

Body size affects individual winter foraging strategies of thick-billed murre in the Bering Sea

Appendix S1

Table S1.1. Loadings matrix from Principal Component Analysis (PCA) of body size components. Only PC1 had an eigen value greater than 1. Percentage of variance incorporated by each PC is given.

	PC1 51.1%	PC2 23.0%	PC3 19.9%	PC4 6.0%
Culmen (mm)	0.589	-0.443	-0.029	0.675
Head+bill (mm)	0.626	-0.269	-0.095	-0.726
Tarsus (mm)	0.373	0.499	0.782	0.035
Wing cord (mm)	0.350	0.695	-0.616	0.125

Table S1.2. Loading matrix of principle components of winter foraging strategies. Only first eight components with eigenvalues greater than 1 are shown as these were used in the hierarchical cluster analysis. Percentage of variance incorporated by each PC is given.

	PC1 22.8%	PC2 14.8%	PC3 11.3%	PC4 9.7%	PC5 6.0%	PC6 5.1%	PC7 4.7%	PC8 4.0%
Diet								
Throat $\delta^{15}\text{N}$	-0.143	0.299	-0.221	0.001	-0.201	0.177	0.084	-0.130
Throat $\delta^{13}\text{C}$	-0.052	0.338	-0.173	0.075	-0.116	0.270	-0.124	-0.036
Breast $\delta^{15}\text{N}$	0.026	0.142	-0.221	0.273	-0.168	-0.283	0.135	0.156
Breast $\delta^{13}\text{C}$	0.135	0.080	0.169	-0.051	-0.175	0.040	0.488	-0.164
Spatial								
% HR in Bering Sea convex hull area (Mm2)	-0.096	0.280	-0.181	0.145	0.324	0.095	0.243	-0.057
Max. distance	-0.029	-0.008	0.333	-0.104	0.037	-0.037	0.193	-0.408
	0.014	0.068	-0.286	0.193	0.459	0.173	0.040	0.234
Temporal								
date of max. depth	-0.006	-0.096	0.304	-0.006	0.244	0.005	0.42	0.018
date at max. distance	-0.099	-0.173	-0.016	-0.074	0.175	-0.077	0.303	0.566
Dive								
max. dive depth	0.147	0.072	0.342	0.164	0.324	-0.045	-0.181	0.085
% 24hr day diving	0.263	0.177	-0.168	-0.088	0.159	-0.132	0.226	-0.144
% 24hr night diving	0.297	-0.188	-0.114	-0.122	-0.053	0.022	-0.117	-0.048
day mean depth	0.045	0.408	-0.014	-0.061	0.220	-0.173	-0.089	-0.137
night mean depth	-0.066	0.211	0.243	-0.305	-0.117	-0.31	-0.128	0.138
SD day depth	0.309	0.101	0.189	0.084	-0.048	0.162	-0.132	0.241
SD night depth	0.026	0.312	0.309	0.088	-0.128	0.154	-0.017	0.200
SD % 24hr night diving	0.319	0.146	-0.147	-0.105	-0.050	-0.078	0.133	-0.010
SD % 24hr day diving	0.326	-0.104	-0.152	-0.073	-0.134	0.076	-0.173	0.050
Dive Bouts								
bout duration	0.249	-0.095	-0.110	-0.355	0.263	0.108	0.043	-0.172
bout depth	-0.128	0.378	0.041	-0.216	0.121	-0.264	-0.116	0.015
% bout diving	0.326	0.136	-0.111	-0.056	-0.171	-0.193	0.152	0.141
post bout interval	-0.116	0.075	0.009	-0.043	-0.268	0.434	0.286	0.053
# of bouts / day	0.038	-0.088	-0.03	0.485	0.057	-0.181	-0.063	-0.367
SD bout duration	0.316	0.003	-0.003	-0.163	0.144	0.277	-0.066	-0.061

Table S1.3 Morphometrics of thick-billed murres (*Uria lomvia algae*) $\pm$ standard deviation. Sample sizes are indicated in parentheses.

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	St Paul		St George		Bogoslof		3
	♂ (39)	♀ (36)	♂ (53)	♀ (29)	♂ (17)	♀ (15)	4
Body Mass (g)	1184 $\pm$ 101	1106 $\pm$ 96	998 $\pm$ 61	960 $\pm$ 65	1038 $\pm$ 73	1003 $\pm$ 54	5
Culmen (mm)	42.8 $\pm$ 2.6	41.6 $\pm$ 2.0	41.1 $\pm$ 2.1	39.8 $\pm$ 2.0	42.1 $\pm$ 2.1	40.1 $\pm$ 1.8	6
Head+bill (mm)	117.1 $\pm$ 3.2	113.7 $\pm$ 2.4	112.0 $\pm$ 3.3	109.9 $\pm$ 2.9	114.9 $\pm$ 2.7	111.1 $\pm$ 3.4	7
Tarsus (mm)	40.7 $\pm$ 1.8	39.0 $\pm$ 1.9	38.9 $\pm$ 1.7	37.8 $\pm$ 1.3	40.1 $\pm$ 1.4	38.9 $\pm$ 2.5	8
Wing (mm)	227 $\pm$ 6	226 $\pm$ 5	223 $\pm$ 6	222 $\pm$ 4	223 $\pm$ 7	224 $\pm$ 5	9
Wing Area (cm ²)*	719.4 $\pm$ 26.2	708.1 $\pm$ 50.0	679.5 $\pm$ 34.9	647.6 $\pm$ 45.8	-	-	10
Wing Loading (Nm ²)*	163.6 $\pm$ 7.4	165.2 $\pm$ 14.7	147.1 $\pm$ 8.1	140.7 $\pm$ 6.0	-	-	11
Body Size (PC1)**	1.17 $\pm$ 1.16	0.22 $\pm$ 1.16	-0.66 $\pm$ 1.22	-1.85 $\pm$ 0.63	-0.166 $\pm$ 1.31	-1.79 $\pm$ 1.07	12
							13
							14
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19 *St Paul ♂ (7), ♀ (8); St George ♂ (12), ♀ (5).

20 ** St Paul ♂ (12), ♀ (21); St George ♂ (11), ♀ (3); Bogoslof ♂ (3), ♀ (3)

Table S1.3. Results of v-tests used to determine significant contribution of variable to each winter foraging cluster of thick-billed murres (Table 2).

	Shallow Night		Deep Day		High Frequency	
	<i>v</i>	<i>p</i>	<i>v</i>	<i>p</i>	<i>v</i>	<i>p</i>
Diet						
Throat $\delta^{15}\text{N}$ (‰)	-2.39	0.017	4.45	<0.001	-1.20	0.229
Throat $\delta^{13}\text{C}$ (‰)	-3.54	<0.001	4.16	<0.001	0.34	0.735
Breast $\delta^{15}\text{N}$ (‰)	-2.20	0.028	1.11	0.269	1.50	0.132
Breast $\delta^{13}\text{C}$ (‰)	-1.59	0.111	-0.68	0.492	2.40	0.017
Spatial						
% HR in Bering Sea convex hull area (Mm ²)	-2.19	0.029	3.67	<0.001	-0.76	0.450
Max. distance (km)	0.20	0.841	0.20	0.845	-0.40	0.691
	-0.60	0.547	1.26	0.207	-0.43	0.668
Temporal						
date of maximum depth	1.75	0.081	-1.76	0.078	-0.42	0.672
date at maximum distance	3.16	0.002	-1.57	0.117	-2.18	0.029
Dive						
maximum dive depth (m)	-0.41	0.681	-1.85	0.065	2.08	0.037
% 24 hr day diving	-3.67	<0.001	0.19	0.848	3.96	<0.001
day mean depth (m)	-3.90	<0.001	3.04	0.002	1.73	0.084
SD % 24 hr day diving	-4.29	<0.001	-0.24	0.812	5.04	<0.001
SD day depth (m)	-2.76	0.006	-2.67	0.008	5.45	<0.001
% 24 hr night diving	-1.09	0.274	-2.56	0.010	3.48	<0.001
night mean depth (m)	-0.81	0.420	0.86	0.389	0.15	0.878
SD % 24 hr night diving	-2.00	0.045	-2.62	0.009	4.55	<0.001
SD night depth (m)	-2.63	0.009	0.73	0.464	2.32	0.021
Dive Bouts						
bout duration (min)	-1.36	0.175	-1.08	0.279	2.48	0.013
bout depth (m)	-2.10	0.036	3.66	<0.001	-0.85	0.396
% of bout diving	-4.08	<0.001	-1.02	0.306	5.50	<0.001
post bout interval (min)	-1.43	0.153	2.41	0.016	-0.50	0.617
# of bouts / day	0.98	0.326	-0.86	0.391	-0.35	0.723
SD bout duration (min)	-2.99	0.003	-1.28	0.200	4.49	<0.001
SD bout depth	-2.76	0.006	-1.36	0.175	4.30	<0.001
SD % of bout diving	-1.46	0.144	-2.28	0.023	3.65	<0.001
SD # bouts / day	-1.04	0.299	-1.99	0.047	2.91	0.004

Table S1.5. Behavioural parameters $\pm$ standard deviations used to determine wintering foraging clusters of thick-billed murre.

	Shallow Night	Deep Day	High Frequency
n	27	9	13
Body Size PC1	-0.42 $\pm$ 0.89	1.20 $\pm$ 0.94	-0.02 $\pm$ 1.52
Diet			
Throat $\delta^{15}\text{N}$ (‰)	14.78 $\pm$ 0.89	17.05 $\pm$ 0.78	14.82 $\pm$ 1.52
Throat $\delta^{13}\text{C}$ (‰)	-18.96 $\pm$ 0.49	-17.89 $\pm$ 0.31	-18.63 $\pm$ 0.31
Breast $\delta^{15}\text{N}$ (‰)	16.09 $\pm$ 0.96	16.69 $\pm$ 0.65	16.71 $\pm$ 1.04
Breast $\delta^{13}\text{C}$ (‰)	-18.60 $\pm$ 0.66	-18.60 $\pm$ 0.60	-18.11 $\pm$ 0.48
Spatial			
% HR in Bering Sea	23 $\pm$ 35	82 $\pm$ 32	27 $\pm$ 50
convex hull area (Mm ²)	50.4 $\pm$ 62.3	52.3 $\pm$ 74.7	43.2 $\pm$ 45.8
Max. distance (km)	190 $\pm$ 43	207 $\pm$ 31	189 $\pm$ 27
Temporal			
date of maximum depth	Jan 31 $\pm$ 29	Jan 13 $\pm$ 44	Jan 20 $\pm$ 26
date at maximum distance	Jan 1 $\pm$ 45	Nov 11 $\pm$ 42	Nov 18 $\pm$ 42
Dive			
maximum dive depth (m)	152.3 $\pm$ 13.7	143.6 $\pm$ 14.2	161.8 $\pm$ 22.7
% 24 hr day diving	5.7 $\pm$ 2.0	7.4 $\pm$ 2.5	10.2 $\pm$ 3.6
day mean depth (m)	44.1 $\pm$ 6.3	54.1 $\pm$ 3.6	50.5 $\pm$ 6.0
SD % 24 hr day diving	3.6 $\pm$ 1.1	4.6 $\pm$ 2.1	7.1 $\pm$ 1.2
SD day depth (m)	13.1 $\pm$ 2.8	11.1 $\pm$ 1.9	20.5 $\pm$ 2.8
% 24 hr night diving	7.9 $\pm$ 3.7	4.5 $\pm$ 2.3	13.0 $\pm$ 6.8
night mean depth (m)	31.4 $\pm$ 6.5	33.6 $\pm$ 7.3	32.3 $\pm$ 4.1
SD % 24 hr night diving	7.2 $\pm$ 3.5	4.1 $\pm$ 1.8	15.1 $\pm$ 6.7
SD night depth (m)	11.2 $\pm$ 2.6	12.9 $\pm$ 2.9	13.9 $\pm$ 3.2
Dive Bouts			
bout duration (min)	67.9 $\pm$ 12.3	65.4 $\pm$ 10.3	80.5 $\pm$ 23.3
bout depth (m)	39.6 $\pm$ 5.1	47.0 $\pm$ 4.3	40.0 $\pm$ 4.1
% of bout diving	39.0 $\pm$ 5.6	41.4 $\pm$ 11.8	59.1 $\pm$ 3.7
post bout interval (min)	310 $\pm$ 194	622 $\pm$ 651	333 $\pm$ 224
# of bouts / day	4.1 $\pm$ 0.7	3.9 $\pm$ 0.5	4.0 $\pm$ 0.5
SD bout duration (min)	68.1 $\pm$ 18.0	68.0 $\pm$ 13.6	105.4 $\pm$ 26.5
SD bout depth	16.9 $\pm$ 2.3	16.8 $\pm$ 1.7	21.4 $\pm$ 3.6
SD % of bout diving	23.9 $\pm$ 5.3	20.9 $\pm$ 5.2	30.1 $\pm$ 4.3
SD # bouts / day	1.48 $\pm$ 0.24	1.34 $\pm$ 0.26	1.72 $\pm$ 0.35