

The following supplement accompanies the article

Assessing the utility of two- and three-dimensional behavioural metrics in habitat usage models

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Table S1. Southern elephant seal identification, trip information, statistics and the scale used for area-restricted search (ARS) detection by passage-time and bottom-time foraging metrics for each trip

Seal ID	Tagging location	Sex	Age class	Trip number	Start date	End date	Trip duration (days)	Distance reach from start location (km)	Passage-time scale (km)	Bottom-time scale (km)
SES-9920_04	Macquarie Is.	Female	Adult	1	27-Jan-2004	26-Jun-2004	151.67	2432.11	35	95
SES-9925_04	Macquarie Is.	Female	Adult	1	31-Jan-2004	30-Jul-2004	181.33	2803.21	5	5
SES-9919_04	Macquarie Is.	Female	Adult	1	6-Feb-2004	11-Jul-2004	156.17	2237.63	115	115
SES-9916_04	Macquarie Is.	Female	Adult	1	19-Feb-2004	21-Jul-2004	153.75	2128.67	5	295
SES-10017_05	Macquarie Is.	Female	Adult	1	31-Jan-2005	31-Aug-2005	212.08	2497.21	5	35
SES-10011_05	Macquarie Is.	Female	Adult	1	1-Feb-2005	8-Sep-2005	219.25	3538.37	165	285
SES-10015_05	Macquarie Is.	Female	Adult	1	4-Feb-2005	23-Sep-2005	230.17	2412.95	5	35
SES-10010_05	Macquarie Is.	Female	Adult	1	9-Feb-2005	20-Apr-2005	70.17	1643.33	5	55
SES-10006_05	Macquarie Is.	Female	Adult	1	12-Feb-2005	5-May-2005	82.08	2110.78	5	45
SES-10021_05	Macquarie Is.	Female	Adult	1	12-Feb-2005	18-Sep-2005	218.67	1926.85	25	25
SES-10020_05	Macquarie Is.	Female	Adult	1	13-Feb-2005	7-Oct-2005	235.25	1859.23	15	35
SES-10018_05	Macquarie Is.	Female	Adult	1	14-Feb-2005	20-Sep-2005	217.83	1908.51	15	55
SES-10016_05	Macquarie Is.	Female	Adult	1	19-Feb-2005	17-Mar-2005	25.58	2213.37	15	5
SES-9920_05	Macquarie Is.	Female	Adult	1	21-Feb-2005	16-Apr-2005	54.08	2288.98	5	5
SES-9925_05	Macquarie Is.	Female	Adult	1	24-Feb-2005	29-Aug-2005	185.67	3634.73	5	5
SES-M037-09	Macquarie Is.	Female	Adult	1	17-Jan-2010	18-Sep-2010	244.00	2802.98	125	105
SES-M001-09	Macquarie Is.	Female	Adult	1	20-Jan-2010	22-Sep-2010	245.17	1282.97	5	25

Seal ID	Tagging location	Sex	Age class	Trip number	Start date	End date	Trip duration (days)	Distance reach from start location (km)	Passage-time scale (km)	Bottom-time scale (km)
SES-M036-09	Macquarie Is.	Female	Adult	1	26-Jan-2010	25-Sep-2010	242.00	1284.40	5	115
SES-M053-09	Macquarie Is.	Female	Adult	1	26-Jan-2010	20-Sep-2010	236.58	2541.18	75	75
SES-M043-09	Macquarie Is.	Female	Adult	1	28-Jan-2010	26-Jun-2010	149.08	2292.51	5	5
SES-M043-09	Macquarie Is.	Female	Adult	2	18-Jul-2010	25-Oct-2010	98.92	662.75	5	5
SES-M979-09	Macquarie Is.	Female	Adult	1	31-Jan-2010	2-Oct-2010	243.08	1336.20	215	225
SES-M040-09	Macquarie Is.	Female	Adult	1	3-Feb-2010	6-Aug-2010	183.50	2502.09	5	45
SES-M059-09	Macquarie Is.	Female	Adult	1	5-Feb-2010	23-Sep-2010	230.17	1778.75	5	5
SES-M721-09	Macquarie Is.	Female	Adult	1	5-Feb-2010	22-Sep-2010	228.75	2374.62	5	75
SES-M746-09	Macquarie Is.	Female	Adult	1	5-Feb-2010	26-Sep-2010	233.75	3404.71	5	5
SES-M752-09	Macquarie Is.	Female	Adult	1	5-Feb-2010	24-Sep-2010	231.00	2467.62	85	95
SES-M994-09	Macquarie Is.	Female	Adult	1	6-Feb-2010	13-Oct-2010	249.25	3642.71	5	45
SES-M044-09	Macquarie Is.	Female	Adult	1	9-Feb-2010	7-Oct-2010	239.67	2001.80	5	75
SES-M052-09	Macquarie Is.	Female	Adult	1	11-Feb-2010	4-Aug-2010	174.17	2141.69	165	165
SES-M061-09	Macquarie Is.	Female	Adult	1	16-Feb-2010	27-Apr-2010	69.83	2309.47	5	225
SES-238	Campbell Is.	Male	Juvenile	1	26-Jan-2012	29-May-2012	123.92	2153.85	5	215
SES-238	Campbell Is.	Male	Juvenile	2	25-Jun-2012	8-Nov-2012	136.25	2243.24	245	245
SES-242	Campbell Is.	Male	Adult	1	1-Mar-2012	31-Mar-2012	29.25	61.11	5	5
SES-242	Campbell Is.	Male	Adult	2	1-Apr-2012	22-Apr-2012	21.00	82.81	5	5
SES-242	Campbell Is.	Male	Adult	3	24-Apr-2012	17-May-2012	22.75	181.64	25	25
SES-259	Campbell Is.	Male	Adult	1	3-Mar-2012	11-Jun-2012	99.75	426.02	15	15
SES-259	Campbell Is.	Male	Adult	2	26-Jun-2012	12-Sep-2012	78.75	737.06	15	15
SES-251	Campbell Is.	Male	Sub-adult	1	15-Mar-2013	21-May-2013	67.00	231.88	15	45
SES-298	Campbell Is.	Male	Juvenile	1	29-Mar-2013	5-Jun-2013	67.92	225.71	55	65
SES-264	Campbell Is.	Male	Sub-adult	1	30-Mar-2013	16-Jun-2013	78.08	1546.84	15	15
SES-301	Campbell Is.	Male	Juvenile	1	31-Mar-2013	1-Aug-2013	123.00	2799.00	5	15
SES-263	Campbell Is.	Male	Adult	1	2-Apr-2013	12-Aug-2013	132.67	703.75	75	65
SES-263	Campbell Is.	Male	Adult	2	9-Nov-2013	11-Jan-2014	63.08	706.27	55	55

Table S2. Data used for modelling southern elephant seal foraging activity in different shelf and open ocean habitats. For each environmental variable, examples of previous studies that have assessed the relationship between foraging activity and that variable are listed. The scale and units of each variable, plus any transformation that was applied to each variable, is also given

	Source	Units	Scale	Transformation	Significance	Previous studies
Environmental variables						
Sea surface temperature (SST)	Feldman GC, McClain CR (2010) Ocean Color Web, MODIS Aqua Reprocessing, NASA Goddard Space Flight Center. Kuring N, Bailey SW (eds) http://oceancolor.gsfc.nasa.gov/	°C	daily	SST ^{0.5}	Small-scale water mass features, upwellings, eddies	(Hindell et al. 1991, Campagna et al. 2006)
Sea surface height anomaly (SSHA)	http://www.aviso.oceanobs.com/en/data/products/sea-surface-height-products/global/index.html	cm	weekly	none	Discrimination of water masses and fronts	(Bradshaw et al. 2004)
Chlorophyll concentration (Chl-a)	Feldman GC, McClain CR (2010) Ocean Color Web, MODIS Aqua Reprocessing, NASA Goddard Space Flight Center. Kuring N, Bailey SW (eds) http://oceancolor.gsfc.nasa.gov/	mg m ⁻³	8 day	Chl-a ^{0.2}	Primary production, prey availability	(Jaud et al. 2012)
Current speed	Galton-Fenzi BK, Hunter JR, Coleman R, Marsland SJ, Warner RC (2012) Modeling the basal melting and marine ice accretion of the Amery Ice Shelf. J Geophys Res C 117:C09031. http://dx.doi.org/10.1029/2012jc008214	m s ⁻¹	weekly	current speed ^{0.3}	Mesoscale activity, currents	(Campagna et al. 2006)
Wind speed	http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis2.pressure.html	m s ⁻¹	daily	none	Storm events	(Sterling et al. 2014)
Habitat grouping variables						
Bathymetry	Smith WHF, Sandwell DT (1997) Global seafloor topography from satellite altimetry and ship depth soundings. Science 277:1957–1962. http://topex.ucsd.edu/WWW_html/mar_topo.html	m	static	none	Depth, discrimination of coastal and oceanic waters	(Campagna et al. 2007)
Sea ice concentration	Cavalieri DJ, Parkinson CL, Gloersen P, Zwally HJ (1996, updated yearly) Sea ice concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data, Version 1. Boulder, CO, USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: http://dx.doi.org/10.5067/8GQ8LZQVL0VL	percentage cover	daily	none	Ice edge position, region of restricted data availability	(Bailleul et al. 2007)
Foraging metric						
Passage-time	Derived from horizontal tracking data (2D)	-	daily	passage-time 0.05		(Fauchald & Tveraa 2003)
Bottom-time	Derived from horizontal tracking and vertical dive data (3D)	-	daily	none		(Bailleul et al. 2008)

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Table S3. First bottom time and first passage time environmental models compared in shelf and open ocean habitats. Top models for each foraging metric were identified as the most parsimonious model with a delta conditional AIC (cAIC) value < 2, and are in **bold**

Open Ocean	Model	cAIC	log likelihood	delta cAIC	w	weighted cAIC
FBT						
	current speed+SSHA	-1.82E+03	9.41E+02	2.46E+00	2.92E-01	2.23E-01
	SSHA+ChlA	-1.81E+03	9.38E+02	8.33E+00	1.55E-02	1.19E-02
	SSHA	-1.80E+03	9.32E+02	1.81E+01	1.19E-04	9.12E-05
	current speed+ChlA	-1.79E+03	9.28E+02	2.77E+01	9.78E-07	7.48E-07
	current speed	-1.79E+03	9.26E+02	3.11E+01	1.76E-07	1.35E-07
	ChlA	-1.78E+03	9.23E+02	3.59E+01	1.60E-08	1.22E-08
	null	-1.77E+03	9.17E+02	4.72E+01	5.50E-11	4.20E-11
	wind speed	-1.77E+03	9.17E+02	4.87E+01	2.67E-11	2.04E-11
FPT						
	current speed+SSHA	-3.98E+03	2.02E+03	0.00E+00	1.00E+00	1.00E+00
	SSHA	-3.96E+03	2.01E+03	1.64E+01	2.73E-04	2.73E-04
	current speed	-3.90E+03	1.99E+03	7.44E+01	7.06E-17	7.06E-17
	null	-3.89E+03	1.98E+03	9.13E+01	1.52E-20	1.52E-20
	wind speed	-3.89E+03	1.98E+03	9.30E+01	6.25E-21	6.25E-21
	ChlA	-3.89E+03	1.98E+03	9.32E+01	5.77E-21	5.77E-21
Shelf	Model	caic	logLik	dAIC	w	wAIC
FBT						
	current speed+SST+SSHA+wind speed	-1.85E+02	1.07E+02	0.00E+00	1.00E+00	5.93E-01
	wind speed+ChlA+current speed+SST+SSHA	-1.83E+02	1.07E+02	1.54E+00	4.62E-01	2.74E-01
	current speed+SST+wind speed	-1.80E+02	1.04E+02	4.59E+00	1.01E-01	5.99E-02
	current speed+SST+SSHA	-1.79E+02	1.03E+02	5.89E+00	5.25E-02	3.11E-02
	wind speed+ChlA+current speed+SST	-1.79E+02	1.04E+02	6.49E+00	3.90E-02	2.31E-02
	current speed+SST+SSHA+ChlA	-1.78E+02	1.03E+02	7.19E+00	2.74E-02	1.63E-02
	SST+current speed	-1.74E+02	9.98E+01	1.12E+01	3.64E-03	2.16E-03
	current speed+SST+ChlA	-1.72E+02	9.99E+01	1.31E+01	1.46E-03	8.64E-04
	SSHA+wind speed+ChlA+current speed	-1.29E+02	7.89E+01	5.60E+01	6.87E-13	4.07E-13
	SST+SSHA+wind speed	-1.28E+02	7.72E+01	5.73E+01	3.60E-13	2.13E-13
	SST+SSHA+wind speed+ChlA	-1.28E+02	7.78E+01	5.75E+01	3.24E-13	1.92E-13
	SST+SSHA	-1.27E+02	7.60E+01	5.77E+01	3.00E-13	1.78E-13
	SST+SSHA+ChlA	-1.27E+02	7.67E+01	5.78E+01	2.78E-13	1.65E-13
	current speed+SSHA+ChlA	-1.24E+02	7.55E+01	6.09E+01	6.10E-14	3.62E-14
	current speed+SSHA+wind speed	-1.19E+02	7.30E+01	6.61E+01	4.37E-15	2.59E-15
	wind speed+SST	-1.16E+02	7.07E+01	6.94E+01	8.61E-16	5.11E-16
	SST	-1.15E+02	6.94E+01	7.00E+01	6.20E-16	3.67E-16
	SST+wind speed+ChlA	-1.14E+02	7.08E+01	7.12E+01	3.52E-16	2.09E-16
	SST+wind speed+ChlA	-1.14E+02	7.08E+01	7.12E+01	3.52E-16	2.09E-16
	current speed+SSHA	-1.14E+02	6.93E+01	7.14E+01	3.09E-16	1.83E-16
	SST+ChlA	-1.13E+02	6.95E+01	7.18E+01	2.59E-16	1.54E-16
	SSHA+wind speed+ChlA	-8.55E+01	5.62E+01	9.96E+01	2.41E-22	1.43E-22
	ChlA+SSHA	-8.50E+01	5.50E+01	1.00E+02	1.90E-22	1.13E-22
	wind speed+SSHA	-7.48E+01	4.99E+01	1.10E+02	1.13E-24	6.69E-25
	SSHA	-7.40E+01	4.86E+01	1.11E+02	7.60E-25	4.50E-25
	current speed+ChlA	-7.35E+01	4.34E+01	1.12E+02	6.10E-25	3.62E-25
	wind speed+current speed	-7.27E+01	4.43E+01	1.12E+02	4.04E-25	2.39E-25
	current speed	-6.37E+01	3.90E+01	1.21E+02	4.60E-27	2.73E-27
	wind speed+ChlA	-2.31E+01	1.86E+01	1.62E+02	6.94E-36	4.11E-36

Open Ocean	Model	cAIC	log likelihood	delta cAIC	w	weighted cAIC
	ChlA	-2.14E+01	1.65E+01	1.64E+02	2.87E-36	1.70E-36
	wind speed	-1.52E+01	1.37E+01	1.70E+02	1.35E-37	8.01E-38
	null	-1.27E+01	1.14E+01	1.72E+02	3.83E-38	2.27E-38
FPT						
	Current speed	-2.25E+02	1.22E+02	0.00E+00	1.00E+00	4.24E-01
	SST+current speed	-2.24E+02	1.22E+02	8.51E-01	6.53E-01	2.77E-01
	current speed+SSHA	-2.23E+02	1.22E+02	1.89E+00	3.88E-01	1.65E-01
	current speed+SST+SSHA	-2.23E+02	1.22E+02	2.31E+00	3.16E-01	1.34E-01
	SST	-2.09E+02	1.13E+02	1.63E+01	2.90E-04	1.23E-04
	SST + SSHA	-2.07E+02	1.14E+02	1.74E+01	1.65E-04	7.02E-05
	SSHA	-2.07E+02	1.13E+02	1.83E+01	1.06E-04	4.50E-05
	null	-2.06E+02	1.12E+02	1.84E+01	9.97E-05	4.23E-05
	ChlA	-2.06E+02	1.12E+02	1.86E+01	9.29E-05	3.94E-05
	wind speed	-2.05E+02	1.12E+02	1.99E+01	4.72E-05	2.00E-05