Supplementary Table S1: Summary details of Ross seal deployments that were used (n = 19) in the habitat models. S55 - SA Agulhas II expedition 2016-2017 (deployed = 11, used = 7), PS111 – Polarstern expedition 2018 (deployed and used = 2); SCALE – South African Seasonal cycle experiment 2019 (deployed and used = 2); NARE 2000/01 – Norwegian expedition 2000-2001 (deployed = 10, used = 8)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ID** | **Campaign** | **Device type** | **Sex** | **Length (cm)** | **Deployment date** | **Deployment latitude** | **Deployment longitude** | **Total tracking duration (days)** |
| Ross1 | NARE 2000/01 | SDR-T16 | Female | 190 | 2001/02/05 | 72° 19' S | 17° 24' W | 69 |
| Ross2 | NARE 2000/01 | SDR-T16 | Male | 210 | 2001/02/05 | 72° 19' S | 17° 33' W | 368 |
| Ross3 | NARE 2000/01 | SDR-T16 | Male | 195 | 2001/02/05 | 72° 09' S | 17° 45' W | 358 |
| Ross5 | NARE 2000/01 | SDR-T16 | Female | 230 | 2001/02/06 | 72° 03' S | 17° 08' W | 364 |
| Ross7 | NARE 2000/01 | SDR-T16 | Female | 232 | 2001/02/08 | 72° 08' S | 17° 03' W | 325 |
| Ross8 | NARE 2000/01 | SDR-T16 | Female | 200 | 2001/02/09 | 69° 59' S | 7° 31' W | 345 |
| Ross9 | NARE 2000/01 | SDR-T16 | Male | 192 | 2001/02/11 | 69° 58' S | 6° 40' W | 24 |
| Ross10 | NARE 2000/01 | SDR-T16 | Female | 227 | 2001/02/11 | 69° 58' S | 6° 39' W | 363 |
| Ross002 | S55 | Splash9 | Female | NA | 2016/01/13 | 70° 06' S | 3° 04' W | 36 |
| Ross011 | S55 | SPOT-300s | Female | NA | 2016/01/22 | 69° 52' S | 2° 00' W | 357 |
| Ross012 | S55 | SPLASH10-309A | Female | NA | 2016/01/22 | 69° 53' S | 2° 02' W | 115 |
| Ross015 | S55 | SPOT-300s | Female | NA | 2016/01/22 | 69° 55' S | 2° 05' W | 57 |
| Ross018 | S55 | SPLASH10-309A | Female | NA | 2016/01/23 | 70° 02' S | 2° 09' W | 176 |
| Ross019 | S55 | SPOT-300s | Female | 186 | 2016/01/23 | 70° 04' S | 2° 13' W | 349 |
| Ross021 | S55 | SPOT-300s | Male | 167 | 2016/01/27 | 70° 30' S | 8° 06' W | 253 |
| Ross022 | PS111 | SPLASH10-309A | Female | 176 | 2018/01/28 | 70°32' S | 8° 06' W | 160 |
| Ross023 | PS111 | SPLASH10-309A | Male | 172 | 2018/01/31 | 71° 06' S | 13° 39' W | 141 |
| Ross024 | SCALE | SPOT-300s | Female | 196 | 2019/10/27 | 59° 17’ S | 5° 12’ W | 83 |
| Ross025 | SCALE | SPOT-300s | Female | 222 | 2019/11/02 | 58° 46’ S | 21° 04’ W | 101 |

Supplementary Table S2: Environmental variables used as covariates in habitat models for Ross seals (*Ommatophoca rossii*).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Environmental variable (abbreviation) | Unit | Spatial resolution | Temporal resolution | Data source |
| Bathymetry (bathym) | m | 0.02° | NA | General Bathymetric Chart of the Oceans (British Oceanographic Data Centre) http://www.gebco.net |
| Ocean floor slope (slope) | ° | 0.02° | NA | Bathymetry derivative |
| Sea surface temperature (sst) | °C | 0.25° | Monthly | National Centres for Environmental Informationhttps://www.ncdc.noaa.gov/oisst |
| Sea surface temperature anomalies (sstA) | °C | 0.25° | Monthly | Sea surface temperature derivative |
| Sea surface temperature gradient (sst\_grad) | ° | 0.25° | Monthly | Sea surface temperature derivative |
| Sea surface height anomalies (sshA) | m | 0.12° | Daily | Ssalto/Duacs (Copernicus Marine and Environment Monitoring Service)http://marine.copernicus.eu  |
| Sea surface height gradient (ssh\_grad) | ° | 0.25° | Daily | Ssalto/Duacs (Aviso and Centre national d'études spatiales)http://www.aviso.altimetry.fr/duacs/  |
| Mixed layer depth (mld) | m | 2° | Seasonal climatology | (de Boyer Montégut, 2004; Raymond, 2018)http://www.ifremer.fr/cerweb/deboyer/mld/home.phphttps://data.aad.gov.au/metadata/records/Polar\_Environmental\_Data |
| Geostrophic current velocity (currmag) | cm/s | 0.25° | Weekly | Ssalto/Duacs (Aviso and Centre national d'études spatiales)http://www.aviso.altimetry.fr/duacs/  |
| Eddy kinetic energy (eke)  | cm²/s² | 0.25° | Weekly | Zonal and meridional geostrophic velocity derivative, calculated as eke = 0.5(curru2 + currv2);where curru = horizontal geostrophic velocity; currv = vertical geostrophic velocity. Ssalto/Duacs (Aviso and Centre national d'études spatiales) http://www.aviso.altimetry.fr/duacs/ |
| Wind magnitude (windmag) | m/s | 1.9° | Daily | National Centres for Environmental Information http://www.esrl.noaa.gov/psd/  |
| Distance to ice edge (dist\_iceedge) | m | 25 km | Daily | Derived from National Snow and Ice Data Center http://nsidc.org/data/NSIDC-0081 |
| Sea ice concentration (ice) | % | 25 km | Daily | Derived from National Snow and Ice Data Center http://nsidc.org/data/NSIDC-0081 |
| Sea ice concentration standard deviation (ice\_sd) | NA | 25 km | Daily | Sea ice concentration derivative |
| Vertical mixing (vmix) |  | 0.1 | 10-year climatology | Upward sea water velocity at 250 m depth(Raymond, 2018)Gordon et al. (2010) The CSIRO Mk3.5 Climate Model. CAWCR Technical Report 21. http://www.cawcr.gov.au/technical-reports/CTR\_021.pdf |
| Vertical mixing standard deviation (vmix\_sd) | NA | 0.1 | 10-year climatology | Vertical mixing derivative |



*Supplementary Figure S1*

Partial dependence plots showing ensemble model predictions of the effect of environmental variables on the probability of area-restricted search behaviour by Ross seals in King Haakon VII Sea during summer. Mean probability (solid line) of area-restricted search behaviour ± sd (grey-shaded) across the 500 bootstraps are shown.

*Abbreviations: slope – slope of the sea floor, eke - eddy kinetic energy, ice - sea ice concenration, sstA – sea surface temperature anomaly, ssh\_grad - sea surface height gradient, sst\_grad - sea surface temperature gradient, vmix – vertical mixing speed, vmix\_sd – vertical mixing speed standard deviation, currmag – current magnitude, windmag – wind magnitude*



*Supplementary Figure S2*

Winter partial dependence plots showing ensemble model predictions of the effect of environmental variables on probability of area-restricted search behaviour by Ross seals in King Haakon VII Sea during winter. Mean probability (solid line) of area-restricted search behaviour ± sd (grey shaded) across the 500 bootstraps are shown.

*Abbreviations: bathym – bathymetry, slope – slope of the sea floor, eke - eddy kinetic energy, ice - sea ice concentration, ssh\_grad – sea surface height gradient, sst\_grad – sea surface temperature gradient, vmix – vertical mixing speed, vmix\_sd – vertical mixing speed standard deviation, windmag – wind magnitude.*

**Animation 1 Legend:** Animation of the annual movements of the satellite-tracked Ross seals. The blue line represents the ice edge (15% ice concentration) and the coloured dots represent individual seals.

**Animation 2 Legend:** Animation of the annual movements of the satellite-tracked Ross seals closely zoomed in, in the eastern Weddell Sea. The blue line represents the ice edge (15% ice concentration) and the coloured dots represent individual seals.

**References**

de Boyer Montégut, C. (2004). Mixed layer depth over the global ocean: An examination of profile data and a profile-based climatology. J. Geophys. Res. 109, C12003. doi:10.1029/2004JC002378.

Greenwell, B. M. (2017). pdp: An R Package for Constructing Partial Dependence Plots. R J. 9, 421–436.

R Core Team (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing. http://www.R-project.org. Available at: https://www.r-project.org/.

Raymond, B. (2018). Polar Environmental Data Layers Australian Antarctic Data Centre - CAASM Metadata (https://data.aad.gov.au/metadata/records/Polar\_Environmental\_Data).