Fourth Meeting of the Population and Conservation Status Working Group

Wellington, New Zealand, 7 – 8 September 2017

Procellariiformes mortality assessment by systematic beach surveys in Brazil

Emanuel Ferreira, Patrícia Pereira Serafini, Rodrigo R. Valle, Camila Domit, Karina R. Groch, Pedro Volkmer Castilho, Marta Cremer, Lisa Oliveira, Andrea Maranho, Marcos Santos, Carla Beatriz Barbosa, Carolina P. Bertozzi, Suzana Paz Martins, André Barreto, Cristiane K. M. Kolesnikovas

SUMMARY

This brief report was prepared in order to present information from *Procellariiformes* mortality in Brazilian coastal areas. We recorded 3641 *Procellariiformes* found in south and southeast Brazil during daily beach surveys within a 14 months period (2015/2016). Beached animal monitoring programs can be useful if carcass data are recorded over the long term, systematically and over a wide geographic area, providing an index of baseline mortality with which anomalous mortality events. Stranded birds can reveal long-term spatial and temporal trends in chronic oil pollution in the marine environment, identify the possible anthropogenic causes of stranding from fisheries activities and responses to legislative and support management actions.

RECOMMENDATIONS

Considering that Brazilian waters comprises an important feeding area used by at least 37 species of *Procellariiformes*, with the greatest richness and abundance being found in its southern colder waters (Piola et al. 2004) and that 3641 *Procellariiformes* were found dead or debilitated in south and southeast Brazil during daily beach surveys within a 14 months period (2015/2016) we recommend that:

1. Systematic beach monitoring continues in Brazil in order to assess patterns on marine animal's mortality, once they can be stablished only within long term monitoring programs.
2. Further analysis on causes of death for beached birds are accomplished and improved in the next years.
3. Further studies on carcasses derivation and permanence under ocean currents studied to assess inference of where the birds are dying in the ocean.

This paper is presented for consideration by ACAP and may contain unpublished data, analyses, and/or conclusions subject to change. Data in this paper shall not be cited or used for purposes other than the work of the ACAP Secretariat, ACAP Meeting of the Parties, ACAP Advisory Committee or their subsidiary Working Groups without the permission of the original data holders.

1. INTRODUCTION

Albatrosses and petrels are migratory species of great international significance of marine ecosystems and represent one of the most endangered groups of birds in the world (Birdlife International 2012). The *Procellariiformes* (including albatrosses, petrels and shearwaters) comprise one of the most endangered bird taxa, as many species have undergone substantial declines in recent times (Phillips et al. 2016). A majority of petrel species and almost all albatrosses currently face a high risk of extinction. Habitat disturbance, nesting habitat degradation and loss, incidental bycatch in fisheries, changes in food supply, pollution and marine debris, invasive species, diseases and other threats have had substantial adverse impacts on albatrosses and petrels worldwide (Carlile et al. 2003, Bourgeois & Vidal 2007, Le Corre 2008). Nevertheless, the most significant threat causing albatrosses and petrels population declines is mortality arising from interactions with fishing gear, especially in longline and trawl fishing operations (Furness 2003, Lewison et al. 2004, Halpern et al. 2008, Anderson et al. 2011, Phillips et al. 2016).

Most of these birds migrate long distances to the Subtropical convergence zone to feed, including trans-Mediterranean migrants such as the *Puffinus puffinus* and albatrosses nesting on the South Georgia and Falklands / Islas Georgias del Sur e Islas Malvinas[1] (Guilford et al. 2009, Phillips et al. 2016). In addition, during the winter, there is a penetration of cold and nutrient-rich waters from the south, which advance through the Brazilian continental shelf until 23-24° S (Campos et al. 1996, Piola et al. 2004). The phenomenon coincides with the post-reproductive dispersion of species such as the *Procellaria aequinoctialis* and *Thalassarche melanophris*, which become more abundant in Brazilian waters during this season.

Despite the scarcity of species breeding in that region, the Brazilian Economic Exclusive Zone (EEZ) is a feeding area used by at least 37 species of *Procellariiformes*, most ACAP species, with the greatest richness and abundance being found in the colder waters and resurgence of the South / Southeast, especially in the Subtropical convergence zone, off the coast of Rio Grande do Sul State, where the warm waters of the Brazilian current meet the cold waters of the Falkland current (Piola et al. 2004).

To understand how this rich biodiversity of albatrosses and petrels species interacts with potential threats within Brazilian waters is an important task that the National Action Plan for the Conservation of Albatrosses and Petrels (PLANACAP) has focused in the last years. Thus, one of the tools available to this purpose was implemented through oil and gas exploration licensing process, a systematic beach survey was designed to describe and analyse trends in stranded data of *Procellariiformes* and other marine animals. Here, we present results from surveys in Southern / Southeastern Brazil during 2015 – 2016 throughout this monitoring program.

2. METHODOLOGY

2.1. Data

[1] A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Islas Malvinas), South Georgia and the South Sandwich Islands (Islas Georgias del Sur e Islas Sandwich del Sur) and the surrounding maritime areas.

Stranded data were obtained from beach surveys conducted by “Projeto de Monitoramento de Praias”, from August 2015 to October 2016, to record marine megafauna (sea turtles, seabirds and marine mammals) as part of a monitoring program, covering ~675 km daily. All bird carcasses detected from waterline to foredunes were recorded, counted, identified based on literature information (eg, Onley & Scofield 2010; Howel 2012), and also were removed from the beach or marked to avoid recounting. The carcasses and animals found debilitated are evaluated for the presence of lesions, external markings, interactions with fishing gears, nylon and / or oil, stains to identify the possible anthropogenic causes of stranding from fisheries activities. To compare strand effort among different areas of the coast, encounter rates were calculated as birds per 100km.

The “Projeto de Monitoramento de Praias da Bacia de Santos (PMP-BS)” is a monitoring program developed to evaluate the impacts from oil and gas production on Santos Basin in birds, sea turtles and marine mammals.

2.2. Study area

The coastline monitored in this study is located in the Southern / Southeast Brazil between 23°22´S and 28°30′S (Figure 1) covering three Brazilian states (São Paulo, Paraná, and Santa Catarina). The coastal region is under the influence of the subtropical convergence between the southward and northward flowing Brazil and Malvinas Currents. The confluence of water masses and the high volume of continental runoff provide physical and chemical conditions for high biological production on the shelf (Seeliger et al. 1998, Piola et al. 2004). The opportunity generated by this high biological productivity makes the southern regions of the country stimulate historically fishing within this area. It is the industrial fisheries who provides most of the landings, accounting for approximately half of the total Brazilian catches (IBAMA, 2005). Historically, it was in the south and southeast that industrial fisheries were mostly developed through a series of government incentives, and this is where fisheries data were best documented.

3. RESULTS AND DISCUSSION

A total of 3641 *Procellariiformes* were found during regular beached surveys during this period (Table 1). The monitoring program registered 13 species of *Procellaridae*, four species of *Diomedeidae* and one *Hydrobatidae*. Of these, 95.52% were found dead and 4.48% alive. The family *Procellariidae* (79.62%) was the most frequent *Procellariiformes* found stranded on the beach. *Puffinus puffinus* was the most commonly detected species (61.05%), followed by *Procellaria aequinoctialis* (12%) and *Macronectes giganteus* (2,39%) and *Calonectris borealis* (2.14%). Each from remaining species constituted less than 3% of recovered carcasses. During this period, an unusual high mortality of *P. puffinus was recorded* in São Paulo state, where more than 1000 animals were counted between October and November of 2015. The family *Diomedeidae* comprehended mostly *Talassarche chlororhynchos* and *T. melanophris* with 20.10% (9.23% and 10.88% respectively). The period from September to December was the one with highest occurrence of stranded birds (Figure 1; Table 2). The carcass encounter rate was calculated to compare different locations, and Paraná state was the higher encounter in southern Brazil.

Due to assess the impacts of anthropogenic factors on seabird populations, a possible alternative or complement to vessel-based observer programs is an animal stranding surveys

(Wiese 2002, Wiese et al. 2004, Camphuysen 2001, Harris et al. 2006). Anthropogenic sources of mortality as signalled by beached animals are difficult to assess in the absence of background mortality rates or known population size (Eguchi 2002, Ford 2006). In general, reports of beached bird surveys rarely mention mortality attributable to bycatch, and a study conducted by Forsell (1999) along the Atlantic coast of North Carolina and Virginia, United States being one of the few exceptions. The author analysed waterbird mortality in coastal gillnets, using beached bird surveys to assess geographic scope and the bird species involved (Forsell 1999).

Therefore, beached animal monitoring programs can be useful, particularly if carcass data are recorded over the long term, systematically and over a wide geographic area, providing an index of baseline mortality with which anomalous mortality events, including acute fisheries-associated mortality, can be compared (Ford 2006, Žydelis et al. 2006, Parrish et al. 2007, Chaloupka et al. 2008). With respect to fisheries mortality, stranding can be particularly useful source of information because carcasses can be assessed for signs of entanglement or hooking (Cox et al. 1998, Žydelis et al. 2006, Byrd et al. 2008). Stranded birds can reveal long-term spatial and temporal trends in chronic oil pollution in the marine environment, identify the possible anthropogenic causes of stranding from fisheries activities and responses to legislative and management actions.

Assessing bird mortality in fishing gear typically requires direct communication with fishermen and observer programs to monitor the bycatch (Neves et al. 2005). This process is usually more difficult and expensive to execute, as it involves fishermen, observers, government and others. Although it is important to document the numbers of birds recovered during beach surveys, it is equally important to determine the cause of death. At the present moment necropsy data and samples are subject of further analysis to uncover the laying causes of this mortality patterns in Brazil. For effective conservation measures, urge the needs to distinguish natural and anthropogenic sources of mortality in stranded animals. To answer this question in the future, complete necropsy of fresh carcasses were performed and determination of the causes of death are on study.

REFERENCES

ANDERSON, O.R.J., SMALL, C.J., CROXALL, J.P., DUNN, E.K., SULLIVAN, B.S., YATES, O. & BLACK, A., 2011. Global seabird bycatch in longline fisheries. Endanger. Species Res. 14, 91-106.

BIRDLIFE INTERNATIONAL. 2012. The IUCN Red List of Threatened Species 2012. http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T22698305A38939569.en. Downloaded on 20 August 2016

BOURGEOIS, K. & VIDAL, E. 2007. The endemic Mediterranean Yelkouan Shearwater Puffinus yelkouan: distribution, threats and a plea for more data. Oryx 42: 187–194.

BYRD, B.L., HOHN, A.A., MUNDEN, F.H., LOVEWELL, G.N. & LO PICCOLO, R.E. 2008. Effects of commercial fishing regulations on stranding rates of Bottlenose Dolphin (Tursiops truncatus). Fishery Bulletin 106: 72–81.

CAMPOS, E.J.D., LORENZZETTI, J.A., STEVENSON, M.R., STECH, J.L. & SOUZA, R.B. 1996. Penetration of waters from the Brazil-Malvinas Confluence region along the South American Continental Shelf up to 23°S. Anais da Academia Brasileira de Ciências, v. 68 (Supl. 1), p. 49-58.

CAMPHUYSEN, C.J. & HEUBECK, M. 2001. Marine oil pollution and beached bird surveys: the development of a sensitive monitoring instrument. Environmental Pollution 112: 443–461

CARLILE, N., PRIDDEL, D., ZINO, F., NATIVIDAD, C. & WINGATE, D.B. 2003. A review of four successful recovery programmes for threatened, sub-tropical petrels. Mar. Ornithol. 31: 185–192.

CHALOUPKA, M., WORK, T.M., BALAZS, G.H., MURAKAWA, S.K.K. & MORRIS, R. 2008. Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982–2003). Marine Biology 154: 887–898.

COX, T.M., READ, A.J., BARCO, S., EVANS, J., GANNON, D.P., KOOPMAN, H.N., MCLELLAN, W.A., MURRAY, K., NICOLAS, J., PABST, D.A., POTTER, C.W., SWINGLE, W.M., THAYER, V.G., TOUHEY, K.M. & WESTGATE, A.J. 1998. Documenting the bycatch of Harbor Porpoises, Phocoena phocoena, in coastal gillnet fisheries from stranded carcasses. Fishery Bulletin 96: 727–734.

EGUCHI, T. 2002. A method for calculating the effect of a die-off from stranding data. Marine Mammal Science 18: 698–709.

FORD, R.G. 2006. Using beached bird monitoring data for seabird damage assessment: the importance of search interval. Marine Ornithology 34: 91–98.

FORSELL, D.J. 1999. Mortality of migratory waterbirds in midAtlantic coastal anchored gillnets during March and April, 1998. US Fish and Wildlife Service Technical Report. Annapolis, MD: US Fish and Wildlife Service, Chesapeake Bay Field Office. 29 pp.

FURNESS, R.W. 2003. Impacts of fisheries on seabirds communities. Scientia Marina 67 (2): 33-45.

GUILFORD, T., MEADE, J., WILLIS, J., PHILLIPS, R. A., BOYLE, D., ROBERTS, S., ... & PERRINS, C. M. 2009. Migration and stopover in a small pelagic seabird, the Manx shearwater Puffinus puffinus: insights from machine learning. Proceedings of the Royal Society of London B: Biological Sciences, rspb-2008.

HALPERN, B.S., WALBRIDGE, S., SELKOE, K.A., KAPPEL, C.V., MICHELI, F., D'GROSA, C., BRUNO, J.F., CASEY, K.S., EBERT, C., FOX, H.E., FUGITA, R., HEINEMANN, D., LENIHAN, H.S., MADIN, E.M.P., PERRY, M.T., SELIG, E.R., SPALDING, M., STENEG, R. & WATSON, R., 2008. A global map of human impact on marine ecosystem. Science 319, 948-952. http://dx.doi.org/ 10.1126/science.1149345

HARRIS, R.J., TSENG, F.S., POKRAS, M.A., SUEDMEYER, B.A., BOGART, J.S.H., PRESCOTT, R.L. & NEWMAN, S.H. 2006. Seabird Ecological Assessment Network (SEANET) volunteer beached bird surveys in Massachusetts, 2003–2004. Marine Ornithology 34: 115–122.

HOWELL, S.N.G. 2012. Petrels, Albatrosses, and Storm-Petrels of North America: A Photographic Guide. 512p.

IBAMA, 2005: Estatística da pesca. Brasil 2004. Grande Unidades da Federação. IBABA, Brasília, 136 p.

LECORRE,M. 2008. Cats,rats and seabirds. Nature 451:134–135.

LEWISON, R.L., CROWDER, L.B., READ, A.J. & FREEMAN, S.A., 2004. Understanding impacts of fisheries bycatch on marine megafauna. Trends Ecol. Evol. 19, 598-604. http://dx.doi.org/10.1016/j.tree.2004.09.004

NEVES, T.S., BUGONI, L., MONTEIRO, D.S., NASCIMENTO, L. & PEPPES, F.V. Seabirds abundance and bycatch on Brazilian longline fishing fleet. CCAMLR/WG-FSA-05/67. 2005.

ONLEY D. & SCOFIELD P. 2010. Albatrosses, Petrels and Shearwaters of the World. Blommsburry Publishing Plc. London, UK.

PARRISH, J.K., BOND, N., NEVINS, H., MANTUA, N., LOEFFEL, R., PETERSON, W.T. & HARVEY, J.T. 2007. Beached birds and physical forcing in the California Current System. Marine Ecology Progress Series 352: 275–288.

PIOLA, A.R., MÖLLER JR.,O.O. & PALMA, E.D. 2004. El Impacto del PlataSobre el OceanoAtlántico. Ciencia Hoy. 82(14):28-37

PHILLIPS, R. A., GALES, R., BAKER, G. B., DOUBLE, M. C., FAVERO, M., QUINTANA, F., TASKER. M. ., WEIMERSKIRCH, M., UHART, A. & WOLFAARDT, A. 2016. The conservation status and priorities for albatrosses and large petrels. Biological Conservation, 201, 169-183.

SEELIGER, U., ODEBRECHT, C. & CASTELLO, J.P. 1998. Os ecossistemas costeiros e marinhos do extremo sul do Brasil Ecoscientia, 396p.

WIESE, F. K. 2002. Estimation and impacts of seabird mortality from chronic marine oil pollution off the coast of Newfoundland. Dissertation, Department of Biology, Memorial University of Newfoundland, St. John’s, Newfoundland, Canada.

WIESE, F.K., ROBERTSON, G.J. & GASTON, A.J. 2004. Impacts of chronic marine oil pollution and the murre hunt in Newfoundland on Thick-billed Murre populations in the Eastern Canadian Arctic. Biological Conservation 116: 205–216.

ŽYDELIS, R., MINDAUGAS, D. & VAITKUS, G. 2006. Beached bird surveys in Lithuania reflect marine oil pollution and bird mortality in fishing nets. Marine Ornithology 34: 161–166..

ANNEX 1

Table 1. Number of *Procellariiformes* stranded during regular beach surveys on the Southern Brazilian coast.

Species	**Dead**	**Alive**	**Total**
Procellariiformes	**3478**	**163**	**3641**
Diomedeidae	**720**	**14**	**734**
Diomedea epomophora	1		1
Phoebetria palpebrata	1		1
Thalassarche chlororhynchos	334	2	336
Thalassarche melanophris	384	12	396
Hydrobatidae	**6**	**2**	**8**
Oceanites oceanicus	6	2	8
Procellariidae	**2752**	**147**	**2899**
Calonectris borealis	75	3	78
Daption capense	7		7
Fulmarus glacialoides	3		3
Macronectes giganteus	77	10	87
Macronectes halli		2	2
Pachyptila belcheri		1	1
Pachyptila desolata	5	1	6
Procellaria aequinoctialis	418	19	437
Pterodroma incerta	5	3	8
Pterodroma mollis	1	2	3
Ardenna gravis	30	3	33
Ardenna grisea	9	2	11
Puffinus puffinus	2122	101	2223

Table 2. Number of *Procellariiformes* stranded by month during regular beach surveys on the Southern Brazilian coast.

Species	aug/15	sep/15	oct/15	nov/15	dec/15	jan/16	feb/16	mar/16	apr/16	may/16	jun/16	jul/16	aug/16	sep/16	oct/16
Procellariiformes	**6**	**73**	**318**	**1566**	**105**	**120**	**2**	**16**	**16**	**349**	**184**	**73**	**79**	**230**	**504**
Diomedeidae	**4**	**23**	**52**	**150**	**14**	**19**		**3**	**3**	**166**	**89**	**33**	**37**	**84**	**57**
Diomedea epomophora										1					
Phoebetria palpebrata															1
Thalassarche chlororhynchos	2	7	29	97	11	18		3	2	40	33	6	14	52	22
Thalassarche melanophris	2	16	23	53	3	1			1	125	56	27	23	32	34
Hydrobatidae			**1**							**6**	**1**				
Oceanites oceanicus			1							6	1				
Procellariidae	**2**	**50**	**265**	**1416**	**91**	**101**	**2**	**13**	**13**	**177**	**94**	**40**	**42**	**146**	**447**
Calonectris borealis					9	9	1	8	12	37	2				
Daption capense										6	1				
Fulmarus glacialoides				1	1										1
Macronectes giganteus		5	13	5						1	18	15	17	7	6
Macronectes halli											1	1			
Pachyptila belcheri										1					
Pachyptila desolata										4	1			1	
Procellaria aequinoctialis	2	8	14	37	13	62		1		119	66	20	20	41	34
Pterodroma incerta			1	4		2					1				
Pterodroma mollis				1	2										
Ardenna gravis			1	4	10	9		1		1				4	3
Ardenna grisea		1		2						2	2	3			1
Puffinus puffinus		36	236	1362	56	19	1	3	1	6	2	1	5	93	402

Table 3. Encounter rates (Nº. animals/100/km) of *Procellariiformes* stranded by region during regular beach surveys on the Southern Brazilian coast.

Species	**São Paulo**	**Paraná**	**Santa Catarina**
Procellariiformes	**0,972**	**1,990**	**1,162**
Diomedeidae	**0,188**	**0,325**	**0,266**
Diomedea epomophora	0,000	0,000	0,001
Phoebetria palpebrata	0,001	0,000	0,000
Thalassarche chlororhynchos	0,089	0,138	0,121
Thalassarche melanophris	0,099	0,186	0,145
Hydrobatidae	**0,001**	**0,003**	**0,005**
Oceanites oceanicus	0,001	0,003	0,005
Procellariidae	**0,783**	**1,662**	**0,890**
Calonectris borealis	0,024	0,035	0,023
Daption capense	0,001	0,000	0,005
Fulmarus glacialoides	0,000	0,003	0,002
Macronectes giganteus	0,024	0,039	0,029
Macronectes halli	0,001	0,000	0,001
Pachyptila belcheri	0,001	0,000	0,000
Pachyptila desolata	0,000	0,003	0,004
Procellaria aequinoctialis	0,074	0,251	0,200
Pterodroma incerta	0,003	0,000	0,003
Pterodroma mollis	0,001	0,006	0,000
Ardenna gravis	0,005	0,003	0,021
Ardenna grisea	0,003	0,000	0,004
Puffinus puffinus	0,649	1,321	0,598

ANNEX 2

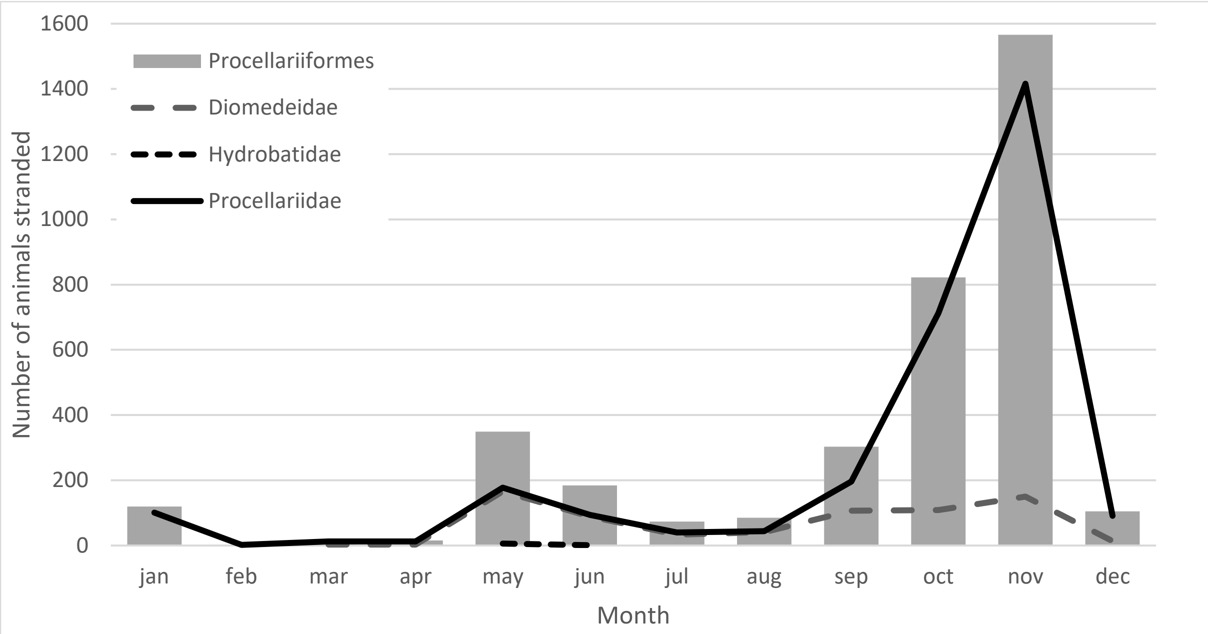

Figure 1. Number of *Procellariiformes* stranded by month during regular beach surveys on the Southern Brazilian coast.