



Agreement on the Conservation  
of Albatrosses and Petrels

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### **Update on the Mortality of Procellariiformes on Beach Surveys along South and South-eastern Brazilian Coast**

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#### **SUMMARY**

The Santos Basin Beach Monitoring Project (PMP-BS) is a large-scale beach survey project that began in August-2015 and until February-2019 had recorded 8,526 Procellariiformes on the beaches, 2,471 of which pertaining to eight ACAP species. Of those, three comprised 94% of the abundance: *Thalassarche chlororhynchos* (n=1,036), *T. melanophris* (n=603) and *Procellaria aequinoctialis* (n=693). Considering only ACAP species, necropsies were performed on 1,428 carcasses but due to advanced decomposition, in 84.2% it was not possible to determine the cause of death. On the remaining 225, 80.0% were considered to have died from natural causes (mainly due to pathologies on the respiratory system) and 16.4% due to anthropogenic causes. Regardless of the cause of death, signs of interaction with fisheries were detected in 49 (3,4%) animals and ingestion of marine debris in 82 (5,7%) animals. Adults represented 73% of *P. aequinoctialis* and 57% of *T. chlororhynchos*. When considering full years (2016-2018), even though the number of animals varied among years (2016=1,190; 2017=280; 2018=654), there was a clear increase in the number of beached seabirds in the second semester of all years. Since effort was homogeneous along the study period, changes in the number of beached animals must reflect changes in abundance, mortality, carcass transport or an interaction of these factors. Considering that only a fraction of animals that die at sea arrive on the coast, the high number of Procellariiformes observed during beach monitoring might imply in very high mortalities at sea. The PMP-BS is scheduled to continue for at least three more years, allowing for more robust interannual comparisons and to evaluate long-term spatial and temporal trends in the occurrence of Procellariiformes and other seabirds.

## 1. INTRODUCTION

The order Procellariiformes includes 178 species, of which 67 are at some extent threatened of extinction (HBW and BirdLife International, 2018). One of the main threats to the group is interaction with commercial fisheries, that can cause direct mortality because of accidental capture (Neves et al., 2006). Due to their largely neritic or oceanic habits, studying albatrosses and petrels at their natural environment is logistically difficult. One way to circumvent this is to study animals that come to shore, both dead or alive.

Information gathered from beached seabirds can be used to understand long term population dynamics and when analyzed systematically can help to describe migration patterns or atypical events. Even though the stranding of an animal depends on many physical (e.g. currents, water temperature) and biological (e.g. buoyancy, decomposition) factors (Hart et al., 2006), long term time series can provide information on the diversity of offshore communities (Pyenson, 2011). Even though this approach has been widely used for sea turtles (e.g. Hart et al., 2006; Koch et al., 2013; Monteiro et al., 2016) and cetaceans (e.g. Maldini et al., 2005; Evans et al., 2005; Danil et al., 2010; Peltier et al., 2014; Moura et al., 2016; Prado et al., 2016), for seabirds it's less common (e.g. Heubeck, 2006; Newman et al., 2006; Tavares et al., 2016; Haney et al., 2016).

Since August 2015, it has been possible to investigate the occurrence of seabirds along the Brazilian coast, due to the implementation of systematic beach surveys in southeast and southern Brazil. The Santos Basin Beach Monitoring Project (*Projeto de Monitoramento de Praias da Bacia de Santos* - PMP-BS) is one of the monitoring programs required by Brazil's federal environmental agency, IBAMA, for the environmental licensing process of oil production and transport by Petrobras at the pre-salt province (25° 05'S 42° 35'W a 25° 55'S 43° 34'W), between 2100m and 2300m isobaths. To evaluate the possible impacts of these activities on marine turtles, marine mammals, and seabirds, the main activity of the PMP-BS is to monitor approximately 1040km of coastline. Preliminary results regarding Procellariiformes, including the first 14 months of the project activities, were presented at PaCSWG4 (Ferreira et al., 2017), and the present report analyzes the results of the whole duration of the project, between August 2015 and February 2019.

## 2. METHODOLOGY

### 2.1. Study Area

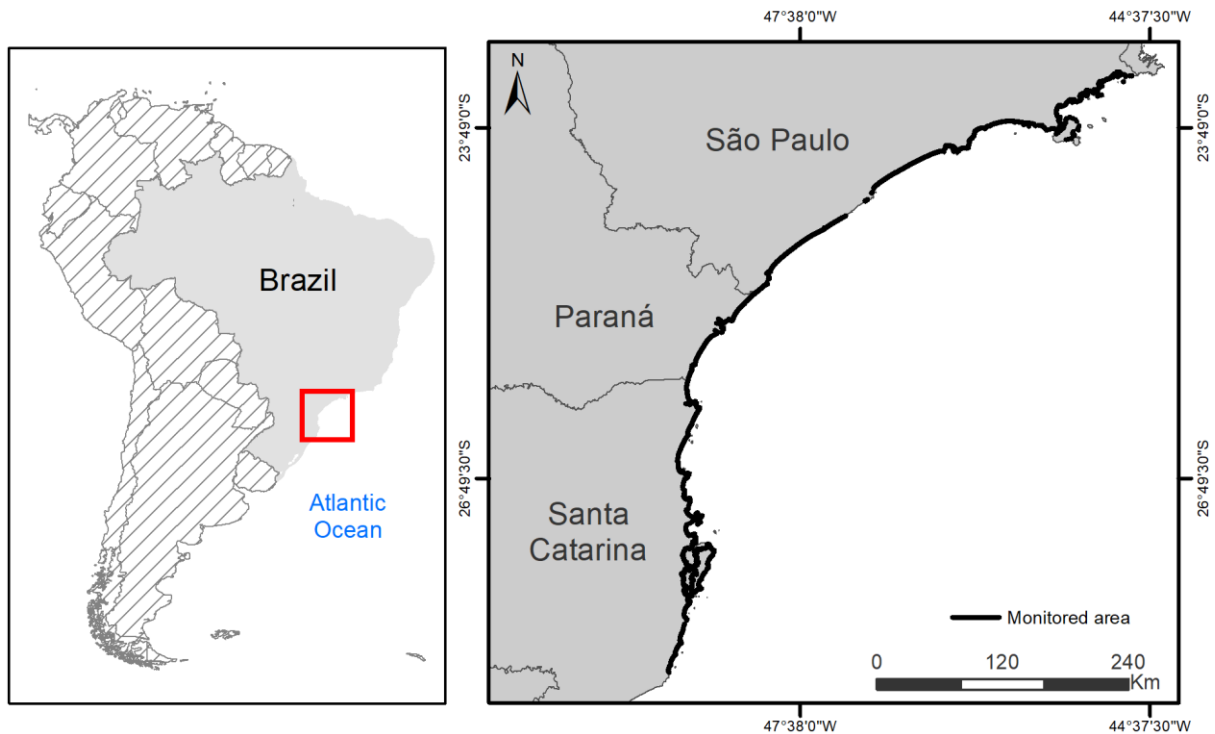
Even though the PMP-BS extends along the states of Rio de Janeiro, São Paulo, Paraná, and Santa Catarina, this work uses data only from the last three states (Figure 1). Monitoring in Rio de Janeiro began almost one year after the other areas and, due to coastline characteristics, in this area much of the monitoring is done from boats, while on the other states only 12,9% of the area is monitored from boats. Thus, in order to allow comparisons within the surveyed area, this work analyzes only data from between 23°22'S and 28°30'S (Figure 1), from August-2015 to February-2019.

### 2.2 Data Collection

Data was obtained from beach surveys that systematically record marine megafauna (sea turtles, marine mammals, and seabirds) along the study area. Due to access difficulties,

beaches are either monitored daily (65% of the area), weekly (14%) or through calls from local population (21%).

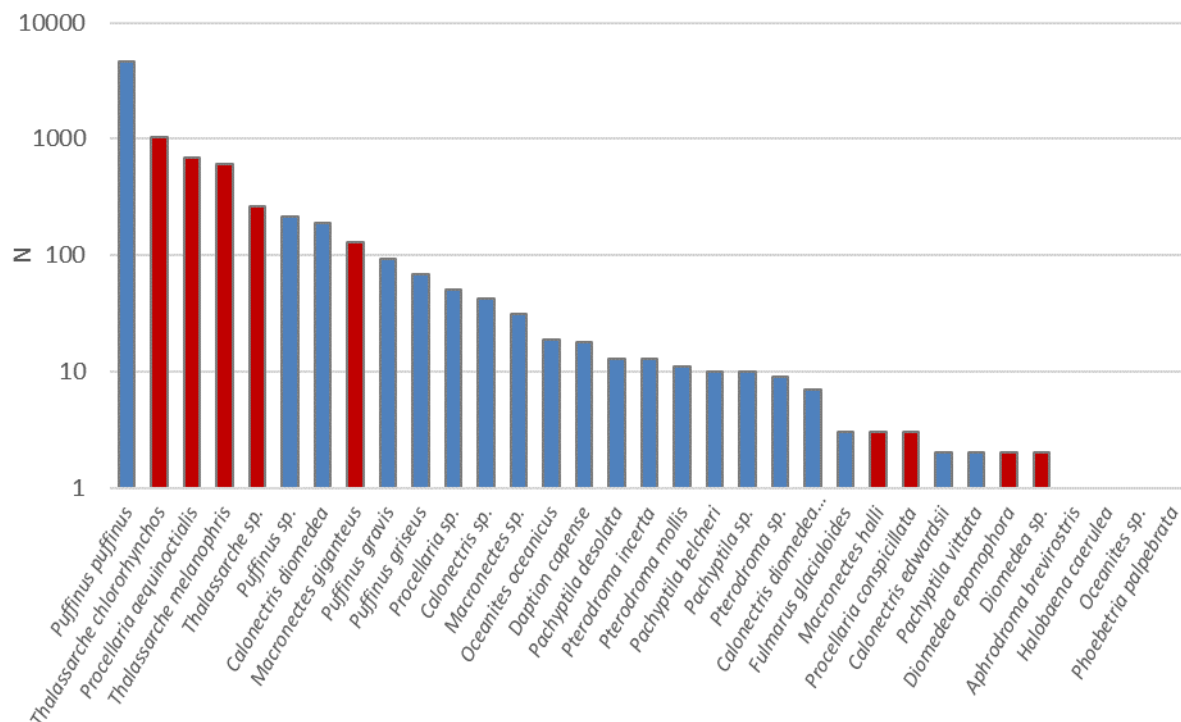
During beach surveys, the area from waterline to foredunes is scanned and all bird carcasses were recorded, counted, identified based on literature information (e. g. Onley & Scofield 2010; Howel 2012). Animals were removed from the beach or marked to avoid recounting. Dead animals were taken to laboratories for necropsy. Both in the field and during necropsies, carcasses were evaluated for the presence of lesions, external markings, interactions with fishing gears, presence of oil and any other signs of possible interaction with human activities.



**Figure 1. Area monitored by the Santos Basin Beach Monitoring Program (*Projeto de Monitoramento de Praias da Bacia de Santos - PMP-BS*).**

### 3. RESULTS AND DISCUSSION

From August-2015 to February-2019 a total of 8,526 Procellariiformes were recorded on the beaches, 2,471 of which pertaining to eight ACAP species (Figure 2). These were among the most abundant, with only three species comprising 94% of the ACAP species' abundance: *Thalassarche chlororhynchos* (n=1,036), *T. melanophris* (n=603) and *Procellaria aequinoctialis* (n=693).



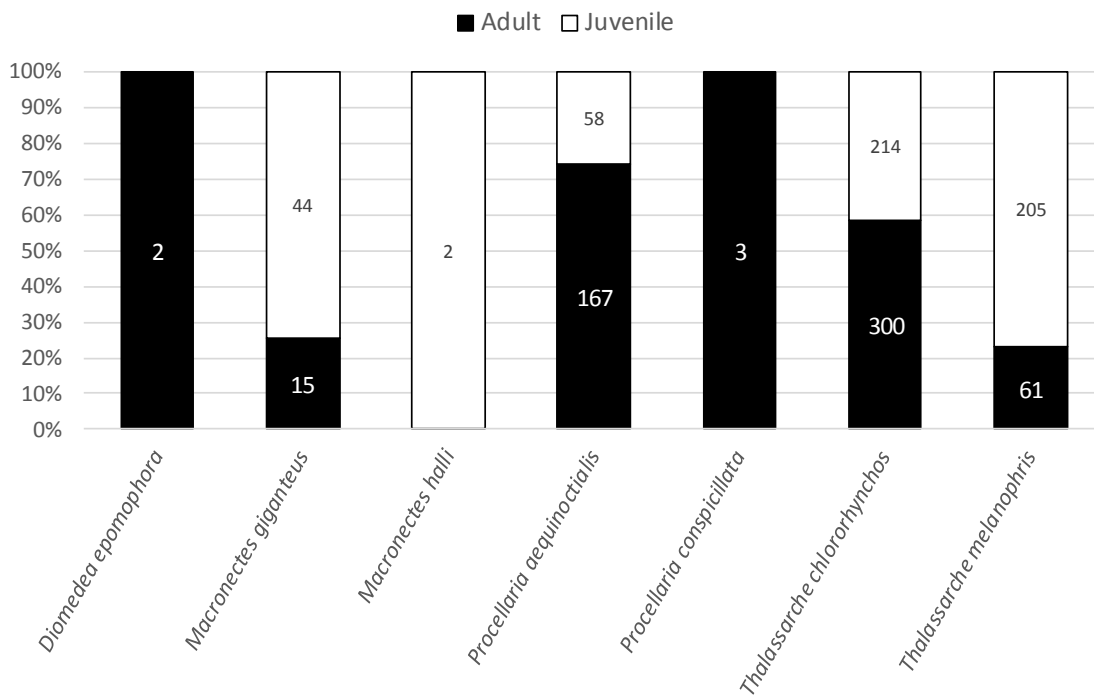
**Figure 2. Abundance of Procellariiformes recorded during beach surveys by the Santos Basin Beach Monitoring Project, from August-2015 to February-2019. Bars in red indicate ACAP species.**

Considering only ACAP species, necropsies were performed on 1,428 carcasses but due to advanced decomposition, in 84.2% it was not possible to determine the cause of death. On the remaining 225 specimens, 80.0% were considered to have died from natural causes (mainly related to pathologies on the respiratory system) and 16.4% anthropogenic causes were identified. Regardless of the cause of death, signs of interaction with fisheries were detected in 49 animals and ingestion of marine debris in 82 animals.

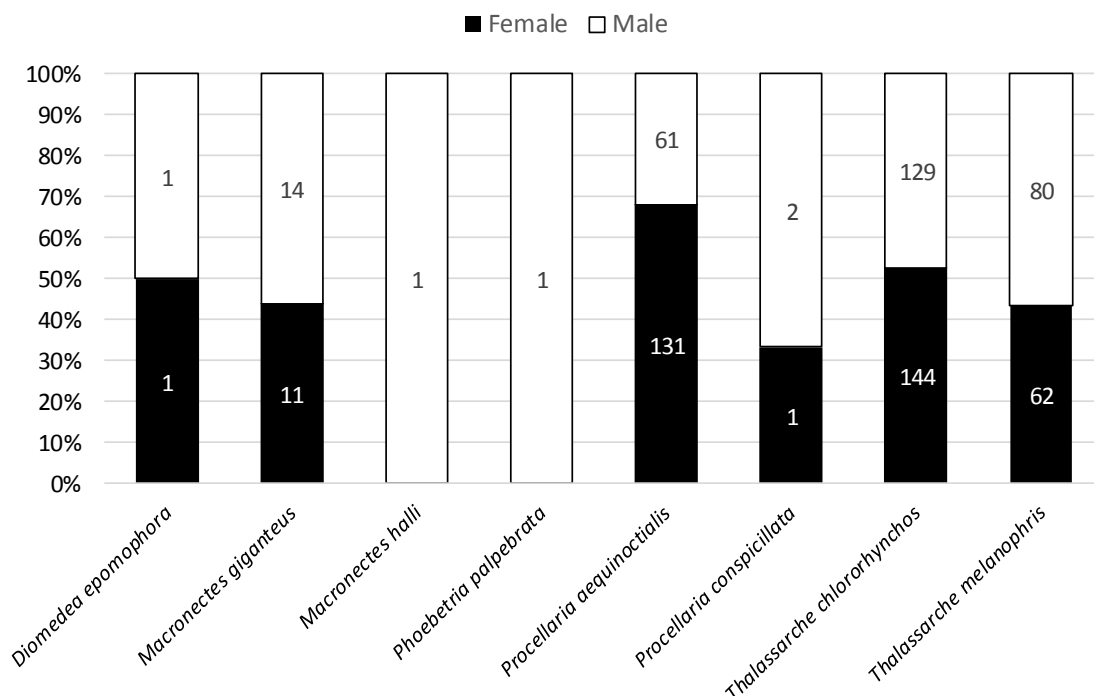
It was possible to determine sex in 635 (44,5%) and developmental stage in 1071 (75,5%) during necropsies of the ACAP species' carcasses. Adults were slightly more frequent in total but represented 73% of *P. aequinoctialis* and 57% of *T. chlororhynchos* (Figure 3A). In these two species females were also more frequent (Figure 3B), making adult females the most frequent category for *P. aequinoctialis* (50,7%) and *T. chlororhynchos* (31,5%). Considering that both species are long-lived, with high adult survival rates (ACAP, 2012), the loss of proportionally more adult females is of concern. For the only other species with enough animals to allow inferences, *T. melanophris*, the pattern was different, with juvenile males being more frequent (57,2%).

The occurrence of Procellariiformes along the monitored area varied among months and years (Figure 4). In all years large numbers of Manx shearwaters (*Puffinus puffinus*) were found on the beaches from late September to November, agreeing with what is known about its migratory patterns (Guilford et al., 2009). As 2015 and 2019 were monitored only partially, only years that were monitored fully (2016-2018) were analyzed in order to understand temporal patterns of occurrence. Considering only ACAP species, the number of animals varied

considerably among years (2016=1,190; 2017=280; 2018=654). However, there was a clear increase in the number of beached seabirds in the second semester of all years (Figure 5).

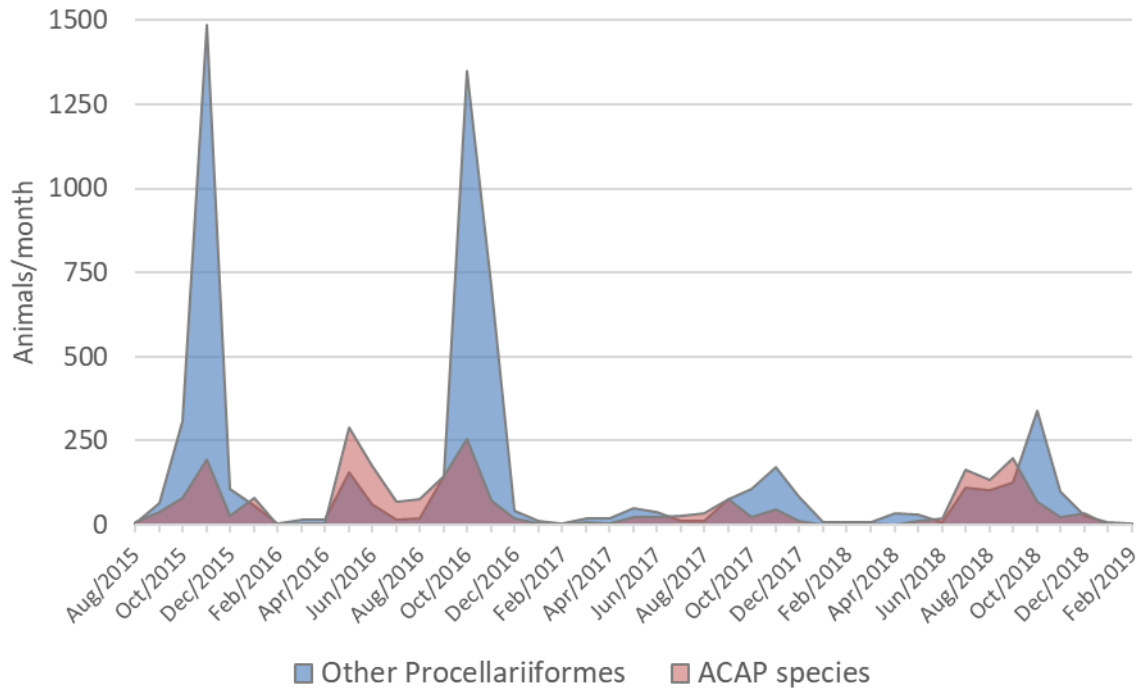


(A)

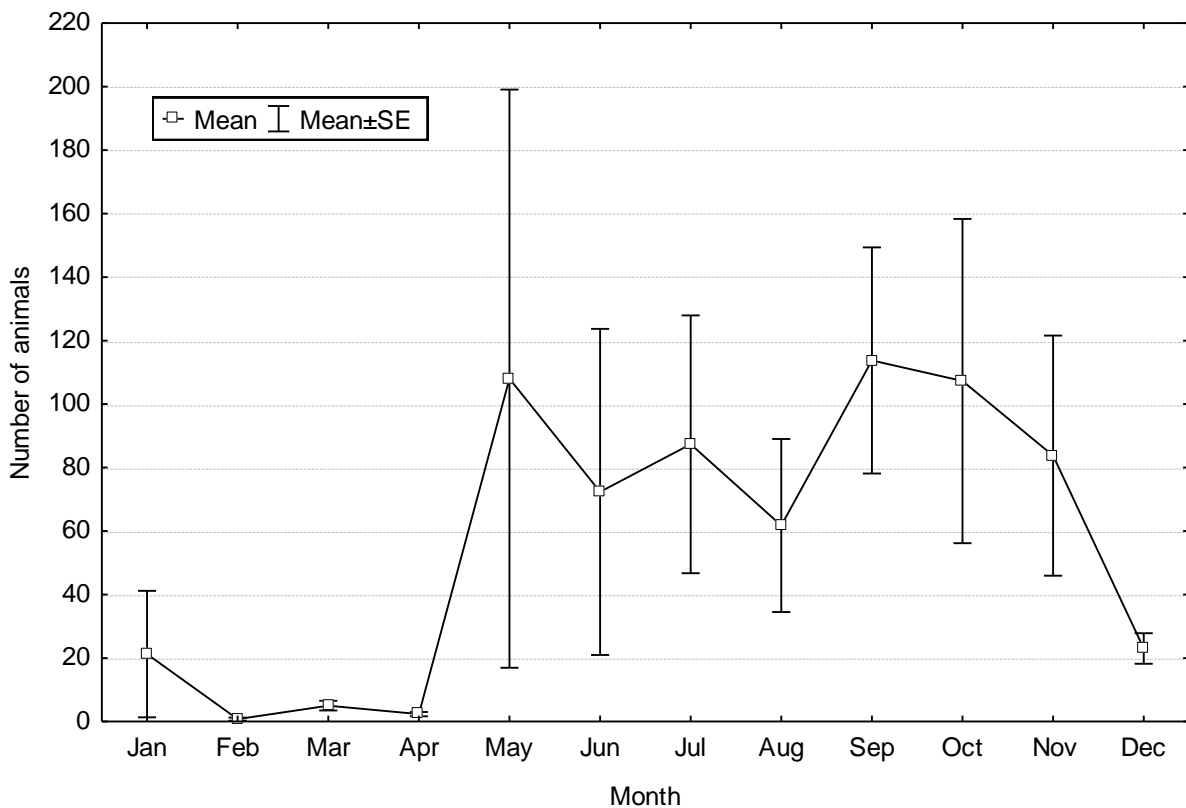


(B)

**Figure 3. Developmental stage (A) and sex (B) of carcasses from ACAP species recorded during beach surveys by the Santos Basin Beach Monitoring Project, from August-2015 to February-2019.**

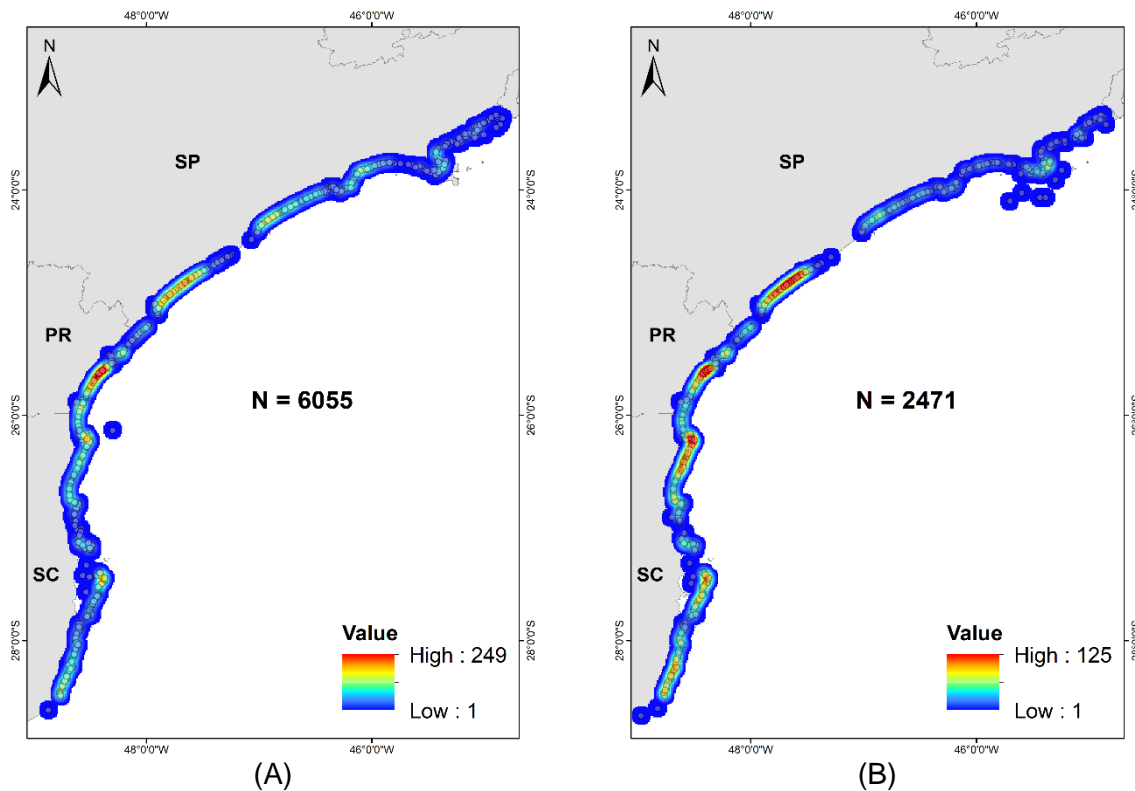


**Figure 4. Number of Procellariiformes recorded per month by the Santos Basin Beach Monitoring Project, from August-2015 to February-2019.**



**Figure 5. Mean number of carcasses from ACAP species recorded per month by the Santos Basin Beach Monitoring Project.**

The stranding pattern of ACAP species was similar to other Procellariiformes (Figure 6). However, there were relatively higher densities of ACAP species in southern São Paulo and northern Santa Catarina (Figure 6B) when compared to other Procellariiformes. This pattern was caused mainly by stranded *P. aequinoctialis* and *T. chlororhynchos* in these areas.



**Figure 6. Spatial distribution of Procellariiformes strandings, from August-2015 to February-2019: (A) non-ACAP species; (B) ACAP species.**

After completing three full years of intensive monitoring, data from PMP-BS allow us to better understand the occurrence and diversity patterns of albatrosses and petrels along the monitored area. The stranding of a carcass on a beach is the end result of different factors interacting: species abundance at sea, mortality rate, carcass buoyancy, drift conditions and, finally, finding and reporting (Peltier & Ridoux, 2015). Since monitoring effort was homogeneous both in time and space, and the surveys were performed by dedicated research teams, it can be assumed that during this period all carcasses were found and reported. Thus, the different patterns of occurrence must reflect changes in the remaining factors.

Considering the literature suggests that only a fraction of animals that die at sea arrive on the coast, the high number of Procellariiformes observed during beach monitoring might be implying in very high mortalities at sea. The PMP-BS is scheduled to continue for at least three more years, allowing for more robust interannual comparisons and to evaluate long-term spatial and temporal trends in the occurrence of Procellariiformes and other seabirds.

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