DISTRIBUTION AND ABUNDANCE OF ANTARCTIC AND SUBANTARCTIC SEABIRDS WITHIN AN OFFSHORE TRANSECT BETWEEN RIO GRANDE/RS AND RIO DE JANEIRO/RJ

Gabriel Vieira Vier*, Júlia Victória Grohmann Finger & Maria Virginia Petry

Universidade do Vale do Rio dos Sinos – UNISINOS. Laboratório de Ornitologia e Animais Marinhos.
Av. Unisinos, nº 950, Cristo Rei, 93022-000, São Leopoldo, Rio Grande do Sul, Brazil.

*e-mail: gabrielvier@hotmail.com

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Abstract: *In this study, we aimed to analyze the distribution and abundance of subantarctic and Antarctic seabirds along the offshore route between Rio Grande (RS) and Rio de Janeiro (RJ). Three surveys were performed during April in 2011, 2012 and 2013. On board censuses were conducted to evaluate the abundance and distribution of seabirds. The most abundant species was the Atlantic yellow-nosed albatross *Thalassarche chlororhynchos*, with 51 individuals and the least species abundant was the Black-bellied Storm Petrel *Fregetta tropica*, with only two individuals. Latitude 29° S showed the largest abundance of seabirds ($n=41$), whereas the smallest abundance was observed at latitude 24° S ($n=2$). The highest richness was observed at latitudes 26° S and 30° S ($n=5$ in each degree). We conclude that most birds that use the Brazilian coast as a foraging area are actually south migrant species and that further studies are necessary to assess factors which may explain the distribution of these birds.*

Keywords: Atlantic Ocean, Latitudinal Variation, Brazilian Coast

Introduction

Most seabirds found along the Brazilian coast breed in the Antarctic and subantarctic regions and remain along the coastal sites in search for food during their migratory period (Vooren & Fernandes, 1989). The distribution of seabirds at sea is influenced by several biotic and abiotic factors, such as productivity, hydrography, fisheries, and distance from the colony (Garthe, 1997; Weichler *et al.*, 2004; Krüger & Petry, 2011). On the east coast of South America, the meeting of the Malvinas Ocean Current with the Brazilian Current causes a phytoplankton bloom that attracts nektonic fauna foraged by seabirds (Jehl, 1974; Veit & Braun, 1984; Orgeira, 1995;). Therefore, this high productivity stimulates the presence of many bird species in this area. There are 38 south migrant species occurring over the continental shelf waters off Brazil mainly during the austral winter period, most of them belonging to the order Procellariiformes composed of albatrosses and petrels

(Costa *et al.*, 2011). Individuals belonging to this order show long lifespan and high reproductive rate (Furness & Monaghan, 1987). Several species nest only every two years, though longer gaps between reproduction attempts are common (Warham, 1996). These characteristics, alongside with mortality in by catch of long-line fisheries, make populations of Procellariiformes highly vulnerable (Neves & Olmos, 1998).

The order Procellariiformes is extremely important to biodiversity maintenance and as top predators; they can provide information on ecosystem changes. Hence, analyzing their distribution outside their reproductive area is of great importance. Therefore, the aim of this study was to analyze the distribution and abundance of subantarctic and Antarctic seabirds along the offshore route between the cities of Rio Grande (Rio Grande do Sul state) and Rio de Janeiro (Rio de Janeiro state), Brazil.

Materials and Methods

Data were collected on board of NApOc Ary Rongel and NPo Almirante Maximiano marine vessels on the route between the Rio Grande/RS (32°09'42" S; 52°06'09" W) and Rio de Janeiro/RJ (22°55'20" S; 43°10'15" W) during three expeditions, all held during April in 2011, 2012, and 2013. A total of 752 nautical miles were covered at an average distance of 63 miles from the land in each year in a latitudinal gradient of 10°.

Seabirds were recorded from the ship bridge while travelling at average speed of 10 knots on the side of the vessel with least sun glare. Observations lasted 10 minutes each

and were conducted with an interval of an hour and a half, covering the photoperiod from 06:00 to 18:00. The viewing angle used for the census was 90° and a limit of a 300 m strip from the ship was set for the counting, thus excluding ship-following birds (Tasker *et al.*, 1984). The survey effort was nil at night. To assess whether the abundance varied among the years sampled, one-way ANOVA using SPSS 21 software was applied to the data. Data normalization measures of variables were log-transformed. The results were considered statistically significant at $p < 0.05$. Frequency of occurrence (FO) was calculated to determine the number of species records among the three years.

Figure 1. Study area between Rio Grande/RS and Rio de Janeiro/RJ.

Results

In all 50 censuses conducted, 152 south migrant birds were observed. There were nine bird species belonging to the following families: Procellariidae (five spp.), Diomedidae (two spp.), and Hydrobatidae (two spp.). All nine species of albatrosses, petrels, and shearwaters are subantarctic breeders. However, storm petrels nest both in the Antarctic coast and in the subantarctic islands. The most abundant species was the Atlantic yellow-nosed albatross *Thalassarche chlororhynchos* (n=51), with a frequency of occurrence of 58.82%. The highest concentration of these individuals

(n = 5) was observed on the coast of Rio de Janeiro at latitude 22° S. The Great Shearwater *Puffinus gravis* and the White-chinned Petrel *Procellaria aequinoctialis* were the second most abundant species with 27 and 23 individuals, respectively. *P. gravis* was sighted in a higher number at latitude 25° S (n=9), but with lower frequency of occurrence (23.52%), whereas *P. aequinoctialis* was most sighted at latitudes 29° S and 30° S (n=11), with a frequency of 63.15%. The least abundant species was the Black-bellied Storm Petrel *Fregetta tropica* (n=2). These individuals were sighted only in 2011 at latitudes 28° S e 26° S with a frequency of

Figure 2. Species abundance according to each sampled year.

Figure 3. Mean abundance according to the sampled years.

3.92%. All five remaining species showed abundance of less than 18 individuals each (Figure 2). Significant difference was observed between the relative abundance in the sampled years ($p=0.025$ and $F=4.107$) (Figure 3).

Latitude 29° S showed the largest abundance of seabirds with 41 individuals, although the highest richness was observed at latitudes 26° S e 30° S, with five species in each

degree. The lowest abundance was observed at latitude 24° S, with only two individuals of two species.

Discussion

All seabirds observed in this survey were out of their breeding season (Harrison, 1983). Their movements are influenced by productivity and they tend to forage over greater areas of open ocean than while in chick attendance period. Antarctic and subantarctic species are also related to deeper water (*P. gravis*), higher atmospheric pressures, lower sea surface temperatures, and greater wind speed (*Thalassarche* sp.) (Krüger & Petry, 2011). This might explain the greater richness at latitudes 26° S and 30° S, which present greater depth than others. Latitudes 29°S, 26°S, and 30°S might have had a higher abundance and richness, respectively, because they were the most sampled ones. The large abundance of the Atlantic yellow-nosed albatross could be explained by its formal distribution. This species breeds on the South Atlantic, but disperse to the Southern Ocean, mainly west to South America, and is very common at latitudes 23°S-45°S. *T. chlororhynchos* presented low frequency of occurrence (FO <4.00%) in the Indian Ocean (Péron *et al.*, 2010), whereas in the Atlantic Ocean, on the Brazilian coast, high frequency of occurrence (FO = 58.82%) was found for this species. The differences in abundance of some species between the sampled years might be explained by variations in the distance of the observers

from the coast, depth, water temperature, atmospheric pressure, and wind speed (Krüger & Petry, 2011) which were not analyzed in this study. The month when surveys were conducted (April) matches with the post-reproduction period of birds, when they migrate to the North. This would also explain the relatively low number of birds compared with those of other studies conducted in southern South America in other months (Orgeira, 1995; Neves, 2000). We conclude that most birds that use the Brazilian coast as a foraging area are actually south migrant species, but further studies are necessary to assess the biotical factors which may explain the distribution of these birds.

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THEMATIC AREA 3

IMPACT OF HUMAN ACTIVITIES ON THE ANTARCTIC MARINE ENVIRONMENT

- 59 Vanzan, M., Barrera-Alba, J. J., Tenório, M. M. B., Werneck, E.W., & Tenenbaum, D. R. Size-Fraction, Trophic Categories and Morphotypes Structure of Plankton Smaller than 20 μm During the Austral Summer (Admiralty Bay, King George Island, Wap)
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- 69 Ferreira, A. L., Jr., Kern, Y., Cruz-Kaled, A. C., Christo, S. W., & Absher, T. M. Pteropods, Chaetognaths and Salps in Admiralty Bay, King George Island, Antarctica
- 74 Franco, D. C., Duarte, R. T. D., Bendia, A. G., Nakayama, C. R., & Pellizari, V. H. Comparison of Microbial Community Structure in Coastal Marine Sediments of Three Austral Summers in Admiralty Bay, King George Island
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- 83 Kandalski, P. K., Cofré, A. H. R., Machado, C., Souza, M. R. D. P., Silva, F. B. V., Zaleski, T., Cettina, L. B., Forgati, M., Piechnik, C. A., Rodrigues, E., & Donatti, L. Histology and Histochemical Characterisation of the Stomach Structure of the Antarctic Fish *Notothenia rossii* (Richardson, 1844) Under Conditions of Thermal Stress
- 88 Rodrigues, E., Jr., Feijó-Oliveira, M., Vani, G. S., Suda, C. N. K., Donatti, L., Lavrado, H. P., & Rodrigues, E. Interactive Effects of Warm Acclimation, Low Salinity, and Trophic Fluoride on the Liver Metabolism of the Antarctic Fish *Notothenia rossii*