

Combined influence of intrinsic and environmental factors in shaping productivity in a small pelagic gull, the black-legged kittiwake *Rissa tridactyla*

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Marine Ecology Progress Series 633: 207–223 (2020)

SUPPLEMENT

Table S1. Numbers of nests belonging to marked black-legged kittiwakes of known age that were monitored each year from 1996–2008 at the Shoup Bay colony in south-central Alaska.

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2006	2007	2008
3	4	1			1	13	1	30	5	4		
4	2	54		23	14	33	17	19	26	3	9	1
5	40	8	4	15	36	26	17	42	7	5	7	24
6	10	52	5	51	9	49	27	36	34	13	4	10
7	21	3	52	17	45	2	36	50	20	8	2	6
8	46	2		39	5	50	1	57	27	24	7	3
9		46		2	44	8	26	1	31	25	9	6
10				4	4	38	3	32	1	29	5	13
11				53	6	9	14	6	45	17	6	11
12					2	13	3	12	5	3	10	17
13						26	12	12	22	25		12
14							8	7	6	2	11	
15								18	4	16	2	17
16									16	2	5	2
17	10									43	1	11
18		5								13	9	3
19			2									10
20												5
21					2							
22						1						

Table S2. Median calendar day that the first egg was laid in black-legged kittiwake nests randomly selected within 15 productivity plots at the Shoup Bay colony in south-central Alaska from 1996–2008. No monitoring crew was present during the incubation period in 2005, so no laying phenology data are available for this year.

Year	Median date of first egg
1996	157
1997	156
1998	155
1999	165
2000	153
2001	155
2002	154
2003	160
2004	158
2005	n.d.
2006	159
2007	154
2008	155

Table S3. Performance of single variable generalized linear mixed effects models explaining the probability of laying success at a Black-legged Kittiwake colony in Prince William Sound, AK from 1996-2008, with individual ID and nested year and colony section as random effects. “Winter” refers to monthly values from November through February prior to the breeding season; “spring” refers to monthly values from March to April prior to the breeding season. Top-ranked variables within each group that outperformed the null model and were not correlated ($r \geq 0.65$) with a higher ranked representative variable were used in subsequent modeling (boldface type); asterisks indicate variables that were top-ranked and outperformed the null but were unusable due to correlation with higher ranked representative variables. Akaike weights are denoted by w_i , and k represents the number of model parameters.

Group	Model	AIC	Δ AIC	w_i	deviance	k
Individual characteristics	age	1420.36	0.00	>0.99	1412	4
	<i>years of breeding experience</i>	1435.41	15.06	<0.01	1427	4
	<i>first or second time breeding</i>	1459.34	38.98	<0.01	1451	4
	<i>previous breeding status</i>	1460.49	40.14	<0.01	1453	4
Colony size	colony size	1476.71	56.35	<0.01	1469	4
Phenology	median first egg lay date	1467.80	47.44	<0.01	1460	4
	<i>median first chick hatch date</i>	1473.44	53.08	<0.01	1466	4
Food	average incubation body condition	1488.68	68.32	<0.01	1481	4
	<i>age-1 herring</i>	1494.30	73.94	<0.01	1481	4
	<i>age-0 herring</i>	1494.46	74.10	<0.01	1481	4
Previous productivity	productivity in previous year	1492.65	72.29	<0.01	1485	4
Winter wind	<i>winter N/S wind magnitude*</i>	1479.82	59.46	<0.01	1472	4
	<i>winter directional N/S wind</i>	1484.27	63.91	<0.01	1477	4
	<i>winter wind magnitude</i>	1484.95	64.59	<0.01	1477	4
	<i>winter E/W wind magnitude</i>	1487.22	66.87	<0.01	1479	4
	<i>winter directional E/W wind</i>	1491.92	71.57	<0.01	1484	4
Spring wind	spring wind magnitude	1488.40	68.05	<0.01	1481	4
	<i>spring E/W wind magnitude</i>	1490.66	70.30	<0.01	1483	4
	<i>spring directional N/S wind</i>	1491.64	71.28	<0.01	1484	4
	<i>spring directional E/W wind</i>	1492.20	71.84	<0.01	1484	4
	<i>spring N/S wind magnitude</i>	1492.28	71.92	<0.01	1484	4
Winter SST	<i>PWS^A winter maximum monthly SST^{B*}</i>	1491.01	70.66	<0.01	1483	4
	<i>GOA winter maximum monthly SST*</i>	1493.49	73.13	<0.01	1486	4
	<i>GOA^C winter monthly mean SST*</i>	1494.01	73.66	<0.01	1486	4
	<i>PWS winter monthly mean SST</i>	1494.52	74.16	<0.01	1487	4
April SST	<i>PWS April SST</i>	1494.61	74.26	<0.01	1487	4
	<i>GOA April SST</i>	1494.82	74.46	<0.01	1487	4
Climate	mean winter Niño 3.4 index value	1489.77	69.42	<0.01	1482	4
	<i>mean winter PDO^D index value</i>	1494.54	74.18	<0.01	1487	4
Null	<i>intercept only</i>	1492.91	72.55	<0.01	1487	3

^APrince William Sound

^BSea surface temperature

^CGulf of Alaska

^DPacific Decadal Oscillation

Table S4. Performance of single variable generalized linear mixed effects models explaining the probability of hatching success at a Black-legged Kittiwake colony in Prince William Sound, AK from 1996-2008, with individual ID and nested year and colony section as random effects. “Winter” refers to monthly values from November through February prior to the breeding season; “spring” refers to monthly values from March to April prior to the breeding season. Top-ranked variables within each group that outperformed the null model and were not correlated ($r \geq 0.65$) with a higher ranked representative variable were used in subsequent modeling (boldface type); asterisks indicate variables that were top-ranked and outperformed the null but were unusable due to correlation with higher ranked representative variables. Akaike weights are denoted by w_i , and k is the number of model parameters.

Group	Model	AIC	Δ AIC	w_i	deviance	k
Age	age	1490.38	2.53	0.08	1482	4
	<i>previous breeding status</i>	1490.48	0.10	<0.01	1482	4
	<i>years of breeding experience</i>	1494.39	4.01	<0.01	1486	4
	<i>first or second time breeding</i>	1495.01	4.63	<0.01	1487	4
Colony size	colony size	1488.43	0.58	0.20	1480	4
Phenology	median first egg lay date	1495.17	7.32	0.01	1487	4
	<i>median first chick hatch date</i>	1497.66	9.81	<0.01	1490	4
Food	average incubation body condition	1489.79	1.94	0.10	1482	4
	<i>age-0 herring</i>	1496.67	6.29	<0.01	1489	4
	<i>age-1 herring</i>	1496.78	6.40	<0.01	1489	4
Previous productivity	productivity in previous year	1496.07	8.22	<0.01	1488	4
Winter wind	winter E/W wind magnitude	1489.02	1.16	0.15	1481	4
	<i>winter directional N/S wind</i>	1491.68	3.82	0.04	1484	4
	<i>winter wind magnitude</i>	1493.85	6.00	0.01	1486	4
	<i>winter N/S wind magnitude</i>	1496.10	8.25	<0.01	1488	4
	<i>winter directional E/W wind</i>	1498.21	10.36	<0.01	1490	4
Spring wind	spring directional N/S wind	1493.68	5.83	0.01	1486	4
	<i>spring directional E/W wind</i>	1494.99	7.14	0.01	1487	4
	<i>spring N/S wind magnitude</i>	1495.36	7.51	0.01	1487	4
	<i>spring E/W wind magnitude</i>	1497.41	9.55	<0.01	1489	4
	<i>spring wind magnitude</i>	1498.01	10.16	<0.01	1490	4
Winter SST	<i>PWS^A winter maximum monthly SST^B*</i>	1494.34	6.49	0.01	1486	4
	<i>GOA^C winter maximum monthly SST*</i>	1495.18	7.32	0.01	1487	4
	<i>GOA winter monthly mean SST</i>	1498.04	10.19	<0.01	1490	4
	<i>PWS winter monthly mean SST</i>	1498.19	10.34	<0.01	1490	4
April SST	<i>PWS April SST</i>	1498.08	10.22	<0.01	1490	4
	<i>GOA April SST</i>	1498.23	10.38	<0.01	1490	4
Precipitation	<i>maximum daily July precipitation</i>	1497.70	9.85	<0.01	1490	4
	<i>number of days with precipitation >2.54mm</i>	1497.88	10.02	<0.01	1490	4
	<i>total July precipitation</i>	1498.03	10.18	<0.01	1490	4
Temperature	<i>July mean maximum daily air temperature</i>	1498.10	10.24	<0.01	1490	4
	<i>July mean daily air temperature</i>	1498.15	10.30	<0.01	1490	4
Climate	<i>mean winter PDO^D index value</i>	1498.11	10.26	<0.01	1490	4
	<i>mean winter Niño 3.4 index value</i>	1498.21	10.36	<0.01	1490	4
Salmon timing	date salmon landings exceed 30,000 fish	1487.85	0.00	0.27	1480	4
	<i>date salmon landings exceed one million fish</i>	1490.85	2.99	0.06	1483	4
	<i>total salmon landings</i>	1497.22	9.36	<0.01	1489	4
Null	<i>intercept only</i>	1496.25	8.39	<0.01	1490	3

^APrince William Sound; ^BSea surface temperature; ^CGulf of Alaska; ^DPacific Decadal Oscillation