

The following supplements accompany the article

Combining stable isotope analyses and geolocation to reveal kittiwake migration

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Supplement 1. Pictures of black-legged kittiwakes *Rissa tridactyla* showing different moulting stages depending on the month and location.



Fig. S1. *Rissa tridactyla*. Kittiwake moulting the first 5 primary feathers (P1–P5). Picture taken off Spitsbergen, Svalbard (Norway) on 30 July 2007. In: www.flickr.com/photos/zenobiarouse/1091734462/in/set-72157601233154816/



Fig. S2. *Rissa tridactyla*. Two Kittiwakes: note that the adult (on the left) is molting the 6th and 7th primary feathers (P6 and P7). Picture taken off Spitsbergen, Svalbard (Norway) on August 2008. In: www.flickr.com/photos/77762547@N00/2875808397



Fig. S3. *Rissa tridactyla*. Kittiwake molting the first 2 primaries (P1 and P2). Picture taken off Spitsbergen, Svalbard (Norway) on August 2008. In: www.flickr.com/photos/marthaenpiet/2876638918



Fig. S4. *Rissa tridactyla* . Kittiwake moulting the 10th primary (P10). Picture taken off Farmoor, Oxon (UK) on November 2007. In: www.flickr.com/photos/36384356@N00/1988212297/



Fig. S5. *Rissa tridactyla*. Kittiwake moulting the outermost primaries. Picture taken off Belmar, New Jersey (USA) on 13 December 2003. In:

http://www.paulagics.com/site/index.php?option=com_joomgallery&func=detail&id=52&Itemid=91



Fig. S6. *Rissa tridactyla*. Kittiwake with completed primary moult. Picture taken off Belmar, New Jersey (USA) on 13 December 2003. In:

http://www.paulagics.com/site/index.php?option=com_joomgallery&func=detail&id=54&Itemid=91-joomimg

Supplement 2. Stable isotope ratios of invertebrates, fish and seabirds in Norwegian, Barents and Labrador seas.

Table S1. Mean \pm SD of carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotope signatures of invertebrates, fish and seabirds from bibliography and/or this study. Highlight colours: Barent sea at white, Norwegian sea at light grey, and Labrador sea at dark grey. ^aLipid extraction not specified; ^bMean of stable isotope signatures of hatching-year and after-hatching year; ^cTotal length; ^dFork length; ^eWing length

8	Species	Specific locations	Date of sampling	n	Tissue (n)	Size and sex	$\delta^{15}\text{N}$ (‰)	$\delta^{13}\text{C}$ (‰)	Data source
Invertebrates									
Barents Sea	<i>Calanus glacialis</i>	E Svalbard (75°40.5'N, 30°15.4'E)	10 Jul 2003	3	Copepod without lipids	Stage V	10.0 \pm 1.3	-20.3 \pm 0.4	Tamelander et al. 2006
		E Svalbard (79°2.1'N, 25°51.8'E)	16 Jul 2003	3	Copepod without lipids	Stage V	8.9 \pm 0.2	-20.9 \pm 0.3	Tamelander et al. 2006
		E Svalbard (79°2.1'N, 25°51.8'E)	16 Jul 2003	3	Copepod without lipids	Adult females	9.1 \pm 0.1	-21.1 \pm 0.2	Tamelander et al. 2006
		NE Svalbard (82°0.27'N, 33°14'E)	15–28 Sep 1999	6	Whole copepod	Stage V and VI (females)	7.4 \pm 0.7	-21.2 \pm 0.7	Soreide et al. 2006
Labrador Sea		W Greenland (69–69°3'N, 52–55°W)	May–Jun 2005	4	Copepod without lipids	3.5–3.6 mm ^c	9.2 \pm 0.1	-19.2 \pm 0.6	Moller 2006
Barents Sea	<i>Calanus hyperboreus</i>	E Svalbard (75°40.5'N, 30°15.4'E)	10 Jul 2003	3	Copepod without lipids	Stage V	9.0 \pm 0.2	-19.2 \pm 0.2	Tamelander et al. 2006
		E Svalbard (78°14.8'N, 27°1.3'E)	14 Jul 2003	3	Copepod without lipids	Stage V	9.1 \pm 0.1	-20.4 \pm 0.2	Tamelander et al. 2006

		E Svalbard (78°14.8'N, 27°1.3'E)	14 Jul 2003	3	Copepod without lipids	Adult females	9.0 ± 0.2	-20.7 ± 0.1	Tamelander et al. 2006
		E Svalbard (79°2.1'N, 25°51.8'E)	16 Jul 2003	3	Copepod without lipids	Adult females	8.9 ± 0.3	-20.2 ± 0.3	Tamelander et al. 2006
		NE Svalbard (82°0.27'N, 33°14'E)	15–28 Sep 1999	6	Whole copepod	Stage V and VI (females)	8.9 ± 0.5	-24.0 ± 0.2	Soreide et al. 2006
Labrador Sea		W Greenland (69–69°3'N, 52–55°W)	Apr–May 2005	10	Copepod without lipids	10.0–10.6 mm ^c	8.4 ± 0.3	-19.4 ± 0.7	Moller 2006
Fish									
Norwegian Sea	Atlantic cod <i>Gadus morhua</i>	Sæterøya, Norway (open sea)	1995	3	Muscle with lipids		12.36 ± 1.89	-19.22 ± 0.42	Fredriksen 2003
Barents Sea	Atlantic cod <i>Gadus morhua</i>	SE Svalbard (77°3.2'N, 28°19.1'E)	July 2003	5	Muscle without lipids	13.0–14.9 cm ^d	14.8 ± 0.3	-20.1 ± 0.2	Tamelander et al. 2006
		S Svalbard (Bjørnøya)	Jun 1995	4	Muscle without lipids	Juvenile, 11.7–26.2 cm ^d	12.6 ± 1.2		Hop et al. 2002
Labrador Sea	Atlantic cod <i>Gadus morhua</i>	NE Newfoundland offshore	Aug 1995	10	Muscle without lipids	27.8 ± 10.8 cm ^d	13.9 ± 0.57	-19.0 ± 0.44	Lawson & Hobson 2000
		Newfoundland nearshore	1990	2	Muscle without lipids		15.1 ± 0.1		Hobson & Montevecchi 1991
		Offshore and coastal waters W Greenland (62–69°N, 50–58°W)	July–Sep 2003	13	Muscle without lipids	26–46 cm ^c	13.1 ± 0.6	-18.1 ± 0.3	Moller 2006

		Newfoundland and Labrador continental shelf	Jan and Jun 2002	155	Muscle with lipids	15–96 _c cm	14.3 ± 0.6	–19.0 ± 0.5	Sherwood & Rose 2005
Barents Sea	Capelin <i>Mallotus villosus</i>	SE Svalbard (77°3.2'N, 28°19.1'E)	July 2003	6	Muscle without lipids	14.6–16.9 _d cm	13.3 ± 0.4	–20.1 ± 0.3	Tamelander et al. 2006
		Kongsforden, W Svalbard (79°N, 12–13°E)	2005–2006	6	Muscle without lipids	12.6–15.1 _c cm	12.8 ± 0.7		Jaeger et al. 2009
Labrador Sea	Capelin <i>Mallotus villosus</i>	Fortune Bay, Newfoundland	1984–1985	4	Muscle ^a		13.1 ± 0.	–21.5 ± 0.4	Dickson 1986
		Newfoundland nearshore	1990	4	Muscle without lipids		13.0 ± 0.6		Hobson & Montevecchi 1991
		E Newfoundland nearshore	2004	4	Muscle without lipids		13.2 ± 0.3	–19.7 ± 0.1	Moody & Hobson 2007
		Newfoundland nearshore	1986–1990	11	Muscle ^a		12.2 ± 0.8	–21.4 ± 0.5	Ostrom et al. 1993
		Offshore and coastal waters W Greenland (62–69°N, 50–58°W)	July 2003	12	Muscle without lipids	13–16 _c cm	11.6 ± 1.2	–19.0 ± 0.6	Moller 2006
		Newfoundland and Labrador continental shelf	Jan and Jun 2002	21	Muscle with lipids	7–18 cm ^c	12.2 ± 0.4	–21.0 ± 0.5	Sherwood & Rose 2005

Barents Sea	Herring <i>Clupea harengus</i>	Kongsforden, W Svalbard (79°N, 12–13°E)	2005– 2006	4	Muscle without lipids	8.3–12.0 cm ^c	14.2 ± 2.0		Jaeger et al. 2009
Labrador Sea	Herring <i>Clupea harengus</i>	E Newfoundland nearshore	Aug 1995	3	Muscle without lipids	28.4 ± 3.11 cm ^d	13.8 ± 0.68	–19.9 ± 0.14	Lawson & Hobson 2000
		E Newfoundland nearshore	Apr 1991– Nov 1993	33	Muscle ^a		13.0 ± 0.3	–20.3 ± 0.5	Hobson et al. 1996
		Newfoundland and Labrador continental shelf	Jan and Jun 2002	5	Muscle with lipids	15–22 cm ^c	12.4 ± 0.3	–21.4 ± 0.8	Sherwood & Rose 2005
Barents Sea	Polar cod <i>Boreogadus saida</i>	Kongsforden, W Svalbard (79°N, 12–13°E)	2005– 2006	5	Muscle without lipids	17.7–20.4 cm ^c	13.5 ± 0.9		Jaeger et al. 2009
		Barents Sea marginal ice zone	Jun 1995	10	Muscle without lipids	Juvenile, 12.0–14.5 cm ^d	13.0 ± 0.9		Hop et al. 2002
		Barents Sea marginal ice zone	Summer 1995	4	Muscle without lipids	Not measured	12.2 ± 0.8	–20.8 ± 0.4	Søreide et al. 2006
Labrador Sea	Polar cod <i>Boreogadus saida</i>	NE Newfoundland offshore	Nov 1995	10	Muscle without lipids	18.1 ± 4.17 cm ^d	13.7 ± 0.43	–18.8 ± 0.29	Lawson & Hobson 2000
		Newfoundland nearshore	1998	8	Muscle ^a		14.0 ± 0.2	–19.3 ± 0.1	Hobson et al. 2002
		Offshore and coastal waters W Greenland (62–69°N, 50–58°W)	Aug–Sep 2003	9	Muscle without lipids	12–15 cm ^c	13.7 ± 0.5	–18.9 ± 0.4	Moller 2006

		Offshore and coastal waters W Greenland (62–69°N, 50–58°W)	Aug–Sep 2003	12	Muscle without lipids	8–10 cm ^c	12.3 ± 0.7	–18.8 ± 0.3	Moller 2006
		Newfoundland and Labrador continental shelf	Jan and Jun 2002	10	Muscle with lipids	7–27 cm ^c	13.5 ± 1.1	–19.9 ± 0.4	Sherwood & Rose 2005
Birds									
Norwegian Sea	Common Eider <i>Somateria mollissima</i>	Sæterøya, Norway (open sea)	1995	5	Muscle with lipids (5)		10.54 ± 1.04	–18.22 ± 1.60	Fredriksen 2003
Barents Sea	Common Eider <i>Somateria mollissima</i>	Kongsfjorden, W Svalbard	1997	5	Muscle without lipids		11.3 ± 0.6	–18.7 ± 0.6	Dahl et al. 2003
Labrador Sea	Common Eider <i>Somateria mollissima</i>	Nuuk fjord area (64–65°N, 50–52°W)	Jan 2004	32	Muscle without lipids	1.48–2.16 kg	11.4 ± 0.6	–17.3 ± 0.8	Moller 2006
Barents Sea	Little Auk <i>Alle alle</i>	W Svalbard (77–19°N, 11–15°E)	2007	73	Whole blood without lipids	Breeding adults	10.7 ± 0.4	–20.1 ± 0.2	Fort et al. 2010
		Kongsfjorden, W Svalbard (79°N, 12–13°E)	2005–2006	11	Muscle without lipids	0.117–0.198 kg; 11.3–12.9 cm ^e	11.2 ± 0.3		Jaeger et al. 2009
Labrador Sea	Little Auk <i>Alle alle</i>	E Greenland (70° 43'N, 21°38'W)	2007	20	Whole blood without lipids	Breeding adults	11.4 ± 0.1	–21.7 ± 0.1	Fort et al. 2010

		Nuuk fjord area (64–65°N, 50–52°W)	Mar 2003	19	Muscle without lipids	0.15–0.22 kg	11.7 ± 0.4	–19.5 ± 0.3	Moller 2006
Barents Sea	Brünnich's Guillemot <i>Uria lomvia</i>	Kongsfjorden, W Svalbard (79°N, 12–13°E)	2005– 2006	10	Muscle without lipids	0.911– 1.116 kg; 21.9–23.4 cm ^e	12.7 ± 0.6		Jaeger et al. 2009
		Barents Sea marginal ice zone	Jun 1995	10	Muscle without lipids	3 males, 7 females; 0.851– 1.061 kg	11.8 ± 0.6		Hop et al. 2002
Labrador Sea	Brünnich's Guillemot <i>Uria lomvia</i>	E Newfoundland nearshore	1996– 2004	89	Muscle without lipids		14.8 ± 0.1 _b	–19.8 ± 0.1 _b	Moody & Hobson 2007
		Sta. Maria Bay, Newfoundland	Feb 2008	13	Muscle without lipids	Adults	13.74 ± 0.6	–20.00 ± 0.3	McFarlane Tranquilla et al. 2010
		Nuuk fjord area (64–65°N, 50–52°W)	Nov 2003	12	Muscle without lipids	0.85–1.03 kg	12.0 ± 0.5	–19.3 ± 0.4	Moller 2006
Norwegian Sea	Kittiwake <i>Rissa tridactyla</i>	Hornøya	2009	6	Feather(P1) Geolocators		14.7 ± 0.62	–18.85 ± 0.49	This study
Barents Sea	Kittiwake <i>Rissa tridactyla</i>	Kongsfjorden, W Svalbard	1997	5	Muscle without lipids		12.1 ± 0.6	–20.5 ± 0.8	Dahl et al. 2003
		Kongsfjorden, W Svalbard (79°N, 12–13°E)	2005– 2006	10	Muscle without lipids	0.330– 0.484 kg; 31.6–33.8 cm ^e	13.4 ± 0.6		Jaeger et al. 2009
		S Svalbard (Bjørnøya)	Jun 1995	11	Muscle without lipids	2 males, 9 females; 0.370– 0.460 kg	12.7 ± 0.7		Hop et al. 2002

		Barents Sea	2009	6	Feather (P7) Geolocators		13.68 ± 0.28	-20.63 ± 0.74	This study
		Barents Sea	2008	12	Feather (P7) Cadavers		14.45 ± 0.49	-20.23 ± 0.58	This study
Labrador Sea	Kittiwake <i>Rissa tridactyla</i>	Nuuk fjord area (64–65°N, 50–52°W)	Sep 2003	12	Muscle without lipids	0.33–0.45 kg	12.1 ± 0.8	-19.5 ± 0.4	Moller 2006
		Labrador Sea	2008	12	Feather (P10) Cadavers		14.89 ± 0.56	-19.08 ± 0.55	This study

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