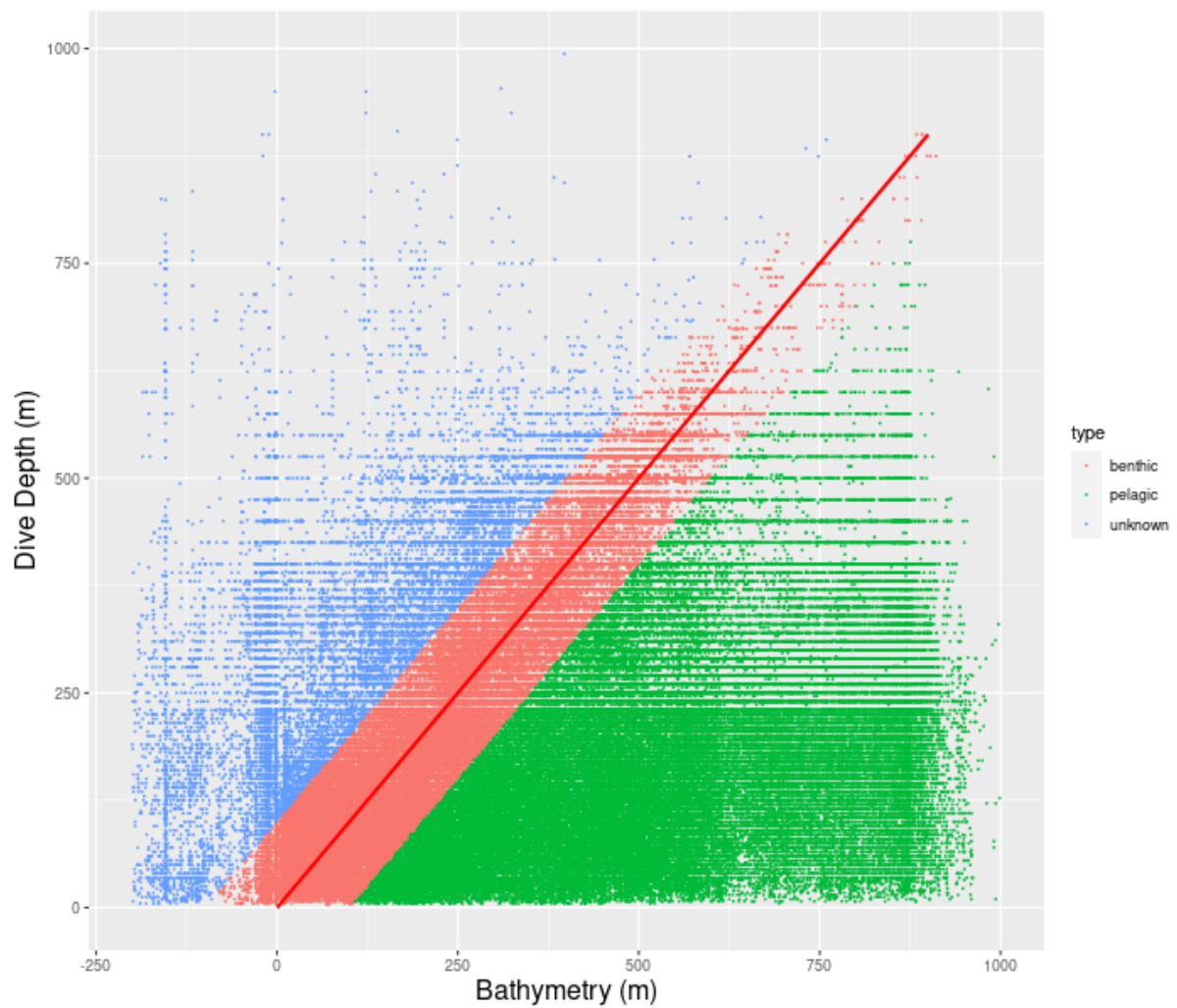


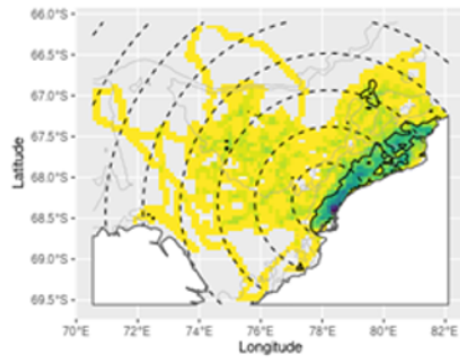
Electronic Supplementary Material



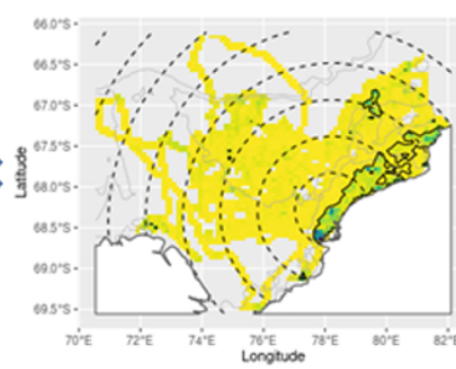
ESM 1. A scatter plot of Weddell seal dive depth and the GEBCO19 bathymetry at the location of that dive. The solid red line indicates the 1:1 demarcation between dive depth and bathymetry at the same location. Dives above this line are deeper than the estimated ocean floor. Green points are those classified as “pelagic” dives (significantly above the ocean floor). The pink dives are classified as “benthic” dives (within the estimated bathymetric error) and the blue dives “unknown” (bathymetry in the area is too uncertain to make a reliable determination of dive type).

Prydz Bay

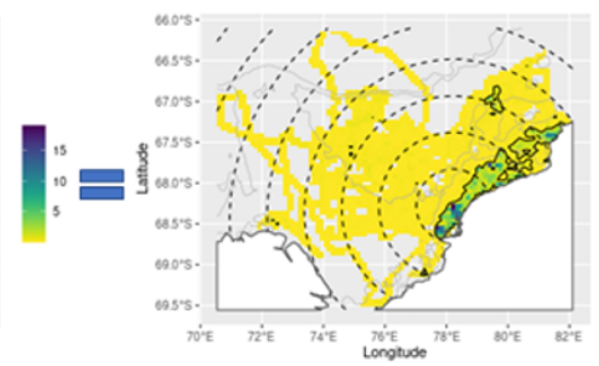
Seals per cell



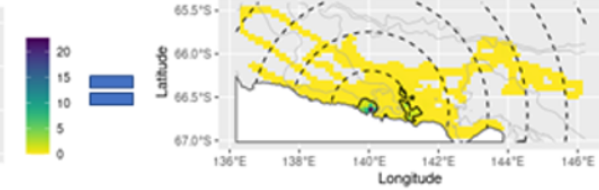
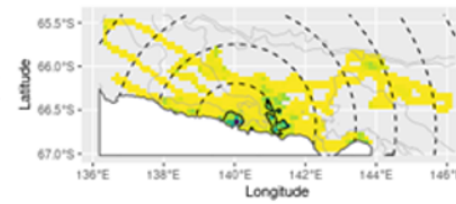
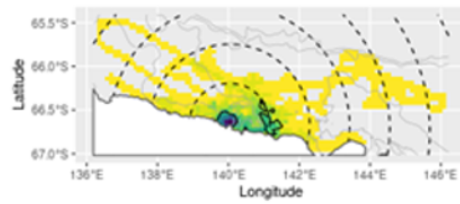
Mean days per cell



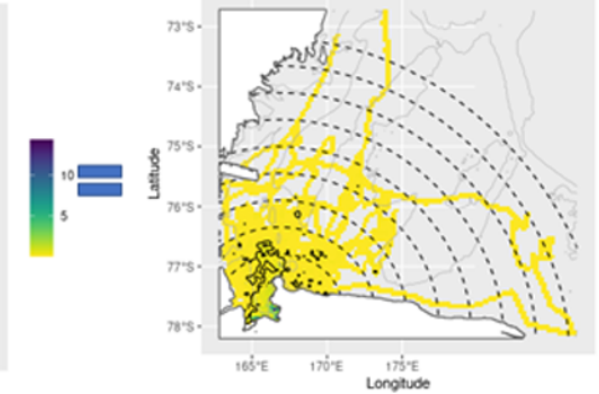
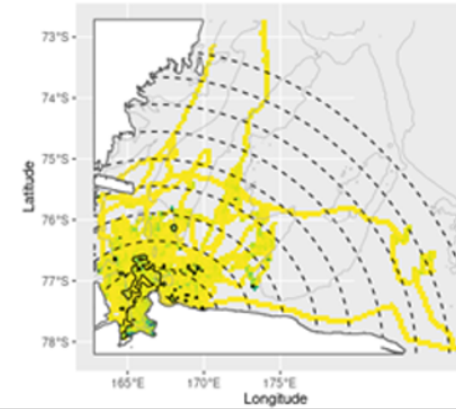
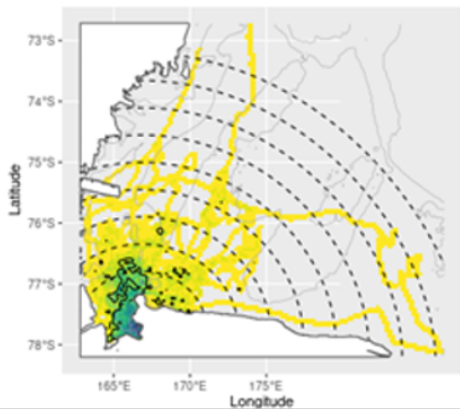
Seal days per cell



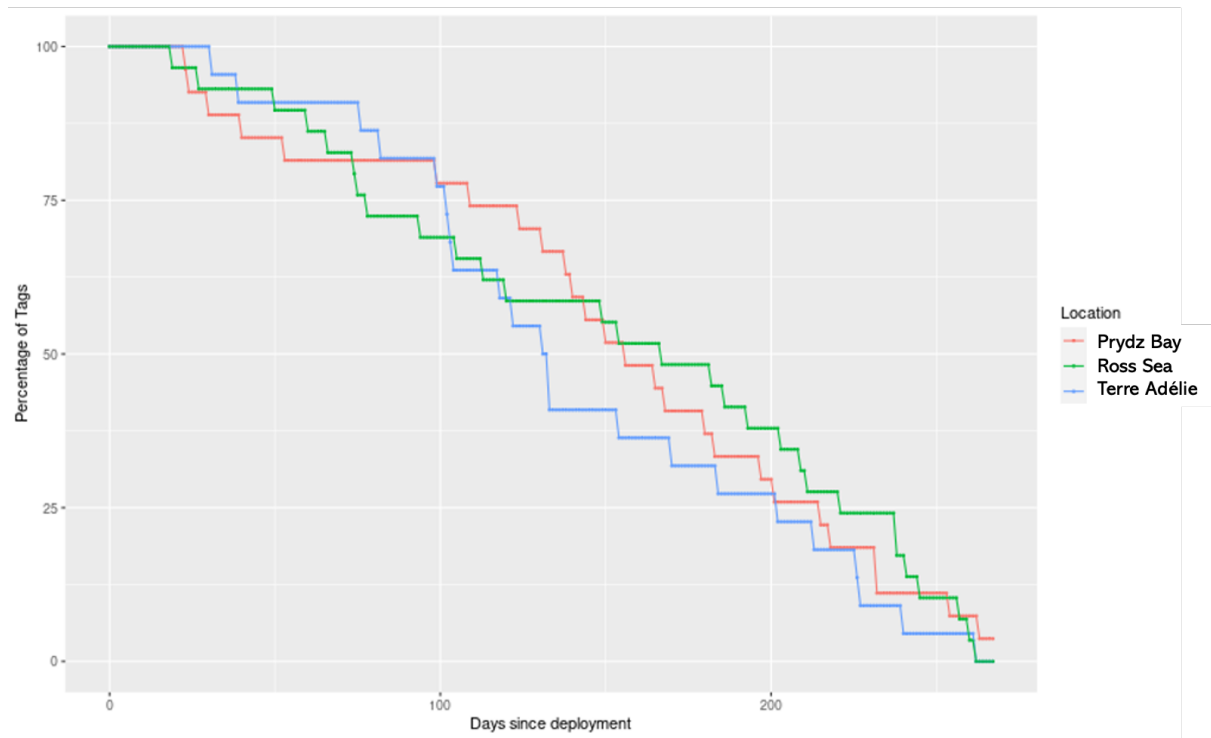
Terre Adélie



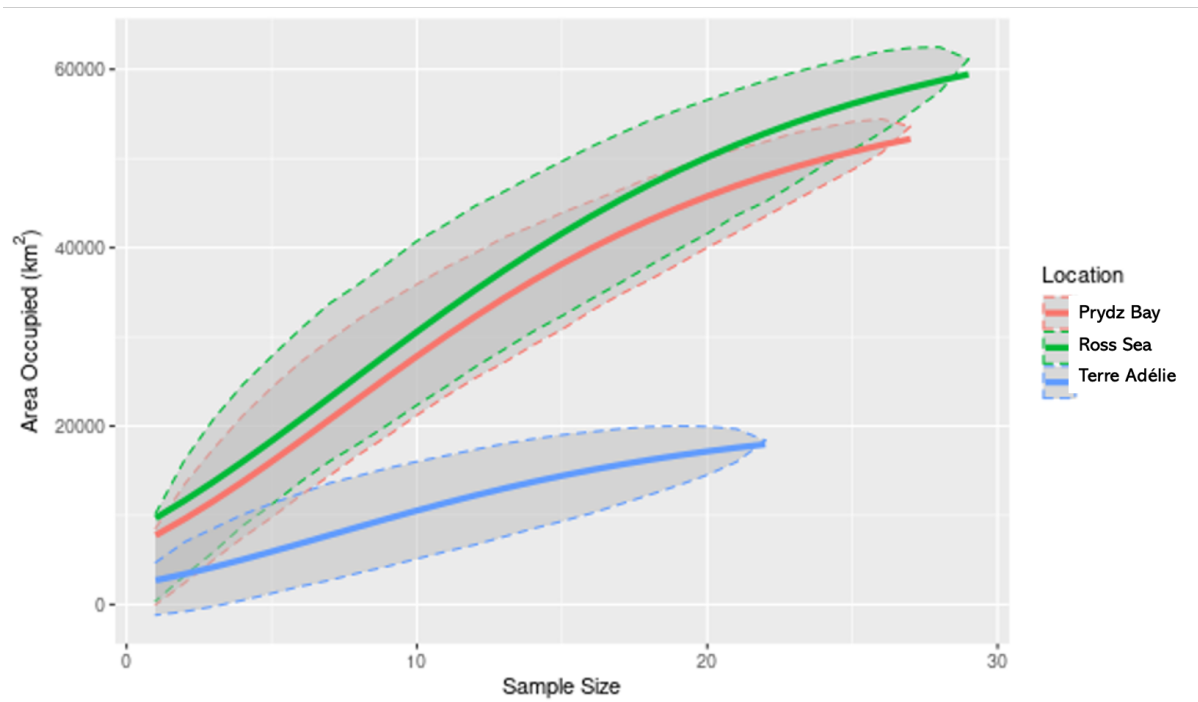
Ross Sea



ESM 2. Schematic of how population level UD_s were calculated: (a) Prydz Bay, (b) *Terre Adélie* and (c) Ross Sea. The top panel in each shows the mean on the individual UD_s for the sample of seals at that site (number of days per seal). The middle panel is the number of seals that used each cell in the course of the study. The bottom panel is the population UD which is the product of the top two panels



ESM 3: Percentage of tags transmitting each day following deployment for each tagging location.



ESM 4. Saturation curves for each location to ascertain how representative our sample of seals were of the broader Weddell seal populations. We did this as per Hindell et al. (2003), using a bootstrap approach that estimated the total area occupied by an increasing number of seals. A single seal was drawn at random from the pool of seals sampled at a particular site and the area occupied by the seal calculated (the number of 5x5 km cells used). A second seal was drawn from the remaining seals and the total area occupied by the two seals calculated (i.e sampling without replacement). This was repeated until all seals in the sample were included. This was repeated 1000 time using a different sequence of seals each time. The mean area occupied for the 1000 bootstraps was calculated for each sample size and the SD calculated (Chernick 1999). Finally we fit Gompertz models to the mean data to estimate the theoretical asymptotic area occupied by the population of seals in each location.

ESM Table 1. Model selection details for the models reported in the paper. *df*= degrees of freedom, *AICc*= Corrected Akaike Information Criteria, $\Delta AICc$ =delta *AICc*. In each case the model is ranked by *AICc* and the top ranked model is taken to be better than the next when $\Delta AICc \geq 2$.

Dependent Variable and # of model parameters	Intercept	Model	<i>df</i>	Log Likelihood	<i>AICc</i>	$\Delta AICc$	<i>AICc</i> Weight
a. Transmission duration		GLM					
1	150.1	Null	2	-443.8	891.8	0	0.881
2	152.2	location	4	-443.6	895.8	4.01	0.119
b. Maximum distance and Sex at DDU		GLM					
1	3.78	Null	2	-32.2	69	0	0.782
2	3.837	sex	3	-32.1	71.5	2.56	0.218
c. UD Area and Location		GLM					
2	7.873	location	4	-118.3	245.1	0	0.999
1	7.658	Null	2	-127.4	259	13.89	0.001
d. UD and Sex at DDU		GLM					
1	6.771		2	-35.5	75.6	0	0.771
2	6.864	sex	3	-35.3	78	2.42	0.229
e. UD and Seal Length		GLM					
2	8.077	location	4	-96.7	202	0	0.719
4	7.795	location*length	5	-96.7	204.3	2.30	0.227
8	5.256	length	7	-95.6	207.2	5.20	0.054
1	7.669	Null	2	-107.0	218.3	16.25	0
3	7.827	length	3	-107.0	220.5	18.44	0

f. Cell use and Environment		GLMM					
32	-0.201	bathymetry +ice+ location + bathymetry * ice + bathymetry *location	10	-6259.0	12538.1	0	0.996
64	-0.201	bathymetry + ice + location + bathymetry * ice + bathymetry * location + ice * location + bathymetry * ice * location	12	-6262.9	12549.9	11.73	0.003
128	-0.187	location bathymetry + ice + location + bathymetry * ice + bathymetry * location + ice *location	14	-6261.6	12551.3	13.17	0.001
16	-0.210	bathymetry +ice+ location + bathymetry *ice	8	-6275.6	12567.3	29.21	0
24	-0.187	bathymetry + ice + location + bathymetry * location	9	-6276.5	12571.1	32.96	0
12	-0.441	bathymetry + ice + bathymetry *ice	6	-6279.8	12571.6	33.47	0
56	0.189	bathymetry + ice + location + bathymetry * location + ice * location	11	-6276.1	12574.2	36.05	0
48	-0.211	bathymetry + ice + location + bathymetry * ice + ice * location	10	-6278.9	12577.8	39.66	0
40	-0.189	bathymetry + ice + location + ice *location	9	-6290.9	12600	61.86	0
8	-0.169	bathymetry + ice + location	7	-6295.3	12604.7	66.59	0
4	-5.55E*10 ⁻⁵	bathymetry + ice	5	-6299.1	12608.2	70.09	0
22	-0.192E	bathymetry +location+ bathymetry * location	8	-6309.1	12634.3	96.16	0
6	-0.181	bathymetry + location	6	-6327.8	12667.6	129.45	0
2	-2.50*10 ⁻²	bathymetry	4	-6331.3	12670.7	132.58	0
7	8.81*10 ⁻²	ice + location	6	-6376.2	12764.4	226.27	0
39	6.95*10 ⁻²	ice + location + ice *location	8	-6374.2	12764.4	226.32	0
3	0.100	ice	4	-6384.0	12776	237.91	0
5	5.23*10 ⁻²	location	5	-6387.1	12784.3	246.18	0

1	7.23*10 ⁻²	Null	3	-6394.5	12794.9	256.8	0
g. Dive type and bathymetry							
		Logistic GLMM, random term=seal					
8	0.3548	bathymetry + location + bathymetry*location	7	-57742.8	115499.6	0	1
4	0.1926	bathymetry + location	5	-58196.3	116402.5	902.91	0
2	-0.6392	bathymetry	3	-58215.3	116436.6	936.96	0
3	1.397	location	4	-79233.2	158474.5	42974.88	0
1	0.08677	Null	2	-79243.4	158490.8	42991.25	0
h. Bathymetry and UD							
		GLM					
8	-370.4	location + utilisation +location*utilisation	10	-143667.0	287354.3	0	1
4	-764	Location + utilisation	6	-143809.0	287629.8	275.49	0
2	-1258	location	4	-144032.0	288071.7	717.37	0
3	-475.5	utilisation	4	-144447.0	288902.4	1548.09	0
1	-1011	Null	2	-144689.0	289382	2027.70	0
i. Ice Concentration and UD							
		GLM					
8	74.19	Location + utilisation + location*utilisation	10	-60262.2	120544.5	0	1
4	78.08	Location + utilisation	6	-60397.6	120807.3	262.79	0
2	81.68	location	4	-60595.6	121199.1	654.61	0
3	79.94	utilisation	4	-60708.2	121424.4	879.86	0
1	83.34	Null	2	-60885.5	121775	1230.52	0

ESM Table 2: Table of physical characteristics in the three deployment locations (Prydz Bay, Terre Adélie and Ross Sea) for (i) the available habitat, (ii) the overall (90% sample UD) and (iii) core (50% sample UDs). Shown are the mean \pm s.e bathymetry in each UD derived from GEBCO19 and the mean sea-ice concentration on July 30 (averaged for the years 2010-2020). Also shown is the overall area of UD at each site.

	Location								
	Prydz Bay			Terre Adélie			Ross Sea		
Type of Utilisation Distribution	Avail able	overa ll	core	Avail able	overa ll	core	Avail able	overa ll	core
Bathymetry (m)	- 1341 ± 881	- 370 \pm 112	- 164 \pm 8.7	- 1158 ± 796	- 262 \pm 118	- 197 \pm 119	- 668 \pm 370	- 608 \pm 147	- 366 \pm 166
Ice concentration (%)	82.4 \pm 6.5	74.2 \pm 8.1	70.0 ± 6.1	83.5 \pm 6.1	82.0 \pm 1.6	80 ± 0.4	85.3 ± 5.6	85.0 \pm 3.7	79.4 \pm 2.2
Number of cells	7585	621	67	2355	92	8	5876	641	61
Area of UD (km ²)		1552 5	1700		2375	200		1602 5	1525

ESM Table 3 A summary of the prey species eaten by Weddell seals around Antarctica, illustrating that Weddell seals are generalist feeders and eat a wide variety of species.

Location	Fish													Squid	Octopus	Gastropods	Crustaceans	Mysidea	Isopoda	Amphipoda	Holutharians	Reference
		Pleurogramma	Dacodraco	Trematomus	Channichthyid	Gymnodraco	Aethotaxis	Channichthyidae	Dissostichus	Lepidonotothen	Notothenia	Pagothenia	Neopagetopsis									
Davis		x	x	x	x	x								x	x	x						Gales and Burton (1988)
Davis		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x				x	Lake <i>et al.</i> (2003)
Davis		x		x	x						x	x		x	x		x				x	Green and Burton (1987)
Ross		x		x					x			x	x									Goetz <i>et al.</i> (2017)
Ross		x							x													Ainley and Siniff (2009); Ainley <i>et al.</i> (2020)
Ross			x	x					x					x	x			x	x	x		Dearborn (1965)

Ross		x		x					x					x								Testa <i>et al.</i> (1985)
Ross	x	x		x					x		x	x										La Mesa <i>et al.</i> (2004)
Ross	x	x		x					x						x	x	x		x	x		Burns <i>et al.</i> (1998)
South Shetlands	x													x			x		x	x		Clarke and MacLeod (1982)
South Shetlands	x													x	x						x	Lipinski and Woyciechowski (1981)
Weddell Sea	x			x			x	x	x					x	x							Plötz (1986)
Graeme Land	x													x	x		x				x	Bertram (1940)
Terre Adelie				x							x			x			x				x	Sapin-Jaloustre (1952)
Hope Bay		x	x	x	x																	Daneri <i>et al.</i> (2018)
Terre Nova Bay		x		x	x				x			x										Rumolo <i>et al.</i> (2020)

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