996). Most breeding populations occur in the Malvinas/Falkland archipelago (Reeves et al. 2018), and other breeding sites in the Fuegian archipelago include Franklin Bay (Isla de los Estados), Goffré Island, Noir Island, Diego Ramírez islands and Mitre Peninsula (Tierra del Fuego Main island) (Clark 1984; Parera et al. 1997; Marín et al. 2006; Cursach et al. 2012; Balza et al. 2017). We counted 15 breeding territories and found 10 active nests of Striated Caracara, containing a total of 15 chicks. Both apparent clutch and brood size ranged between 1-3 eggs and chicks respectively, with a mean

brood size of 1.5 chicks*successful nest$^{-1}$. Trophic niche analysis previously suggested that sea lion feaces would be an important food source during the non-breeding season in the archipelago (Balza et al. 2020), and one out of five individuals fitted with GPS from Franklin Bay visited Goffré Island in the first five months post-fledgling (UB & ARR, unpublished). Therefore, it seems plausible that the Año Nuevo Islands have the potential to be a relevant foraging area also for non-breeders from other islands. Following BirdLife International (2013) numbers, Observatorio island could harbour up to 3% of the global breeding pairs of the species. Rat (22 % occurrence) and rabbit (11 % occurrence) hairs were found in Striated Caracara's pellets (n= 8) in the area (UB & ARR unpublished), so the potential exists for these birds to feed on carcasses of invasive mammals in the case of management intervention. In all surveys we observed rabbits on a daily basis, rats frequently and in 2016 a free ranging cat, whose carcass was found in 2021. We still lack any data on the invasive species apart from their presence, but there is plenty of evidence that invasive species have detrimental effects on island ecosystems (e.g., Spatz et al. 2014; Wood et al. 2017). Before implementing any eradication plan, it would be necessary to determine to what extent the scavenger species depend on invasive mammals to survive the most restrictive periods of the year, which is a common pattern in raptors throughout the world (Speziale and Lambertucci 2013; Barbar et al. 2016, although it is not the case of the Striated Caracara in Isla de los Estados, see Balza et al. 2020). Tourism activity is increasing in the Fuegian archipelago, and although Observatorio Island is not currently open to tourist, it is important to have baseline information to monitor further changes (Raya Rey et al. 2017). Our study further suggests that even in this small area, spatial heterogeneity will be relevant for both ecological studies and management implementation. Future studies and proper management of

Observatorio Island could lead to the conservation of one of the most important bird areas in the Southwestern Atlantic.

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**Author Contribution Statement**

UB and ARR conceived and designed research; UB, ML, LP, IFN, SCB, FZ, ID, SA, RI and ARR conducted fieldwork; UB analyzed data; ID produced drone-based mosaics; JC conducted vegetation cover classification maps; UB wrote the first version of the manuscript; ARR

retrieved funds; UB, ML, LP and ARR contributed with critical writing, discussion and editing various versions of the manuscript.

## Ethics declarations

## Conflict of interest

The authors declare no conflict of interest regarding this article.

## Ethical approval

Not applicable.

## Consent for publication

Not applicable.

## Supplemental material

Online Resource 1

Data for replicate the Magellanic penguin density estimation can be found in https://github.com/ulisesbalza/magellanic_penguin_density

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Figure 1

Click here to access/download;Figure;Figure 1.jpg

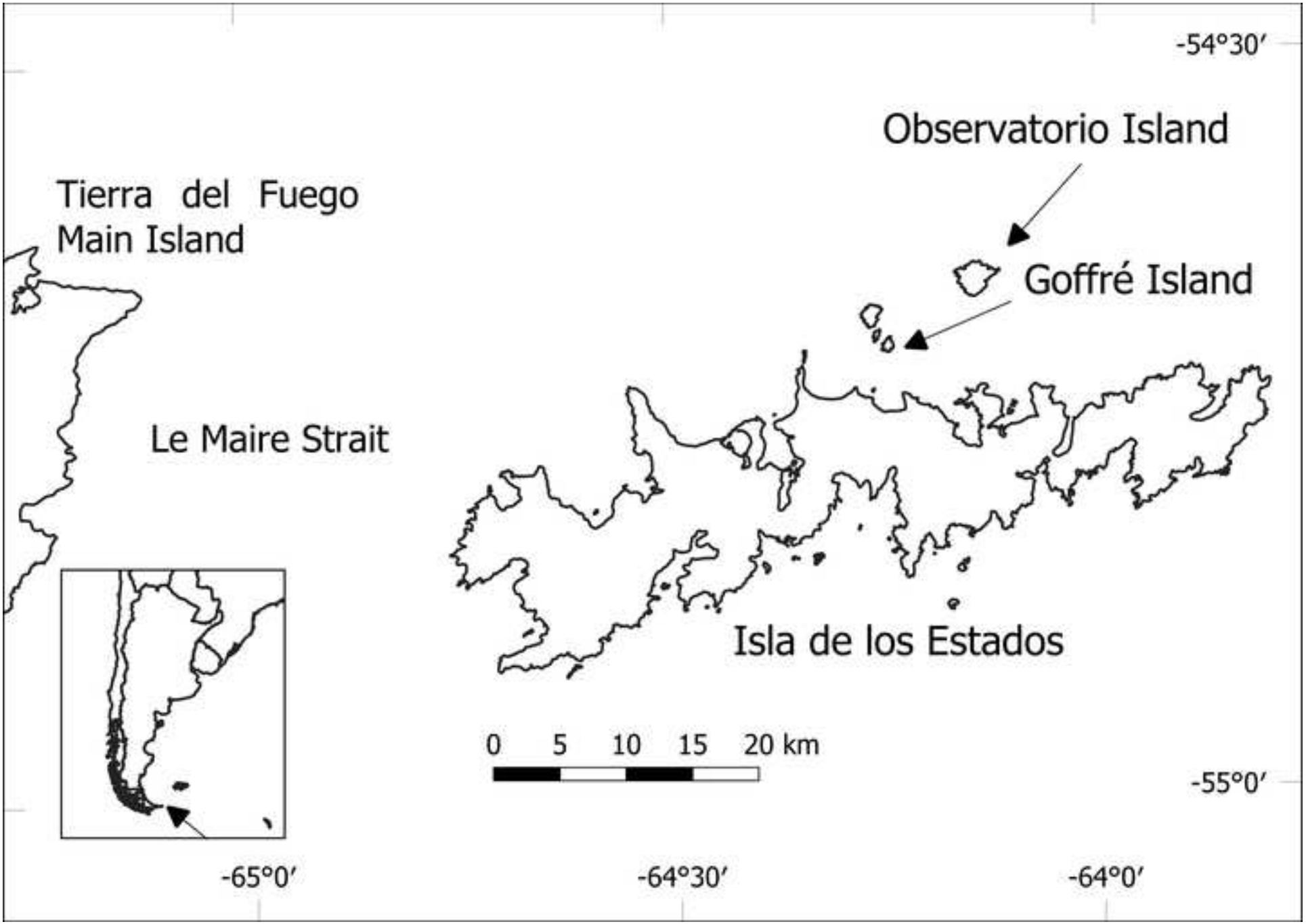

Figure 2

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Figure 3

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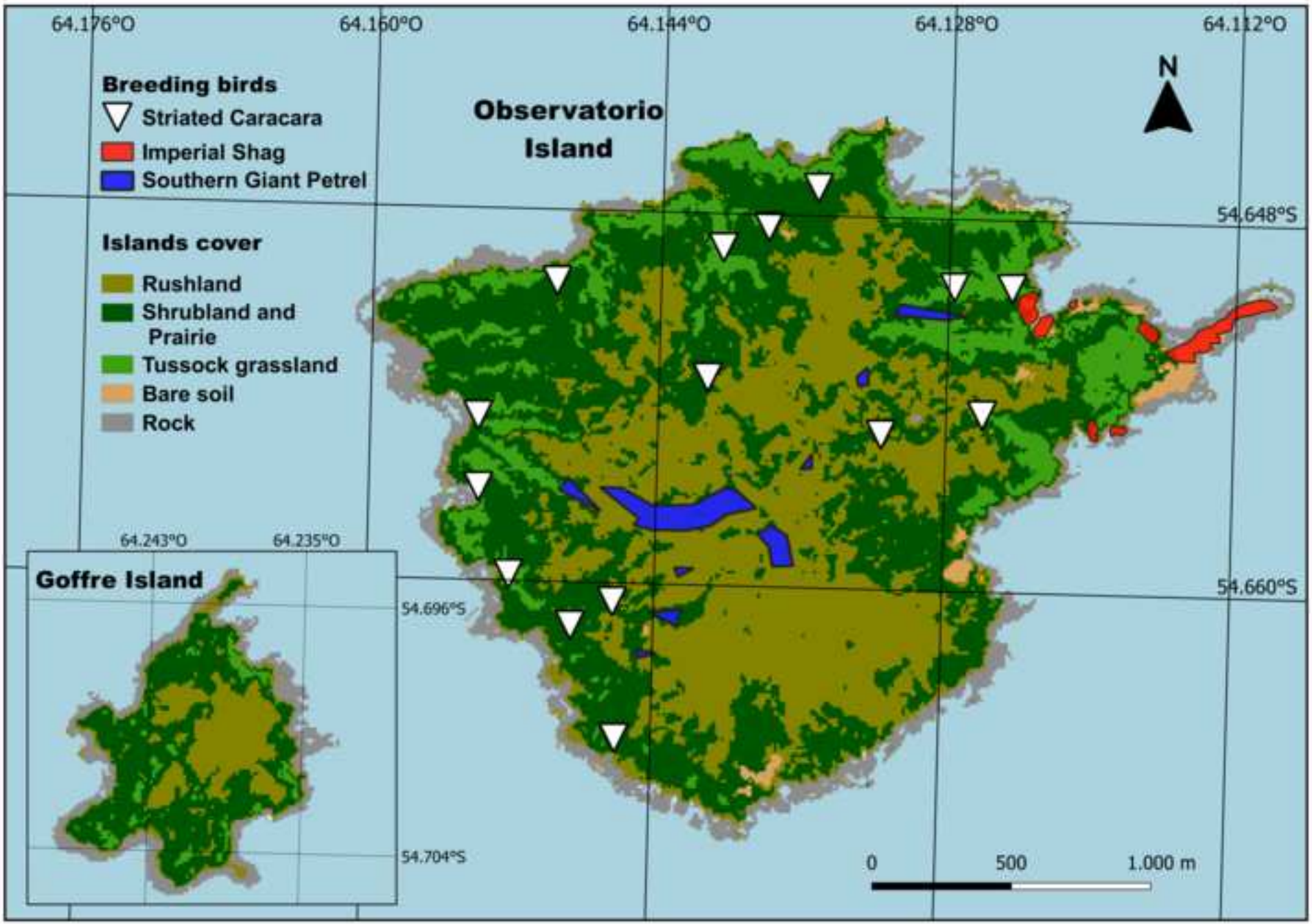

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1 **Balza et al Figures**

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3 **Figure 1.** Map showing the location of Observatorio and Goffré Islands within the Fuegian

4 archipelago.

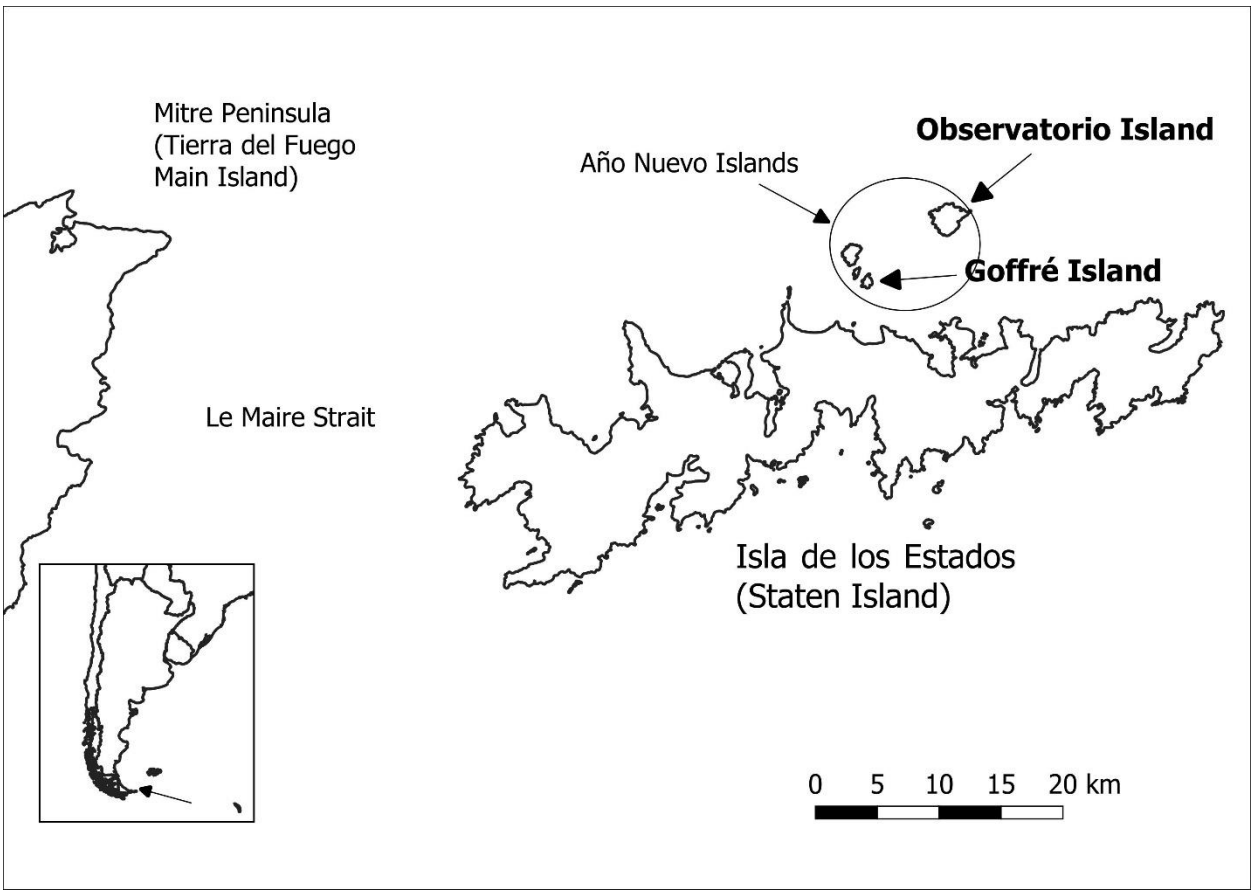


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**Figure 2.** Main vegetation cover types. From left to right: Rush land, prairies and tussock grassland.

**Figure 3.** Vegetation cover map of Observatorio and Goffré Island showing Striated Caracara nesting sites, and Southern Giant Petrel and Imperial Shag colonies. The Magellanic penguin colony it is not shown as it was found throughout the study area, except for the Imperial Shag colony area (see Table 1).

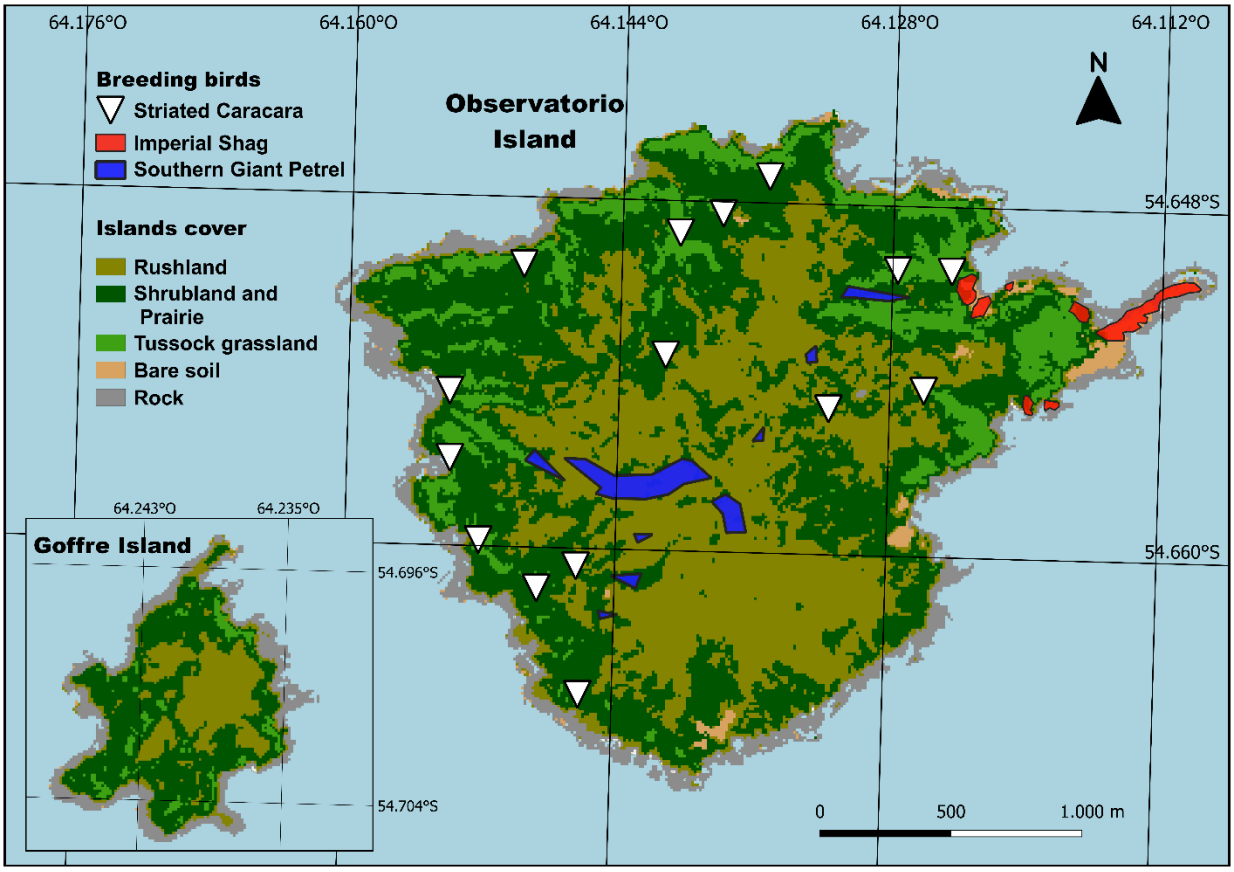

**Figure S1.** Spatial autocorrelation for Magellanic penguin nearest neighbour distances in Observatorio Island.

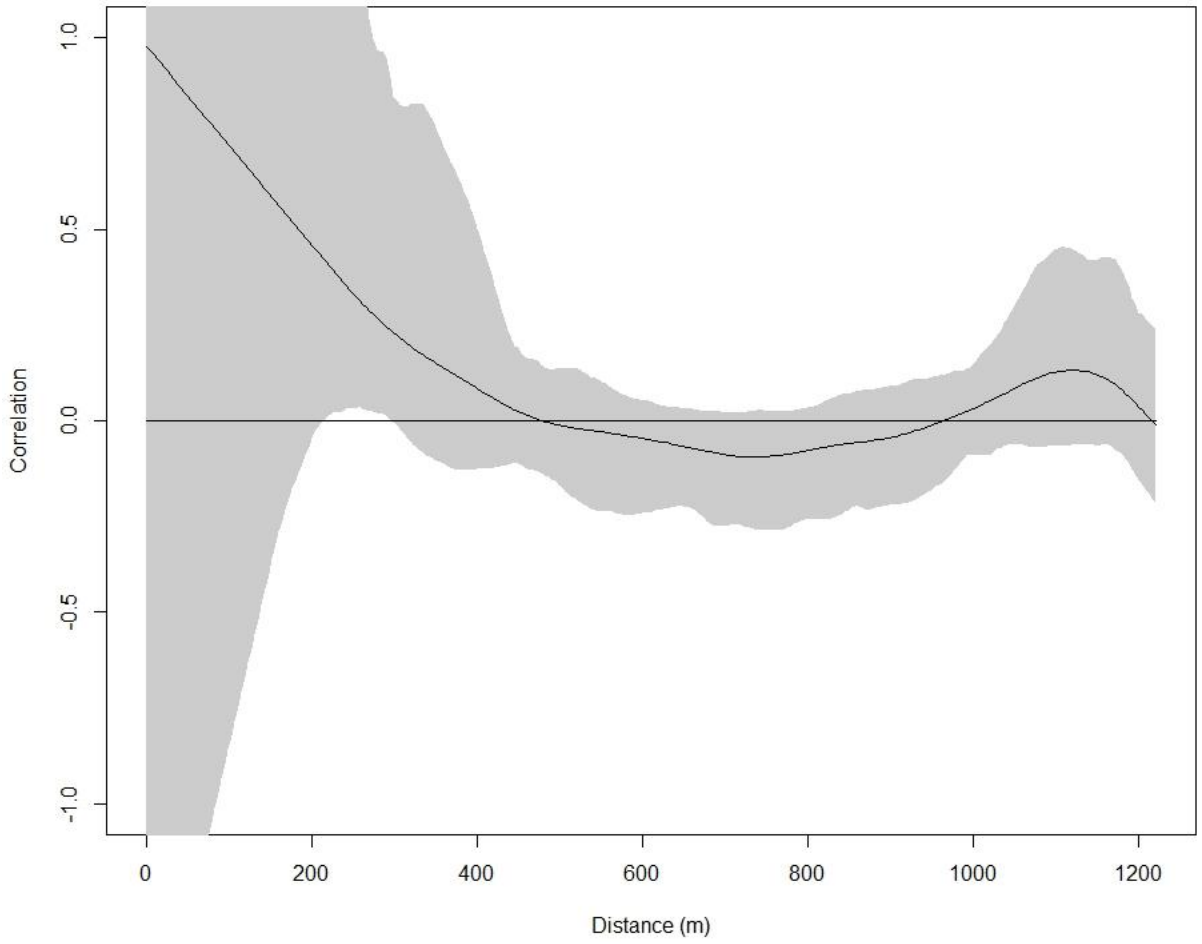

**Table 1.** Breeding pairs estimates and minimum counts for seabird species known to breed on Observatorio and Goffré Island. In bold are globally or nationally threatened or near threatened species. Status are LC: Least Concern and NT: Near Threatened.

| **Common name** | **Scientific name** | **Global status** | **National status** | **Estimated population size in the site (breeding pairs) Mean (95% CI)** | **% of global population** |
|---|---|---|---|---|---|
| Magellanic Penguin | *Spheniscus magellanicus* | **NT** | **NT** | Observatorio Island 33,229 (17,524-48,976)<br>Goffré Island 2,966 (2,260 -3,903) | 1.3 (0.6-2.4) |
| Southern Giant Petrel | *Macronectes giganteus* | LC | **NT** | 387 | 0.2-0.3 |
| Imperial Shag | *Leucocarbo atriceps* | LC | LC | 8,739 | Global population estimates not available |
| Striated caracara | *Phalcoboenus australis* | **NT** | **EN** | 15 | 1.2-3.0 |

Link(s) to supporting data

Click here to download Link(s) to supporting data
http://github.com/ulisesbalza/magellanic_penguin_density