The following supplements accompany the article

Climate affects seabird population dynamics both via reproduction and adult survival

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Marine Ecology Progress Series 454:273–284 (2012)

Supplement 1. This supplement provides information about the location (Fig. S1), length, nature and source (Table S1) of the studies used in the analyses

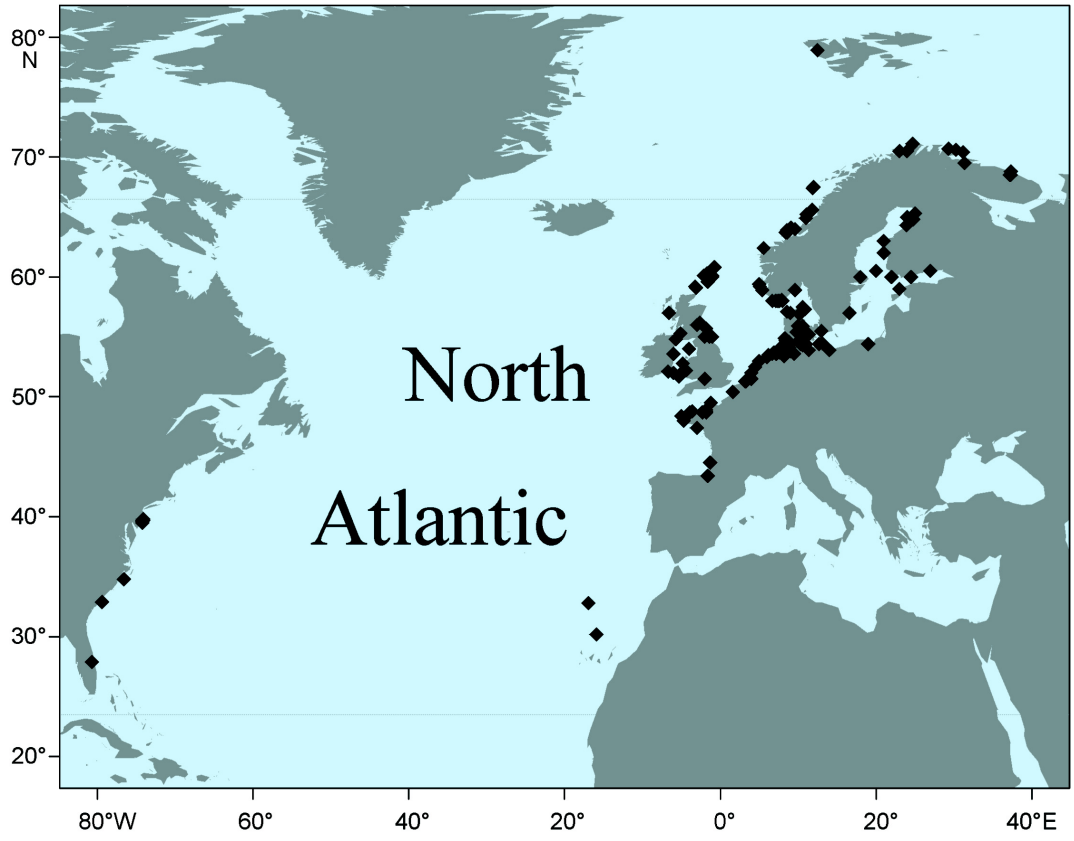

Fig. S1. Study sites (◆) in the North Atlantic

Table S1. Studies used in the analyses, with information on the species, location (name, country, latitude and longitude), years covered, total number of years with data (N, excluding missing values), types of count and reference. Studies are sorted alphabetically by higher taxon and species, then numerically by increasing latitude. Negative longitudes indicate degrees west of Greenwich. Types of counts, as inferred from the methods in the sources cited, are coded as 1 (rough guesstimate), 2 (estimate based on a proxy), 3 (estimate without standardised methodology), 4 (extrapolation based on a small sample plot), 5 (uncorrected estimate based on a single count), 6 (estimate based on a single count corrected for later information), 7 (maximum of several counts), 8 (mean of several counts), or 9 (individually surveyed nesting sites)

Species	Location	Country	Lat.	Long.	Years	N	Type	Reference
Alcinae								
Alca torda	Cap Fréhel	France	48.7	–2.3	1967–2000	30	5	Monnat (2004)
Alca torda	Wales	UK	52.0	–5.0	1986–2001	16	5	Mavor et al. (2002)
Alca torda	Costa Head	UK	59.2	–3.2	1976–1988	13	4	Thompson & Walsh (2000)
Cepphus grylle	Nord-Rønner	Denmark	57.3	10.9	1961–1984	19	3	Asbirk (1976, 1988a)
Cepphus grylle	Hirsholme	Denmark	57.5	10.6	1971–1987	17	3	Asbirk (1978, 1988a)
Cepphus grylle	Sumburgh	UK	59.9	–1.3	1976–1999	24	8	Heubeck (2000)
Cepphus grylle	Troswick Ness	UK	60.0	–1.3	1976–1999	24	8	Heubeck (2000)
Cepphus grylle	Noss	UK	60.1	–1.0	1984–1998	14	5	Heubeck (2000)
Cepphus grylle	Eshaness	UK	60.3	–1.7	1976–1999	24	8	Heubeck (2000)
Cepphus grylle	Burravoe	UK	60.8	–0.7	1976–1999	22	8	Heubeck (2000)
Cepphus grylle	Bol'shoi Ainov	Russia	69.5	31.4	1961–1989	29	3	Krasnov et al. (1995)
Fratercula arctica	Morlaix	France	48.7	–3.9	1978–2000	23	5	Siorat (2004b)
Fratercula arctica	Rouzic	France	48.8	–3.6	1959–2000	37	3	Pénicaud (1979); Siorat (2004b)
Fratercula arctica	May	UK	56.2	–2.6	1973–1996	24	5	Harris et al. (1997)
Fratercula arctica	Fair Isle	UK	59.6	–1.6	1972–1989	17	5	Harris (1984); Lloyd et al. (1991)
Fratercula arctica	Runde	Norway	62.4	5.6	1989–2004	16	5	Lorentsen (2006)
Fratercula arctica	Sklinna	Norway	65.2	11.1	1981–2004	24	6	Lorentsen (2006)
Fratercula arctica	Røst	Norway	67.4	11.9	1983–2004	22	5	Anker-Nilssen & Røstad (1993); Lorentsen (2006)
Fratercula arctica	Bol'shoi Ainov	Russia	69.5	31.4	1957–1989	33	3	Krasnov et al. (1995)
Fratercula arctica	Hornøya	Norway	70.4	31.2	1981–2000	17	4	Barrett (2001)
Uria aalge	Cap Sizun	France	48.0	–4.7	1965–2000	35	8	Monnat et al. (2004)
Uria aalge	Cap Fréhel	France	48.7	–2.3	1970–2000	25	8	Monnat et al. (2004)
Uria aalge	Rouzic	France	48.8	–3.6	1959–2000	33	3	Pénicaud (1979); Monnat et al. (2004)

Uria aalge	Skomer	UK	51.7	–5.3	1970–1988	19	8	Harris (1991); Hatchwell & Birkhead (1991)
Uria aalge	Farne	UK	55.7	–1.8	1971–1988	18	5	Harris (1991)
Uria aalge	May	UK	56.2	–2.6	1978–1998	21	8	Rothery et al. (1988); Wanless & Kinnear (1988); Harris & Wanless (1995); Rindorf et al. (2000)
Uria aalge	Canna	UK	57.0	–6.6	1974–1996	23	9	Swann (2000)
Uria aalge	Costa Head	UK	59.2	–3.2	1976–1988	13	4	Thompson & Walsh (2000)
Uria aalge	Sumburgh	UK	59.9	–1.3	1977–1988	12	5	Harris (1991)
Uria aalge	Hermaness	UK	60.8	–0.8	1976–1988	13	5	Harris (1991)
Uria aalge	Runde	Norway	62.4	5.6	1988–2004	17	6	Anker-Nilssen et al. (1996); Lorentsen (2006)
Uria aalge	Vedøy	Norway	67.5	12.0	1980–2004	23	6	Lorentsen (2006)
Uria aalge	Kharlov	Russia	68.8	37.3	1958–1994	35	5	Krasnov & Barrett (2006)
Uria aalge	Hornøya	Norway	70.4	31.2	1980–2000	19	8	Barrett (2001)
Uria aalge	Hjelmsøy	Norway	71.1	24.7	1984–2004	21	6	Lorentsen (2006)
Uria lomvia	Kharlov	Russia	68.5	37.2	1958–1993	34	5	Krasnov et al. (1995)
Uria lomvia	Hjelmsøy	Norway	71.1	24.7	1984–2004	21	6	Lorentsen (2006)
Uria lomvia	Ossian Sars	Svalbard	78.9	12.5	1990–2001	12	5	Lorentsen (2002)
Hydrobatinae								
Hydrobates pelagicus	Biarritz	France	43.4	–1.6	1973–2000	27	5	Hémery et al. (1986); Cadiou (2004)
Larinae								
Larus argentatus	Rouzic	France	48.8	–3.6	1959–1978	17	3	Pénicaud (1979)
Larus argentatus	Zeebrugge	Belgium	51.3	3.2	1986–2001	16	5	Stienen et al. (2002)
Larus argentatus	Zwin	Belgium	51.3	3.3	1986–1999	13	5	Stienen et al. (2002)
Larus argentatus	Deltagebied	Netherlands	51.5	4.0	1928–1996	69	4	Spaans (1998b)
Larus argentatus	Holland	Netherlands	52.5	4.5	1930–1996	67	4	Spaans (1998b)
Larus argentatus	Bardsey	UK	52.8	–4.8	1953–1967	15	3	Harris (1970)
Larus argentatus	Waddenzee	Netherlands	53.3	6.0	1928–1996	69	4	Spaans (1998b)
Larus argentatus	Borkum	Germany	53.6	6.7	1949–1990	37	3	Behm-Berkelmann et al. (1991)
Larus argentatus	Wilhelmshaven	Germany	53.6	8.2	1948–1972	24	5	Behm-Berkelmann et al. (1991)
Larus argentatus	Asseler Sand	Germany	53.6	9.5	1978–1990	13	3	Behm-Berkelmann et al. (1991)
Larus argentatus	Memmert	Germany	53.7	6.9	1928–1996	69	1	Behm-Berkelmann et al. (1991); Südbeck et al. (1998)
Larus argentatus	Juist	Germany	53.7	7.0	1948–1990	41	3	Behm-Berkelmann et al. (1991)
Larus argentatus	Norderney	Germany	53.7	7.2	1953–1990	38	5	Behm-Berkelmann et al. (1991)
Larus argentatus	Baltrum	Germany	53.7	7.4	1972–1999	28	3	Thiessen (1986); Behm-Berkelmann et al. (1991)

Larus argentatus	Langeoog	Germany	53.7	7.6	1948–1990	43	1	Behm-Berkelmann et al. (1991)
Larus argentatus	Mellum	Germany	53.7	8.2	1928–1996	67	1	Behm-Berkelmann et al. (1991); Südbeck et al. (1998)
Larus argentatus	Spiekeroog	Germany	53.8	7.7	1945–1990	41	3	Behm-Berkelmann et al. (1991)
Larus argentatus	Knechtsand	Germany	53.8	8.4	1967–1990	24	5	Behm-Berkelmann et al. (1991)
Larus argentatus	Hullen	Germany	53.8	9.0	1970–1990	21	5	Behm-Berkelmann et al. (1991)
Larus argentatus	Nordkehdingen	Germany	53.8	9.2	1971–1990	20	5	Behm-Berkelmann et al. (1991)
Larus argentatus	Scharhörn	Germany	54.0	8.4	1935–1997	56	1	Behm-Berkelmann et al. (1991); Südbeck et al. (1998)
Larus argentatus	Trischen	Germany	54.1	8.7	1948–1999	52	3	Garthe et al. (2000)
Larus argentatus	Katinger Watt	Germany	54.3	8.8	1971–1983	13	3	Thiessen (1986)
Larus argentatus	Kirr	Germany	54.4	12.7	1972–1997	26	3	Spretke (1998)
Larus argentatus	Norderoog	Germany	54.5	8.5	1969–1980	12	3	Thiessen (1986)
Larus argentatus	Süderoog	Germany	54.5	8.5	1971–1983	13	3	Thiessen (1986)
Larus argentatus	Südfall	Germany	54.5	8.7	1969–1980	12	3	Thiessen (1986)
Larus argentatus	Hamburger Hallig	Germany	54.6	8.8	1971–1983	13	3	Thiessen (1986)
Larus argentatus	Oehe-Schleimünde	Germany	54.6	10.0	1969–1983	14	5	Thiessen (1986)
Larus argentatus	Amrum-Odde	Germany	54.7	8.4	1965–1994	28	5	Hälterlein & Südbeck (1996)
Larus argentatus	Foteviken	Sweden	55.5	13.0	1954–1977	23	3	Mathiasson (1980)
Larus argentatus	Nord-Rønner	Denmark	57.3	10.9	1961–1976	13	3	Møller (1978)
Larus argentatus	Hirsholme	Denmark	57.5	10.6	1930–1975	30	5	Møller (1978)
Larus argentatus	Rauna	Norway	58.0	6.7	1988–2004	17	3	Lorentsen (2006)
Larus argentatus	Agneskjær	Norway	58.0	7.1	1989–2004	16	5	Lorentsen (2006)
Larus argentatus	Lille Slettingen	Norway	58.0	7.5	1992–2004	12	5	Lorentsen (2006)
Larus argentatus	Nordreskjær	Norway	58.0	7.6	1987–2004	17	5	Lorentsen (2006)
Larus argentatus	Telemark	Norway	58.9	9.6	1974–2004	31	6	Lorentsen (2006)
Larus argentatus	Sem' Ostrovov	Russia	68.5	37.3	1980–1992	13	5	Krasnov et al. (1995)
Larus canus	Merlimont	France	50.4	1.6	1975–1995	21	9	Sueur (2004)
Larus canus	Zwin	Belgium	51.3	3.3	1980–1994	15	5	Seys et al. (1998)
Larus canus	Deltagebied	Netherlands	51.5	4.0	1960–1996	37	4	Keijl & Aarts (1998)
Larus canus	Holland	Netherlands	52.5	4.5	1960–1996	37	4	Keijl & Aarts (1998)
Larus canus	Waddenzee	Netherlands	53.3	6.0	1960–1996	37	4	Keijl & Aarts (1998)
Larus canus	Borkum	Germany	53.6	6.7	1948–1988	38	1	Behm-Berkelmann et al. (1991)
Larus canus	Asseler Sand	Germany	53.6	9.5	1977–1990	14	5	Behm-Berkelmann et al. (1991)

Larus canus	Memmert	Germany	53.7	6.9	1928–1990	61	5	Behm-Berkelmann et al. (1991)
Larus canus	Juist	Germany	53.7	7.0	1960–1990	31	5	Behm-Berkelmann et al. (1991)
Larus canus	Norderney	Germany	53.7	7.2	1952–1990	39	1	Behm-Berkelmann et al. (1991)
Larus canus	Mellum	Germany	53.7	8.2	1928–1990	60	5	Behm-Berkelmann et al. (1991)
Larus canus	Spiekeroog	Germany	53.8	7.7	1948–1990	43	3	Behm-Berkelmann et al. (1991)
Larus canus	Wangerooge	Germany	53.8	7.9	1975–1989	15	5	Behm-Berkelmann et al. (1991)
Larus canus	Hullen	Germany	53.8	9.0	1946–1990	44	5	Behm-Berkelmann et al. (1991)
Larus canus	Nordkehdingen	Germany	53.8	9.2	1973–1990	18	5	Behm-Berkelmann et al. (1991)
Larus canus	Oehe-Schleimünde	Germany	54.6	10.0	1926–1996	65	2	Thiessen (1986); Südbeck et al. (1998)
Larus canus	Hirsholme	Denmark	57.5	10.6	1935–1974	26	1	Møller (1978)
Larus canus	Grønningen	Norway	58.0	8.0	1989–2004	16	5	Lorentsen (2006)
Larus canus	Telemark	Norway	58.9	9.6	1974–2004	31	6	Lorentsen (2006)
Larus canus	Sem' Ostrovov	Russia	68.5	37.3	1975–1993	19	5	Krasnov et al. (1995)
Larus canus	Bol'shoi Ainov	Russia	69.5	31.4	1962–1989	28	3	Krasnov et al. (1995)
Larus fuscus	Rouzic	France	48.8	–3.6	1959–1978	17	9	Pénicaud (1979)
Larus fuscus	Zwin	Belgium	51.3	3.3	1985–2000	15	5	Stienen et al. (2002)
Larus fuscus	Deltagebied	Netherlands	51.5	4.0	1970–1995	26	4	Spaans (1998a)
Larus fuscus	Skomer	UK	51.7	–5.3	1980–1998	19	4	Perrins & Smith (2000)
Larus fuscus	Holland	Netherlands	52.5	4.5	1977–1996	20	4	Spaans (1998a)
Larus fuscus	Waddenzee	Netherlands	53.3	6.0	1970–1996	27	4	Spaans (1998a)
Larus fuscus	Memmert	Germany	53.7	6.9	1928–1990	62	3	Behm-Berkelmann et al. (1991)
Larus fuscus	Norderney	Germany	53.7	7.2	1979–1990	12	5	Behm-Berkelmann et al. (1991)
Larus fuscus	Baltrum	Germany	53.7	7.4	1981–1999	19	5	Thiessen (1986); Behm-Berkelmann et al. (1991)
Larus fuscus	Langeoog	Germany	53.7	7.6	1978–1990	13	5	Behm-Berkelmann et al. (1991)
Larus fuscus	Mellum	Germany	53.7	8.2	1974–1990	17	3	Behm-Berkelmann et al. (1991)
Larus fuscus	Spiekeroog	Germany	53.8	7.7	1976–1990	14	5	Behm-Berkelmann et al. (1991)
Larus fuscus	Trischen	Germany	54.1	8.7	1982–1999	18	3	Garthe et al. (2000)
Larus fuscus	Amrum-Odde	Germany	54.7	8.4	1975–1994	20	5	Hälterlein & Südbeck (1996)
Larus fuscus	Rauna	Norway	58.0	6.7	1988–2004	17	6	Lorentsen (2006)
Larus fuscus	Agneskjær	Norway	58.0	7.1	1989–2004	16	6	Lorentsen (2006)
Larus fuscus	Lille Slettingen	Norway	58.0	7.5	1989–2004	16	6	Lorentsen (2006)
Larus fuscus	Store Slettingen	Norway	58.0	7.5	1986–2004	19	6	Lorentsen (2006)

Larus fuscus	Kjellingø	Norway	58.0	7.6	1986–2004	19	6	Lorentsen (2006)
Larus fuscus	Nordreskjær	Norway	58.0	7.6	1986–2004	19	6	Lorentsen (2006)
Larus fuscus	Store Lyngholmen	Norway	58.1	7.9	1989–2004	16	6	Lorentsen (2006)
Larus fuscus	Telemark	Norway	58.9	9.6	1974–2004	31	6	Lorentsen (2006)
Larus fuscus	Krunnit	Finland	65.3	25.0	1948–1963	13	5	Helle et al. (1988)
Larus marinus	Banneg	France	48.4	–5.0	1981–2004	21	5	Cadiou & Yésou (2006)
Larus marinus	Rouzic	France	48.8	–3.6	1959–1978	17	9	Pénicaud (1979)
Larus marinus	Skokholm	UK	51.7	–5.3	1959–1985	26	5	Harris (1970); Sutcliffe (1986)
Larus marinus	Skomer	UK	51.7	–5.3	1960–1999	40	8	Perrins & Smith (2000)
Larus marinus	Knotterne	Denmark	55.9	10.6	1954–1976	21	5	Møller (1978)
Larus marinus	Nord-Rønner	Denmark	57.3	10.9	1961–1976	14	5	Møller (1978)
Larus marinus	Rauna	Norway	58.0	6.7	1984–2004	19	6	Lorentsen (2006)
Larus marinus	Agneskjær	Norway	58.0	7.1	1992–2004	13	6	Lorentsen (2006)
Larus marinus	Merra	Norway	58.0	7.3	1988–2004	17	6	Lorentsen (2006)
Larus marinus	Store Slettingen	Norway	58.0	7.5	1987–2000	12	6	Lorentsen (2002)
Larus marinus	Telemark	Norway	58.9	9.6	1974–2004	31	6	Lorentsen (2006)
Larus marinus	Sem' Ostrovov	Russia	68.5	37.3	1980–1992	13	5	Krasnov et al. (1995)
Larus marinus	Bol'shoi Ainov	Russia	69.5	31.4	1962–1989	28	3	Krasnov et al. (1995)
Larus minutus	Lauwersmeer	Netherlands	53.5	6.2	1971–1990	20	5	Koks (1998)
Larus minutus	Vejlerne	Denmark	57.0	9.0	1961–1976	16	7	Møller (1978)
Larus ridibundus	Zwin	Belgium	51.3	3.3	1971–1998	28	1	Seys et al. (1998)
Larus ridibundus	Jadebusen	Germany	53.4	8.2	1949–1965	17	5	Behm-Berkelmann et al. (1991)
Larus ridibundus	Borkum	Germany	53.6	6.7	1949–1990	37	1	Behm-Berkelmann et al. (1991)
Larus ridibundus	Leybucht	Germany	53.6	7.2	1954–1990	37	3	Behm-Berkelmann et al. (1991)
Larus ridibundus	Horumersiel	Germany	53.6	8.0	1975–1990	16	5	Behm-Berkelmann et al. (1991)
Larus ridibundus	Juist	Germany	53.7	7.0	1960–1990	31	3	Behm-Berkelmann et al. (1991)
Larus ridibundus	Norderney	Germany	53.7	7.2	1968–1990	22	3	Behm-Berkelmann et al. (1991)
Larus ridibundus	Baltrum	Germany	53.7	7.4	1972–1990	19	3	Behm-Berkelmann et al. (1991)
Larus ridibundus	Langeoog	Germany	53.7	7.6	1960–1990	31	5	Behm-Berkelmann et al. (1991)
Larus ridibundus	Spiekeroog	Germany	53.8	7.7	1966–1990	25	3	Behm-Berkelmann et al. (1991)
Larus ridibundus	Wangerooge	Germany	53.8	7.9	1948–1990	42	5	Behm-Berkelmann et al. (1991)
Larus ridibundus	Hullen	Germany	53.8	9.0	1946–1990	45	3	Behm-Berkelmann et al. (1991)

Larus ridibundus	Neuwerk	Germany	53.9	8.5	1974–1990	17	5	Behm-Berkelmann et al. (1991)
Larus ridibundus	Böhmke & Werder	Germany	53.9	14.0	1973–1999	27	3	Bellebaum (2002)
Larus ridibundus	Scharhörn	Germany	54.0	8.4	1972–1990	19	5	Behm-Berkelmann et al. (1991)
Larus ridibundus	Trischen	Germany	54.1	8.7	1948–1999	52	3	Thiessen (1986); Garthe et al. (2000)
Larus ridibundus	Helmsand	Germany	54.1	8.9	1966–1996	30	3	Thiessen (1986); Garthe et al. (2000)
Larus ridibundus	Katinger Watt	Germany	54.3	8.8	1971–1982	12	5	Thiessen (1986)
Larus ridibundus	Kirr	Germany	54.4	12.7	1983–1999	17	3	Bellebaum (2002)
Larus ridibundus	Norderoog	Germany	54.5	8.5	1969–1980	12	3	Thiessen (1986)
Larus ridibundus	Hamburger Hallig	Germany	54.6	8.8	1972–1983	12	3	Thiessen (1986)
Larus ridibundus	Oehe-Schleimünde	Germany	54.6	10.0	1970–1983	14	1	Thiessen (1986)
Larus ridibundus	Rantum-Becken	Germany	54.9	8.3	1969–1980	12	3	Thiessen (1986)
Larus ridibundus	Gamborg Fjord	Denmark	55.4	9.8	1946–1962	16	1	Møller (1978)
Larus ridibundus	Foteviken	Sweden	55.5	13.0	1954–1977	24	5	Mathiasson (1980)
Rissa tridactyla	Kergulan	France	48.0	–4.7	1957–1970	14	5	Monnat & Cadiou (2004)
Rissa tridactyla	Kergulan	France	48.0	–4.7	1979–2000	22	5	Monnat & Cadiou (2004)
Rissa tridactyla	Kerisit	France	48.0	–4.7	1979–2000	22	5	Monnat & Cadiou (2004)
Rissa tridactyla	Kermaden	France	48.0	–4.7	1979–2000	22	5	Monnat & Cadiou (2004)
Rissa tridactyla	Pointe du Raz	France	48.0	–4.7	1982–2000	19	5	Monnat & Cadiou (2004)
Rissa tridactyla	Rouzic	France	48.8	–3.6	1959–1978	17	9	Pénicaud (1979)
Rissa tridactyla	Wales	UK	52.0	–5.0	1986–2001	16	5	Mavor et al. (2002)
Rissa tridactyla	Helgoland	Germany	54.2	7.9	1956–1999	44	5	Fleet (1984); Garthe et al. (2000)
Rissa tridactyla	South Shields	UK	55.0	–1.4	1948–1984	37	9	Coulson & Thomas (1985); Porter & Coulson (1987)
Rissa tridactyla	May	UK	56.2	–2.6	1971–1998	27	8	Harris & Galbraith (1983); Wanless & Kinnear (1988); Rindorf et al. (2000)
Rissa tridactyla	Canna	UK	57.0	–6.6	1973–1999	27	9	Swann (2000)
Rissa tridactyla	Hanstholme	Denmark	57.1	8.6	1969–1984	16	5	Møller (1978); Asbirk (1988b)
Rissa tridactyla	Nord-Rønner	Denmark	57.3	10.9	1958–1984	25	5	Asbirk (1976); Møller (1978); Asbirk (1988b)
Rissa tridactyla	Hirsholme	Denmark	57.5	10.6	1941–1954	12	5	Møller (1978)
Rissa tridactyla	Costa Head	UK	59.2	–3.2	1976–1988	13	4	Thompson & Walsh (2000)
Rissa tridactyla	Fair Isle	UK	59.6	–1.6	1987–1999	13	8	Rothery et al. (2002)
Rissa tridactyla	Sklinna	Norway	65.2	11.1	1983–2004	22	5	Lorentsen (2006)
Rissa tridactyla	Vedøy	Norway	67.5	12.0	1988–2004	17	6	Lorentsen (2006)

Rissa tridactyla	Kharlov	Russia	68.8	37.3	1958–1994	37	5	Krasnov & Barrett (1995)
Rissa tridactyla	Hornøya	Norway	70.4	31.2	1980–2000	19	8	Barrett (2001)
Rissa tridactyla	Hjelmsøy	Norway	71.1	24.7	1991–2004	14	5	Lorentsen (2006)
Rissa tridactyla	Ossian Sars	Svalbard	78.9	12.5	1990–2001	12	5	Lorentsen (2002)
Pelecanus								
P. occidentalis	Florida	USA	27.9	–80.7	1970–1983	14	9	Wilkinson et al. (1994)
P. occidentalis	South Carolina	USA	32.9	–79.4	1970–1991	22	9	Wilkinson et al. (1994)
P. occidentalis	North Carolina	USA	34.8	–76.6	1972–1991	16	9	Wilkinson et al. (1994)
Phalacrocoracinae								
Phalacrocorax carbo	Landes	France	48.7	–1.8	1970–2000	26	5	Debout & Marion (2004)
P. carbo	Chausey	France	48.8	–1.8	1971–2000	30	5	Debout et al. (1995); Debout & Marion (2004)
P. carbo	St Marcouf	France	49.5	–1.2	1965–2000	31	5	Debout & Marion (2004)
P. carbo	Brændegård	Denmark	55.1	10.4	1973–1994	22	5	Bregnballe & Gregersen (1995)
P. carbo	Ormø	Denmark	55.2	11.4	1972–1994	23	5	Bregnballe & Gregersen (1995)
P. carbo	Vorsø	Denmark	55.9	10.0	1944–1994	51	5	Bregnballe & Gregersen (1995)
P. carbo	Craigleith	UK	56.0	–3.0	1969–1987	17	5	Lloyd et al. (1991)
P. carbo	Lamb	UK	56.0	–3.0	1970–1987	18	5	Lloyd et al. (1991)
P. carbo	SE Scotland	UK	56.0	–3.0	1986–2001	16	5	Mavor et al. (2002)
P. carbo	Toft Sø	Denmark	56.9	10.2	1982–1994	13	5	Bregnballe & Gregersen (1995)
P. carbo	Shetland	UK	60.0	–1.0	1986–2001	16	5	Mavor et al. (2002)
P. carbo	Sula	Norway	63.7	8.4	1986–2004	19	5	Lorentsen (2006)
P. carbo	Grogna	Norway	63.7	8.6	1986–2004	19	3	Lorentsen (2006)
P. carbo	Froan Sør	Norway	63.9	8.6	1986–2004	19	5	Lorentsen (2006)
P. carbo	Melstein	Norway	64.0	9.6	1986–2004	19	5	Lorentsen (2006)
P. carbo	Froan Nord	Norway	64.1	9.1	1986–2004	19	5	Lorentsen (2006)
P. carbo	Vikna	Norway	64.9	11.0	1985–2004	20	5	Lorentsen (2006)
P. carbo	Sklinna	Norway	65.2	11.1	1983–2004	21	5	Lorentsen (2006)
P. carbo	Vega	Norway	65.6	11.8	1987–2004	18	5	Lorentsen (2006)
P. carbo	Reinøykalven	Norway	70.5	24.0	1985–2004	19	5	Lorentsen (2006)
P. carbo	Stauren	Norway	70.5	24.0	1985–2004	19	5	Lorentsen (2006)
P. carbo	Store Kamøy	Norway	70.5	24.0	1991–2004	14	5	Lorentsen (2006)
P. carbo	Tarhalsen	Norway	70.5	24.0	1985–2004	19	5	Lorentsen (2006)
P. carbo	Kongsfjorden	Norway	70.7	29.3	1985–2002	18	5	Debout et al. (1995); Lorentsen (2002)

Stictocarbo aristotelis	Houat	France	47.4	–3.0	1980–1991	12	5	Monnat & Pasquet (2004)
S. aristotelis	Landes	France	48.7	–1.8	1977–2000	19	5	Monnat & Pasquet (2004)
S. aristotelis	Rouzic	France	48.8	–3.6	1959–1978	17	3	Pénicaud (1979)
S. aristotelis	Chausey	France	48.9	–1.8	1971–2000	29	5	Monnat & Pasquet (2004)
S. aristotelis	Farne	UK	55.7	–1.8	1949–1978	30	7	Potts et al. (1980)
S. aristotelis	May	UK	56.2	–2.6	1950–1998	41	9	Aebischer & Wanless (1992); Harris et al. (1994); Harris & Wanless (1996); Rindorf et al. (2000)
S. aristotelis	Canna	UK	57.0	–6.6	1974–1999	26	9	Swann (2000)
S. aristotelis	Kjørholmane	Norway	58.9	5.4	1979–1998	17	3	Lorentsen (2002)
S. aristotelis	Sklinna	Norway	65.2	11.1	1981–2004	24	6	Røv (1990); Lorentsen (2006)
S. aristotelis	Røst	Norway	67.4	11.9	1985–2004	20	5	Lorentsen (2006)
S. aristotelis	Sem' Ostrovov	Russia	68.5	37.3	1960–1979	19	5	Krasnov et al. (1995)
S. aristotelis	Lille Kamøy	Norway	70.5	23.0	1991–2004	13	6	Lorentsen (2006)
Procellariidae								
Calonectris diomedea	Selvagem Grande	Portugal	30.2	–15.9	1980–1998	17	9	Mougin et al. (2000)
Fulmarus glacialis	Rouzic	France	48.8	–3.6	1960–1978	16	9	Pénicaud (1979)
Fulmarus glacialis	Wales	UK	52.0	–5.0	1986–2001	16	5	Mavor et al. (2002)
Fulmarus glacialis	Great Saltee	Ireland	52.1	–6.7	1969–1980	12	5	Lloyd et al. (1991)
Fulmarus glacialis	NE England	UK	55.0	–2.0	1986–2001	16	5	Mavor et al. (2002)
Fulmarus glacialis	Craigleith	UK	56.0	–3.0	1969–1987	16	5	Lloyd et al. (1991)
Fulmarus glacialis	Canna	UK	57.0	–6.6	1973–1999	27	9	Swann (2000)
Fulmarus glacialis	Eynhallow	UK	59.1	–3.1	1957–1977	21	7	Dunnet et al. (1979)
Fulmarus glacialis	Costa Head	UK	59.2	–3.2	1976–1988	13	4	Thompson & Walsh (2000)
Fulmarus glacialis	Ferkingstadøyane	Norway	59.2	5.1	1973–1989	17	5	Folkedal et al. (1989)
Fulmarus glacialis	Urter	Norway	59.4	5.0	1975–1989	15	5	Folkedal et al. (1989)
Fulmarus glacialis	Shetland	UK	60.0	–1.0	1986–2001	16	5	Mavor et al. (2002)
Pterodroma madeira	Madeira	Portugal	32.8	–16.9	1986–2000	15	7	Zino et al. (2001)
Stercorariinae								
Stercorarius parasiticus	Fair Isle	UK	59.6	–1.6	1948–1962	15	9	O'Donald (1983)
S. parasiticus	Foula	UK	60.1	–2.1	1960–1994	30	8	Furness (1983, 1987); Phillips et al. (1996, 1998)
S. parasiticus	Sem' Ostrovov	Russia	68.5	37.3	1975–1993	19	5	Krasnov et al. (1995)
Sterninae								

Chlidonias niger	Krimpenerwaard	Netherlands	52.0	4.0	1978–1992	15	5	van der Winden et al. (1996)
Chlidonias niger	Öland	Sweden	57.0	16.6	1975–1988	12	3	Alexandersson (1983, 1991)
Sterna albifrons	Channel coast	UK	51.5	–2.0	1969–1998	30	4	Ratcliffe et al. (2000)
Sterna albifrons	Borkum	Germany	53.6	6.7	1948–1985	36	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Memmert	Germany	53.7	6.9	1928–1989	59	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Juist	Germany	53.7	7.0	1948–1990	41	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Norderney	Germany	53.7	7.2	1952–1990	39	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Langeoog	Germany	53.7	7.6	1947–1990	44	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Mellum	Germany	53.7	8.2	1928–1982	46	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Spiekeroog	Germany	53.8	7.7	1948–1990	40	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Wangerooge-West	Germany	53.8	7.9	1928–1990	60	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Wangerooge-Ost	Germany	53.8	7.9	1946–1966	21	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Minsener Oldeoog	Germany	53.8	8.0	1946–1990	45	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Knechtsand	Germany	53.8	8.4	1963–1983	20	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Neuwerk	Germany	53.9	8.5	1975–1990	16	5	Behm-Berkelmann et al. (1991)
Sterna albifrons	Irish Sea coast	UK	54.0	–4.0	1969–1998	30	4	Ratcliffe et al. (2000)
Sterna albifrons	Scharhörn	Germany	54.0	8.4	1947–1988	42	3	Behm-Berkelmann et al. (1991)
Sterna albifrons	Trischen	Germany	54.1	8.7	1924–1993	64	5	Hälterlein & Südbeck (1996)
Sterna albifrons	Kleiner Binnensee	Germany	54.3	10.6	1970–1983	13	5	Thiessen (1986)
Sterna albifrons	Bottsand	Germany	54.4	10.3	1969–1983	15	5	Thiessen (1986)
Sterna albifrons	Delta Wisły	Poland	54.4	19.0	1977–1988	12	5	Hongell (1989)
Sterna albifrons	Südfall	Germany	54.5	8.7	1971–1983	13	5	Thiessen (1986)
Sterna albifrons	Oehe-Schleimünde	Germany	54.6	10.0	1969–1983	14	5	Thiessen (1986)
Sterna albifrons	Amrum-Odde	Germany	54.7	8.4	1969–1983	15	5	Thiessen (1986)
Sterna albifrons	North Sea coast	UK	55.0	–1.0	1969–1998	30	4	Ratcliffe et al. (2000)
Sterna albifrons	Matsalu	Estonia	59.0	23.0	1958–1978	21	5	Mänd (1982)
Sterna albifrons	Kalajoki	Finland	64.3	23.9	1976–1989	14	9	Hongell (1989)
Sterna albifrons	Tauvo	Finland	64.8	24.8	1973–1989	14	3	Hongell (1989)
Sterna caspia	Sverige	Sweden	60.0	18.0	1984–1996	13	5	Hario & Stjernberg (1997)
Sterna caspia	Turun saaristo	Finland	60.0	22.0	1984–1996	13	5	Hario & Stjernberg (1997)
Sterna caspia	Suomenlahti Länsi	Finland	60.0	24.5	1984–1996	13	3	Hario & Stjernberg (1997)
Sterna caspia	Åland	Finland	60.5	20.0	1984–1996	13	3	Hario & Stjernberg (1997)

Sterna caspia	Itäinen Suomenlahti (colonial)	Finland	60.5	27.0	1984–1996	13	5	Hario & Stjernberg (1997)
Sterna caspia	Itäinen Suomenlahti (solitary)	Finland	60.5	27.0	1984–1996	13	3	Hario & Stjernberg (1997)
Sterna caspia	Selkämeri (colonial)	Finland	62.0	21.0	1984–1996	13	5	Hario & Stjernberg (1997)
Sterna caspia	Selkämeri (solitary)	Finland	62.0	21.0	1984–1996	13	3	Hario & Stjernberg (1997)
Sterna caspia	Merenkurkku (colonial)	Finland	63.0	21.0	1984–1996	13	5	Hario & Stjernberg (1997)
Sterna caspia	Merenkurkku (solitary)	Finland	63.0	21.0	1984–1996	13	3	Hario & Stjernberg (1997)
Sterna caspia	Perämeri	Finland	65.0	24.0	1984–1996	13	3	Hario & Stjernberg (1997)
Sterna caspia	Krunnit	Finland	65.3	25.0	1948–1963	13	5	Helle et al. (1988)
Sterna dougallii	Morlaix	France	48.7	–3.9	1987–2000	13	3	Cadiou & Thomas (2004)
Sterna dougallii	Lady's I	Ireland	52.0	–6.0	1986–2001	16	5	Thompson et al. (1996); Mavor et al. (2002)
Sterna dougallii	Anglesey	UK	52.2	–4.4	1986–2001	16	5	Thompson et al. (1996); Mavor et al. (2002)
Sterna dougallii	Rockabill	Ireland	53.6	–6.0	1986–2001	16	5	Thompson et al. (1996); Mavor et al. (2002)
Sterna dougallii	Larne Lough	Ireland	54.8	–5.7	1986–2001	16	5	Thompson et al. (1996); Mavor et al. (2002)
Sterna dougallii	Coquet	UK	55.3	–1.5	1986–2001	16	5	Thompson et al. (1996); Mavor et al. (2002)
Sterna dougallii	Farne	UK	55.7	–1.8	1986–2001	16	5	Thompson et al. (1996); Mavor et al. (2002)
Sterna dougallii	Firth of Forth	UK	56.0	–3.0	1990–2001	12	5	Mavor et al. (2002)
Sterna hirundo	Mordecai	USA	39.5	–74.2	1976–1987	12	3	Burger & Gochfeld (1991)
Sterna hirundo	East Ham	USA	39.6	–74.2	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	Egg	USA	39.6	–74.2	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	Little	USA	39.6	–74.2	1976–1988	13	3	Burger & Gochfeld (1991)
Sterna hirundo	SW Cedar Bonnet	USA	39.6	–74.2	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	West Ham	USA	39.6	–74.2	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	Cedar Creek	USA	39.7	–74.2	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	East Carvel	USA	39.7	–74.2	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	Log Creek	USA	39.7	–74.2	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	Pettit	USA	39.7	–74.2	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	East Vol	USA	39.7	–74.1	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	West Vol	USA	39.7	–74.1	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	Buster	USA	39.8	–74.1	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	High Bar	USA	39.8	–74.1	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	North Lavallette	USA	39.8	–74.1	1976–1990	15	3	Burger & Gochfeld (1991)

Sterna hirundo	NW Lavallette	USA	39.8	–74.1	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	South Lavallette	USA	39.8	–74.1	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	SW Lavallette	USA	39.8	–74.1	1976–1990	15	3	Burger & Gochfeld (1991)
Sterna hirundo	Deltagebied	Netherlands	51.5	4.0	1920–1994	75	3	Stienen & Brenninkmeijer (1998)
Sterna hirundo	IJsselmeer	Netherlands	53.0	5.0	1920–1994	75	3	Stienen & Brenninkmeijer (1998)
Sterna hirundo	Waddenzee	Netherlands	53.3	6.0	1920–1994	75	3	Stienen & Brenninkmeijer (1998)
Sterna hirundo	Banter See	Germany	53.5	8.1	1980–1998	19	9	Becker (1998); Wendeln et al. (2000)
Sterna hirundo	Borkum	Germany	53.6	6.7	1954–1985	30	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Leybucht	Germany	53.6	7.2	1956–1990	35	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Horumersiel	Germany	53.6	8.0	1970–1989	19	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Wilhelmshaven	Germany	53.6	8.2	1948–1964	17	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Memmert	Germany	53.7	6.9	1928–1990	60	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Juist	Germany	53.7	7.0	1948–1990	40	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Norderney	Germany	53.7	7.2	1953–1990	32	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Baltrum	Germany	53.7	7.4	1969–1990	22	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Langeoog	Germany	53.7	7.6	1948–1990	39	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Elisabeth-Außengroden	Germany	53.7	7.9	1970–1990	21	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Mellum	Germany	53.7	8.2	1928–1990	59	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Spiekeroog	Germany	53.8	7.7	1956–1990	34	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Wangerooge-West	Germany	53.8	7.9	1928–1990	60	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Wangerooge-Ostgroden	Germany	53.8	7.9	1946–1990	45	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Minsener Oldeoog	Germany	53.8	8.0	1946–1996	51	3	Behm-Berkelmann et al. (1991); Becker (1998)
Sterna hirundo	Wangerooge-Ostdüne	Germany	53.8	8.0	1980–1993	14	9	Becker (1998)
Sterna hirundo	Knechtsand	Germany	53.8	8.4	1960–1983	24	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Hullen	Germany	53.8	9.0	1946–1990	45	3	Behm-Berkelmann et al. (1991)
Sterna hirundo	Nordkehdingen	Germany	53.8	9.2	1979–1990	12	5	Behm-Berkelmann et al. (1991)
Sterna hirundo	Neuwerk	Germany	53.9	8.5	1970–1997	28	3	Behm-Berkelmann et al. (1991); Südbeck et al. (1998)
Sterna hirundo	Wismarbucht	Germany	53.9	11.4	1964–1996	33	3	Südbeck et al. (1998)
Sterna hirundo	Böhmke & Werder	Germany	53.9	14.0	1973–1996	24	3	Südbeck et al. (1998)
Sterna hirundo	Scharhörn	Germany	54.0	8.4	1936–1997	59	3	Behm-Berkelmann et al. (1991); Südbeck et al. (1998)
Sterna hirundo	Trischen	Germany	54.1	8.7	1982–1997	16	5	Südbeck et al. (1998)
Sterna hirundo	Helmsand	Germany	54.1	8.9	1982–1993	12	5	Südbeck et al. (1998)

Sterna hirundo	Graswarder	Germany	54.4	11.0	1955–1995	36	5	Südbeck et al. (1998)
Sterna hirundo	Kirr	Germany	54.4	12.7	1972–1997	26	3	Spretke (1998)
Sterna hirundo	Norderoog	Germany	54.5	8.5	1952–1996	42	3	Thiessen (1986); Südbeck et al. (1998)
Sterna hirundo	Hiddensee	Germany	54.5	13.1	1964–1996	33	3	Südbeck et al. (1998)
Sterna hirundo	Oehe-Schleimünde	Germany	54.6	10.0	1963–1980	18	3	Thiessen (1986); Südbeck et al. (1998)
Sterna hirundo	Farsund	Norway	58.0	6.7	1992–2004	13	5	Lorentsen (2006)
Sterna hirundo	Mandal	Norway	58.0	7.6	1992–2004	13	5	Lorentsen (2006)
Sterna hirundo	Telemark	Norway	58.9	9.6	1974–2004	31	6	Lorentsen (2006)
Sterna hirundo	Krunnit	Finland	65.3	25.0	1948–1963	13	5	Helle et al. (1988)
Sterna nilotica	Hullen	Germany	53.8	9.0	1959–1990	31	5	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Borkum	Germany	53.6	6.7	1954–1990	33	3	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Leybucht	Germany	53.6	7.2	1965–1980	16	3	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Juist	Germany	53.7	7.0	1948–1990	40	3	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Baltrum	Germany	53.7	7.4	1971–1990	19	3	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Langeoog	Germany	53.7	7.6	1953–1990	38	3	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Spiekeroog	Germany	53.8	7.7	1964–1990	27	3	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Wangerooge-West	Germany	53.8	7.9	1935–1990	53	3	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Wangerooge-Ost	Germany	53.8	7.9	1948–1990	43	3	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Minsener Oldeoog	Germany	53.8	8.0	1947–1990	44	1	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Hullen	Germany	53.8	9.0	1965–1990	25	5	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Nordkehdingen	Germany	53.8	9.2	1972–1990	19	5	Behm-Berkelmann et al. (1991)
Sterna paradisaea	Wismarbucht	Germany	53.9	11.4	1964–1996	33	3	Südbeck et al. (1998)
Sterna paradisaea	Scharhörn	Germany	54.0	8.4	1949–1995	47	1	Behm-Berkelmann et al. (1991); Südbeck et al. (1998)
Sterna paradisaea	Trischen	Germany	54.1	8.7	1982–1997	16	5	Südbeck et al. (1998)
Sterna paradisaea	Graswarder	Germany	54.4	11.0	1955–1995	36	5	Südbeck et al. (1998)
Sterna paradisaea	Norderoog	Germany	54.5	8.5	1952–1996	45	3	Thiessen (1986); Südbeck et al. (1998)
Sterna paradisaea	Oehe-Schleimünde	Germany	54.6	10.0	1963–1980	18	3	Thiessen (1986); Südbeck et al. (1998)
Sterna paradisaea	Foula	UK	60.1	–2.1	1969–1994	26	3	Furness (1983); Phillips et al. (1996)
Sterna paradisaea	Krunnit	Finland	65.3	25.0	1948–1963	13	5	Helle et al. (1988)
Sterna paradisaea	Sem' Ostrovov	Russia	68.5	37.3	1969–1993	24	3	Krasnov et al. (1995)
Sterna sandvicensis	Banc d'Arguin	France	44.5	–1.3	1973–2000	28	5	Yésou & Sadoul (2004)
Sterna sandvicensis	Channel coast	UK	51.5	–2.0	1969–1998	30	4	Ratcliffe et al. (2000)

Sterna sandvicensis	Minsener Oldeoog	Germany	53.8	8.0	1952–1990	38	3	Behm-Berkelmann et al. (1991)
Sterna sandvicensis	Irish Sea coast	UK	54.0	–4.0	1969–1998	30	4	Ratcliffe et al. (2000)
Sterna sandvicensis	Scharhörn	Germany	54.0	8.4	1976–1992	17	5	Hälterlein & Südbeck (1996)
Sterna sandvicensis	Trischen	Germany	54.1	8.7	1969–1983	15	3	Thiessen (1986)
Sterna sandvicensis	Norderoog	Germany	54.5	8.5	1969–1983	14	3	Thiessen (1986)
Sterna sandvicensis	North Sea coast	UK	55.0	–1.0	1969–1998	30	4	Ratcliffe et al. (2000)
Sterna sandvicensis	Foteviken	Sweden	55.5	13.0	1954–1977	23	5	Mathiasson (1980)
Sulidae								
Morus bassanus	Rouzic	France	48.8	–3.6	1959–2005	42	5	Pénicaud (1979); Siorat & Rocamora (1995); Siorat (2004a); Grémillet et al. (2006)
Morus bassanus	Great Saltee	Ireland	52.1	–6.7	1953–1976	23	3	Nelson (1978a)
Morus bassanus	Ailsa Craig	UK	55.3	–5.1	1947–1976	30	3	Nelson (1978b)
Morus bassanus	Fair Isle	UK	59.6	–1.6	1986–2001	16	5	Mavor et al. (2002)
Morus bassanus	Syltefjord	Norway	70.6	30.3	1966–1977	12	5	Brun (1979); Barrett (1981)

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Supplement 2. In this supplement, we provide further details on the methods. We give a species-wise overview of the explanatory variables used, explicate the computational implementation of Eq. (4) and explain the phylogenetic methodology applied

Species-wise explanatory variables used

The species-specific explanatory variables are summarised in Table S2. They were inferred from del Hoyo et al. (1992, 1996), Poole & Gill (1992–2003), and Schreiber & Burger (2002). Life history was defined as the first axis in a principal component analysis incorporating the species' ages at maturity and clutch size. This axis explained 77% of the total variation. Its correlation with clutch size was $r = 0.88$, and with age at maturity $r = -0.85$.

Table S2. Demographic and ecological covariates used for the 29 seabird species. Numbers given in italics have been estimated based on the respective figures of related species (see section 'Estimation of phylogenetic inertia and extrapolation of missing covariates' in this supplement)

Species	Body mass (g)	Foraging distance (km)	Foraging depth (m)	Cluch size	Age at maturity (yr)	Life history
Alcinae						
Alca torda	720	40	100	1	4.47	–0.7127
Cepphus grylle	430	5	30	2	3.46	0.5475
Fratercula arctica	510	10	70	1	6	–1.2295
Uria aalge	1100	80	180	1	5.92	–1.2059
Uria lomvia	1000	170	200	1	5.1	–0.9442
Hydrobatinae						
Hydrobates pelagicus	30	*314*	0.1	1	*4.24*	–0.6200
Larinae						
Larus argentatus	1044	2	2	2.8	4.47	0.7464
Larus canus	399	0.1	0.1	2.8	2.45	1.8019
Larus fuscus	830	1	0.1	2.7	4	0.8604
Larus marinus	1488	0.1	2	2.8	4.47	0.7464
Larus minutus	125	0.1	0.1	2.7	2.45	1.7208
Larus ridibundus	247	0.1	0.1	2.6	2.45	1.6398
Rissa tridactyla	400	10	1	2	3.87	0.3509
Pelecanus						
Pelecanus occidentalis	3200	20	2	2.6	3	1.2843
Phalacrocoracinae						
Phalacrocorax carbo	2236	30	30	4.24	2.8	2.7348
Stictocarbo aristotelis	1600	20	8	3	2.45	1.9640
Procellariidae						
Calonectris diomedea	647	*139*	0.3	1	8.16	–1.7692
Fulmarus glacialis	580	450	3	1	8.66	–1.8736
Pterodroma madeira	204	*227*	0.1	1	*5.86*	–1.1880
Stercorariinae						
Stercorarius parasiticus	400	0	0	1.9	4	0.2118
Sterninae						
Chlidonias niger	65	0	0	2.6	2.45	1.6398

Sterna albifrons	55	1.5	0.1	2.45	2.45	1.5182
Sterna caspia	662	60	2	2	3	0.7979
Sterna dougallii	110	1	1	2	3	0.7979
Sterna hirundo	130	10	1	2.4	3.2	1.0089
Sterna nilotica	209	0.1	0.1	3	5	0.7118
Sterna paradisaea	101	20	1	1.8	3.46	0.3854
Sterna sandvicensis	218	50	1	1.1	3.46	–0.1821
Sulidae						
Morus bassanus	3070	180	15	1	4	–0.5177

Implementation of Eq. (4)

In Eq. (4), the response variable f is a vector of length NT (with N, number of populations included; T, number of time lags considered; in the current study, $N = 378$, $T = 25$), where each element $f_{T(i-1)+\tau+1}$ (with $i \in [1, N]$, $\tau \in [0, T-1]$) is the response (i.e. either climatic responsiveness or relationship with the NAO) of population i to the NAO conditions prevailing τ years ago. The explanatory variables X_k and age at maturity $\alpha(i)$ are vectors V of length NT, where the elements V_{25i-j} (with $i \in [1, N]$, $j \in [0, T-1]$) contain the values of the variable representative of population i, i.e. each value of V is repeated T times. The population identifier i, as well as species and higher taxon labels, are vectors V of length NT, where the elements V_{25i-j} (with $i \in [1, N]$, $j \in [0, T-1]$) are dummy variables unique to the respective population i, its species, or its higher taxon, respectively. The NAO time lag τ is a vector of length NT, where the elements $\tau_{T(i-1)+j+1} = j$ (for all $i \in [1, N]$ and $j \in [0, T-1]$), i.e. the sequence $[0, T-1]$ is repeated N times. κ, b_0, b_k, t_0 and t_1 are scalars.

Estimation of non-linear mixed effects models was carried out using the R language function 'nlme' (Pinheiro et al. 2006, R Development Core Team 2006). Temporal autocorrelation was taken into account using argument 'correlation' and specifying an autoregressive process of order 1. The R script used to evaluate the full model in Table 1 of the main text was:

```
nlme(model = climatic.responsiveness ~ kappa + b0 * exp(-(lag - (t0 + t1 * age.at.maturity))^2),
fixed = kappa+b0+t0+t1 ~ 1,
random = kappa ~ 1 | taxon / species / ID,
correlation=corAR1(),
start=c(kappa=0, b0=0.1, t0=0, t1=1))
```

The R script used to evaluate the full model in Table 3 of the main text was:

```
nlme(model = relationship.with.NAO ~ kappa
+ (b10 + b11*body.mass + b12*coast) * exp(-(lag - 0)^2)
+ (b20 + b21*coast) * exp(-(lag - 1)^2)
+ (b30 + b31*life.history + b32*latidude + b33*life.history*latitude + b34*coast) * exp(-(lag - am)^2),
fixed = kappa+b10+b11+b12+b20+b21+b30+b31+b32+b33+b34 ~ 1,
random = kappa ~ 1 | ID,
correlation=corAR1(),
start=c(kappa=0, b10=0, b11=0, b12=0, b20=0, b21=0, b30=0, b31=0, b32=0, b33=0, b34=0))
```

Estimation of phylogenetic inertia and extrapolation of missing covariates

Based on a number of references, a phylogeny of the 29 species in the study's sample was built (Fig. S2; Cracraft 1985, Strauch 1985, Sibley & Ahlquist 1990, Viot et al. 1993, Hedges & Sibley 1994, Moum et al. 1994, 2002, Friesen et al. 1996, Siegel-Causey 1997, Chu 1998, Nunn & Stanley 1998, Crochet et al. 2000, 2002, Ericson et al. 2003, Bridge et al. 2005, Pons et al. 2005). A number of ways exist to express a trait's phylogenetic inertia (e.g. Diniz-Filho et al. 1998, Blomberg & Garland 2002). Here, we calculated it as the variance of the trait explained by sister taxa, i.e. as the r^2 of trait values between neighbouring branches across all nodes of the seabird phylogeny. Trait values for internal nodes were estimated from the trait values at the tips of the phylogeny assuming minimum evolution (McArdle & Rodrigo 1994). Unresolved nodes were ignored in this calculation, resulting in 20 pairs of sister taxa in the phylogeny. Branch lengths were approximated by each taxon's number of species (Grafen 1989; letting $\rho = 1$). P-values were obtained using a nonparametric bootstrap, i.e. by re-ordering the trait values 12000 times randomly along the tips of the phylogeny and calculating the corresponding inertias. The p-value was defined as the proportion of simulated phylogenetic inertias equal to or larger than the one observed.

The same minimum-evolution model was used in order to estimate explanatory variables that were unavailable for some of the species (see Table S2).

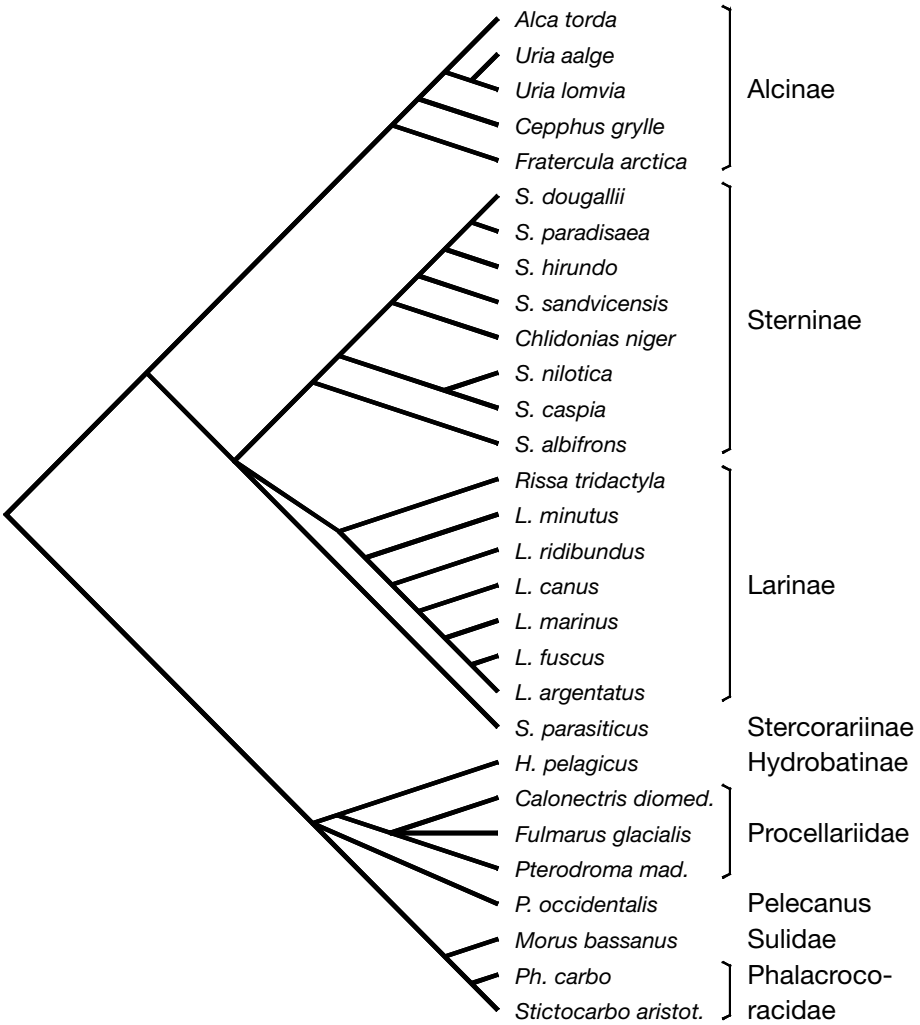

Fig. S2. Phylogenetic relationships assumed in estimation of phylogenetic inertia and extrapolation of missing covariates

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