

Tables in MSc dissertation: 'Stable isotope values of Marion Island myctophids using otoliths from fur seal faecal samples' – A van Tonder 2023

Correcting stable isotope values of myctophid otolith organic matter before applying offsets

Correction values (‰) for stable carbon isotope ratios ($\delta^{13}\text{C}$) of otolith material based on cleaning load – mass of otolith powder (mg) to volume of NaOCl (ml). The correction values and associated error were derived from nearest neighbour regression (*loess*) curves at a 95% confidence level, span = 0.75, using R (R Core Team 2020, RStudio Team 2020). The curves were established using otolith material of *Gymnoscopelus piabilis* from Antarctic fur seal (*Arctocephalus gazella*) faecal samples collected at the Prince Edward Islands.

Cleaning load (mg.ml ⁻¹)	Correction value	Minimum correction value	Maximum correction value	Standard error (SE)
19.0000	0.0667	-0.1753	0.3086	0.1165
19.4810	0.0837	-0.1362	0.3037	0.1059
19.9620	0.1007	-0.1045	0.3059	0.0988
20.4430	0.1176	-0.0799	0.3151	0.0951
20.9241	0.1344	-0.0614	0.3302	0.0943
21.4051	0.1511	-0.0476	0.3498	0.0957
21.8861	0.1678	-0.0369	0.3724	0.0985
22.3671	0.1843	-0.0278	0.3965	0.1021
22.8481	0.2008	-0.0193	0.4209	0.1060
23.3291	0.2172	-0.0105	0.4448	0.1096
23.8101	0.2335	-0.0007	0.4677	0.1127
24.2911	0.2497	0.0105	0.4889	0.1152
24.7722	0.2658	0.0234	0.5083	0.1167
25.2532	0.2819	0.0381	0.5257	0.1174
25.7342	0.2979	0.0547	0.5410	0.1171
26.2152	0.3138	0.0737	0.5539	0.1156
26.6962	0.3302	0.0978	0.5626	0.1119
27.1772	0.3470	0.1257	0.5682	0.1065
27.6582	0.3639	0.1550	0.5728	0.1006
28.1392	0.3809	0.1830	0.5788	0.0953
28.6203	0.3977	0.2071	0.5884	0.0918
29.1013	0.4143	0.2254	0.6032	0.0909
29.5823	0.4304	0.2373	0.6235	0.0930
30.0633	0.4458	0.2436	0.6480	0.0974
30.5443	0.4605	0.2464	0.6746	0.1031
31.0253	0.4742	0.2480	0.7004	0.1089
31.5063	0.4868	0.2506	0.7230	0.1137
31.9873	0.4981	0.2562	0.7399	0.1164
32.4684	0.5105	0.2685	0.7525	0.1165
32.9494	0.5264	0.2890	0.7638	0.1143
33.4304	0.5445	0.3150	0.7741	0.1105
33.9114	0.5639	0.3437	0.7842	0.1060

34.3924	0.5835	0.3722	0.7948	0.1017
34.8734	0.6021	0.3975	0.8067	0.0985
35.3544	0.6188	0.4172	0.8204	0.0971
35.8354	0.6324	0.4295	0.8354	0.0977
36.3165	0.6420	0.4336	0.8503	0.1003
36.7975	0.6463	0.4298	0.8628	0.1042
37.2785	0.6444	0.4186	0.8702	0.1087
37.7595	0.6351	0.4008	0.8695	0.1128
38.2405	0.6175	0.3771	0.8579	0.1158
38.7215	0.5904	0.3477	0.8331	0.1169
39.2025	0.5540	0.3131	0.7949	0.1160
39.6835	0.5177	0.2785	0.7568	0.1151
40.1646	0.4836	0.2452	0.7221	0.1148
40.6456	0.4519	0.2133	0.6905	0.1149
41.1266	0.4226	0.1831	0.6621	0.1153
41.6076	0.3957	0.1547	0.6367	0.1160
42.0886	0.3713	0.1283	0.6142	0.1170
42.5696	0.3493	0.1041	0.5946	0.1181
43.0506	0.3299	0.0820	0.5777	0.1193
43.5316	0.3130	0.0624	0.5637	0.1207
44.0127	0.2988	0.0451	0.5524	0.1221
44.4937	0.2871	0.0303	0.5439	0.1236
44.9747	0.2782	0.0181	0.5382	0.1252
45.4557	0.2719	0.0085	0.5354	0.1269
45.9367	0.2684	0.0014	0.5355	0.1286
46.4177	0.2677	-0.0031	0.5385	0.1304
46.8987	0.2698	-0.0051	0.5447	0.1323
47.3797	0.2747	-0.0045	0.5540	0.1344
47.8608	0.2825	-0.0015	0.5666	0.1368
48.3418	0.2933	0.0040	0.5826	0.1393
48.8228	0.3070	0.0118	0.6022	0.1421
49.3038	0.3237	0.0219	0.6255	0.1453
49.7848	0.3435	0.0342	0.6527	0.1489
50.2658	0.3663	0.0487	0.6839	0.1529
50.7468	0.3922	0.0652	0.7192	0.1575
51.2278	0.4212	0.0836	0.7588	0.1626
51.7089	0.4535	0.1040	0.8029	0.1683
52.1899	0.4889	0.1262	0.8516	0.1746
52.6709	0.5276	0.1502	0.9050	0.1817
53.1519	0.5696	0.1760	0.9632	0.1895
53.6329	0.6149	0.2035	1.0263	0.1981
54.1139	0.6635	0.2327	1.0943	0.2074
54.5949	0.7156	0.2636	1.1675	0.2176
55.0759	0.7711	0.2963	1.2458	0.2286
55.5570	0.8300	0.3307	1.3293	0.2404
56.0380	0.8924	0.3668	1.4180	0.2531

56.5190	0.9584	0.4048	1.5121	0.2666
57.0000	1.0280	0.4445	1.6115	0.2809

Correction values (‰) for stable nitrogen isotope ratios ($\delta^{15}\text{N}$) of otolith material based on cleaning load – mass of otolith powder (mg) to volume of NaOCl (ml). The correction values and associated error were derived from nearest neighbour regression (*loess*) curves at a 95% confidence level, span = 0.75, using R (R Core Team 2020, RStudio Team 2020). The curves were established using otolith material of *Gymnoscopelus piabilis* from Antarctic fur seal (*Arctocephalus gazella*) faecal samples collected at the Prince Edward Islands.

Cleaning load (mg.ml ⁻¹)	Correction value	Minimum correction value	Maximum correction value	Standard error (SE)
19.0000	2.2350	1.5851	2.8849	0.3129
19.4810	2.0100	1.4191	2.6008	0.2845
19.9620	1.7971	1.2458	2.3485	0.2654
20.4430	1.5965	1.0659	2.1270	0.2554
20.9241	1.4079	0.8820	1.9339	0.2532
21.4051	1.2316	0.6979	1.7653	0.2570
21.8861	1.0674	0.5177	1.6171	0.2646
22.3671	0.9154	0.3455	1.4853	0.2744
22.8481	0.7755	0.1842	1.3668	0.2847
23.3291	0.6478	0.0362	1.2594	0.2945
23.8101	0.5323	-0.0968	1.1613	0.3029
24.2911	0.4289	-0.2137	1.0715	0.3094
24.7722	0.3377	-0.3137	0.9891	0.3136
25.2532	0.2586	-0.3964	0.9136	0.3154
25.7342	0.1917	-0.4615	0.8450	0.3145
26.2152	0.1388	-0.5062	0.7839	0.3106
26.6962	0.1118	-0.5125	0.7361	0.3006
27.1772	0.1092	-0.4852	0.7036	0.2862
27.6582	0.1264	-0.4348	0.6877	0.2702
28.1392	0.1590	-0.3726	0.6907	0.2560
28.6203	0.2025	-0.3096	0.7146	0.2466
29.1013	0.2523	-0.2551	0.7597	0.2443
29.5823	0.3040	-0.2148	0.8227	0.2498
30.0633	0.3530	-0.1903	0.8962	0.2616
30.5443	0.3948	-0.1804	0.9700	0.2769
31.0253	0.4249	-0.1828	1.0327	0.2926
31.5063	0.4389	-0.1956	1.0734	0.3055
31.9873	0.4322	-0.2176	1.0819	0.3128
32.4684	0.4050	-0.2451	1.0551	0.3130
32.9494	0.3626	-0.2752	1.0004	0.3071
33.4304	0.3071	-0.3096	0.9239	0.2969
33.9114	0.2409	-0.3507	0.8326	0.2849
34.3924	0.1661	-0.4015	0.7338	0.2733
34.8734	0.0851	-0.4646	0.6347	0.2647
35.3544	-0.0001	-0.5417	0.5415	0.2608
35.8354	-0.0870	-0.6323	0.4582	0.2625
36.3165	-0.1736	-0.7332	0.3861	0.2695

36.7975	-0.2575	-0.8391	0.3241	0.2800
37.2785	-0.3365	-0.9430	0.2701	0.2920
37.7595	-0.4083	-1.0378	0.2211	0.3031
38.2405	-0.4708	-1.1167	0.1750	0.3110
38.7215	-0.5217	-1.1738	0.1303	0.3139
39.2025	-0.5599	-1.2070	0.0872	0.3116
39.6835	-0.5937	-1.2361	0.0488	0.3093
40.1646	-0.6250	-1.2656	0.0155	0.3084
40.6456	-0.6541	-1.2951	-0.0130	0.3086
41.1266	-0.6807	-1.3241	-0.0373	0.3098
41.6076	-0.7050	-1.3524	-0.0577	0.3117
42.0886	-0.7270	-1.3796	-0.0744	0.3142
42.5696	-0.7466	-1.4055	-0.0878	0.3172
43.0506	-0.7640	-1.4298	-0.0982	0.3206
43.5316	-0.7790	-1.4524	-0.1056	0.3242
44.0127	-0.7917	-1.4731	-0.1103	0.3281
44.4937	-0.8021	-1.4919	-0.1123	0.3321
44.9747	-0.8102	-1.5088	-0.1116	0.3364
45.4557	-0.8161	-1.5239	-0.1083	0.3408
45.9367	-0.8196	-1.5370	-0.1022	0.3454
46.4177	-0.8209	-1.5485	-0.0934	0.3503
46.8987	-0.8200	-1.5584	-0.0816	0.3555
47.3797	-0.8168	-1.5669	-0.0666	0.3612
47.8608	-0.8114	-1.5744	-0.0484	0.3674
48.3418	-0.8037	-1.5809	-0.0265	0.3742
48.8228	-0.7938	-1.5868	-0.0008	0.3818
49.3038	-0.7817	-1.5925	0.0290	0.3903
49.7848	-0.7674	-1.5981	0.0633	0.4000
50.2658	-0.7509	-1.6041	0.1023	0.4108
50.7468	-0.7322	-1.6108	0.1463	0.4230
51.2278	-0.7114	-1.6184	0.1956	0.4367
51.7089	-0.6883	-1.6272	0.2505	0.4520
52.1899	-0.6632	-1.6375	0.3112	0.4691
52.6709	-0.6358	-1.6496	0.3780	0.4881
53.1519	-0.6063	-1.6637	0.4511	0.5091
53.6329	-0.5747	-1.6798	0.5305	0.5321
54.1139	-0.5409	-1.6983	0.6164	0.5572
54.5949	-0.5050	-1.7191	0.7090	0.5845
55.0759	-0.4670	-1.7424	0.8083	0.6141
55.5570	-0.4269	-1.7682	0.9144	0.6458
56.0380	-0.3847	-1.7967	1.0272	0.6798
56.5190	-0.3404	-1.8278	1.1469	0.7161
57.0000	-0.2941	-1.8616	1.2734	0.7547

Determining otolith-to-muscle offset values for myctophids

Carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotope values of myctophids sampled near Dronning Maud Land, Antarctica from February to March 2019. Individual (conspecific) fish were randomly assigned to samples, with 16 – 17 fish pooled per sample. The offset (Δ) between muscle and otolith (muscle minus otolith) values for the samples are also shown. (EA = *Electrona antarctica*, GO = *Gymnoscopelus opisthopterus*).

Sample (number of fish)	Fish total length (mean \pm SD, mm)	Fish wet mass (mean \pm SD, g)	Otolith value (‰)		Muscle value (‰)		Otolith-to- muscle offset (‰)	
			$\delta^{13}\text{C}$	$\delta^{15}\text{N}$	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$	$\Delta^{13}\text{C}$	$\Delta^{15}\text{N}$
EA1 (17)	77 \pm 7	4 \pm 1	-24.5	7.7	-25.9	9.3	-1.4	1.6
EA2 (16)	79 \pm 14	5 \pm 3	-25.0	7.9	-26.0	9.1	-1.0	1.2
EA3 (17)	77 \pm 11	4 \pm 2	-25.4	7.8	-26.1	9.5	-0.7	1.7
EA4 (17)	79 \pm 8	4 \pm 2	-24.6	7.9	-26.0	9.2	-1.4	1.3
EA5 (16)	77 \pm 8	4 \pm 1	-24.0	7.4	-25.7	9.2	-1.7	1.8
EA6 (16)	77 \pm 11	5 \pm 2	-24.3	7.3	-25.8	9.3	-1.5	2.0
Mean \pm SD	78 \pm 10	4 \pm 2	-24.6 \pm 0.5	7.7 \pm 0.2	-25.9 \pm 0.1	9.3 \pm 0.1	-1.3 \pm 0.4	1.6 \pm 0.3
GO1 (17)	88 \pm 8	4 \pm 1	-24.2	8.0	-25.1	10.7	-0.9	2.7
GO2 (17)	91 \pm 10	4 \pm 2	-23.6	8.1	-25.5	10.5	-1.9	2.4
Mean \pm SD	90 \pm 9	4 \pm 2	-23.9 \pm 0.4	8.1 \pm 0.1	-25.3 \pm 0.3	10.6 \pm 0.1	-1.4 \pm 0.6	2.6 \pm 0.2

Applying otolith-to-muscle offsets to cleaned and corrected otolith values

Carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotope values of selected sampling units of myctophids at the Prince Edward Islands (PEIs). ES denotes *Electrona subaspera*, GF – *Gymnoscopelus fraseri*, GN – *G. nicholsi*, GP – *G. piabilis*. The sampling periods were around January 2005 and December 2010. The values are of otoliths collected from faecal samples of various fur seal colonies on Marion Island, part of the PEIs. The otoliths were cleaned with NaOCl before measurement and corrected for oversight in solvent volume. Applying the otolith-to-muscle offset established for myctophids provided estimates of muscle values. The uncertainty, final standard deviation (SD), is the sum of both measurand uncertainty (including cleaning correction and muscle estimation) as well as the standard deviation of sampling units.

Sampling unit	$n \delta^{13}\text{C}; n \delta^{15}\text{N}$	Cleaned and corrected otolith value (‰, mean \pm SD)		Estimated muscle value (‰, mean \pm final SD)	
		$\delta^{13}\text{C}$	$\delta^{15}\text{N}$	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
ES2005	10; 5	-22.5 \pm 1.2	4.9 \pm 1.9	-23.7 \pm 1.4	6.5 \pm 1.9
ES2010	10; 8	-22.2 \pm 1.0	6.1 \pm 1.9	-23.5 \pm 1.3	7.7 \pm 1.9
GF2005	14; 10	-22.2 \pm 1.1	5.7 \pm 2.0	-23.4 \pm 1.4	7.3 \pm 2.0
GF2010	18; 11	-22.1 \pm 1.1	5.5 \pm 2.2	-23.4 \pm 1.3	7.1 \pm 2.2
GN2005	18; 9	-22.1 \pm 1.4	6.7 \pm 1.9	-23.4 \pm 1.6	8.3 \pm 1.9
GN2010	15; 14	-23.2 \pm 1.1	6.7 \pm 2.2	-24.5 \pm 1.4	8.3 \pm 2.2
GP2005	19; 19	-20.5 \pm 1.3	5.1 \pm 2.5	-21.8 \pm 1.5	6.7 \pm 2.5
GP2010	30; 29	-21.7 \pm 1.1	5.1 \pm 2.2	-22.9 \pm 1.4	6.7 \pm 2.2

Comparing novel muscle estimates with published counterparts from elsewhere in the Southern Ocean

Carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotope values of muscle of myctophids compared between different study sites. KAR – Îles Kerguelen (Cherel et al. 2010).

BB-KPL – Kerguelen Plateau (Woods et al. 2020). MI– Marion Island – part of the Prince Edward Islands (PEIs), ~ values estimated from figure, and *Gymnoscopelus* sp. here only include *G. fraseri* and *G. piabilis* and exclude *G. braueri* (Pakhomov et al. 2006). PEIs – this study. DML – Dronning Maud Land (this study). The values for this study (PEIs) were estimated using offsets from organic material of otoliths from fur seal faecal samples. Final standard deviation (SD) is the sum of analytical and measurand uncertainty.

Species	This study (‰, mean \pm analytical SD; final SD)	Location	$\delta^{13}\text{C}$ (‰, mean \pm SD)	$\delta^{15}\text{N}$ (‰, mean \pm SD)
<i>E. antarctica</i>	DML	KAR	-21.4 \pm 0.5	8.9 \pm 0.3
	$\delta^{13}\text{C}$ = -25.9 \pm 0.1	BB-KPL	-25.2 \pm 0.7	8.2 \pm 0.6
	$\delta^{15}\text{N}$ = 9.3 \pm 0.1			
<i>E. subaspera</i>	PEIs	KAR	-20.2 \pm 0.4 (t = -10.98, df = 23.85, p < 0.01)	7.3 \pm 0.3 (t = -0.17, df = 12.46, p = 0.87)
	$\delta^{13}\text{C}$ = -23.6 \pm 0.6; 1.3			
	$\delta^{15}\text{N}$ = 7.2 \pm 1.0; 2.1			
<i>Electrona</i> sp.	PEIs	MI	~ -24.7	~ 6.6
	$\delta^{13}\text{C}$ = -23.6 \pm 1.3			
	$\delta^{15}\text{N}$ = 7.2 \pm 2.1			
<i>G. fraseri</i>	PEIs	KAR	-21.1 \pm 0.4 (t = -8.94, df = 41.22, p < 0.01)	9.0 \pm 0.4 (t = -3.81, df = 22.46, p < 0.01)
	$\delta^{13}\text{C}$ = -23.4 \pm 0.6; 1.3			
	$\delta^{15}\text{N}$ = 7.2 \pm 1.1; 2.1			
<i>G. opisthopterus</i>	DML	BB-KPL	-25.4 \pm 0.6	9.2 \pm 0.6
	$\delta^{13}\text{C}$ = -25.3 \pm 0.3			
	$\delta^{15}\text{N}$ = 10.6 \pm 0.1			
<i>G. nicholsi</i>	PEIs	KAR	-21.1 \pm 0.3 (t = -9.60, df = 37.47, p < 0.01)	10.2 \pm 0.5 (t = -3.95, df = 26.06, p < 0.01)
	$\delta^{13}\text{C}$ = -23.9 \pm 1.0; 1.6			

	$\delta^{15}\text{N} = 8.3 \pm 1.2;$ 2.2	BB-KPL	-22.7 ± 0.7	9.0 ± 0.8
	PEIs			
<i>G. piabilis</i>	$\delta^{13}\text{C} = -22.5 \pm 0.9;$ 1.5	KAR	-19.8 ± 0.3 (t = -11.68, df = 58.19, p < 0.01)	8.8 ± 0.2 (t = -5.98, df = 49.48, p < 0.01)
	$\delta^{15}\text{N} = 6.7 \pm 2.4$			
	PEIs			
<i>Gymnoscopelus</i> sp.	$\delta^{13}\text{C} = -23.2 \pm 1.6$	MI	~ -20.8 to -24.5	~ 9.0 to 9.5
	$\delta^{15}\text{N} = 7.2 \pm 1.5;$ 2.4			

Using novel muscle estimates as source values in predator stable isotope dietary mixing models (unresolved for killer whales)

Carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotope values of clustered potential prey items of juvenile, sub-adults and adult female southern elephant seals (*Mirounga leonina*) at the sub-Antarctic Prince Edward Islands. Prey items include novel data for myctophids from the Prince Edward Islands (PEI; Chapter 2) that replace conspecific data from other sites (Îles Crozet = CI and Îles Kerguelen = KI), as found in Lübcker et al. (2017). All values are either for whole organisms (krill) or estimates of muscle values for fish and squid.

	Type	n	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	Reference
Prey cluster 1						
<i>Electrona antarctica</i>	Fish	12	KI	-21.4 ± 0.5	8.9 ± 0.3	Cherel et al. 2010
<i>Electrona carlsbergi</i>	Fish	12	KI	-21.6 ± 0.4	9.5 ± 0.2	Cherel et al. 2010
<i>Gymnoscopelus bolini</i>	Fish	12	KI	-20.5 ± 0.4	9.9 ± 0.5	Cherel et al. 2010
<i>Gobionotothen marionensis</i>	Fish	5	PEI	-20.6 ± 0.4	8.5 ± 0.6	Bushula et al. 2005
<i>Protomyctophum andriashevi</i>	Fish	7	KI	-20.9 ± 0.3	8.7 ± 0.4	Cherel et al. 2010
<i>Protomyctophum choriodon</i>	Fish	12	KI	-20.0 ± 0.5	7.8 ± 0.3	Cherel et al. 2010
		60		-20.9 ± 0.7	8.9 ± 0.8	
Prey cluster 2						
<i>Electrona subaspera</i>	Fish	5	PEI	-23.7 ± 1.4	6.5 ± 1.9	Chapter 2
<i>Gymnoscopelus fraseri</i>	Fish	10	PEI	-23.4 ± 1.4	7.3 ± 2.0	Chapter 2
<i>Gymnoscopelus nicholsi</i>	Fish	9	PEI	-23.4 ± 1.6	8.3 ± 1.9	Chapter 2
		24		-23.5 ± 1.5	7.5 ± 2.1	
Prey cluster 3						
<i>Gymnoscopelus braueri</i>	Fish	12	KI	-22.3 ± 0.7	9.8 ± 0.3	Cherel et al. 2010
<i>Gymnoscopelus piabilis</i>	Fish	19	PEI	-21.8 ± 1.5	6.7 ± 2.5	Chapter 2
<i>Kreftlichthys anderssoni</i>	Fish	12	KI	-22.3 ± 0.2	7.6 ± 0.2	Cherel et al. 2010
<i>Lepidonotothen larseni</i>	Fish	5	PEI	-22.1 ± 0.4	7.2 ± 0.8	Bushula et al. 2005
<i>Protomyctophum bolini</i>	Fish	12	KI	-22.4 ± 0.6	9.2 ± 0.4	Cherel et al. 2010
<i>Protomyctophum gemmatum</i>	Fish	4	KI	-22.1 ± 0.1	8.7 ± 0.4	Cherel et al. 2010
<i>Martialia hyadesi</i>	Squid	10	CI	-22.6 ± 0.4	8.5 ± 0.8	Guerreiro et al. 2015
		74		-22.2 ± 0.9	8.1 ± 1.8	
Prey cluster 4						
<i>Euphausia vallentini</i>	Krill	19	PEI	-22.6 ± 0.6	3.4 ± 0.5	Lübcker et al. 2017
<i>Euphausia frigida</i>	Krill	18	PEI	-22.3 ± 0.7	3.7 ± 0.6	Lübcker et al. 2017

				37	-22.5 ± 0.6	3.5 ± 0.6	
Prey cluster 5							
<i>Thysanoessa</i> sp.	Krill	18	PEI	-24.3 ± 0.3	5.6 ± 0.8	Lübcker et al. 2017	
		18		-24.3 ± 0.3	5.6 ± 0.8		
Prey cluster 6							
<i>Moroteuthopsis longimana</i>	Squid	40	PEI	-24.8 ± 1.0	10.2 ± 0.7	van Tonder et al. 2021	
		40		-24.8 ± 1.0	10.2 ± 0.7		

Carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotope values of clustered potential prey items of adult male southern elephant seals (*Mirounga leonina*), for which considered prey was different than other classes. Prey items include novel data for myctophids from the Prince Edward Islands (PEI; Chapter 2) that replace conspecific data from other sites (Îles Crozet = CI and Îles Kerguelen = KI), as found in Lübcker et al. (2017). All values are either for whole organisms (krill) or estimates of muscle values for fish and squid.

	Type	<i>n</i>	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	Reference
Prey cluster 1						
<i>Electrona antarctica</i>	Fish	12	KI	-21.4 ± 0.5	8.9 ± 0.3	Cherel et al. 2010
<i>Electrona carlsbergi</i>	Fish	12	KI	-21.6 ± 0.4	9.5 ± 0.2	Cherel et al. 2010
<i>Gymnoscopelus bolini</i>	Fish	12	KI	-20.5 ± 0.4	9.9 ± 0.5	Cherel et al. 2010
<i>Gobionotothen marionensis</i>	Fish	5	PEI	-20.6 ± 0.4	8.5 ± 0.6	Bushula et al. 2005
<i>Protomyctophum andriashevi</i>	Fish	7	KI	-20.9 ± 0.3	8.7 ± 0.4	Cherel et al. 2010
<i>Protomyctophum choriodon</i>	Fish	12	KI	-20.0 ± 0.5	7.8 ± 0.3	Cherel et al. 2010
		60		-20.9 ± 0.7	8.9 ± 0.8	
Prey cluster 2						
<i>Electrona subaspera</i>	Fish	5	PEI	-23.7 ± 1.4	6.5 ± 1.9	Chapter 2
<i>Gymnoscopelus fraseri</i>	Fish	10	PEI	-23.4 ± 1.4	7.3 ± 2.0	Chapter 2
<i>Gymnoscopelus nicholsi</i>	Fish	9	PEI	-23.4 ± 1.6	8.3 ± 1.9	Chapter 2
<i>Thysanoessa</i> sp.	Krill	18	PEI	-24.3 ± 0.3	5.6 ± 0.8	Lübcker et al. 2017
		42		-23.8 ± 1.2	6.7 ± 1.9	
Prey cluster 3						
<i>Gymnoscopelus braueri</i>	Fish	12	KI	-22.3 ± 0.7	9.8 ± 0.3	Cherel et al. 2010
<i>Gymnoscopelus piabilis</i>	Fish	19	PEI	-21.8 ± 1.5	6.7 ± 2.5	Chapter 2
<i>Krefftichthys anderssoni</i>	Fish	12	KI	-22.3 ± 0.2	7.6 ± 0.2	Cherel et al. 2010
<i>Lepidonotothen larseni</i>	Fish	5	PEI	-22.1 ± 0.4	7.2 ± 0.8	Bushula et al. 2005
<i>Protomyctophum bolini</i>	Fish	12	KI	-22.4 ± 0.6	9.2 ± 0.4	Cherel et al. 2010
<i>Protomyctophum gemmatum</i>	Fish	4	KI	-22.1 ± 0.1	8.7 ± 0.4	Cherel et al. 2010
<i>Martialia hyadesi</i>	Squid	10	CI	-22.6 ± 0.4	8.5 ± 0.8	Guerreiro et al. 2015
		74		-22.2 ± 0.9	8.1 ± 1.8	
Prey cluster 4						
<i>Galiteuthis glacialis</i>	Squid	10	CI	-21.3 ± 0.5	13.8 ± 0.6	Guerreiro et al. 2015
<i>Histioteuthis eltaninae</i>	Squid	10	CI	-21.5 ± 0.6	13.9 ± 0.3	Guerreiro et al. 2015

<i>Mastigoteuthis</i> sp. A (Clarke)	Squid	10	CI	-21.5 ± 0.5	13.8 ± 0.7	Guerreiro et al. 2015
<i>Alluroteuthis antarcticus</i>	Squid	10	CI	-21.3 ± 1.4	13.1 ± 0.2	Guerreiro et al. 2015
<i>Moroteuthis ingens</i>	Squid	10	CI	-21.8 ± 0.4	12.8 ± 0.2	Guerreiro et al. 2015
<i>Moroteuthis knipovitchi</i>	Squid	10	CI	-22.1 ± 1.5	12.9 ± 0.5	Guerreiro et al. 2015
		60		-21.6 ± 1.0	13.4 ± 0.7	
Prey cluster 5						
<i>Moroteuthopsis longimana</i>	Squid	40	PEI	-24.8 ± 1.0	10.2 ± 0.7	van Tonder et al. 2021
		40		-24.8 ± 1.0	10.2 ± 0.7	

Stable isotope values of potential prey items of killer whales (*Orcinus orca*) as found in Reisinger et al. (2016). AM = adult male, UY = under yearling, Y = yearling, SA = sub-adult, AF = adult female. Prey items include novel data for myctophids from the Prince Edward Islands (PEI; Chapter 2) that replace conspecific data from other sites (Îles Crozet = CI and Îles Kerguelen = KI)

	Type	<i>n</i>	Site	δ ¹³ C (‰)	δ ¹⁵ N (‰)	Reference
Prey cluster 1						
<i>Arctocephalus tropicalis</i>	Seal	13	PEI	-20.5 ± 0.5	12.1 ± 0.3	Reisinger et al. 2016
<i>Mirounga leonina</i> UY	Seal	5	PEI	-21.5 ± 0.4	11.9 ± 0.2	Reisinger et al. 2016
<i>Mirounga leonina</i> Y	Seal	5	PEI	-21.1 ± 0.7	11.3 ± 0.5	Reisinger et al. 2016
<i>Mirounga leonina</i> SA	Seal	5	PEI	-20.6 ± 0.4	11.2 ± 0.3	Reisinger et al. 2016
<i>Mirounga leonina</i> AF	Seal	5	PEI	-20.4 ± 0.8	11.1 ± 0.6	Reisinger et al. 2016
<i>Mirounga leonina</i> AM	Seal	5	PEI	-19.8 ± 1.0	12.7 ± 0.6	Reisinger et al. 2016
<i>Dissostychus elegenoides</i>	Fish	10	PEI	-20.2 ± 0.6	12.7 ± 0.6	Reisinger et al. 2016
		48		-20.5 ± 0.8	12.0 ± 0.7	
Prey cluster 2						
<i>Aptenodytes patagonicus</i>	Penguin	8	PEI	-22.3 ± 0.1	10.5 ± 0.3	Reisinger et al. 2016
<i>Eudyptes chrysolophus</i>	Penguin	5	PEI	-22.5 ± 0.1	9.2 ± 0.3	Reisinger et al. 2016
<i>E. c. filholi</i>	Penguin	7	PEI	-22.6 ± 0.4	8.5 ± 0.6	Reisinger et al. 2016
		20		-22.5 ± 0.3	9.5 ± 1.0	
Prey cluster 3						
<i>Electrona subaspera</i>	Fish	8	PEI	-23.5 ± 1.3	7.7 ± 1.9	Chapter 2
<i>Gymnoscopelus fraseri</i>	Fish	11	PEI	-23.4 ± 1.3	7.1 ± 2.2	Chapter 2
<i>Gymnoscopelus piabilis</i>	Fish	29	PEI	-22.9 ± 1.4	6.7 ± 2.2	Chapter 2
		48		-23.1 ± 1.4	7.0 ± 2.2	
Prey cluster 4						

<i>Gymnoscopelus nicholsi</i>	Fish	14	PEI	-24.5 ± 1.4	8.3 ± 2.2	Chapter 2
		14		-24.5 ± 1.4	8.3 ± 2.2	

Proportional contributions (mode [credible interval]) of clusters of prey to the diets of juvenile (J), sub-adult (SA) and adult female (AF) southern elephant seals (*Mirounga leonina*). Proportional contributions were determined using the R package *siar* using stable isotope values of elephant seal whiskers sampled at the sub-Antarctic Prince Edward Islands. Prey values were sourced from the literature and means \pm standard deviations (SD) are reported here. The constituent species for each cluster and its reference can be found in tables below. SDs for the isotopic tracers relative to measurement reproducibility for standards are a measure of model performance, with lower variability indicative of better performance. *M.hya* = *Martialia hyadesi*; *Thy. sp.* = *Thysanoessa* sp. and *M. lon* = *Moroteuthopsis longimana*. The model for adult male southern elephant seals (AM) had different cluster constituents as other classes.

Cluster	Type	<i>n</i>	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	J	SA	AF
1	Fish	60	-20.9 \pm 0.7	8.9 \pm 0.8	5% [0%-25%]	5% [0%-35%]	1% [0%-53%]
2	Fish	24	-23.5 \pm 1.5	7.5 \pm 2.1	12% [0%-30%]	7% [0%-25%]	7% [0%-19%]
3	Fish + <i>M.hya</i>	74	-22.2 \pm 0.9	8.1 \pm 1.8	9% [0%-28%]	8% [0%-27%]	12% [0%-24%]
4	Krill	37	-22.5 \pm 0.6	3.5 \pm 0.6	26% [8%-48%]	14% [0%-29%]	15% [2%-29%]
5	Krill (<i>Thy. sp.</i>)	18	-24.3 \pm 0.3	5.6 \pm 0.8	32% [10%-63%]	21% [0%-36%]	9% [0%-43%]
6	Squid (<i>M. lon</i>)	40	-24.8 \pm 1.0	10.2 \pm 0.7	NA	17% [3%-39%]	17% [2%-38%]
SD $\delta^{13}\text{C}$ (‰)					0.1	<0.1	<0.1
SD $\delta^{15}\text{N}$ (‰)					0.1	0.1	<0.1
Cluster	Type	<i>n</i>	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	AM		
1	Fish	60	-20.9 \pm 0.7	8.9 \pm 0.8	48% [22%-66%]		
2	Fish + <i>Thy. sp.</i>	42	-23.8 \pm 1.2	6.7 \pm 1.9	19% [0%-28%]		
3	Fish + <i>M.hya</i>	74	-22.2 \pm 0.9	8.1 \pm 1.8	21% [1%-37%]		
4	Squid	60	-21.5 \pm 1.0	13.4 \pm 0.7	3% [0%-14%]		
5	Squid (<i>M. lon</i>)	40	-24.8 \pm 1.0	10.2 \pm 0.7	1% [0%-14%]		
SD $\delta^{13}\text{C}$ (‰)					<0.1		
SD $\delta^{15}\text{N}$ (‰)					<0.1		