APPENDIX 1

TABLE S1

Fledgling survival and recruitment modeling: resighting probability --- performance of competing models exploring the best general structure for multi-state models estimating resighting probability (p) for Black-legged Kittiwakes banded as chicks at the Shoup Bay colony, Prince William Sound, Alaska, during 1991–2006

Model	Hypothesis	$\Delta QAIC_c$	w_i	K
	Resight probability varies ...			
$p_{(state + age class)}$	... between breeding states and between age classes.	0.00	>0.99	57
$p_{(age class * year)}$	... between age classes and among years, with a different yearly pattern between age classes.	221.24	<0.01	90
$p_{(age class + year)}$	... between age classes and among years.	238.67	<0.01	73
$p_{(state * year)}$	... between breeding states and among years, with a different yearly pattern between breeding states.	653.54	<0.01	90
$p_{(state + year)}$	... between breeding states and among years.	693.84	<0.01	73
$p_{(state * cohort)}$	... between breeding states and among cohorts, with a different cohort pattern between breeding states.	858.14	<0.01	80
$p_{(state + cohort)}$	... between breeding states and among cohorts.	864.05	<0.01	68
$p_{(state + linear cohort trend)}$	... between breeding states and with a linear trend over cohorts.	955.15	<0.01	57
$p_{(state)}$	... between breeding states only.	969.20	<0.01	56
$p_{(cohort)}$	... among cohorts only.	1595.91	<0.01	67
$p_{(year)}$	... among years only.	1603.87	<0.01	72
$p_{(linear cohort trend)}$	... by a linear trend over cohorts only.	1729.97	<0.01	56
$p_{(constant)}$	Resight probability does not vary.	1928.83	<0.01	55

Asterisks denote interactive models, which include both additive and interactive effects. Model structures for survival and breeding state (pre-recruits vs. breeders) transition probabilities were set to general state and time dependence (by year). Model weights are denoted by w_i, and K represents the number of estimable parameters in each model adjusted for any parameters fixed during analysis. $\Delta QAIC_c$ values reflect ΔAIC_c values adjusted according to a median ĉ estimate of 2.13.

TABLE S2

Fledgling survival and recruitment modeling: apparent survival probability --- performance of competing models exploring the best general structure for multi-state models estimating the probability of apparent survival (ϕ; survival + fidelity) for Black-legged Kittiwakes banded as chicks at the Shoup Bay colony, Prince William Sound, Alaska, during 1991–2008

Model	Hypothesis	$\Delta QAIC_c$	w_i	K
	Apparent survival varies ...			
$\varphi_{(age\ class\ *\ cohort)}$	... between age classes and among cohorts, with a different cohort pattern between age classes.	0.00	>0.99	44
$\varphi_{(state\ +\ cohort)}$	... between age classes and among cohorts.	20.45	<0.01	31
$\varphi_{(age\ class\ *\ year)}$	... between age classes and among years, with a different yearly pattern between age classes.	35.74	<0.01	51
$\varphi_{(age\ +\ cohort)}$	... among ages and among cohorts.	36.60	<0.01	47
$\varphi_{(cohort\ +\ year)}$	... among cohorts and among years.	37.58	<0.01	47
$\varphi_{(age\ class\ +\ year)}$	... between age classes and among years.	48.99	<0.01	34
$\varphi_{(state\ +\ cohort)}$	... between breeding states and among cohorts.	88.14	<0.01	31
$\varphi_{(age\ *\ cohort)}$	... among ages and among cohorts, with a different age pattern among cohorts.	91.51	<0.01	140
$\varphi_{(state\ *\ cohort)}$	... between breeding states and among cohorts, with a different cohort pattern between breeding states.	106.66	<0.01	45
$\varphi_{(cohort)}$	... only among cohorts.	108.17	<0.01	30
$\varphi_{(cohort\ *\ year)}$	... among cohorts and among years, with a different yearly pattern among cohorts.	115.91	<0.01	152
$\varphi_{(state\ +\ year)}$	... between breeding states and among years.	165.51	<0.01	34
$\varphi_{(state\ *\ year)}$	... between breeding states and among years, with a different yearly pattern between breeding states.	173.99	<0.01	51
$\varphi_{(state\ +\ age\ class)}$	... between breeding states and between age classes.	201.87	<0.01	18

$\varphi_{(state * age classs)}$	... between breeding states and between age classes, with a different age class pattern between breeding states.	203.87	<0.01	19
$\varphi_{(age class)}$	... only between age classes.	205.50	<0.01	17
$\varphi_{(state + age)}$	... between breeding states and among ages.	224.51	<0.01	34
$\varphi_{(age)}$	... only among ages.	227.15	<0.01	33
$\varphi_{(state * age)}$	... between breeding states and among ages, with a different age pattern between breeding states.	247.00	<0.01	51
$\varphi_{(year)}$	... only among years.	291.85	<0.01	33
$\varphi_{(state)}$	... only between breeding states.	314.86	<0.01	17
$\varphi_{(constant)}$	Apparent survival does not vary.	400.24	<0.01	16

Asterisks denote interactive models, which include both additive and interactive effects. Model structure for resight probability was set to the best competing structure (recruitment state + age class, where states were pre vs. post recruitment), and transition model structure was set to the best competing structure from transition modeling (age). Model weights are denoted by w_i, and K represents the number of estimable parameters in each model adjusted for any parameters fixed during analysis. $\Delta QAIC_c$ values reflect ΔAIC_c values adjusted according to a median ĉ estimate of 2.13.

TABLE S3

Post-recruitment survival modeling: resighting probability --- performance of competing models exploring the best general structure for multi-state models estimating resighting probability (p) of post-recruitment breeders and non-breeders (determined by nest-site attendance) of Black-legged Kittiwakes banded as chicks at and eventually recruiting to the Shoup Bay colony, Prince William Sound, Alaska, during 1991–2006

Model	Hypothesis	$\Delta QAIC_c$	w_i	K
	Resight probability varies ...			
$p_{(state + year)}$	... among breeding states and among years.	0.00	>0.99	105
$p_{(state + cohort)}$	... among breeding states and among cohorts.	37.14	<0.01	99
$p_{(state * year)}$	... among breeding states and among years, with a different yearly pattern of resighting probability among states.	39.95	<0.01	137
$p_{(state * cohort)}$	... among breeding states and among cohorts, with a different cohort-based pattern of resighting probability among states.	53.95	<0.01	119
$p_{(state + age)}$	... among breeding states and among ages.	60.34	<0.01	105
$p_{(state)}$	... only in relation to breeding state.	65.48	<0.01	89
$p_{(state * age)}$	... among breeding states and over age, with a different age-based pattern of resighting probability among states.	88.26	<0.01	131
$p_{(age)}$	... only by age.	216.94	<0.01	103
$p_{(year)}$	... only among years.	235.01	<0.01	103
$p_{(cohort)}$	... only by cohort.	274.86	<0.01	97
$p_{(constant)}$	Resight probability does not vary.	303.64	<0.01	87

Asterisks denote interactive models, which include both additive and interactive effects. Model structures for survival and transition probabilities were set to general state and time dependence (by year). Model weights are denoted by w_i, and K represents the number of estimable parameters in each model adjusted for any parameters fixed during analysis. $\Delta QAIC_c$ values reflect ΔAIC_c values adjusted according to a median $\hat{c}$ estimate of 1.76.

TABLE S4

Post-recruitment survival modeling: transition probability --- performance of competing models exploring the best general structure for multi-state models estimating the probability of state transition (ψ), where states were pre-recruitment, breeding, and post-recruitment non-breeding, for Black-legged Kittiwakes banded as chicks at and eventually recruiting to the Shoup Bay colony, Prince William Sound, Alaska, during 1991–2006

Model	Hypothesis	$\Delta QAIC_c$	w_i	K
	Breeding state transition probability varies ...			
$\Psi_{(state * time)}$	... between breeding states and among years, with a different yearly pattern between breeding states.	0	> 0.99	104
$\Psi_{(state * age)}$	... between breeding states and among ages, with a different age pattern between breeding states.	196.73	< 0.01	98
$\Psi_{(state + age)}$	... between breeding states and among ages.	231.18	< 0.01	72
$\Psi_{(state + time)}$	... between breeding states and among years.	247.82	< 0.01	72
$\Psi_{(state + cohort)}$	... between breeding states and among cohorts.	387.35	< 0.01	72
$\Psi_{(state * cohort)}$	... between breeding states and among cohorts, with a different cohort pattern between breeding states.	395.00	< 0.01	98
$\Psi_{(age)}$	... among ages only.	424.71	< 0.01	70
$\Psi_{(time)}$	... among years only.	453.13	< 0.01	70
$\Psi_{(constant)}$	... does not vary.	643.58	< 0.01	54
$\Psi_{(cohort)}$	... among cohorts only.	658.32	< 0.01	70

Asterisks denote interactive models, which include both additive and interactive effects. Model structure for resight probability was set to the best competing structure (breeding state + year), and survival was set to general state and time dependence (by year). Model weights are denoted by w_i, and K represents the number of estimable parameters in each model adjusted for any parameters fixed during analysis. $\Delta QAIC_c$ values reflect ΔAIC_c values adjusted according to a median ĉ estimate of 1.76.

TABLE S5

Post-recruitment survival modeling: apparent survival probability – performance of competing models exploring the best general structure for multi-state models estimating the probability of apparent survival (ϕ; survival + fidelity) of post-recruitment breeders and non-breeders (determined by nest-site attendance) of Black-legged Kittiwakes banded as chicks at and eventually recruiting to the Shoup Bay colony, Prince William Sound, Alaska, during 1991–2006

Model	Hypothesis	$\Delta QAIC_c$	w_i	K
	Survival probability of recruits varies ...			
$\varphi_{(state + cohort)}$	... between breeding states and among cohorts.	0	0.94	82
$\varphi_{(state)}$	... only between breeding states.	6.88	0.03	72
$\varphi_{(cohort)}$	... only among cohorts.	8.38	0.01	81
$\varphi_{(state + age class)}$	... between breeding states and between age classes.	8.93	0.01	73
$\varphi_{(state * age class)}$	... between breeding states and between age classes, with a different age pattern between breeding states.	10.98	< 0.01	74
$\varphi_{(state * cohort)}$	... between breeding states and among cohorts, with a different cohort pattern between breeding states.	13.14	< 0.01	92
$\varphi_{(constant)}$	Survival probability of recruits does not vary.	15.49	< 0.01	71
$\varphi_{(age class)}$	... only between age classes.	17.53	< 0.01	72
$\varphi_{(state + year)}$	... between breeding states and among years.	19.67	< 0.01	88
$\varphi_{(state + age)}$	... between breeding states and among ages.	23.06	< 0.01	88
$\varphi_{(year)}$	... only among years.	23.11	< 0.01	87
$\varphi_{(age)}$	... only among ages.	37.05	< 0.01	87
$\varphi_{(state * year)}$	... between breeding states and among years, with a different yearly pattern between breeding states.	42.78	< 0.01	104
$\varphi_{(state * age)}$	... between breeding states and among ages, with a different age pattern between breeding states.	45.76	< 0.01	104

*Asterisks denote interactive models, which include both additive and interactive effects. Model structures for resight probability and transition probability were set to the best competing structure (state + time, state * time, respectively). Model weights are denoted by w_i, and K represents the number of estimable parameters in each model adjusted for any parameters fixed during analysis. $\Delta QAIC_c$ values reflect ΔAIC_c values adjusted according to a median ĉ estimate of 1.76.*