

## Supplemental Tables

Table S1: Survey effort and ice conditions by year. Under **Survey effort**, **Stations sampled** and **Effort per station** indicate how many stations were sampled in that year and the amount of visual survey effort associated with each station (summarized as mean  $\pm$  standard deviation). Under **Ice conditions**, each column describes a different ice category, indicating the number of stations and the ice coverage (summarized as mean  $\pm$  standard error). Note: some visual surveys did not record ice conditions, so the total number of stations under **Ice conditions** may not equal the **Stations sampled**.

Year	<u>Survey effort</u>		<u>Ice conditions</u>			
	Stations sampled	Effort per station (km)	Open water	Thin ice	First-year ice	Multi-year ice
2012	19	18.8 $\pm$ 4.8	14 (2.4% $\pm$ 4.0%)	1 (10.0% $\pm$ 7.7%)	0	0
2013	47	20.8 $\pm$ 7.3	3 (16.3% $\pm$ 5.5%)	22 (51.2% $\pm$ 7.5%)	20 (67.0% $\pm$ 7.0%)	0
2014	68	14.4 $\pm$ 3.8	9 (10.5% $\pm$ 3.7%)	10 (55.2% $\pm$ 6.1%)	48 (44.8% $\pm$ 6.1%)	0
2015	60	15.0 $\pm$ 4.6	13 (4.6% $\pm$ 2.7%)	37 (56.7% $\pm$ 6.4%)	10 (73.1% $\pm$ 5.7%)	0
2016	51	15.3 $\pm$ 4.5	8 (7.8% $\pm$ 3.7%)	31 (59.2% $\pm$ 6.8%)	12 (75.8% $\pm$ 5.9%)	1 (13.0% $\pm$ 4.7%)
Total	245	16.3 $\pm$ 5.6	47 (6.4% $\pm$ 1.6%)	101 (55.6% $\pm$ 3.2%)	90 (57.0% $\pm$ 3.2%)	1 (13.0% $\pm$ 2.2%)

Table S2: Density and frequency (% sites observed) of predators within and across clusters. See Table 2 for scientific names. Note that we removed sites with no observed predators from the cluster analysis, so the frequencies in the **All clusters** column are greater than the frequencies in Table 2, which included sites with no predators observed.

Species	Open water <i>Ind km<sup>-1</sup> [frequency]</i>	Marginal ice <i>Ind km<sup>-1</sup> [frequency]</i>	Pack ice <i>Ind km<sup>-1</sup> [frequency]</i>	All clusters <i>Ind km<sup>-1</sup> [frequency]</i>
Snow petrel	1.554 [95.7%]	3.116 [96.3%]	0.463 [92.5%]	1.665 [95.1%]
Adélie penguin	0.004 [6.5%]	4.036 [42.6%]	0.948 [67.9%]	1.153 [27.8%]
Antarctic fur seal	0.073 [50.7%]	2.892 [100.0%]	0.121 [52.8%]	0.736 [62.0%]
Crabeater seal	0.005 [6.5%]	0.437 [38.9%]	1.380 [52.8%]	0.421 [23.7%]
Antarctic petrel	0.404 [92.8%]	0.258 [85.2%]	0.177 [66.0%]	0.318 [85.3%]
Antarctic fulmar	0.240 [59.4%]	0.033 [29.6%]	0.045 [18.9%]	0.147 [44.1%]
Kelp gull	0.056 [44.2%]	0.158 [74.1%]	0.108 [49.1%]	0.092 [51.8%]
Blue petrel	0.125 [32.6%]	0.090 [13.0%]	0.001 [1.9%]	0.089 [21.6%]
Southern giant petrel	0.084 [73.2%]	0.101 [88.9%]	0.066 [52.8%]	0.084 [72.2%]
Cape petrel	0.084 [47.8%]	0.116 [20.4%]	0.006 [13.2%]	0.074 [34.3%]
Leopard seal	0.004 [8.7%]	0.080 [38.9%]	0.025 [30.2%]	0.026 [20.0%]
Antarctic tern	0.012 [9.4%]	0.061 [38.9%]	0.003 [5.7%]	0.021 [15.1%]
Gentoo penguin	0.005 [2.2%]	0.054 [5.6%]	0.017 [11.3%]	0.019 [4.9%]
Antarctic shag	0.022 [0.7%]	0.000 [0.0%]	0.000 [0.0%]	0.012 [0.4%]
Minke whale	0.002 [3.6%]	0.018 [13.0%]	0.003 [9.4%]	0.006 [6.9%]
Killer whale	0.000 [0.0%]	0.023 [5.6%]	0.005 [3.8%]	0.006 [2.0%]
Pale-faced sheathbill	0.002 [5.8%]	0.006 [18.5%]	0.006 [13.2%]	0.004 [10.2%]
Weddell seal	0.002 [5.1%]	0.001 [1.9%]	0.006 [15.1%]	0.003 [6.5%]
Southern elephant seal	0.004 [5.8%]	0.000 [0.0%]	0.002 [5.7%]	0.002 [4.5%]
Emperor penguin	<0.001 [0.7%]	0.000 [0.0%]	0.002 [1.9%]	0.001 [0.8%]
Southern bottlenose whale	0.001 [1.4%]	0.000 [0.0%]	0.000 [0.0%]	0.001 [0.8%]
Ross seal	<0.001 [0.7%]	0.000 [0.0%]	0.000 [0.0%]	<0.001 [0.4%]

Table S3: Direction cosines along the reduced dimensions (NMDS1-NMDS3), goodness of fit ( $r^2$ ), and significance ( $p$ ) of the multiple regression analysis of environmental variables with respect to non-metric multidimensional scaling ordination scores. For descriptions of environmental variables, see Table 2. Statistically significant variables indicated in bold.

Variables	Direction cosines			$r^2$	$p$
	NMDS1	NMDS2	NMDS3		
Mixed layer depth	0.245	0.958	0.149	0.003	0.917
Temperature	0.073	0.468	0.881	0.029	0.135
Salinity	-0.054	0.831	-0.554	0.004	0.841
Chl <i>a</i>	0.578	-0.601	0.552	0.011	0.580
Phaeopigment	-0.526	0.848	0.069	0.011	0.564
<b>Ice coverage</b>	<b>0.325</b>	<b>-0.391</b>	<b>-0.861</b>	<b>0.054</b>	<b>0.013</b>
Time of day				0.003	0.683
Day	0.009	0.015	-0.025		
Night	-0.027	-0.050	0.048		
<b>Year</b>				<b>0.061</b>	<b>0.002</b>
2012	-0.070	-0.093	0.260		
2013	-0.062	-0.306	-0.036		
2014	-0.015	-0.007	0.061		
2015	-0.011	0.258	-0.079		
2016	0.106	0.076	-0.047		
Macrozooplankton cluster				0.028	0.197
1	0.024	0.041	-0.020		
2a	0.072	0.048	-0.003		
2b	-0.065	-0.101	0.117		
3a	-0.133	-0.158	0.123		
3b	-0.169	-0.073	-0.309		
Ice type				0.014	0.497
Open	-0.031	0.081	0.085		
Thin	-0.018	-0.002	-0.095		
First year	0.022	-0.043	0.040		
Multi-year	0.618	0.278	-0.039		

## Supplemental Figures



Figure S1. Geographic distributions of seabird species observed during visual surveys, averaged across years.



Figure S2: Geographic distributions of marine mammal species observed during visual surveys, averaged across years.

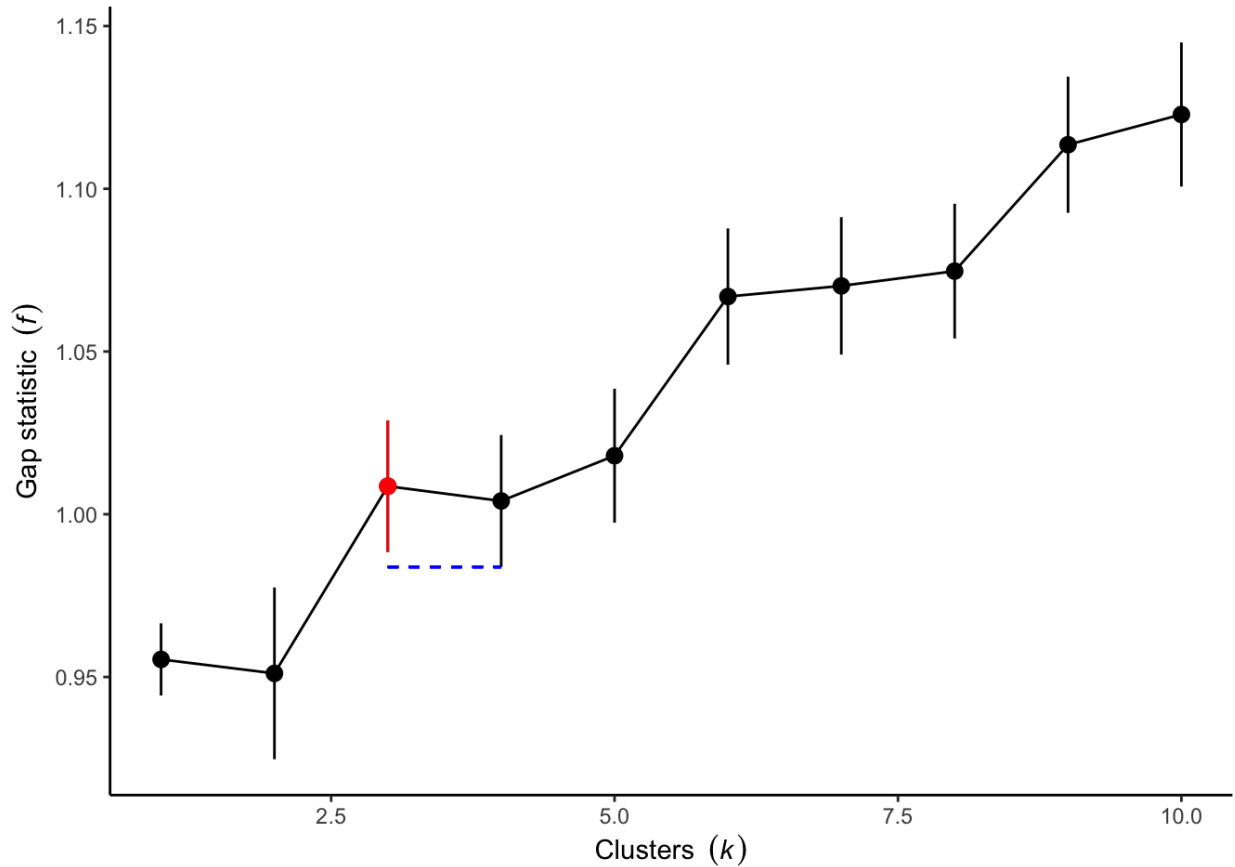


Figure S3: The gap statistic (mean and standard error) by number of clusters. We chose  $k=3$  clusters (red) by identifying the shoulder in the curve. Heuristically, the shoulder is defined as the minimum  $k$  where  $f(k) > f(k+1) - s(k+1)$ , where  $s$  is the standard error of  $f$ . Both  $k=1$  and  $k=3$  satisfy this property, but based on visual inspection we decided  $k=3$  was a better choice for the shoulder of the curve. The blue dashed line represents the threshold  $f(4) - s(4)$ .