 <p>Agreement on the Conservation of Albatrosses and Petrels</p>	<p><b>Fifth Meeting of the Population and Conservation Status Working Group</b> <i>Florianópolis, Brazil, 9 - 10 May 2019</i></p>
	<p><b>Procellariiformes admitted by Instituto de Pesquisa e Reabilitação de Animais Marinhos, Espírito Santo, Brazil, 2016–2018</b> <b><i>Ralph Eric Thijl Vanstreels, Renata Hurtado, Leandro Egert, Renata C. C. Bhering, Luis Felipe S. P. Mayorga</i></b></p>

### SUMMARY

There is limited data on the occurrence of Procellariiformes along the coast of Espírito Santo state, southeast Brazil. Between 2016 and 2016, the Instituto de Pesquisa e Reabilitação de Animais Marinhos (IPRAM) received a total of 60 individuals from 10 species: *Puffinus puffinus* (26 individuals), *Calonectris diomedea* (8 individuals), *Thalassarche chlororhynchos* (8), *Ardenna gravis* (4), *Pachyptila belcheri* (4), *Procellaria aequinoctialis* (4), *Pterodroma mollis* (3), *Ardenna grisea* (1), *Oceanites oceanicus* (1), *Thalassarche melanophris* (1). Admissions were most frequent from the northern coast of the state (especially São Mateus and Linhares municipalities), which may be related to the lower human density, the extensive sandy beaches and the shallow waters of the Abrolhos Bank. Each species had a different seasonal distribution, with the most pronounced peaks of admissions in May (especially *A. gravis* and *T. chlororhynchos*) and October (almost exclusively *P. puffinus*). Although these data does not allow to evaluate the potential effects of the Mariana dam disaster of 2015, which had large-scale impacts on the estuarine and coastal areas of Espírito Santo, the fact that the area is frequented by a number of visitors and vagrants species suggests that this disaster may have had consequences for Procellariiformes breeding at oceanic islands and continents several thousands of kilometres away from the coast of Espírito Santo.

## 1. INTRODUCTION

Although the coast of Espírito Santo in southeast Brazil is not breeding grounds to Procellariiformes, this state's continental waters are important wintering grounds for these seabirds. Nineteen Procellariiformes species have been recorded in the state (Simon *et al.* 2011; LePage 2019). The state also bears relevance to the conservation of albatrosses and petrels because it is the origin of the Itaipava fleet. This fleet is predominantly composed by small vessels (<14 m) which, following the regional collapse of coastal resources, shifted to pelagic fishing in the South Brazil Bight employing a range of artisanal hook-and-line gears and techniques that result in significant bycatch of Procellariiformes (Bugoni *et al.* 2008).

Furthermore, the coast of Espírito Santo is also uniquely significant because it suffered the impacts of the Mariana dam disaster in 2015, the greatest environmental disaster of Brazil's history. After the rupture of an iron ore tailings dam operated by SAMARCO, a Brazilian mining company joint-venture between Vale and the English-Australian BHP Billiton, approximately 60 million cubic meters of mining waste were washed into the Doce River at Mariana, Minas Gerais, causing a toxic brown mudflow that flowed 530 km until reaching the sea 17 days later at Linhares, Espírito Santo. In addition to causing 19 deaths and disastrous impacts to the environment and communities along the Doce River (Fernandes *et al.* 2016), the toxic effects of the heavy metal-contaminated mudflow also been a concern for the marine fauna along the Espírito Santo coast (Frainer *et al.* 2016; Marta-Almeida *et al.* 2016; Miranda and Marques 2016; Gomes *et al.* 2018).

Instituto de Pesquisa e Reabilitação de Animais Marinhos (IPRAM – Institute of Research and Rehabilitation of Marine Animals) is a non-profit organization that rescues and rehabilitates marine animals in Espírito Santo state, southeast Brazil. Although it was initially focused on the rehabilitation of penguins, since 2016 IPRAM has also received live and dead Procellariiformes found along the coast or rescued from offshore oil platforms. Here we present data on the Procellariiformes received by IPRAM, providing preliminary data from the understudied coastline of Espírito Santo.

## 2. RESULTS

Between 2016 and 2018, a total of 60 individuals from 10 species were received, of which 24 were alive and 36 were dead (Table 1).

**Table 1. Procellariiformes received for rehabilitation or post-mortem examination at Instituto de Pesquisa e Reabilitação de Animais Marinhos (IPRAM), Espírito Santo, Brazil, 2016–2018.**

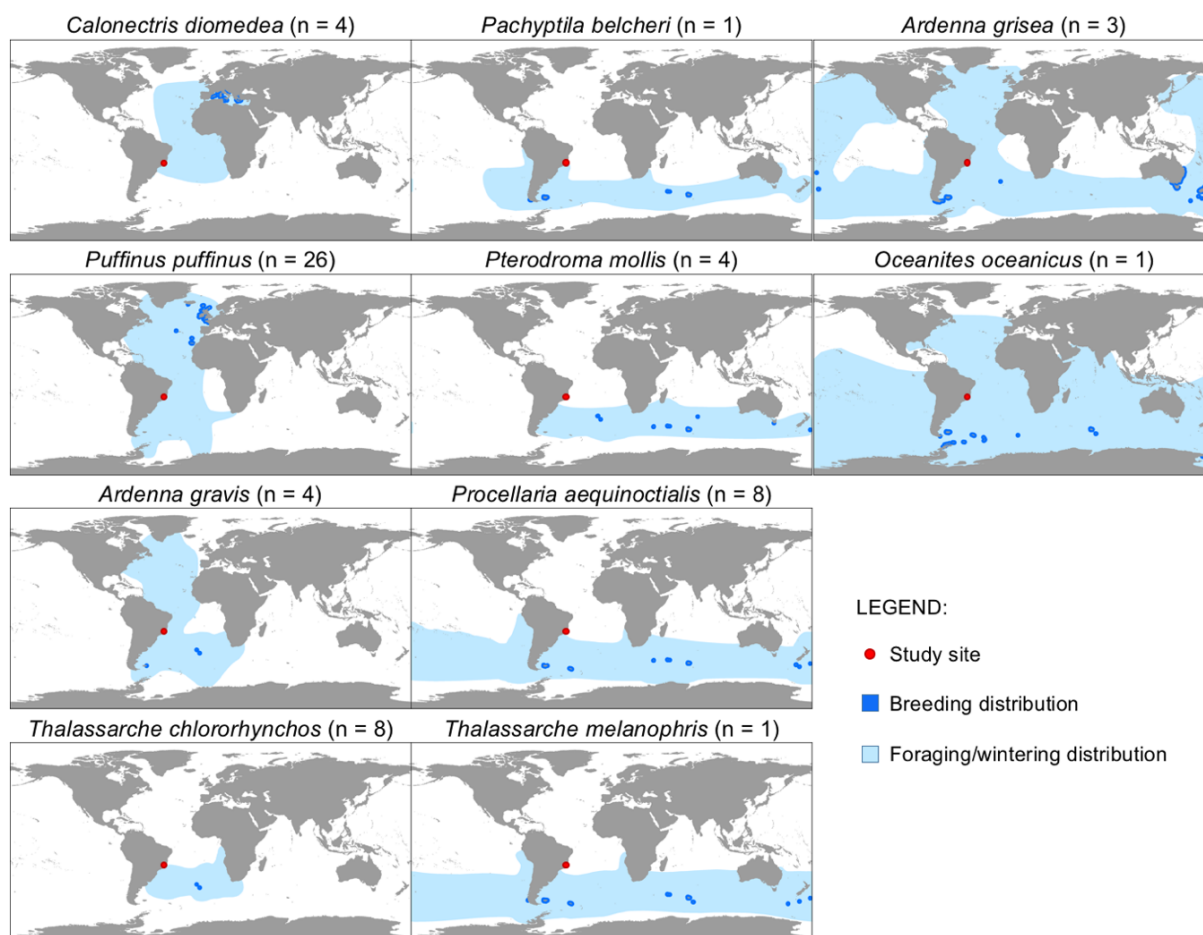
Family and species	Live	Dead	Total
Diomedidae			
Atlantic Yellow-nosed Albatross ( <i>Thalassarche chlororhynchos</i> )	3	5	8
Black-browed Albatross ( <i>Thalassarche melanophris</i> )	0	1	1
Procellariidae			
Great Shearwater ( <i>Ardenna gravis</i> )	1	3	4
Sooty Shearwater ( <i>Ardenna grisea</i> )	1	0	1
Cory's Shearwater ( <i>Calonectris diomedea</i> )	3	5	8
Slender-billed Prion ( <i>Pachyptila belcheri</i> )	4	0	4
White-chinned Petrel ( <i>Procellaria aequinoctialis</i> )	2	2	4
Soft-plumaged Petrel ( <i>Pterodroma mollis</i> )	2	1	3
Manx Shearwater ( <i>Puffinus puffinus</i> )	7	19	26
Oceanitidae			
Wilson's Storm-Petrel ( <i>Oceanites oceanicus</i> )	1	0	1
<b>Total</b>	<b>24</b>	<b>36</b>	<b>60</b>

Males and females were received in similar proportion (25 males, 26 females, 9 unknown sex); however, males were slightly more frequent among live birds (11 males, 9 females, 4 unknown

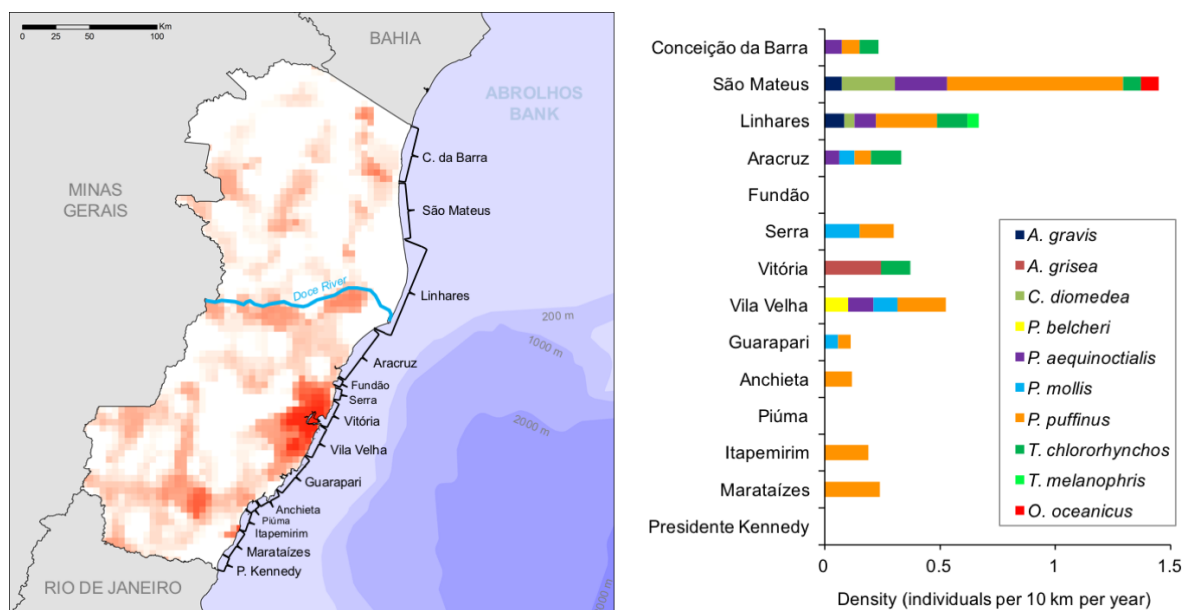
sex) whereas females were slightly more frequent among dead birds (14 males, 17 females, 5 unknown sex). On the other hand, juveniles were most frequent among Diomedidae (7 juveniles, 2 adults) whereas adults were most frequent among Procellariidae (7 juveniles, 41 adults, 2 unknown age group).

Figure 1 represents the location of Espírito Santo is considered in relation to the natural distribution of these species. The municipalities of São Mateus and Linhares municipalities were recorded as the most frequent origin of birds admitted to IPRAM (19 and 12 individuals, respectively), and this remained true after adjusting for the extent of the coastline of each municipality (Figure 2).

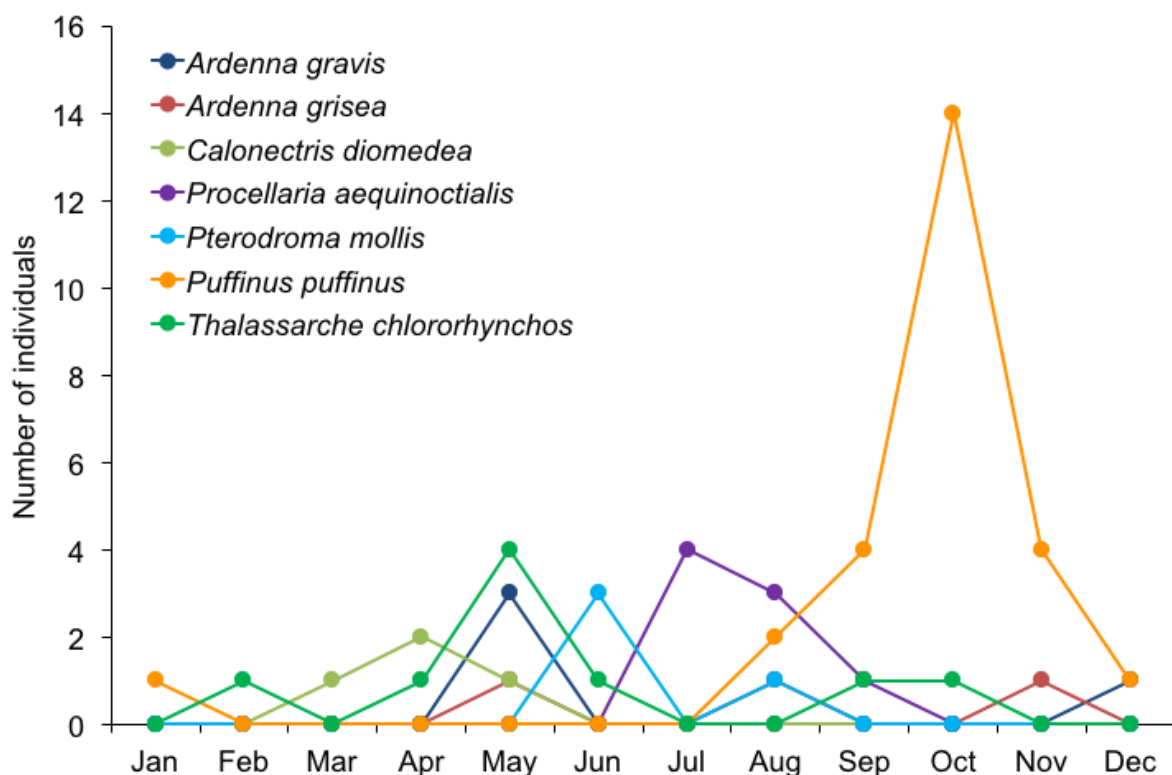
The number of individuals received changed considerably over the years, with fewer birds admitted in 2016 (5 live, 4 dead) and 2017 (4 live, 5 dead) than in 2018 (15 live, 27 dead). The monthly distribution of admissions varied depending on the species, as shown in Figure 3. There was an apparent progression in the peak admission of each species over the months: April (*Calonectris diomedea*), May (*Ardenna gravis* and *Thalassarche chlororhynchos*), June (*Pterodroma mollis*), July and August (*Procellaria aequinoctialis*), and October (*Puffinus puffinus*).



**Figure 1. Comparison of the natural distribution of the Procellariiformes species relative to the study site (Espírito Santo state, Brazil). Data from International Union for the Conservation of Nature (2019).**



**Figure 2. Geographic distribution of the Procellariiformes received by the Instituto de Pesquisa e Reabilitação de Animais Marinhos, Espírito Santo, Brazil, 2016–2018. Left: Map of Espírito Santo state, showing the coastal municipalities in relation to the human population density (red shaded areas) and bathymetry (blue shaded areas). Right: Density of Procellariiformes across coastal municipalities.**



**Figure 3. Monthly distribution of Procellariiformes birds received by the Instituto de Pesquisa e Reabilitação de Animais Marinhos, Espírito Santo, Brazil, 2016–2018.**

### 3. DISCUSSION

Our results show that Espírito Santo state, especially its northern coast, is seasonally visited by a number of Procellariiformes from both the Northern and Southern hemispheres. When the location of Espírito Santo the natural distribution of these species is considered, the following groups can be identified: (a) 30 individuals of species that breed in the Northern Hemisphere and are predominantly restricted to the Atlantic Ocean (*C. diomedea*, *P. puffinus*), a) 12 individuals of species that breed in the Southern Hemisphere and are predominantly restricted to the Atlantic Ocean (*A. gravis*, *T. chlorohrychos*), (c) 14 individuals of species predominantly restricted to the Southern Ocean (*P. belcheri*, *P. mollis*, *P. aequinoctialis*, *T. melanophris*), and (d) four individuals of species that breed in the Southern Hemisphere but are globally distributed (*A. grisea*, *O. oceanicus*). It is worth noting the remarkable distance from Espírito Santo to the nearest breeding colonies of the species recorded at IPRAM: 3200 km to Tristan da Cunha, 3600 km to the Falkland Islands, 6000 km to Cape Verde, and 7500 km to the Mediterranean Sea.

Interestingly, despite breeding a mere 1200 km east off the coast of Espírito Santo at the Trindade and Martim Vaz Archipelago, Trindade Petrels (*Pterodroma arminjoniana*) were not received during the study period. The only other Procellariiformes species known to breed in Brazil also was not received, the Audubon's Shearwater (*Puffinus lherminieri*) which breeds at Fernando de Noronha Archipelago (1900 km northeast from Espírito Santo).

The number of individuals and species diversity were greater in the northern coast of the state, where there are extensive sandy beaches and human density is slow. Furthermore, this region is located in the southern part of the Abrolhos Bank, where there is significant blooming of biological productivity in winter (Ghisolfi et al. 2015). The monthly distribution also corroborates the interpretation that the Procellariiformes visiting the Espírito Santo coast are motivated by this winter bloom, as most individuals were received from May to November.

Although a considerably greater number of individuals was received in 2018 compared to 2016 and 2017, this is likely related to changes in beach survey efforts (which became more intensive and consistent) and might not necessarily reflect biological phenomena. Because the data in this study was collected only after the Mariana dam disaster in 2015, it is difficult to interpret whether the number of Procellariiformes received by IPRAM is related or not to the environmental impacts of this disaster. Nonetheless, it is worth noting that large numbers of Procellariiformes were received from the municipalities near the Doce River estuary, suggesting that the disaster impacted on an area that is highly significant for these seabirds. Because the region regularly receives migratory Procellariiformes from the Northern and Southern hemispheres, the impacts of this disaster may have consequences for seabirds breeding at colonies thousands of kilometers away from the coast of Espírito Santo. Further studies on the heavy metal toxicology and long-term health impacts on seabird communities that migrate to Espírito Santo will therefore be valuable in order to better understand the consequences of the Mariana dam disaster.

### 4. ACKNOWLEDGEMENTS

We are grateful to the Instituto Estadual do Meio Ambiente e Recursos Hídricos (IEMA) for the valuable support and collaboration.

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