The following supplements accompany the article

Foraging ecology during nesting influences body size in a pursuit-diving seabird

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Supplement 1. Instrument effect on the foraging and breeding performance of thick-billed murres at the Pribilof Islands

The majority of birds (85%, n = 190) with data loggers had chicks alive at the end of the deployment period (St. Paul: 83/89; St. George: 69/101). Most birds that lost a chick were from St. George Island (78%, n = 28). Most of the instruments deployed were retrieved (73%, n = 189), and more often from birds with TDRs (88%, n = 34) than from those with GPS and TDRs (68%, n = 120). Nest attendance differed between tagged and control pairs ($F_{1, 237} = 15.115$, $P < 0.0001$) regardless of colony or year ($P > 0.05$). Pairs that had a tagged bird spent less time at the nest site (61.7 ± 0.52 mins/hr, $n = 23$) than those in which both members were untagged (63 ± 0.35 mins/hr, $n = 94$) across years. Chick feeding rates were affected by both logger effect and year ($F_{1, 138} = 6.166$, $P = 0.014$). In 2009, chicks from pairs with a tagged member (0.17 ± 0.04 feeds/h, $n = 18$) were fed less often than those from control pairs (0.28 ± 0.02 feeds/h, $n = 67$; $F_{1, 78} = 7.703$, $P = 0.007$); however, no differences were found in 2008 (control: 0.15 ± 0.02 feeds/h, $n = 46$; tagged: 0.18 ± 0.04 feeds/h, $n = 18$; $F_{1, 60} = 0.657$, $P = 0.421$). Overall trip duration did not differ between tagged and control birds (log-transformed: $F_{1, 526} = 0.192$, $P = 0.661$) regardless of colony or year ($P > 0.05$). However, tagged birds (18.3 ± 1.0, n = 10) of both colonies had longer trips overnight than control birds (13.2 ± 0.33, n = 65; $F_{1, 67} = 14.07$, $P < 0.0001$) with no differences during daytime trips (control: 2.2 ± 0.14, n = 416; tagged: 1.7 ± 0.71, n = 51; $F_{1, 459} = 0.017$, $P = 0.896$). Corticosterone levels were higher in tagged birds (St. Paul: 0.76 ± 0.04 ng/ml, n = 38; St. George: 0.86 ± 0.05 ng/ml, n = 28) than control birds (St. Paul: 0.72 ± 0.04 ng/ml, n = 61; St. George: 0.69 ± 0.03 ng/ml, n = 68; $F_{1, 191} = 5.182$, $P = 0.023$) with no differences between colonies ($F_{1, 191} = 0.055$, $P = 0.814$).

The simultaneous use of GPSs and TDRs provided new insights into the foraging strategies of thick-billed murres traditionally investigated through diving analysis (but see Harding et al. 2013). There was no apparent effect of double tagging on trip duration compared to control birds, or dive depth compared to TDR birds. Nevertheless, double-instrumented birds had lower nest attendance, chick-feeding rates (1 of 2 years) and higher stress levels than non-or single-tagged birds. Thus, double-tagged birds appeared to work harder to raise chicks, although foraging patterns were apparently less affected. The poor foraging conditions of the study period likely aggravated the effects of double tagging, possibly due to the increased drag of the GPS back-attachment rather than the added weight of the two tags (GPS and TDR; less than 3% of the an adult's weight; Elliott et al. 2009, Vandenabeele et al. 2011), or due to the use of shrink tubing to encase the GPS, that might have slightly added to the positive buoyancy of the birds.

References

Elliott KH, Davoren GK, Gaston AJ (2007) The influence of buoyancy and drag on the dive behaviour of an arctic seabird, the thick-billed murre. Can J Zool 85:352–361

Harding A, Paredes R, Suryan R, Roby D, and others (2013) Does location really matter? An inter-colony comparison of seabirds breeding at varying distances from productive oceanographic features in the Bering Sea. Deep-Sea Res II 94: 178–191

Vandenabeele SP, Shepard ELC, Grogan A, Wilson RP (2011) When three per cent may not be three per cent; device-equipped seabirds experience variable flight constraints. Mar Biol 159: 1–14

Supplement 2. Models and AIC_c outputs used for the analysis of ΔCORT of adult Thick-billed murres breeding at the Pribilof Islands. Heterogeneity Control: for sex and colony, but not size.

Model	Terms	Biological Meaning
BC0	Intercept only	Null.
BC1	Sex	ΔCORT varies primarily by sex.
BC2	Colony	ΔCORT varies between the colonies.
BC3	Size	ΔCORT varies linearly with body size.
BC4	Sex + colony	ΔCORT varies by sex and by colony.
BC5	Size + colony	ΔCORT varies by size and also by colony.
BC6	Size + sex	ΔCORT varies by size and by sex.
BC7	Size + sex + colony	ΔCORT varies by size, sex, and colony.
BC8	Size + sex + size:sex	The pattern in ΔCORT changes with size differs by sex.
BC9	Size + colony + size:colony	The pattern in ΔCORT changes with size differs by colony.
BC10	Size + sex + colony + size:sex	The pattern in ΔCORT changes with size differs by sex. In addition the colonies have different levels of CORT change.
BC11	Size + sex + colony + size:colony	The pattern in ΔCORT changes with size differs by colony. In addition, the sexes have different levels of CORT change.
BC13	Size + $size^2$	ΔCORT varies quadratically with body size.
BC14	Size + colony + $size^2$	ΔCORT varies by colony and quadratically with body size.
BC15	Size + sex + $size^2$	ΔCORT varies by sex and quadratically with body size.
BC16	Size + sex + colony + $size^2$	ΔCORT varies by sex and colony and quadratically with body size.
BC17	Size + sex + size:sex + $size^2$	The pattern in ΔCORT changes with size differs by sex and quadratically with body size.
BC18	Size + colony + size:colony + $size^2$	The pattern in ΔCORT changes with size differs by colony and quadratically with body size.
BC19	Size + sex + colony + size:sex + $size^2$	The pattern in ΔCORT changes with size differs by sex and quadratically with body size. In addition the colonies have different levels of CORT change.
BC20	Size + sex + colony + size:colony + $size^2$	The pattern in ΔCORT changes with size differs by colony and quadratically with body size. In addition the sexes have different levels of CORT change.
BC21	Size + colony + $size^2$:colony + $size^2$	The pattern in ΔCORT changes quadratically with body size, but differently b/w colonies.
BC22	Size + sex + colony + $size^2$:sex + $size^2$	The pattern in ΔCORT changes with size differs by sex and quadratically with body size, however the non-linear relationship between ΔCORT and size is different b/w sexes. In addition the colonies have different levels of CORT change.
BC23	Size + sex + colony + $size^2$:colony + $size^2$	The pattern in ΔCORT changes with size differs by colony and quadratically with body size. The non-linear relationship between ΔCORT and size is different between colonies. In addition the sexes have different levels of CORT change.

Model	**Terms**		**Biological Meaning**		
MODEL	df	AIC	K	AICc	ΔAICc
BC13	6	605.3698	3	605.6198	0
BC14	7	605.739	4	606.1601	0.540253
BC15	7	607.072	4	607.4931	1.873253
BC21	8	607.5057	5	608.144	2.524198
BC16	8	607.5071	5	608.1454	2.525598
BC18	8	607.6451	5	608.2834	2.663598
BC17	8	608.5054	5	609.1437	3.523898
BC0	4	609.4873	1	609.5281	3.908316
BC19	9	608.714	6	609.6172	3.997426
BC22	8	609.0002	5	609.6385	4.018698
BC23	9	609.2694	6	610.1726	4.552826
BC20	9	609.4406	6	610.3438	4.724026
BC9	7	610.5444	4	610.9655	5.345653
BC2	5	610.8835	2	611.0072	5.387411
BC1	5	610.9323	2	611.056	5.436211
BC3	5	611.1791	2	611.3028	5.683011
BC5	6	612.0929	3	612.3429	6.7231
BC4	6	612.2765	3	612.5265	6.9067
BC8	7	612.5338	4	612.9549	7.335053
BC6	6	612.7933	3	613.0433	7.4235
BC11	8	612.4136	5	613.0519	7.432098
BC10	8	613.056	5	613.6943	8.074498
BC7	7	613.777	4	614.1981	8.578253

Supplement 3. Examples of tri-dimensional tracking of thick-billed murres breeding at St. Paul and St. George Islands. Color tracks show daytime (yellow) and overnight (purple–slope and pink–shelf) foraging trips. Dots along the track indicate flying or resting positions and vertical lines indicate dives.