

N isotope data for individual amino acids from modern west Antarctic seals

Website: <https://www.bco-dmo.org/dataset/732754>

Data Type: Cruise Results

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Project

» [Collaborative Research: Exploring the Vulnerability of Southern Ocean Pinnipeds to Climate Change - An Integrated Approach](#) (Southern Ocean Pinnipeds)

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Abstract

This dataset includes N isotope data for individual amino acids from modern west Antarctic seals.

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Coverage

Spatial Extent: N:-62.47 E:175.143 S:-77.652 W:162.684

Temporal Extent: 2008 - 2011

Dataset Description

These data are published and discussed in:

Brault, E. (2017). An Examination of the Ecological and Oceanographic Effects of Mid-to-Late Holocene Climate Changes on the Ross Sea Ecosystem. UC Santa Cruz. ProQuest ID: Brault_ucsc_0036E_11435. Merritt ID: ark:/13030/m5dg1n5d. Retrieved from <https://escholarship.org/uc/item/99s5j3fk>

Methods & Sampling

Sampling Sites and Sample Collection:

Tissue samples from Ross, Weddell, and crabeater seals were collected along western Antarctica from the West Antarctic Peninsula (WAP) to the Ross Sea during multiple field seasons and, in most cases, body mass, age class (juvenile, subadult, and adult), gender, and location were recorded for each sampled seal. Seals were

sampled during the austral summers of 2008/09 and 2010/11 on RV Oden cruises along the western Antarctic coast. Mostly whole blood samples were obtained. In some cases, clot (blood with serum removed), red blood cells (RBCs, whole blood exposed to an anticoagulant, heparin, before having plasma removed), and hair samples (body fur or whiskers) were also taken. The sampling protocol is described in Aubail et al. (2011); all animal captures were conducted in accordance with the regulations of the Swedish Polar Research Secretariat (Registration No. 2010-112).

All other samples were obtained from animal captures conducted under National Marine Fisheries Service permit No. 87-1851-00. Additionally, the Institutional Animal Care and Use Committee (IACUC) at the University of Santa Cruz (UC Santa Cruz) approved all protocols for the following samples. Whiskers were taken from crabeater seals during multiple cruises on the RV Lawrence M. Gould along the WAP. Plasma was also obtained from a few of the fall 2007 individuals (G105, G110, and G112). In addition, serum or plasma was obtained from two Weddell seals during the fall 2007 sampling in this region, and whiskers were taken from two WAP Weddell seals in the austral summer of 2009/10. Hückstädt et al. (2012b) describe the procedure for sampling the whiskers, and Goetz et al. (2017) describe the protocol used for collecting the seal serum and plasma.

Several blood samples were obtained from Weddell seals in the McMurdo Sound region, Ross Sea, Antarctica over multiple field seasons. Twelve whole blood samples were taken from juvenile Weddell seals near Inexpressible Island (74.9 °S, 163.7 °E) during the austral summer of 2010/11. Whole blood samples were taken from Weddell seals in the austral summer of 2010/11 and austral spring of 2012. RBCs were sampled in the austral summer of 2009/10, austral summer of 2011/12, and austral spring of 2012. Whole blood, plasma, and serum were obtained from five Weddell seals sampled in the austral spring of 2015, and whole blood from an additional seven Weddell seals was also acquired during this time. Goetz et al. (2017) describe the sampling protocol for these Weddell seals.

Lastly, a few samples were obtained from crabeater seals in McMurdo Sound. Hair samples were taken from three recently deceased juvenile crabeater seals that were found on the seasonal pack ice around Cape Royds in the austral summer of 2009/10. Whole blood was sampled, using the protocol of Goetz et al. (2017), from a male adult crabeater seal found in Erebus Bay during the austral summer of 2010/11.

Taxonomic Groups:

Pinnipedia

Phocidae

Lobodon carcinophaga - crabeater seal

Ommatophoca rossii - Ross seal

Leptonychotes weddellii - Weddell seal

Sample Preparation:

After sample collection, all samples were kept frozen at -20 °C. Blood samples were freeze-dried with a Labconco Freeze Dry System (Lyph Lock 4.5) and homogenized manually prior to analysis. Lipid extraction was not performed on the blood samples. Blood has a relatively low lipid content and a test set of blood samples with and without lipid extraction revealed no significant effect of lipid extraction on blood values. Hair samples, which have higher lipid contents, were lipid extracted. Hair samples were washed with Milli-Q water (Thermo Fisher Scientific, Inc.) and then rinsed 3 times in an ultrasonic bath with petroleum ether for 15 minutes. Hückstädt et al. (2012a) used a similar protocol to lipid-extract the crabeater seal whisker samples.

Compound Specific Isotope Analysis (CSIA):

CSIA was performed at UC Santa Cruz via gas chromatography-isotope ratio mass spectrometry (GC-IRMS). All samples were prepared for GC-IRMS analysis using the method described in McCarthy et al. (2007) and McCarthy et al. (2013). In brief, samples were hydrolyzed (6 N HCl for 20 hr at 110 °C) and converted to trifluoroacetic anhydride (TFAA) derivatives. Samples were stored in a -20 °C freezer in a 1:3 TFAA:DCM (methylene chloride) mixture until the day of instrumental analysis. Immediately before the analysis, the TFAA:DCM mixture was evaporated under N₂ and samples were diluted in ethyl acetate.

Amino acid $\delta^{15}\text{N}$ values were measured on a Thermo Trace GC coupled to a Thermo-Finnigan DeltaPlus XP isotope-ratio-monitoring mass spectrometer (oxidation furnace at 980 °C and reduction furnace at 650 °C). The column for the N isotope analysis was a SGE Analytical Science BPX5 column 60 m by 0.32 mm with a 1 μm film thickness. The injector temperature was 250 °C with a split He flow of 2 mL/min. The GC temperature program for $\delta^{15}\text{N}$ analysis was: initial temp = 70 °C hold for 1 min; ramp 1 = 10 °C/min to 185 °C, hold for 2 min; ramp 2 = 2 °C/min to 200 °C, hold for 10 min; ramp 3 = 30 °C/min to 300 °C, hold for 6 min. Directly measured amino acid $\delta^{15}\text{N}$ values were corrected based on bracketing external standards, as described in McCarthy et al. (2013).

Samples were injected and analyzed 3 to 4 times, and the mean value, standard deviation, and number of injections are reported. The $\delta^{15}\text{N}$ values of 11 amino acids could be quantified. These were alanine (Ala), glycine (Gly), threonine (Thr), serine (Ser), valine (Val), leucine (Leu), Pro, aspartic acid + asparagine (Asp), Glu, Phe, and lysine (Lys). In all samples, isoleucine (Ile) was either not detectable or had low peak areas (< 70) and, thus, Ile $\delta^{15}\text{N}$ values should be considered with caution. Lysine was not detected in one sample (R101) and not in all injections of a few samples (R114, W006, and W013), but peak areas were sufficient (>70) when it was detectable.

Data Processing Description

BCO-DMO Processing:

- modified parameter names (replaced spaces with underscores);
- added the LSID and AphiaID from WoRMS;
- replaced spaces with underscores in all columns;
- replaced "&" in data Region column with "and";
- sorted by Common_name.

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Data Files

File
modern_seal_aa_isotopes.csv (Comma Separated Values (.csv), 40.38 KB) MD5:6895e60b1ddaacd9deee49ca1ee9d3e3
Primary data file for dataset ID 732754

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Related Publications

Aubail, A., Teilmann, J., Dietz, R., Rigét, F., Harkonen, T., Karlsson, O., Rosing-Asvid, A., & Caurant, F. (2011). Investigation of mercury concentrations in fur of phocid seals using stable isotopes as tracers of trophic levels and geographical regions. *Polar Biology*, 34(9), 1411–1420. <https://doi.org/10.1007/s00300-011-0996-z>
Methods

Braut, E. (2017). An Examination of the Ecological and Oceanographic Effects of Mid-to-Late Holocene Climate Changes on the Ross Sea Ecosystem. UC Santa Cruz. ProQuest ID: Braut_ucsc_0036E_11435. Merritt ID: ark:/13030/m5dg1n5d. Retrieved from <https://escholarship.org/uc/item/99s5j3fk>
Results

Goetz, K. T., Burns, J. M., Hückstädt, L. A., Shero, M. R., & Costa, D. P. (2017). Temporal variation in isotopic composition and diet of Weddell seals in the western Ross Sea. *Deep Sea Research Part II: Topical Studies in Oceanography*, 140, 36–44. <https://doi.org/10.1016/j.dsr2.2016.05.017>
Methods

Hückstädt, L. A., Koch, P. L., McDonald, B. I., Goebel, M. E., Crocker, D. E., & Costa, D. P. (2011). Stable isotope analyses reveal individual variability in the trophic ecology of a top marine predator, the southern elephant seal. *Oecologia*, 169(2), 395–406. <https://doi.org/10.1007/s00442-011-2202-y>
Methods

Hückstädt, L., Burns, J., Koch, P., McDonald, B., Crocker, D., & Costa, D. (2012). Diet of a specialist in a changing environment: the crabeater seal along the western Antarctic Peninsula. *Marine Ecology Progress Series*, 455, 287–301. <https://doi.org/10.3354/meps09601>
Methods

McCarthy, M. D., Benner, R., Lee, C., & Fogel, M. L. (2007). Amino acid nitrogen isotopic fractionation patterns as indicators of heterotrophy in plankton, particulate, and dissolved organic matter. *Geochimica et Cosmochimica Acta*, 71(19), 4727–4744. doi:[10.1016/j.gca.2007.06.061](https://doi.org/10.1016/j.gca.2007.06.061)
Methods

McCarthy, M. D., Lehman, J., & Kudela, R. (2013). Compound-specific amino acid $\delta^{15}\text{N}$ patterns in marine algae: Tracer potential for cyanobacterial vs. eukaryotic organic nitrogen sources in the ocean. *Geochimica et Cosmochimica Acta*, 103, 104–120. <https://doi.org/10.1016/j.gca.2012.10.037>
Methods

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Parameters

Parameter	Description	Units
Common_name	Common name of the seal	unitless
Scientific_name	Scientific name (genus and species) of the seal	unitless
WoRMS_LSID	Life Science Identifier (LSID) assigned to the species by the World Register of Marine Species (WoRMS; http://www.marinespecies.org/)	unitless
AphiaID	World Register of Marine Species (WoRMS; http://www.marinespecies.org/) species identifier	unitless
Sample_ID	Sample identification code	unitless
Region	General location of sampling	unitless
Latitude	Latitude of sample collection (negative values = south)	decimal degrees
Longitude	Longitude of sample collection (negative values = west; positive values = east)	decimal degrees
Calendar_age	Calendar age of specimen	unitless
Age_class	Age class of the specimen (subadult, adult)	unitless
Gender	Sex of the specimen (male, female)	unitless
Sample_type	Description of the type of tissue analyzed (clotted blood, plasma, whisker, whole blood)	unitless
Amino_acid	Amino acid analyzed	unitless
d15N	Stable nitrogen isotope value	permil (‰), AIR
N_std_dev	Standard deviation of d15N values	permil (‰), AIR
injections	Number of sample injections on GC-IRMS	unitless

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Instruments

Dataset-specific Instrument Name	GC-IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	CSIA was performed at UC Santa Cruz via gas chromatography-isotope ratio mass spectrometry (GC-IRMS). Amino acid $\delta^{15}\text{N}$ values were measured on a Thermo Trace GC coupled to a Thermo-Finnigan DeltaPlus XP isotope-ratio-monitoring mass spectrometer (oxidation furnace at 980 °C and reduction furnace at 650 °C).
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

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Project Information

Collaborative Research: Exploring the Vulnerability of Southern Ocean Pinnipeds to Climate Change - An Integrated Approach (Southern Ocean Pinnipeds)

Coverage: McMurdo Dry Valleys Region; Royal Society Range, Victoria Land Coast , Antarctic Peninsula, Amundsen Sea, Ross Sea

NSF abstract:

Building on previously funded NSF research, the use of paleobiological and paleogenetic data from mummified elephant seal carcasses found along the Dry Valleys and Victoria Land Coast in areas that today are too cold to support seal colonies (*Miroungina leonina*; southern elephant seals; SES) supports the former existence of these seals in this region. The occurrence and then subsequent disappearance of these SES colonies is consistent with major shifts in the Holocene climate to much colder conditions at the last ~1000 years BCE).

Further analysis of the preserved remains of three other abundant pinnipeds ? crabeater (*Lobodon carciophagus*), Weddell (*Leptonychotes weddelli*) and leopard (*Hydrurga leptonyx*) will be studied to track changes in their population size (revealed by DNA analysis) and their diet (studied via stable isotope analysis). Combined with known differences in life history, preferred ice habitat and ecosystem sensitivity among these species, this paleoclimate proxy data will be used to assess their exposure and sensitivity to climate change in the Ross Sea region during the past ~1-2,000 years

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Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1141849
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1142108

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