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Research Article

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Abundance and Biodiversity of Top Predators - Seabirds and Marine Mammals - in Antarctic Seas

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Abstract

This article concerns the comparison of data collected in different Antarctic seas by the same team, same platform (mainly from the bridge of icebreaking RV Polarstern, 18 m above sea level), and thus the same methodology. Drastic differences were noted, from very high numbers in the Weddell Sea to very low ones in the Amundsen Sea. Biodiversity was low, as reflected by low numbers of species, a few of them representing the vast majority in numbers of individuals: between 85% and 95% of the total

Material and Methods

Our methodology consists of 30 minutes transect counts from the bridge 18 m above sea level by one observer, without width limitation, light and visibility allowing during transects in four hours' watches. It was discussed and described in more detail previously in various papers.

The aim of birdwatcher's members of the "Seabird Group" is to express data as density, in order to allow for extrapolating and comparing data. This is why a historical "compulsory" method was developed, limiting counts to ten minutes and to a width of 300 m. This method works well in areas with very high seabird density as the northern North Sea, but is problematic in polar areas with very low density. Moreover, it must be considered a good routine method, all observers applying the same technic. But there exists nothing like compulsory methods in science, even if results are always influenced by the sampling methods, from bacteria, zooplankton, fish, to seabirds and marine mammals.

As a more realistic alternative, we concluded Minke that results should be presented raw form (numbers per count) without any calculation as density nor correction for behaviours such as diving periods for birds and whales, nor hauling-out daily rhythm of seals, and especially not for animals not observed but believed to be present in the area.

Results

In order to allow comparison between expeditions, results are presented as numbers per 30 min transect count. Main data are summarised in Table 1. As examples, some more complete data are presented as annex.

In the **Weddell Sea** in the frame of the first European Polarstern Study (EPOS I), 30 seabird species were tallied, representing 52,000 individuals registered during 290 transect counts, corresponding thus to a mean value of 180 per count. Most numerous species were in decreasing order of abundance: Adélie penguin *Pygoscelis adeliae*, chinstrap penguin *Pygoscelis antarctica*, Cape pigeon *Daption capense,* and snow petrel *Pagodroma nivea*. They formed together 95% of the total. Important factors influencing their distribution were hydrological: open water *vs* ice covered areas: Outer Marginal Ice Zone (OMIZ), Inner Marginal Ice Zone (OMIZ) and Close Pack Ice (CPI). Moreover, the vast majority of the chinstrap penguins were concentrated on a few icebergs in open water and OMIZ. Cetaceans were mainly Antarctic thus whale *Balaenoptera bonaerensis* in

CPI (41 of the 44 individuals noted, belonging to six species). Among the six species of pinnipeds, crabeater seal *Lobodon carcinophagus* was by far the most numerous and represented 84% of the six per count individuals registered, mainly in CPI, followed by Antarctic fur seal *Arctocephalus gazella* (12%) [1].

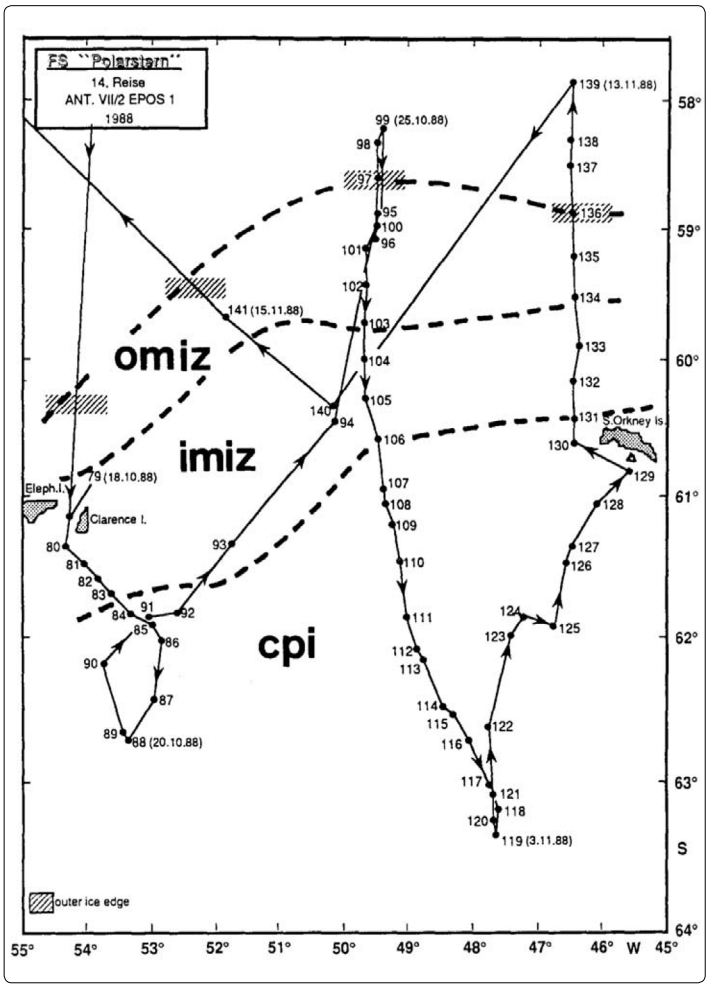
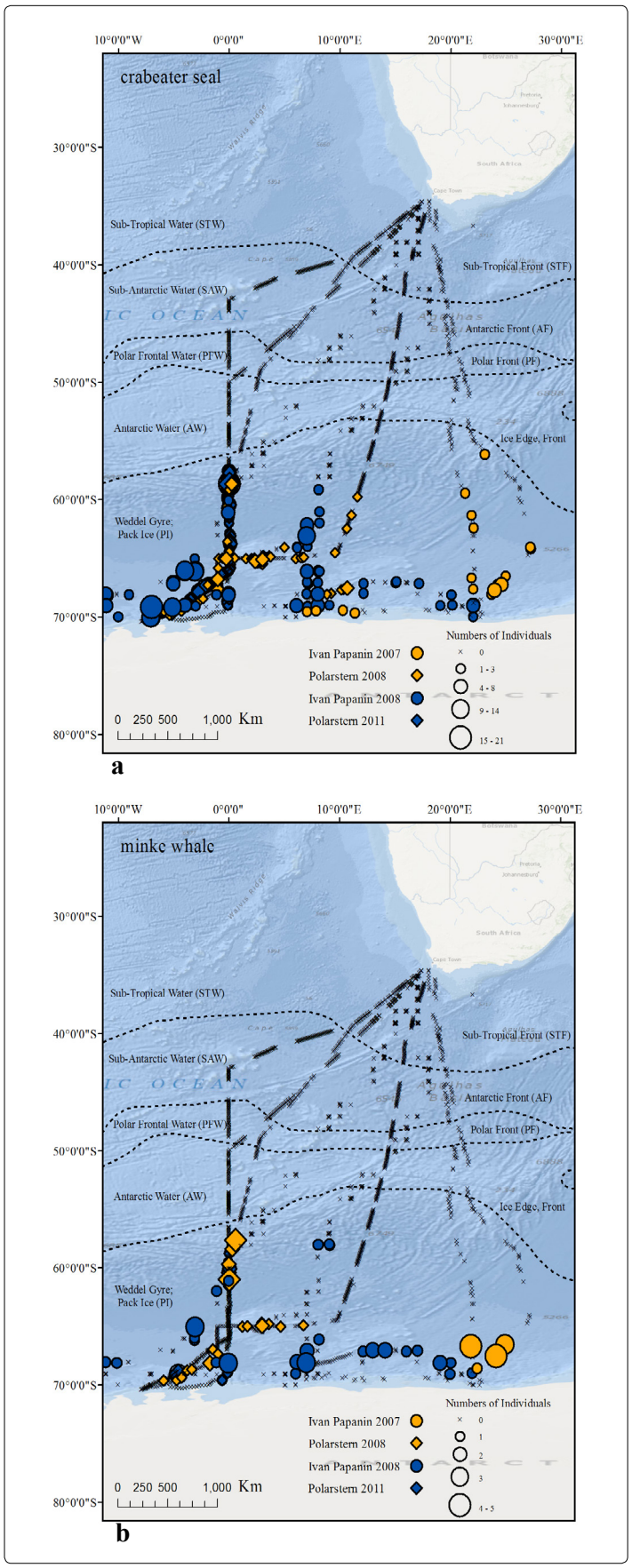


Figure 1: Route of RV Polarstern in the Weddell Sea (EPOS I) showing ship's stations and the limits of the main ice zones: Outer Marginal Ice Zone OMIZ, Inner Marginal Ice Zone IMIZ and Close Pack Ice CPI [1].

Along four return transects between **South Africa and Antarctica**, data collected in the Antarctic area during 1,470 counts concern 27 seabird species for a total of 7,070 individuals (15 per count). Most numerous species were Antarctic petrel *Thalassoica antarctica*, blue petrel *Halobaena caerula*, prion *Pachyptila sp.* and snow petrel representing 70% of the total. Tallied cetaceans were mainly humpback whale *Megaptera novaeangliae* in Antarctic Water and Antarctic Minke whale in the ice covered area, representing 58% and 18% respectively of the 500 individuals of the eight species recorded (one per count). Pinnipeds were mainly crabeater seals in the ice-covered area 0.5 individuals per count belonging to 5 species, *i.e.* 92% of the total [2, 3].



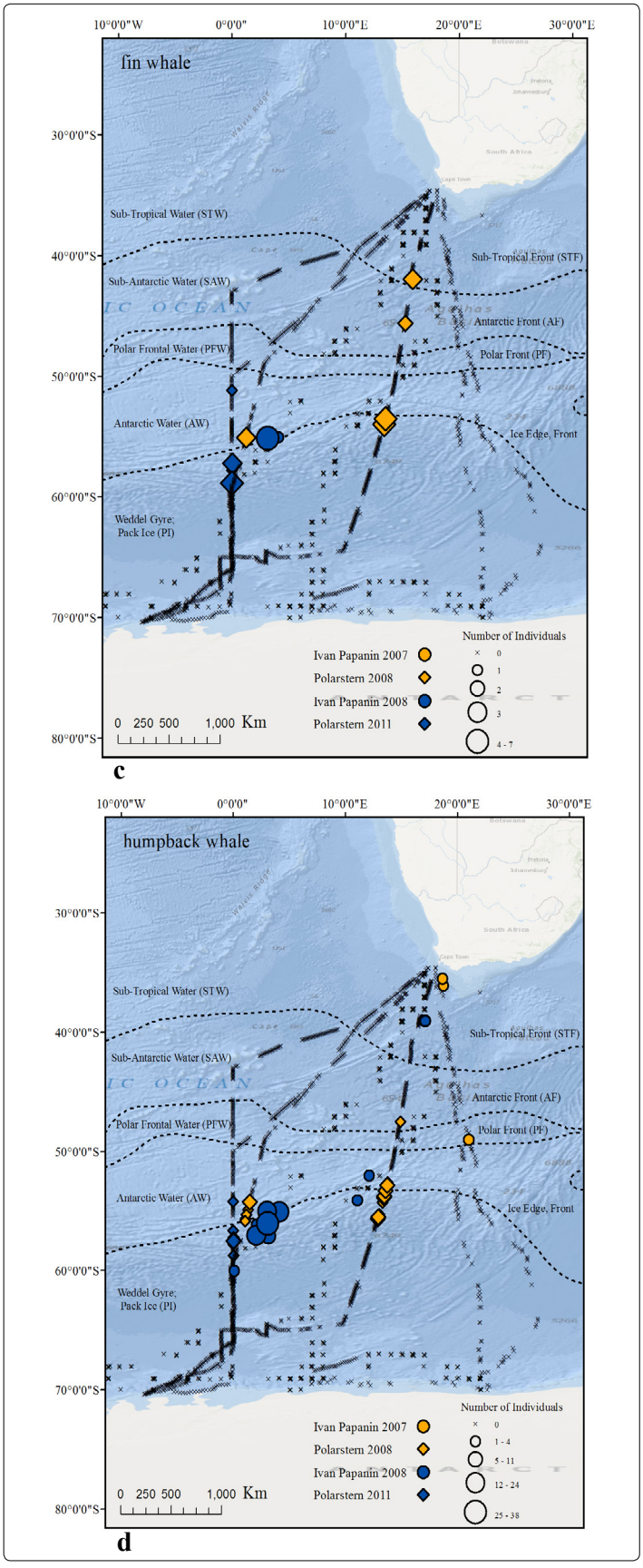


Figure 2: Examples of distribution maps of cetaceans during the different transects between South Africa and Antarctica [3].

Major hotspots were tallied along the **Scotia Ridge** (South Georgia Island) concerning mainly Antarctic prion *Pachyptila desolata*, white-chinned petrel *Procellaria*, southern fulmar *Fulmarus glacialoides* and chinstrap penguin for a total of 40 seabirds per count belonging to 25 species. Main cetaceans were hourglass dolphin *Lagenorhynchus cruciger*, humpback whale *Megaptera novaeangliae* and southern right whale *Eubalaena australis* (including an individual photo-identified in October 1972 in Peninsula Valdès, Argentina) for a total of eight species (0.5 per count) [4].

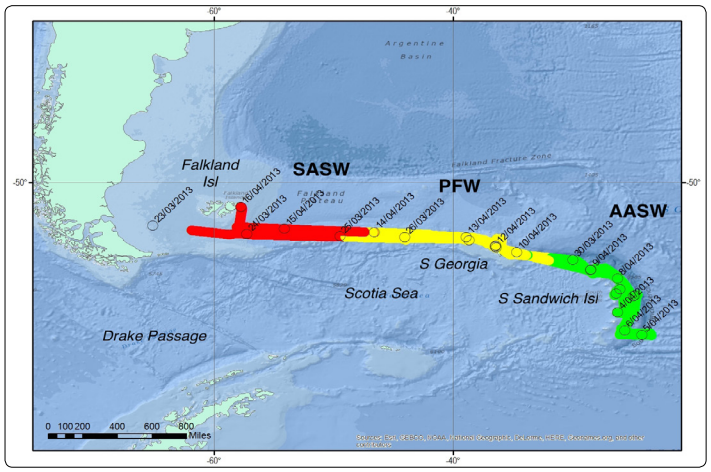


Figure 3: Main water masses recognised during the return expedition to South Georgia Island [4].

Photo 1: Photo-identification of southern right whale close to South Georgia Island, previously recorded in Argentina in 1972 [4]; photo H. Robert, PolE.

In the **Amundsen Sea**, a total of 8,270 seabirds composed of 15 species were tallied during 1,070 half-hour transect counts in the Amundsen Sea Embayement (ASE) and Pine Island Bay (PIB), This represents thus a mean value of eight birds per count period. The most numerous species were Antarctic petrel *Thalassoica antarctica,* Adélie penguin and snow petrel together representing 80% of the total. Large numbers of seabirds were concentrated on three medium-sized tabular icebergs that occurred close enough to the ship that we could distinguish species. They represented 44% of the recorded seabirds: 85% were Antarctic petrels, 40% snow petrels, and 33% Cape petrels *Daption c. capense*, as well as a few

Adélie penguins [5]. When these hotspots are excluded from the calculations, the mean number of seabirds became five birds per count. Moreover, large groups of petrels were flying toward these icebergs so increasing their importance (Photos 2). The distribution of Adélie penguin followed, as expected, the presence of pack ice, so that local densities in pack ice were actually much higher than the mean value cited here. Basically the same conclusion applies to snow petrel, crabeater seal more bound to CPI, and Minke whale to the ice edge and OMIZ. In contrast, Antarctic petrel was more an open water species, especially close to the shelf edge. Among recorded pinnipeds of four species: crabeater seal (two per count), of which half were hauled-out on ice floes and half were swimming pods of juveniles accompanied by one or two adults [6]. Cetaceans were Antarctic Minke whale and fin whale *Balaenoptera physalus*, representing together 85% of the total of 170 of four species, *i.e.* 0.15 per count [7].

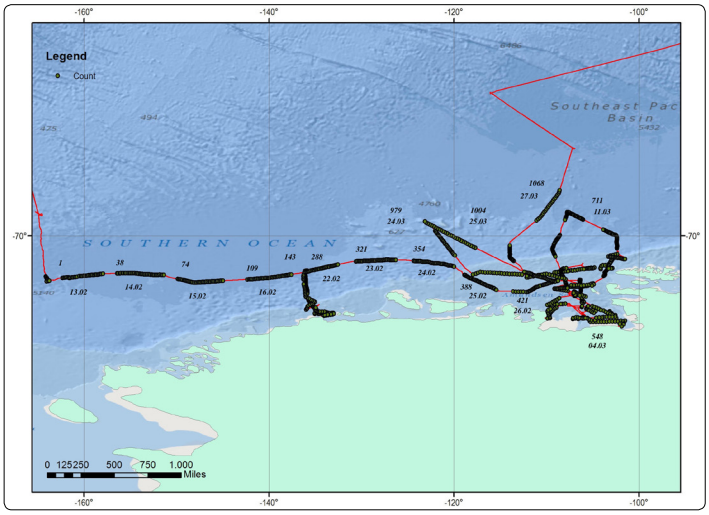
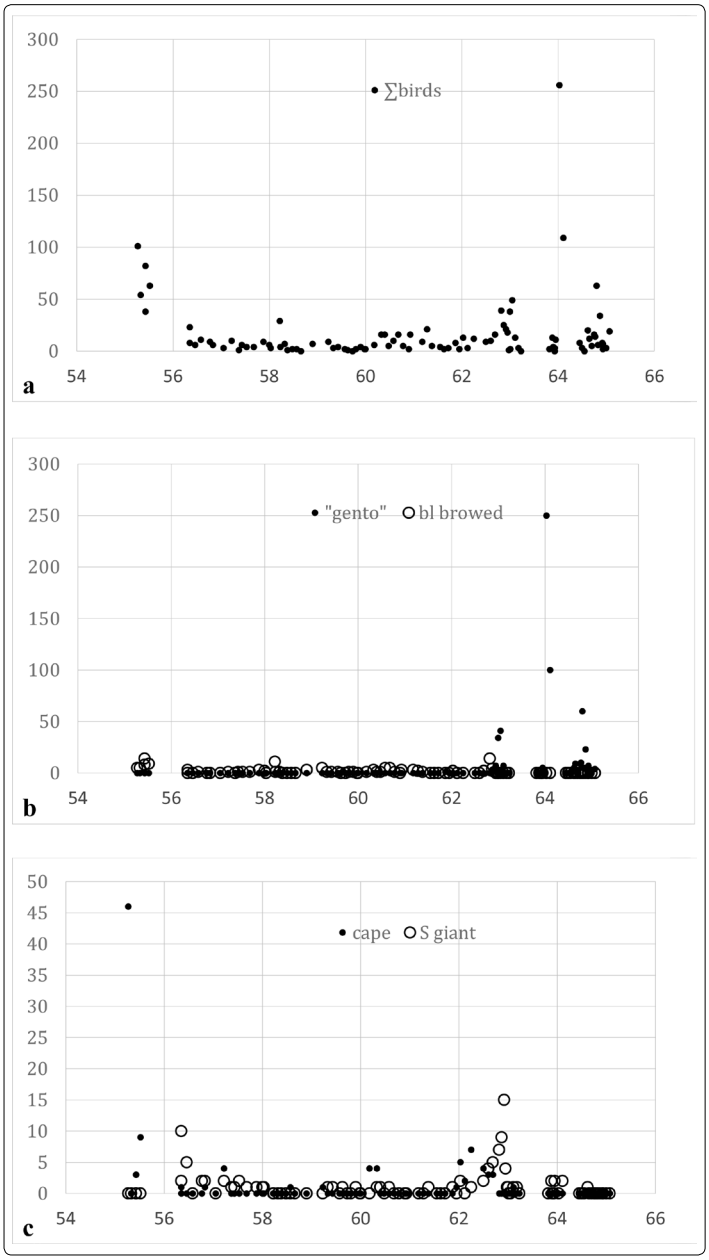


Figure 4: Distribution of top predators' counts during the Amundsen Sea expedition [7].

Photos 2: A swimming pod of juveniles crabeater seals accompanied by a few adults [7]; photo CJ.

Seabird observations along the **West Antarctic Peninsula** (de Gerlache Strait) concern mainly gentoo penguins *Pygoscelis papua* (16 per count, for a total of 23 per count belonging to 14 species). Next abundant species were black-bellied storm-petrel *Fregetta tropica* and southern giant petrel *Macronectes giganteus* (1.5 per count each) and southern polar skua *Catharacta maccormicki* (1.2 per count). Most striking cetacean observation concerns a pod of 10 to 13 adult humpback whales tallied on five, six and seven March at latitudes of 64.30°S, 65.00°S and 62°50°S respectively. Moreover, a small pod of three adults closely accompanying three young calves was tallied three times close to this pod, on four, six and seven March 2015. The adults were clearly identified by their flukes. This implies that this pod was following the ship at a distance for days; as is known for seabird followers, this might lead to an important overestimation of their abundance [8]. One of the adults observed and photographed on six March 2015 was photo-identified again on ten August 2019 at Chocö (Colombia) (happywhale.com).



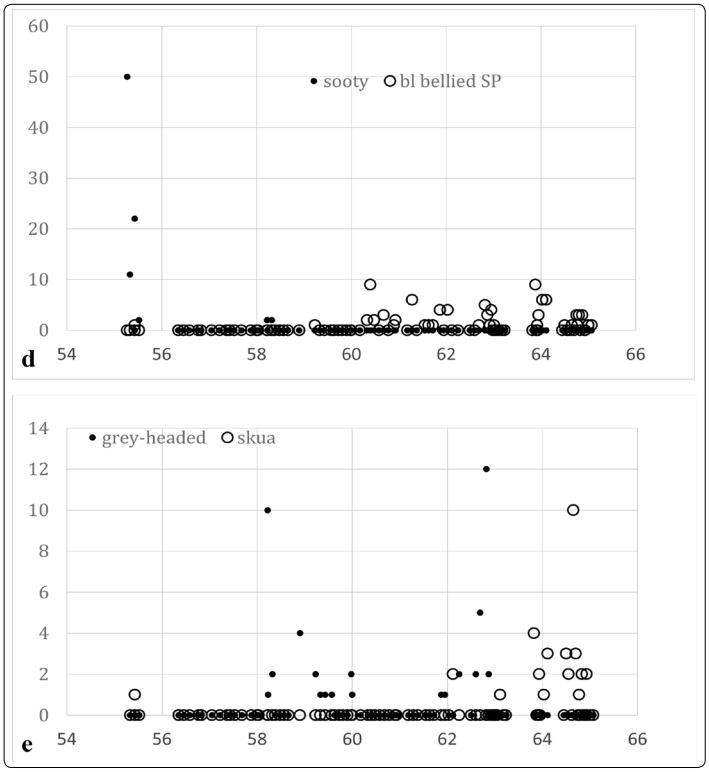
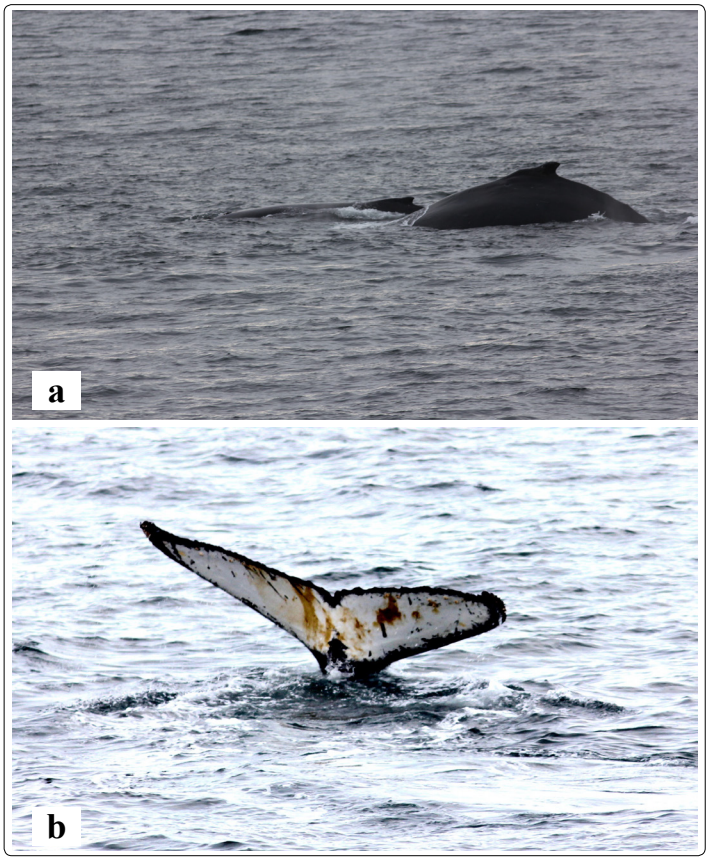


Figure 5: Distribution of all seabirds (a) and the main species in the Drake Passage and de Gerlache Strait [8].



Photos 3: Humpback whales in the de Gerlache Strait: mother with calf (a), fluke of a photo-identified individual (b) [8]; photos CJ.

Discussion

Polar areas, both austral and boreal, are known for their low biodiversity and biomass in comparison e.g. with tropical ones. In the case of the at-sea distribution of top predators – seabirds and marine mammals – this was illustrated along latitudinal transects in the Atlantic Ocean (*e.g.* [9]).

Major geographical were detected in Antarctic areas.

Most striking differences concern seabird data: 180 individuals per count in the Weddell Sea, belonging to 30 species, 40 per count around S Georgia Isl (25 species), 24 per count around the West Antarctic Peninsula (14 sp), 15 per count in the South Africa – Antarctica transect (27 sp) and 8 per count (5 when excluding iceberg hotspots) in the Amundsen Sea (15 sp). The seabird distribution is strongly influenced by hydrological factors reflecting ecological differences: water masses and fronts, pack ice and ice edge, and bathymetry allowing to detect the main (upwelling) fronts especially at the slope of the continental shelf. Moreover, very important local concentrations (hotspots) strongly influence these mean values. The presence of long-distance followers not detected as such, might lead to strong over-evaluation of actual densities. This was already suspected for seabirds, but might also apply to whales. In both cases, they become especially obvious in areas with very low ships' density.

Differences are less marked for cetaceans: between 0.14 per count (6 sp) and two per count (2 sp). For pinnipeds: between 0.5 and 7 per count (3 to 6 sp).

Such data reflect a very low biodiversity, taking into account the low number of species and the strong dominance of a few species. Such abundant species are also different in the different areas, an important qualitative difference.

Considering the abundance of predators is basically reflecting prey availability, these data also reflect important differences in bio-productivity.

Acknowledgements

We are very grateful for multiple invitations to participate in RV *Polarstern* expeditions (AWI, Bremerhaven, Germany).

Table 1: Summary of the seabird and marine mammal at-sea distribution in Antarctic seas: main species

Area	Weddell Sea	Transect South Africa - Antarctica	South Georgia isl	Amundsen Sea	West Antarctic Peninsula
Number of counts	*290*	*1900*	*365*	*1000*	*100*
Reference	[1]	[2,3]	[4]	[7]	[8]
Seabirds: number of species	30	27	25	15	14
Seabird abundance (N percount)	180	15	40	8 (5*)	23
Main species	Adélie penguin chinstrap penguin Cape pigeon snow petrel	Antarctic petrel blue petrel prion snow petrel	Antarctic prion white-chinned petrel southern fulmar chinstrap penguin	Antarctic ptrel Adélie penguin snow petrel	gento penguin black-belliedstorm-petrel southern giant petrel
Cetaceans: number of species	6	6	8	6	4
Cetacean abundance (N percount)	0.14	1	0.5	0.15	2
Main species	Antarctic Minke whale	humpback whale	hourglass dolphin humpback whale	Antarctic Minke whale fin whale	humpback whale fin whale southern right whale
Pinnipeds: number of species	6	5	3	4	2
Pinniped abundance (N percount)	6	0.5	7	2	7
Main speies	crabeater seal Antarctic fur seal	crabeater seal	Antarctic fur seal	crabeater seal	Antarctic fur seal
* excluding the iceberg hotspots					

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Annex 1: Total numbers of animals of the higher trophic levels encountered during EPOS 1 (one count = half an hour)

Zone		Antarctic zone					Sub-antarctic and sub-tropical zones
		Open water	OMIZ	IMIZ	CPI	Total	
Ice cover (tenths)		0	<3	3 to 8	>8		0
Water temperature (°C, mean value)		0,2	−1,4	−1,5	−1,7		9,4
Number of counts		40	30	51	170	291	94
Emperor Penguin	*Aptenodytes forsteri*	0	0	0	193	193	0
Chinstrap Penguin	*Pygoscelis antarctica*	96	825	1353	496	2770	76
Chinstrap Penguin[a]	*Pygoscelis antarctica*	9520	7737	1217	0	18474	0
Adélie Penguin	*Pygoscelis adeliae*	0	31	957	18573	19561	0
Wandering Albatross	*Diomedea exulans*	0	0	0	0	0	82
Black-browed Albatross	*Diomedea melanophris*	48	0	1	0	49	549
Grey-headed Albatross	*Diomedea chrysostoma*	7	0	0	0	7	26
Light-mantled Sooty Albatross	*Phoebetria palpebrata*	11	0	0	0	11	1
Giant Petrel	*Macronectes* sp.	212	42	35	43	332	226
Antarctic Petrel	*Thalassoica antarctica*	2	18	90	111	221	101
Snow Petrel	*Pagodroma nivea*	9	210	250	776	1245	11
Blue Petrel	*Halobaena caerulea*	175	0	21	0	196	230
Cape Pigeon	*Daption capense*	2997	981	3225	149	7352	1551
Atlantic Petrel	*Pterodroma incerta*	0	0	0	0	0	157
Soft-plumaged Petrel	*Pterodroma mollis*	0	0	0	0	0	14
Antarctic Fulmar	*Fulmarus glacialoides*	296	142	551	8	997	1403
American Sheathbill	*Chionis alba*	0	1	16	0	21	0
Antarctic Prion	*Pachyptila desolata*	311	12	19	0	342	662
White-chinned Petrel	*Procellaria aequinoctalis*	7	0	0	1	8	87
Sooty Shearwater	*Puffinus griseus*	0	0	0	0	0	55
Great Shearwater	*Puffinus gravis*	0	0	0	0	0	51
Cory Shearwater	*Calonectris diomedea*	0	0	0	0	0	3
Little Shearwater	*Puffinus assimilis*	2	0	0	0	2	0
Wilson Storm Petrel	*Oceanites oceanicus*	33	40	36	4	113	145
White-bellied Storm Petrel	*Fregetta grallaria*	35	0	0	0	35	9
Black-bellied Storm Petrel	*Fregetta tropica*	1	1	1	0	3	0
Diving Petrel	*Pelecanoides magellani*	1	0	0	0	1	1
Antarctic Tern	*Sterna vittata*	1	17	30	10	58	32
Sub-antarctic Skua	*Catharacta lonnbergi*	8	1	16	13	38	14
Arctic Skua	*Stercorarius parasiticus*	0	0	0	0	0	1
Dominican Gull	*Larus dominicanus*	6	9	99	78	192	3
Σ birds		**13778**	**10067**	**7917**	**20459**	**52221**	**5490**
Crabeater seal	*Lobodon carcinophagus*	0	3	32	1431	1466	0
Leopard seal	*Hydrurga leptonyx*	0	2	12	58	72	0
Fur seal	*Arctocephalus gazella*	5	103	96	0	204	11
Ross's seal	*Ommatophoca rossii*	0	0	0	1	1	0
Weddell seal	*Leptonychotes weddellii*	0	0	0	3	3	0
Elephant seal	*Mirounga leonina*	0	1	0	0	1	0
Σ seals		**5**	**109**	**140**	**1493**	**1747**	**11**
Hourglass dolphin	*Lagenorhynchus crucigel*	0	0	0	0	0	18
Pilot whale	*Globicephala melaena*	0	0	0	0	0	80
Killer whale	*Orcinus orca*	0	0	0	1	1	5
Sperm whale	*Physeter macrocephalus*	0	0	0	0	0	2
Minke whale	*Balaenoptera acurostrata*	0	3	4	34	41	0
Fin whale	*Balaenoptera physalus*	0	2	0	0	2	30
large whale		0	0	0	0	0	2
Σ cetaceans		**0**	**5**	**4**	**35**	**44**	**137**

[a] On icebergs

Annex 2: Seabirds and marine mammals encountered along the North Scotia Ridge and South Sandwich Trench; total numbers recorded; n = number of half-an-hour transect counts on board Polarstern, and number of helicopter flights; mean per count: seabirds for total > 10, per hour respectively [4].

	Species	Platform n >	*Polarstern* (left)(a) Number 365	Mean / count	*Polarstern* (right)(a) Number 282	Mean / count	*Polarstern* Out of effort (b)	Helicopter Mammal Number 7 flights	Mean / hour	Remark
1	king penguin	*Aptenodytes patagonicus*	215	0,59	201	0,71		+		250
2	gentoo penguin	*Pygoscelis papua*	80	0,22	42	0,15				
3	chinstrap penguin	*Pygoscelis antarctica*	2852	7,81	1632	5,79		+		4,000 on 10 icebergs
4	rockhopper penguin	*Eudyptes chrysocome*	5		7					
5	macaroni penguin	*Eudyptes chrysolophus*	66	0,18	42	0,15				
	penguin sp.		141	0,39	93	0,33				
6	southern royal albatross	*Diomedea [epomorpha] epomorpha*	14	0,04	14	0,05				
7	wandering albatross	*Diomedea [exulans] sp.*	184	0,50	175	0,62				
	wand/roy albatross	*Diomedea [exulans]/ [epomorpha] sp.*	25	0,07						
8	black-browed albatross	*Thalassarche [melanophrys] melanophrys*	732	2,01	977	3,46				
9	grey-headed albatross	*Thalassarche chrysostoma*	52	0,14	46	0,16				
10	sooty albatross	*Phoebetria fusca*	8		6					
11	light-mantled sooty albatross	*Phoebetria palpebrata*	30	0,08	32	0,11				
12	southern giant petrel	*Macronectes giganteus*	567	1,55	685	2,43				
13	northern giant petrel	*Macronectes halli*	40	0,11	63	0,22				
	giant petrel sp.	*Macronectes sp.*	38	0,10	84	0,30				
14	southern fulmar	*Fulmarus glacialoides*	709	1,94	831	2,95				
15	Cape petrel	*Daption capense*	360	0,99	450	1,60				
16	snow petrel	*Pagodroma [nivea] sp.*	9		11	0,04				
17	white-chinned petrel	*Procellaria aequinoctialis*	936	2,56	1189	4,22				
18	Kerguelen petrel	*Pterodroma brevirostris*	123	0,34	136	0,48				
19	great-winged petrel	*Pterodroma [macroptera] macroptera*	1		1					
20	soft-plumaged petrel	*Pterodroma mollis*	345	0,95	379	1,34				
21	Atlantic petrel	*Pterodroma incerta*	2		2					
22	grey petrel	*Procellaria cinerea*	6		4					
23	blue petrel	*Halobaena caerulea*	278	0,76	325	1,15				
24	Antarctic prion	*Pachyptila desolata*	9769	26,76	7487	26,55				Mainly South Georgia
25	slender-billed prion	*Pachyptila belcheri*	9		2					
26	fairy prion	*Pachyptila turtur*	106	0,29	42	0,15				
	prion sp.	*Pachyptila sp.*	1253	3,43	742	2,63				
27	sooty shearwaterr	*Puffinus griseus*	67	0,18	142	0,50				
28	great shearwater	*Puffinus gravis*	19	0,05	28	0,10				
29	Wilson storm-petrel	*Oceanites oceanicus*	340	0,93	503	1,78				
30	grey-backed storm-petrel	*Oceanites nereis*	31	0,08	24	0,09				
31	black-bellied storm-petrel	*Fregetta tropica*	787	2,16	859	3,05				
	storm-petrel sp.		24	0,07	2	0,01				
32	common diving-petrel	*Pelecanoides urinatrix*			33	0,12				
	South Georgian diving-petrel	*Pelecanoides georgicus*								One wrecked on board
	diving-petrel sp.	*Pelecanoides sp.*	369	1,01	376	1,33				
	South Georgia shag	*Phalacrocorax [atriceps] georgianus*	19	0,05	13	0,05				
	snowy sheathbill	*Chionis alba*	1		1					Falkland Isl

34	Antarctic tern	*Sterna vittata*	111	0,30	117	0,41				
35	south polar skua	*Catharacta [skua] maccormicki*	1		1					
36	brown skua	*Catharacta [skua] antarctica*	15	33	11	0,04				
37	arctic skua	*Stercorarius parasiticus*			1					
	phalarope sp.	*Phalaropus sp.*	1							Off South America
	total all birds		**20740**	**56,82**	**17811**	**63,16**				
	total selected birds (c)		**18870**	**51,70**	**16501**	**45,21**				
	Commerson's dolphin	*Cephalorhynchus commersonii*					+			Strait of Magellan
1	Hourglass dolphin	*Lagenorhynchus cruciger*	76	0,21	60	0,21				
	dolphin sp.		20	0,05	16	0,06		1		
2	long-finned pilot whale	*Globicephala melas*			30	0,11				
3	killer whale	*Orcinus orca*			3	0,01				
4	sperm whale	*Physeter macrocephalus*			1	0,00		1		
5	southern bottlenosed whale	*Hyperoodon australis*						9		
6	southern right whale	*Eubalaena australis*	6	0,02	3	0,01	4	9	0,71	
7	humpback whale	*Megaptera novaeangliae*	41	0,11	41	0,15	2	33	2,36	
8	fin whale	*Balaenoptera physalus*	6	0,02	11	0,04	3	14	1,00	
	large whale sp.		35	0,10	37	0,13				
	total all cetaceans		**184**	**0,50**	**152**	**0,54**				
	total selected cetaceans (c)		**129**	**0,35**	**149**	**0,53**				
1	south American fur seal	*Arctocephalus australis*	14	0,04	52	0,18				Off South America
2	Antarctic fur seal	*Arctocephalus gazella*	1634	4,48	2317	8,22				South Georgia
	seal sp.		511	1,40						
3	southern elephant seal	*Mirounga leonina*	2	0,01	6	0,02				
	total all pinnipeds		**2281**	**6,25**	**2402**	**8,08**				
	total selected pinnipeds (c)		**1650**	**4,52**	**2375**	**8,42**				

(a): counting from backboard and portside of the bridge respectively; (b): not included in calculations; (c): after exclusion of unidentified and strictly coastal species

Joiris et al. 2015a.

Annex 3: Marine mammals encountered during four return transects between South Africa and Antarctica during summer; total numbers recorded; n = number of half-an-hour transect counts; mean number per count, for totals > 25 identified individuals [3].

Species	Expedition Ship Period n	BELARE 07 *I. Papanin* Dec. 2007 201	ANT 25/ 2 *Polarstern* 2008/ 09 686	BELARE 08 *I. Papanin* 2008/ 09 444	ANT 28/ 2 *Polarstern* 2011/ 12 596	Total 1927	Mean N/ count	Remark
sub-antarctic/Antarctic fur seal	*Arctocepahlus tropicalis/gazella*		2	3	15	20		
S African fur seal	*Arctocepahlus [pusillus] doriferus*	*	5	*		5		off S African coast
fur seal sp	*Arctocepahlus sp.*				8	8		
leopard seal	*Hydrurga leptonyx*	2	4		5	11		
Weddell seal	*Leptonychotes weddellii*	5		17	6	28	0.015	
crabeater seal	*Lobodon carcinophaga*	35	167	325	205	732	0.380	
Ross seal	*Ommatophoca rossii*	1	3	3	3	10		
seal sp		18	54	101	13	186		
long-finned pilot whale	*Globicephala melas*	40 + 50**				40	0.021	
hourglass dolphin	*Lagenorhynchus cruciger*	6				6		
dusky dolphin	*Lagenorhynchus obscurus*			19 + 40**		19		
killer whale	*Orcinus orca*	24**		5**		0		
bottlenose dolphin	*Tursiops truncatus*		2			2		

sperm whale	*Physeter macrocephalus*		31	7		38	0.020	
Arnoux's beaked whale	*Berardius arnuxii*	6**				0		
southern bottlenose whale	*Hyperodon planifrons*	4	2	1**		6		mostly off S African coast
Gray's beaked whale	*Mesoplon gravi*			3		3		off S African coast
Cuvier's beaked whale	*Ziphus cavirostris*			4		4		
dolphin sp		75				75		probable dusky or common
Antarctic Minke whale	*Balaenoptera bonaerensis*	16	36	41	11	104	0.054	
sei whale	*Balaenoptera borealis*	2	10	1		13		
southern blue whale	*Balaenoptera [musculus] intermedia/brevicauda*				2	2		
fin whale	*Balaenoptera physalus*		29	5	16	50	0.026	
humpback whale	*Megaptera novaeangliae*	5	76	197	17	295	0.153	
large whale sp		*	46	*	15	61		
total		169	467	707	316	1718		
mean per count		0.841	2.323	3.517	1.572	0.882	0.882	

* not recorded; ** out of effort

Annex 4: "Top predators" **- s**eabirds and marine mammals - recorded during Polarstern expeditionin the Amundsen Sea [7]. *partim* >74°S, to 109°W; n = number of 30min transect counts; N = total number; mean per count (> 0.01).

	n ***Ice (%)*** ***SST (°C)*** ***Salinity*** ***Depth (m)*** ***Speed (knots)****	***1068*** ***5.7*** ***-0.83*** ***33.15*** ***2017*** ***6.53***		
Species	***Species***	**N**	**Mean**	**Remark**
Emperor penguin	*Aptenodytes forsteri*	236	0.22	
Adélie penguin	*Pygoscelis adeliae*	1766	1.65	Including 40 on an iceberg
Wandering albatross	*Diomedea [exulans]*	1		
Light-mantled albatross	*Phoebetria palpebrata*	18	0.02	
Southern giant petrel	*Macronectes giganticus*	346	0.32	
Southern fulmar	*Fulmarus glacialoides*	191	0.18	
Antarctic petrel	*Thalassoica antarctica*	3343	3.13	Including 2310 on icebergs
Snow petrel	*Pagodroma nivea*	1280	1.20	Including 550 on icebergs
Cape petrel	*Daption capense capense*	408	0.38	Including 35 close to an iceberg
Mottled petrel	*Pterodroma inexpectata*	41	0.04	
Blue petrel	*Halobaena caerulea*	56	0.05	
Blue petrel/ prion sp	*Halobaena/ Pachyptila sp.*	148	0.14	
Slender-billed prion	*Pachyptila belcheri*	30	0.03	
Black-bellied storm-petrel	*Fregatta tropica*	1		
South polar skua	*Catharacta [skua] maccormicki*	102	0.10	
Antarctic tern	*Sterna vittata*	303	0.28	Including 20 on icebergs
∑ birds		**8270**	**7.75**	Including 2900 on icebergs
∑ birds		**5370**	**5.03**	Excluding the icebergs hotspots
Number of identified species		*15*		
Leopard seal	*Hydrurga leptonis*	6		
Weddell seal	*Leptonychotes weddellii*	40	0.04	
Crabeater seal	*Lobodon carcinophaga*	2351	2.20	1205 on ice, 1053 in water
Ross seal	*Ommatophaga rossii*	3		
Pinniped sp	*Pinnipedia*	71	0.07	
∑ pinnipeds		**2468**	**2.31**	
Sperm whale	*Physeter macrocephalus*	2		

Minke whale	*Balaenoptera bonaerensis*	133	0.12	
Fin whale	*Balaenoptera physalus*	19	0.02	
Humpback whale	*Megaptera novaeangliae*	9	0.01	
Whale sp		3		
∑ **cetaceans**		**170**	**0.16**	

* Low speed: ice breking and/ or seismic activities

Annex 5. Seabirds recorded in the Drake Passage and de Gerlache Straitt, West Antarctic Peninsula,

Zone >	**Drake Passage**		**de Gerlache Strait**		**Total**		**Remark**
n >	***65***		***32***		***97***		
	N	**mean**	**N**	**mean**	**N**	**mean**	
Gentoo penguin, *Pygoscelis papua*	0		88	2.75	88	0.92	
Chinstrap penguin, *P. antarctica*	0		6		6		
Penguin sp, *Spheniscidae sp*	0		501	15.7	501	5.16	Maily gentoo
Wanderer albatross, *Diomedea exulans*	26	0.40	0		26	0.27	
Royal albatross, *D. epomorphora*	37	0.57	0		37	0.38	
Black-browed albatross, *D. melanophris*	124	1.91	5		129	1.33	
Grey-headed albatross, *D. chrysostoma*	48	0.74	2		51	0.52	
Light-mantled albatross, *Phoebetria palpe*	1		0		1		
Southern giant petrel, *Macronectesgigant*	61	0.94	39	1.22	100	1.03	
Cape petrel, *Dapion c. capense*	102	1.57	1		103	1.06	
Snow petrel, *Pagodroma nivea*	0		2		2		
Antarctic fulmar, *Fulmarus glacialoides*	7	0.11	10	0.31	17	0.18	
Antarctic prion, *Pachyptila vittata*	74	1.14	1		75	0.77	
Prion/ blue petrel sp, *Pachyptila/Halobae*	3		0		3		
Great winged petrel, *Pterodromamacropt*	1		0		1		
Soft-plumaged petrel, *P. mollis*	3		10	0.31	13	0.13	
White-chinned petrel, *Procellaria aequino*	2		0		2		
Sooty shearwater, *Puffinus griseus*	89	1.37	0		89	0.92	
Black-bellied storm-petrel, *Fregetta tropic*	44	0.68	48	1.50	92	0.95	
Storm-petrel sp, *Oceanitidae sp*	6		6		6		
Diving-petrel sp, *Pelacanoididae sp*	1		0		1		
Imperial shag, *Phalacrocorax atripe* s	142	2.18	4		142	1.46	Coastal
South polar skua, *Catharactamaccormick*	7		30	0.94	37	0.38	
Kelp gull, *Larus dominicanus*	0		0		15	0.15	Coastal
Dolphin gull, *L. scoresbii*	1		0		1		Coastal
Antarctic tern, Sterna vittata	3		0		39	0.40	Coastal
∑ birds	782	12.0	753	23.5	1577	16.3	
Number of identified species	19		14		23		

n = number of 30 min counts; N: total number; mean per count (≥10 individuals).