

DISTRIBUTION AND FLOATING POPULATION OF BIRDS ON PENGUIN ISLAND, SOUTH SHETLANDS, ANTARCTICA

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Abstract: Knowledge on the abundance and distribution of birds is extremely important for the assessment of potential population fluctuations of species and for how such fluctuations may affect their conservation. This study aims to perform the mapping of breeding and distribution of species that nested on Penguin Island (62°06'15"S; 57°55'30"W) in 2011/2012 and 2012/2013, as well as to assess the abundance of breeding pairs for each species and compare these data with those of previous studies. The location of breeding groups of birds nesting on the site was geo-referenced with the assistance of a GPS receiver. The data collected were processed in the ArcGIS software program to draw a map with the distribution and breeding areas for each species. A census of breeding pairs for the summers of 2011/12 and 2012/13 was also conducted. We recorded 6618 breeding pairs of *Pygoscelis antarcticus* on Penguin Island in 2011/12 and 4657 breeding pairs in 2012/13. Regarding *Pygoscelis adeliae*, 183 breeding pairs were observed in 2011/12. With respect to *Macronectes giganteus*, 138 breeding pairs were observed in 2011/12, whereas 418 pairs were recorded in 2012/13. Nests of the following species were also found *Oceanites oceanicus*, *Chionis albus*, *Stercorarius lonnbergi*, *Larus dominicanus*, and *Sterna vitatta*.

Keywords: Abundance, Seabirds, Breeding, Mapping

Introduction

Knowledge on the abundance and distribution of birds is extremely important for the assessment of potential population fluctuations of species and for how such fluctuations may affect their conservation. Although monitoring of the number of birds is of extreme importance, there are few studies on the species populations that nest on Penguin Island. South Shetlands is one of the archipelagos most sought by tour companies, with considerable increase in the number of tourists in recent years. Approximately 300,000 visitors were recorded in Antarctica (IAATO, 2013) in 2011/12, and according to Sander *et al.* (2004), Petry *et al.* (2015) and Bender *et al.*, 2016, there is evidence of tourism on the South Shetlands, and Penguin Island is one of the most visited sites. Furthermore, long-term studies on the monitoring of populations suggest that occurring environmental changes are able to affect the abundance,

distribution, and phenology of species (Walther *et al.*, 2002, Chambers *et al.*, 2013, Petry *et al.*, 2015). The three most abundant species that dwell and reproduce on Penguin Island are *Pygoscelis adeliae*, *Pygoscelis antarcticus*, and *Macronectes giganteus*. Works on these species have been conducted by Jablonski (1980), Jablonski (1984), and Sander *et al.* (2004). It is also worth mentioning the presence and reproduction of species that breed in isolated nests on Penguin Island, such as *Oceanites oceanicus*, *Chionis albus*, *Stercorarius lonnbergi*, *Larus dominicanus*, and *Sterna vitatta*. This study aims to perform the mapping of areas of reproduction and distribution of bird species that nested on Penguin Island in 2011/2012 and 2012/13, as well as to assess the abundance of breeding pairs for each species and compare these data with those of previous studies.



Materials and Methods

The study was conducted on Penguin Island (62°06'15"S; 57°55'30"W) during the austral summers of 2011/2012 and 2012/2013. The reproduction sites of breeding birds on the area were georeferenced with the assistance of a GPS receiver. Later, the data collected were processed using the ArcGIS software program to draw a map with the distribution and breeding areas for each species. To conduct a census of the species, three observers performed direct counting of the number of breeding pairs simultaneously, and the difference in score between them could not exceed 10% in accordance with the methodology of CCAMLR, 2004 (Commission for the Conservation of Antarctic Marine Living Resources). The total number of breeding pairs of each nesting species was obtained from the mean of the counts. The same methodology was used throughout the two years of the study.

Results

Two breeding groups of *Pygoscelis antarcticus* were observed, comprising Colony I and a colony mixed with *Pygoscelis adeliae*. In total, 6618 breeding pairs of *Pygoscelis antarcticus* were observed in 2011/12 and 4657 breeding pairs in 2012/13. With respect to *Pygoscelis adeliae*, 183 breeding pairs were counted in 2011/12. Regarding *Macronectes giganteus*, 138 breeding pairs were observed in 2011/12, whereas there were 418 pairs in 2012/13. The breeding pairs of the three most abundant breeding species are shown in Table 1. Next to the breeding groups of *M. giganteus*, which extended to the northwest of the island, one nest of *Oceanites oceanicus*, two nests of *Larus dominicanus*, and two nests of *Sterna vitatta* were also observed. A nest of *Stercorarius lonnbergi* was also observed near one of the breeding group of *P. antarcticus*. Also, there were two nests of *Chionis albus* near colonies of *P. antarcticus*. The distribution of the bird species studied

was represented on a map with reference to 2011/12 and 2012/13 (Figure 1).

Discussion

The total number of Pygoscelid penguins observed in 2012/13 was lower than that of the previous year considering that the census was not conducted in the mixed colony of *P. antarcticus* and *P. adeliae*. The population of Colony I floated between the two groups between the reproductive years: reproductive group I presented a decreased of 1161 breeding pairs of *P. antarcticus* from 2011 to 2012, whereas reproductive group II presented an increase of 500 pairs. These two breeding groups (GR1 and GR2) were located nearby, separated by a distance shorter than 500 meters, thus under very similar biotic and abiotic conditions. In this situation, the breeding pairs do not always return to the same breeding group, which may cause a change in the occupation of reproductive areas between these two groups in different years.

The present study, conducted during the austral summer of 2011/12, shows a reduction of 94% in the breeding population of *P. adeliae* compared with that found by Jablonski (1984) in 1980/81 (Table 2). Regarding the study conducted by Sander *et al.* (2004) in 2003/04, the colony of *P. adeliae* presented a 73% reduction in the population in 2011/12. Smaller colonies are more exposed and more at risk for predators because the reproductive success and resilience of the colony are reduced. Changes in the population of *P. adeliae* over a few decades have been, in part, caused by global warming (Croxall, 2002). The breeding pairs of *P. antarcticus* presented 60% recovery in 2011/12 according to the study by Sander *et al.* (2004), but remained below 13% of the number of breeding pairs that Jablonski (1984) found in 1980/81. This shows the resilience of *P. antarcticus* with respect to population variation.

Table 1. Number of breeding pairs of *P. antarcticus*, *P. adeliae*, and *M. giganteus* in 2011/12 and 2012/13.

No. of breeding pairs/Year	<i>P. antarcticus</i> GR1	<i>P. antarcticus</i> GR2	<i>P. adeliae</i> *	<i>P. antarcticus</i> *	<i>M. giganteus</i>
No. pairs /2011/12	2818	3000	183	800	138
No. pairs/ 2012/13	1157	3500	X	X	491

* Individuals in the mixed colony of *P. adeliae* and *P. antarcticus*; x = this year was not possible to conducted the census of the *P. antarcticus* and *P. adeliae* colony mixed due to accumulation of ice on the slope.

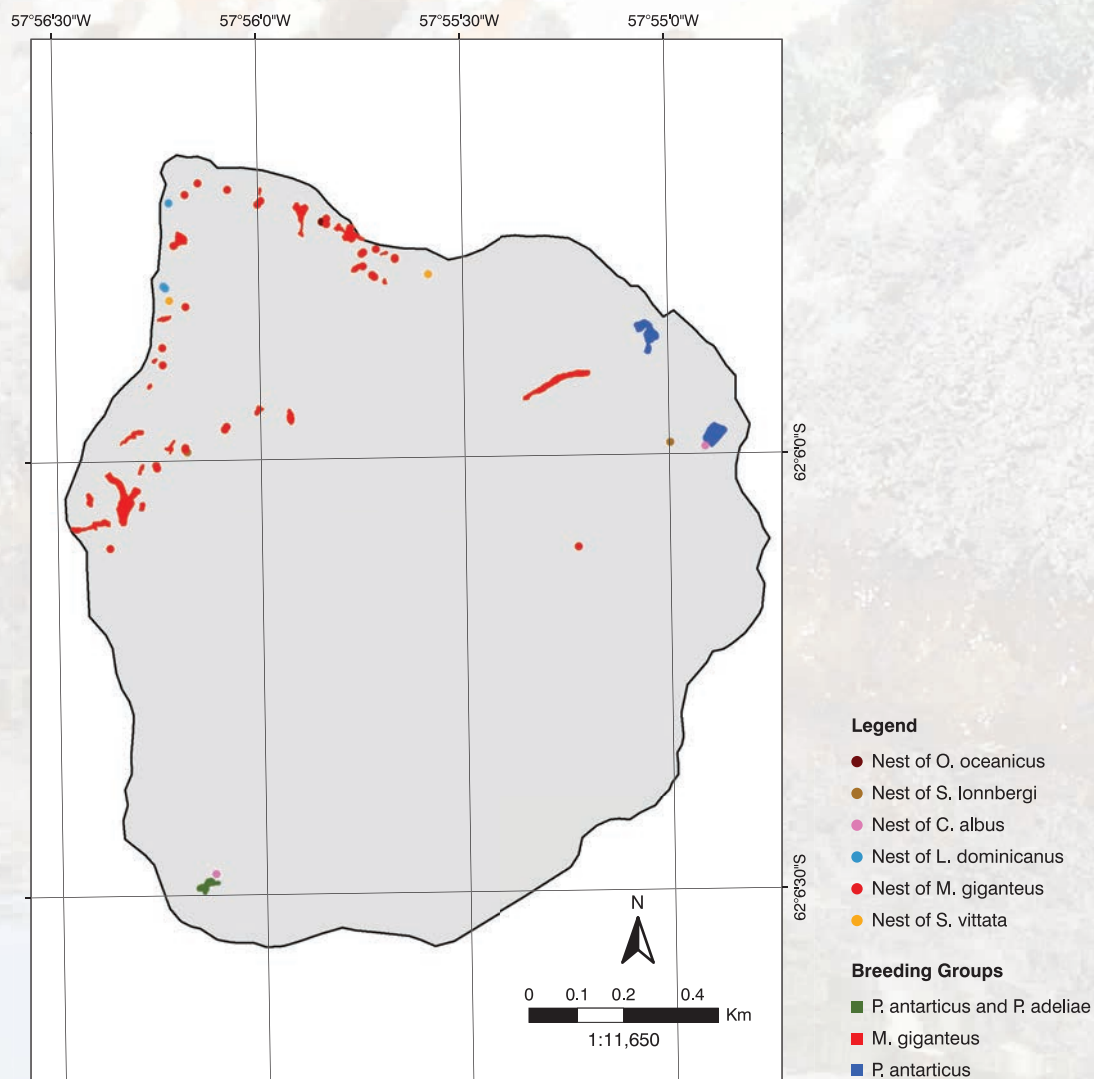


Figure 1. Distribution of breeding areas of bird species that nest on Penguin Island, Antarctica.

Table 2. Comparison between breeding pairs found on Penguin Island in the austral summers in several years by different authors.

Years	Autors	<i>P. antarcticus</i>	<i>P. adeliae</i>
1979/80	Jablonski, 1980	7058	1710
1980/81	Jablonski, 1984	7581	3114
2003/2004	Sander <i>et al.</i> 2004	2672	684
2011/2012	This study	6618	183
2012/2013	This study	4657*	*

Captions: * The mixed colony of *P. antarcticus* and *P. adeliae* was not evaluated due to logistical problems.



Macronectes giganteus presented an increase of 353 breeding pairs from 2011/12 to 2012/13, showing their ability to repopulate sites that offer ideal conditions. Changes in the physical and biological environment are directly associated with fluctuations in seabird populations (Constable *et al.*, 2014; Hinke *et al.*, 2014).

Conclusion

We conclude that the birds of this site are affected by disturbances over time and present great repopulation capacity of reproductive sites. However, there are long periods without ratings on Penguin Island, therefore not being possible to assess the patterns of these fluctuations. Continuous mapping studies of breeding pairs are needed to assess population fluctuations and verify the

possible disturbance that led these birds to reduce or cease reproduction in these sites.

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