

Table S1. Species studied in the interspecific analyses. Scientific species names follow Schreiber and Burger (2002), vernacular names Gill and Wright (2006). Parameters are chicks fledged (“cf”) and adult survival (“as”). Length of time series is given in years. “Original” indicates whether data were given in the original study (X) or whether they were read from figures (blank).

Scientific species name	Vernacular species name	Colony	Parameter	Length	Original	References
Procellariidae						
<i>Calonectris diomedea</i>	Cory’s shearwater	Selvagem Grande	cf	14		Mougin et al. 2000
<i>Calonectris diomedea</i>	Cory’s shearwater	Selvagem Grande	as	10	X	Mougin et al. 1990
<i>Fulmarus glacialis</i>	northern fulmar	Eynhallow	cf	21		Ollason and Dunnet 1980
<i>Fulmarus glacialis</i>	northern fulmar	Eynhallow	as	17	X	Dunnet and Ollason 1978
<i>Pterodroma madeira</i>	Zino’s petrel	Madeira	cf	15	X	Zino et al. 2001
<i>Puffinus puffinus</i>	Manx shearwater	Canna	cf	22	X	Swann 1995, Swann 2000
<i>Puffinus puffinus</i>	Manx shearwater	Skokholm	cf	4	X	Brooke 1978
<i>Puffinus puffinus</i>	Manx shearwater	Skokholm	cf	4	X	Brooke 1978
<i>Puffinus puffinus</i>	Manx shearwater	Skokholm	as	4	X	Brooke 1990
Sulidae						
<i>Morus bassanus</i>	northern gannet	Troup Head	cf	8	X	Wanless et al. 1996a
<i>Morus bassanus</i>	northern gannet	Bass Rock	as	16	X	Nelson 1978
Phalacrocoracidae						
<i>Phalacrocorax carbo</i>	great cormorant	Ceann Leathad	cf	6	X	Budworth et al. 2000
<i>Phalacrocorax carbo</i>	great cormorant	Vorsø	as	19		Frederiksen and Bregnballe 2000
<i>Stictocarbo aristotelis</i>	European shag	Canna	cf	24		Swann 2000
<i>Stictocarbo aristotelis</i>	European shag	Farne I	cf	5	X	Potts et al. 1980
<i>Stictocarbo aristotelis</i>	European shag	May	cf	22	X	Aebischer 1986, Aebischer and Wanless 1992
<i>Stictocarbo aristotelis</i>	European shag	May	cf	13		Rindorf et al. 2000
<i>Stictocarbo aristotelis</i>	European shag	Runde	cf	4	X	Røv 1990
<i>Stictocarbo aristotelis</i>	European shag	Farne I	as	9	X	Potts et al. 1980
<i>Stictocarbo aristotelis</i>	European shag	May	as	11	X	Harris et al. 2000a
Stercorariidae						
<i>Catharacta skua</i>	great skua	Foula	cf	5	X	Catry et al. 1998
<i>Catharacta skua</i>	great skua	Foula	as	8	X	Catry et al. 1998
<i>Catharacta skua</i>	great skua	Foula	cf	5	X	Catry et al. 1998
<i>Catharacta skua</i>	great skua	Foula	as	8	X	Catry et al. 1998
<i>Stercorarius parasiticus</i>	parasitic jaeger	Foula	cf	9	X	Phillips et al. 1996
<i>Stercorarius parasiticus</i>	parasitic jaeger	Fair Isle	as	6	X	O’Donald 1983
Laridae						
<i>Larus argentatus</i>	herring gull	May	cf	6	X	Wanless et al. 1996b
<i>Larus argentatus</i>	herring gull	Sligneach Mor	cf	4	X	Craik and Campbell 2000
<i>Larus argentatus</i>	herring gull	Trébéron	cf	7	X	Pons and Migot 1995
<i>Larus argentatus</i>	herring gull	Tryskärgrund	cf	6	X	Kilpi 1989
<i>Larus argentatus</i>	herring gull	May	as	4	X	Wanless et al. 1996b
<i>Larus argentatus</i>	herring gull	Skomer	as	19		Perrins and Smith 2000
<i>Larus argentatus</i>	herring gull	Trébéron	as	6	X	Pons and Migot 1995
<i>Larus canus</i>	mew gull	Hanko	cf	8	X	Kilpi 1995
<i>Larus fuscus</i>	lesser black-backed gull	May	cf	6	X	Wanless et al. 1996b
<i>Larus fuscus</i>	lesser black-backed gull	Skomer	cf	10		Perrins and Smith 2000

<i>Larus fuscus</i>	lesser black-backed gull	Söderskär	cf	10	X	Hario 1990
<i>Larus fuscus</i>	lesser black-backed gull	May	as	4	X	Wanless et al. 1996b
<i>Larus fuscus</i>	lesser black-backed gull	Skomer	as	20		Perrins and Smith 2000
<i>Larus marinus</i>	great black-backed gull	Skomer	cf	4		Perrins and Smith 2000
<i>Larus marinus</i>	great black-backed gull	Sligneach Mor	cf	5	X	Craik and Campbell 2000
<i>Rissa tridactyla</i>	black-legged kittiwake	Canna	cf	14	X	Swann 2000
<i>Rissa tridactyla</i>	black-legged kittiwake	Dunmore Black Knob	cf	5	X	Walsh and McGrath 1989
<i>Rissa tridactyla</i>	black-legged kittiwake	Dunmore Inner Harbour	cf	6	X	Walsh and McGrath 1989
<i>Rissa tridactyla</i>	black-legged kittiwake	Dunmore Outer Harbour	cf	5	X	Walsh and McGrath 1989
<i>Rissa tridactyla</i>	black-legged kittiwake	Fair Isle	cf	14		Rothery et al. 2002
<i>Rissa tridactyla</i>	black-legged kittiwake	Hornøya	cf	5	X	Erikstad et al. 1995
<i>Rissa tridactyla</i>	black-legged kittiwake	May	cf	13	X	Harris and Wanless 1997, Rindorf et al. 2000
<i>Rissa tridactyla</i>	black-legged kittiwake	S Shields	cf	30		Coulson and Thomas 1985
<i>Rissa tridactyla</i>	black-legged kittiwake	Wales	cf	16		Mavor et al. 2002
<i>Rissa tridactyla</i>	black-legged kittiwake	Breizh	as	14	X	Cam et al. 1998
<i>Rissa tridactyla</i>	black-legged kittiwake	Fair Isle	as	11	X	Rothery et al. 2002
<i>Rissa tridactyla</i>	black-legged kittiwake	Foula	as	11		Oro and Furness 2002
<i>Rissa tridactyla</i>	black-legged kittiwake	Hornøya	as	12	X	Sandvik et al. 2005
<i>Rissa tridactyla</i>	black-legged kittiwake	Lizard Point	as	6	X	Coulson and Butterfield 1986
<i>Rissa tridactyla</i>	black-legged kittiwake	May	as	11	X	Harris et al. 2000a
<i>Rissa tridactyla</i>	black-legged kittiwake	S Shields	as	44		Coulson and Strowger 1999
<i>Sterna antillarum</i>	least tern	New Jersey	cf	10		Burger 1989
<i>Sterna dougallii</i>	roseate tern	Bird Island	cf	4		Burger et al. 1996
<i>Sterna dougallii</i>	roseate tern	Cedar Beach	cf	4		Burger et al. 1996
<i>Sterna dougallii</i>	roseate tern	Falkner Island	as	8	X	Spendelov and Nichols 1989
<i>Sterna hirundo</i>	common tern	Augustgroden	cf	16	X	Becker 1998
<i>Sterna hirundo</i>	common tern	Banter See	cf	16	X	Becker 1998
<i>Sterna hirundo</i>	common tern	Buster	cf	5	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Cedar Creek	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	E Carvel	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	E Ham	cf	9	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	E Vol	cf	12	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Flat Creek	cf	5	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Gulf Point	cf	4	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Hester Sedge	cf	10	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	High Bar	cf	12	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Little	cf	10	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Log Creek	cf	11	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Minsener Oldeog	cf	17		Becker 1998, Thyen et al. 2000
<i>Sterna hirundo</i>	common tern	Mordecai	cf	11	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	N Lavallette	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	NW Lavallette	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Petit	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	S Lavallette	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	SW Cedar Bonnet	cf	8	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	SW Lavallette	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Thorofare	cf	7	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	W Carvel	cf	7	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	W Ham	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	W Long Point	cf	5	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	W Vol	cf	13	X	Burger and Gochfeld 1991
<i>Sterna hirundo</i>	common tern	Banter See	as	7	X	Becker et al. 2001
<i>Sterna maxima</i>	royal tern	Bird Bank	cf	4	X	Blus et al. 1979
<i>Sterna paradisaea</i>	Arctic tern	Foula	cf	11	X	Furness 1983
<i>Sterna paradisaea</i>	Arctic tern	Machias Seal Island	cf	4	X	Newell 1985
Alcidae						
<i>Alca torda</i>	razorbill	May	cf	6	X	Harris and Wanless 1989
<i>Alca torda</i>	razorbill	Hornøya	as	8	X	Sandvik et al. 2005
<i>Alca torda</i>	razorbill	May	as	11	X	Harris et al. 2000a

<i>Alca torda</i>	razorbill	Shiant Islands	as	6	X	Steventon 1979
<i>Fratercula arctica</i>	Atlantic puffin	Dùn	cf	17	X	Harris et al. 1998
<i>Fratercula arctica</i>	Atlantic puffin	May	cf	14	X	Harris and Bailey 1992
<i>Fratercula arctica</i>	Atlantic puffin	Hornøya	as	12	X	Sandvik et al. 2005
<i>Fratercula arctica</i>	Atlantic puffin	May	as	20	X	Harris et al. 1997
<i>Fratercula arctica</i>	Atlantic puffin	Skomer	as	4	X	Ashcroft 1979
<i>Uria aalge</i>	common murre	May	cf	10	X	Harris and Bailey 1992
<i>Uria aalge</i>	common murre	May	cf	13		Rindorf et al. 2000
<i>Uria aalge</i>	common murre	Stora Karlsö	cf	4	X	Hedgren 1980
<i>Uria aalge</i>	common murre	Canna	as	12	X	Harris et al. 2000b
<i>Uria aalge</i>	common murre	Colonsay	as	5	X	Harris et al. 2000b
<i>Uria aalge</i>	common murre	Hornøya	as	14	X	Sandvik et al. 2005
<i>Uria aalge</i>	common murre	May	as	13	X	Harris et al. 2000b
<i>Uria lomvia</i>	thick-billed murre	Hornøya	as	13	X	Sandvik et al. 2005

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Table S2. Responsiveness to climatic variation in chick production of 22 species of North Atlantic seabirds. Responsiveness to climate – estimated for time lags between zero and six years – was defined as the coefficient of determination derived from Pearson's correlation (see Material and Methods). Superscripts in brackets indicate the number of colonies that exhibited significant correlations at the 5% level. The columns "n_s" and "n_y" provide sample sizes in terms of colonies and colony-years, respectively. Bold numbers give summary statistics: the column "0–3" indicates the mean responsiveness across these time lags. Significance levels in this column ($0.05 > p^* \geq 0.01 > p^{**} \geq 0.001$) and the final row are derived from a bootstrapping procedure (see Material and Methods). The cells at the intersection between the "0–3" column and the "Mean" and "p" rows provide overall test results for time lags 0–3 across all species.

Species	n _s	n _y	Time lags							
			0	1	2	3	4	5	6	
Procellariidae										
<i>Calonectris diomedea</i>	1	14	0.001	0.044	0.014	0.017	0.019	0.020	0.328 ⁽¹⁾	0.109
<i>Fulmarus glacialis</i>	1	21	0.310 ⁽¹⁾	0.003	0.006	0.006	0.081	0.133	0.220 ⁽¹⁾	0.008
<i>Prerodroma madeira</i>	1	15	0.218	0.567 ⁽¹⁾	0.129	0.010	0.231 **	0.013	0.013	0.007
<i>Puffinus puffinus</i>	3	30	0.100	0.022	0.134 ⁽¹⁾	0.130	0.096	0.134	0.045	0.390 ⁽¹⁾
Sulidae										
<i>Morus bassanus</i>	1	8	0.556 ⁽¹⁾	0.169	0.004	0.084	0.203	0.080	0.105	0.338
Phalacrocoracidae										
<i>Phalacrocorax carbo</i>	1	6	0.005	0.158	0.358	0.333	0.214	0.199	0.785 ⁽¹⁾	0.073
<i>Stictocorbo aristotelis</i>	5	68	0.086	0.123	0.072	0.073	0.089	0.051	0.080	0.123 ⁽¹⁾
Stercorariidae										
<i>Catharacta skua</i>	1	5	0.147	0.057	0.019	0.067	0.073	0.116	0.516	0.338
<i>Stercorarius parasiticus</i>	1	9	0.009	0.141	0.706 ⁽¹⁾	0.502 ⁽¹⁾	0.339 *	0.114	0.011	0.502 ⁽¹⁾
Laridae										
<i>Larus argentatus</i>	4	23	0.261 ⁽¹⁾	0.246 ⁽¹⁾	0.103	0.188	0.234	0.188	0.195 ⁽¹⁾	0.326 ⁽¹⁾
<i>Larus canus</i>	1	8	0.005	0.296	0.223	0.000	0.131	0.191	0.578 ⁽¹⁾	0.034
<i>Larus fuscus</i>	3	26	0.070	0.226	0.106	0.071	0.118	0.091	0.071	0.123
<i>Larus marinus</i>	2	9	0.052	0.324	0.134	0.504	0.254	0.113	0.091	0.174 ⁽³⁾
<i>Rissa tridactyla</i>	9	108	0.074	0.231 ⁽⁴⁾	0.149 ⁽¹⁾	0.052	0.126	0.120	0.068	0.137
<i>Sterna antillarum</i>	1	10	0.001	0.051	0.200	0.427 ⁽¹⁾	0.170	0.091	0.019	0.145
<i>Sterna dougallii</i>	2	8	0.334	0.766	0.224	0.257	0.395	0.157	0.544 ⁽¹⁾	0.042
<i>Sterna hirundo</i>	26	282	0.110 ⁽¹⁾	0.087 ⁽¹⁾	0.038	0.073 ⁽¹⁾	0.077	0.265 ⁽⁸⁾	0.060 ⁽¹⁾	0.100 ⁽¹⁾
<i>Sterna maxima</i>	1	4	0.825	0.175	0.357	0.623	0.495	0.479	0.088	0.037
<i>Sterna paradisaea</i>	2	15	0.282	0.197	0.109	0.142	0.182	0.163	0.517 ⁽¹⁾	0.231
Alcidae										
<i>Alca torda</i>	1	6	0.054	0.005	0.690 ⁽¹⁾	0.284	0.258	0.022	0.279	0.589
<i>Fratercula arctica</i>	2	31	0.071	0.088	0.076	0.021	0.064	0.015	0.007	0.083
<i>Uria aalge</i>	3	27	0.023	0.142	0.072	0.126	0.091	0.260 ⁽¹⁾	0.362 ⁽²⁾	0.051
Sum	72	733	0.163 ⁽⁴⁾	0.187 ⁽⁶⁾	0.188 ⁽⁴⁾	0.177 ⁽³⁾	0.179 ⁽⁹⁾	0.137 ⁽¹⁰⁾	0.226 ⁽⁸⁾	0.180
Mean	3	33	0.40	0.18	0.18	0.18	0.26	0.095	0.71	0.029
p										0.024

Table S3. Responsiveness to climatic variation in adult survival of 17 species of North Atlantic seabirds. Asterisks indicate significance levels ($0.1 > p^* \geq 0.05 > p \geq 0.01 > p^{**} \geq 0.001$). See Table S2 for further explanations.

Species	n_S	n_Y	Time lags							
			0	1	2	3	4	5	6	
Procellariidae										
<i>Calonectris diomedea</i>	1	10	0.153	0.118	0.132	0.082	0.121	0.237	0.002	0.213
<i>Fulmarus glacialis</i>	1	17	0.388 ⁽¹⁾	0.099	0.067	0.005	0.140 ⁺	0.091	0.005	0.026
<i>Puffinus puffinus</i>	1	4	0.476	0.003	0.355	0.099	0.234	0.007	0.230	0.241
Sulidae										
<i>Morus bassanus</i>	1	16	0.031	0.033	0.060	0.077	0.050	0.023	0.003	0.009
Phalacrocoracidae										
<i>Phalacrocorax carbo</i>	1	19	0.045	0.005	0.093	0.467 ⁽¹⁾	0.153 [*]	0.003	0.064	0.020
<i>Stictocorbo aristotelis</i>	2	20	0.261	0.137	0.009	0.032	0.109	0.075	0.287	0.196
Stercorariidae										
<i>Catharacta skua</i>	1	8	0.305	0.138	0.000	0.011	0.113	0.260	0.226	0.317
<i>Stercorarius parasiticus</i>	1	6	0.282	0.261	0.202	0.414	0.290	0.436 ⁽¹⁾	0.874 ⁽¹⁾	0.014
Laridae										
<i>Larus argentatus</i>	3	29	0.027	0.235 ⁽¹⁾	0.089	0.252	0.151	0.141	0.034	0.085
<i>Larus fuscus</i>	2	24	0.057	0.000	0.022	0.067	0.037	0.136	0.238 ⁽¹⁾	0.223 ⁽¹⁾
<i>Rissa tridactyla</i>	7	109	0.061	0.109 ⁽²⁾	0.057	0.041	0.067	0.084	0.063	0.066
<i>Sterna dougallii</i>	1	8	0.054	0.521 ⁽¹⁾	0.001	0.055	0.158	0.013	0.256	0.026
<i>Sterna hirundo</i>	1	7	0.736 ⁽¹⁾	0.003	0.001	0.007	0.187	0.040	0.138	0.109
Alcidae										
<i>Alca torda</i>	3	25	0.210	0.074	0.036	0.137	0.115	0.075	0.065	0.335 ⁽¹⁾
<i>Fratercula arctica</i>	3	36	0.237 ⁽¹⁾	0.086	0.226 ⁽¹⁾	0.132	0.170 [*]	0.122	0.081	0.176 ⁽¹⁾
<i>Uria lomvia</i>	1	13	0.168	0.010	0.024	0.010	0.053	0.042	0.111	0.100
<i>Uria aalge</i>	4	44	0.124 ⁽¹⁾	0.046	0.109	0.100 ⁽¹⁾	0.095	0.048	0.197 ⁽¹⁾	0.036
Sum	34	395	⁽⁴⁾	⁽⁴⁾	⁽⁴⁾	⁽¹⁾	⁽²⁾	⁽³⁾	⁽³⁾	⁽³⁾
Mean	2	23	0.213	0.110	0.087	0.117	0.132	0.108	0.169	0.129
P			0.0063	0.66	0.88	0.57	0.31	0.70	0.098	0.42

Table S4. Correlations between the responsiveness to climatic variability in offspring production and adult survival, respectively, and six explanatory variables at different time lags (0–3 yr). Values provided are the correlation coefficients between the interspecific variation of the climatic responsiveness at the given time lag, and the explanatory variables. The sample size (n) is the number of phylogenetically independent contrasts. Asterisks indicate significance levels: $0.1 > p^+ \geq 0.05 > p^* \geq 0.01 > p^{**} \geq 0.001$. Bold numbers give summary statistics across columns or rows: the column “0–3” and the row “overall probability” indicate probabilities derived from a bootstrapping procedure (see Material and Methods). The cells at the intersection between the “0–3” column and the “overall probability” rows provide overall test results for time lags 0–3 across all explanatory variables except the principal component, which is given in separate rows. Probabilities are given in italics to facilitate the discrimination from correlation coefficients.

Explanatory variable	n	0	1	Time lag 2	3	0–3
Climatic responsiveness in offspring production						
clutch size	14	-0.664**	-0.047	+0.140	+0.052	<i>0.15</i>
chick production	19	-0.268	+0.174	+0.105	+0.107	<i>0.82</i>
age at maturity	19	+0.411 ⁺	-0.214	-0.449*	-0.122	<i>0.076</i>
adult survival	19	-0.147	-0.148	-0.438*	-0.417*	<i>0.40</i>
foraging distance	19	+0.015	-0.181	-0.286	-0.467*	<i>0.18</i>
diving depth	19	+0.257	-0.022	+0.069	+0.300	<i>0.73</i>
overall probability		<i>0.081</i>	<i>0.90</i>	<i>0.35</i>	<i>0.34</i>	<i>0.30</i>
principal component	19	-0.433*	+0.204	+0.436*	+0.300	<i>0.031</i>
Climatic responsiveness in adult survival						
clutch size	9	+0.045	-0.118	-0.128	+0.474	<i>0.37</i>
chick production	13	-0.243	+0.184	+0.104	+0.551*	<i>0.054</i>
age at maturity	14	+0.033	-0.058	-0.164	-0.411 ⁺	<i>0.64</i>
adult survival	14	+0.045	-0.195	+0.166	-0.073	<i>0.87</i>
foraging distance	14	+0.227	-0.413 ⁺	-0.106	-0.349	<i>0.11</i>
diving depth	13	-0.231	-0.153	-0.004	+0.240	<i>0.46</i>
overall probability		<i>0.73</i>	<i>0.43</i>	<i>0.90</i>	<i>0.020</i>	<i>0.24</i>
principal component	14	-0.096	+0.187	+0.056	+0.499*	<i>0.088</i>