

The following supplement accompanies the article

Factors affecting adult survival and inter-colony movement at the three South African colonies of Cape gannet

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Supplement. Glossary of statistical terms, full results from multistate model, and details of covariate parameters with intervals and model selection summary from the single state models.

Glossary of statistical terms

- **Analysis of deviance:** the deviances of specific models are compared relative to the difference in deviance between a fully parameterised model and a constant model with a single parameter. This comparison allows one to see what proportion of the variation explained in the fully parameterised model (relative to the constant model) is accounted for by a smaller number of covariates.
- **Credible intervals:** the Bayesian version of a confidence interval is called a credible interval. It is calculated from the posterior distribution for a particular parameter that the Bayesian analysis produces. If the 95% credible interval includes 0, then the parameter estimate will not be significant at the 5% level.
- **Full time dependence:** a fully time dependent model means that a separate parameter is estimated for every year in the study period. At the other end of the spectrum is a ‘constant over time’ model whereby a single parameter is estimated for all years, i.e. there would be a single constant estimate for each year of the study period. A model with 1 or more covariates can be viewed as lying in between these 2 extremes.
- **Logit scale:** refers to a particular transformation of an outcome variable that ranges between 0 and 1 (such as a probability), $\log(p/1 - p)$. The transformed outcome can then take on any real number between $-\infty$ and ∞ . Parameter estimates can then be back-transformed to the original scale and interpreted as odds ratios.
- **Process variance:** variation in parameter estimates is typically affected by natural variation (process variance) and by variation inherent in the sampling process (sampling variance). A random effects analysis allows one to separate these 2 distinct sources of variation.
- **Recapture rate:** refers to the probability of being detected (or recaptured) during sampling. Recapture rates are integral to capture–recapture models and are an important factor in extracting accurate survival rates. Essentially, it is important to account for the fact that if an individual is not detected (recaptured) at time i , this does not necessarily mean that the individual did not survive. The individual could have survived and simply not been detected during the sampling process.
- **Recovery rate:** refers to the probability that dead marked individuals are reported during each period. Recovery information therefore comes from individuals known to be dead, e.g. where a ringed seabird washes up on a beach and the ring number is reported, and can be incorporated in an analysis together with information on live recapture.

Table S1. *Morus capensis*. Multistate model results from data on the 3 South African Cape gannet colonies from 1989 to 2009. S_{year} : survival probability for that year; R_{year} : recapture probability for that year; CI: Bayesian credible interval

Year	Lambert's Bay			Malgas Island			Bird Island		
	Mean	SD	95% CI	Mean	SD	95% CI	Mean	SD	95% CI
Survival									
S_1990	0.901	0.023	(0.85-0.94)	0.947	0.010	(0.92-0.97)	0.927	0.016	(0.89-0.95)
S_1991	0.881	0.023	(0.83-0.92)	0.897	0.014	(0.87-0.92)	0.913	0.015	(0.88-0.94)
S_1992	0.898	0.020	(0.86-0.94)	0.895	0.015	(0.86-0.92)	0.901	0.017	(0.86-0.93)
S_1993	0.873	0.020	(0.83-0.91)	0.853	0.017	(0.82-0.89)	0.904	0.016	(0.87-0.93)
S_1994	0.844	0.019	(0.81-0.88)	0.842	0.016	(0.81-0.87)	0.896	0.017	(0.86-0.93)
S_1995	0.876	0.024	(0.83-0.92)	0.848	0.024	(0.80-0.89)	0.849	0.031	(0.79-0.90)
S_1996	0.768	0.025	(0.72-0.82)	0.761	0.021	(0.72-0.80)	0.861	0.026	(0.81-0.91)
S_1997	0.805	0.023	(0.76-0.85)	0.899	0.013	(0.87-0.92)	0.890	0.021	(0.84-0.92)
S_1998	0.844	0.022	(0.80-0.89)	0.891	0.014	(0.86-0.92)	0.895	0.019	(0.85-0.93)
S_1999	0.805	0.027	(0.75-0.86)	0.898	0.017	(0.86-0.93)	0.898	0.020	(0.85-0.93)
S_2000	0.793	0.027	(0.74-0.85)	0.854	0.021	(0.81-0.90)	0.890	0.020	(0.85-0.93)
S_2001	0.814	0.027	(0.76-0.87)	0.917	0.018	(0.88-0.95)	0.913	0.019	(0.88-0.95)
S_2002	0.827	0.029	(0.77-0.88)	0.879	0.023	(0.83-0.92)	0.877	0.025	(0.82-0.92)
S_2003	0.777	0.039	(0.70-0.85)	0.849	0.031	(0.78-0.90)	0.879	0.026	(0.82-0.92)
S_2004	0.848	0.057	(0.73-0.96)	0.917	0.028	(0.86-0.96)	0.883	0.032	(0.80-0.93)
S_2005	0.793	0.098	(0.55-0.95)	0.918	0.029	(0.86-0.97)	0.901	0.031	(0.83-0.95)
S_2006	0.787	0.099	(0.48-0.91)	0.878	0.039	(0.79-0.94)	0.898	0.027	(0.83-0.94)
S_2007	0.781	0.101	(0.49-0.91)	0.860	0.047	(0.76-0.94)	0.904	0.028	(0.84-0.95)
S_2008	0.878	0.060	(0.71-0.96)	0.914	0.038	(0.83-0.97)	0.920	0.025	(0.87-0.96)
S_2009	0.885	0.046	(0.77-0.96)	0.914	0.035	(0.83-0.97)	0.923	0.023	(0.88-0.96)
Recapture									
R_1989	0.187	0.036	(0.12-0.27)	0.242	0.035	(0.18-0.32)	0.208	0.037	(0.14-0.28)
R_1990	0.221	0.025	(0.17-0.27)	0.252	0.021	(0.21-0.29)	0.100	0.011	(0.08-0.12)
R_1991	0.309	0.025	(0.26-0.36)	0.215	0.017	(0.18-0.25)	0.154	0.012	(0.13-0.18)
R_1992	0.176	0.017	(0.14-0.21)	0.268	0.017	(0.24-0.30)	0.050	0.006	(0.04-0.06)
R_1993	0.507	0.023	(0.46-0.55)	0.410	0.020	(0.37-0.45)	0.068	0.007	(0.05-0.08)
R_1994	0.297	0.018	(0.26-0.33)	0.293	0.017	(0.26-0.33)	0.100	0.009	(0.08-0.12)
R_1995	0.388	0.020	(0.35-0.43)	0.283	0.016	(0.25-0.31)	0.132	0.011	(0.11-0.16)
R_1996	0.411	0.021	(0.37-0.45)	0.311	0.017	(0.28-0.35)	0.064	0.007	(0.05-0.08)
R_1997	0.367	0.019	(0.33-0.41)	0.309	0.016	(0.28-0.34)	0.010	0.002	(0.01-0.01)
R_1998	0.348	0.019	(0.31-0.39)	0.245	0.013	(0.22-0.27)	0.008	0.002	(0.004-0.01)

R_1999	0.245	0.017	(0.21-0.28)	0.204	0.012	(0.18-0.23)	0.010	0.002	(0.01-0.01)
R_2000	0.260	0.017	(0.23-0.29)	0.175	0.011	(0.15-0.20)	0.029	0.004	(0.02-0.04)
R_2001	0.243	0.016	(0.21-0.28)	0.228	0.013	(0.20-0.25)	0.031	0.004	(0.02-0.04)
R_2002	0.259	0.017	(0.23-0.29)	0.183	0.012	(0.16-0.21)	0.004	0.001	(0.002-0.01)
R_2003	0.315	0.024	(0.27-0.37)	0.095	0.009	(0.08-0.11)	0.015	0.003	(0.01-0.02)
R_2004	0.186	0.021	(0.15-0.23)	0.044	0.006	(0.03-0.06)	0.084	0.011	(0.07-0.11)
R_2005	0.012	0.004	(0.01-0.02)	0.022	0.004	(0.01-0.03)	0.007	0.002	(0.004-0.01)
R_2006	0.045	0.011	(0.03-0.07)	0.043	0.007	(0.03-0.06)	0.043	0.007	(0.03-0.06)
R_2007	0.083	0.027	(0.05-0.17)	0.154	0.020	(0.12-0.20)	0.026	0.005	(0.02-0.04)
R_2008	0.079	0.023	(0.05-0.15)	0.028	0.005	(0.02-0.04)	0.001	0.001	(0.0003-0.003)
Recovery									
Constant	0.010	0.002	(0.009-0.014)	0.004	0.001	(0.002-0.006)	0.023	0.002	(0.02-0.027)

Table S2. *Morus capensis*. Covariate effects for the 3 South African Cape gannet colonies from 1989 to 2009. SST(W): sea surface temperature aggregated over the winter months for the appropriate area; SOI(W): Southern Oscillation Index averaged over the winter months; Time to 50%: time in months that it took the industry to achieve at least 50% of the quota (a2: time since initial capture to account for the effect of transients; TD: trap dependence)

Model specification	Lambert's Bay		Malgas Island		Bird Island	
	β	95% interval	β	95% interval	β	95% interval
SST(W)	0.768	(0.5423;0.9938)	0.413	(0.1733;0.6524)	0.388	(0.0705;0.7057)
SOI(W)	-0.023	(-0.0339;-0.0112)	0.017	(0.0046;0.0303)	0.016	(-0.0072;0.0396)
Biomass	-0.001	(-0.0019;-0.0003)	0.002	(0.0004;0.0029)	-0.003	(-0.0045;-0.0014)
Time to 50%	-0.15	(-0.1949;-0.1044)	-0.063	(-0.1121;-0.0142)	-0.128	(-0.209;-0.047)
Annual catch	0.043	(0.0252;0.0600)	0.017	(0.0040;0.0294)	-0.305	(-0.482;-0.128)
Diet	-0.045	(-0.071;-0.018)	-0.011	(-0.019;-0.002)	-0.02	(-0.029;-0.010)

Table S3. *Morus capensis*. Model selection summary for the models fitted to the 3 South African Cape gannet colonies from 1989 to 2009. a2: time since initial capture to account for the effect of transients; TD: trap dependence; SST(W): sea surface temperature aggregated over the winter months for the appropriate area; SOI(W): Southern Oscillation Index averaged over the winter months; Time to 50%: time in months that it took the industry to achieve at least 50% of the quota; AnnCatch: annual catch; AIC: Akaike Information Criterion; Δ AIC: difference in AIC between the current and the best model; w: Akaike weight, i.e. relative support of current model compared to the other model in the set; K: no. of estimated parameters

Model	AIC	Δ AIC	w	K	Deviance
Lambert's Bay					
ϕ (a2 t // t)p(t TD) r(.) F(.)	23388.25	0	1	45	23297.82
ϕ (a2 SST(W))p(t TD) r(.) F(.)	23422.3	34.05	0	26	23370.15
ϕ (a2 Time to 50%)p(t TD) r(.) F(.)	23433.07	44.82	0	26	23380.92
ϕ (a2 AnnCatch)p(t TD) r(.) F(.)	23448.75	60.5	0	26	23396.61
ϕ (a2 SOI(W))p(t TD) r(.) F(.)	23458.25	70	0	26	23406.10
ϕ (a2 Biomass)p(t TD) r(.) F(.)	23466.52	78.27	0	26	23414.37
ϕ (a2 Diet)p(t TD) r(.) F(.)	23467.52	79.27	0	27	23413.361
ϕ (a2 ..)p(t TD) r(.) F(.)	23471.62	83.37	0	25	23421.49
Malgas Island					
ϕ (a2 t // t)p(t TD) r(.) F(.)	28281.58	0	1	45	28191.22
ϕ (a2 SST(W))p(t TD) r(.) F(.)	28388.96	107.38	0	26	28336.84
ϕ (a2 SOI(W))p(t TD) r(.) F(.)	28395.37	113.79	0	26	28343.24
ϕ (a2 Biomass)p(t TD) r(.) F(.)	28395.56	113.98	0	26	28343.44

φ (a2 AnnCatch)p(t TD) r(.) F(.)	28396.1	114.52	0	26	28343.98
φ (a2 Time to 50%)p(t TD) r(.) F(.)	28396.52	114.94	0	26	28344.40
φ (a2 Diet)p(t TD) r(.) F(.)	28397.03	119.78	0	26	28344.90
φ (a2 ..)p(t TD) r(.) F(.)	28401.36	119.78	0	25	28351.24
Bird Island					
φ (a2 t // t)p(t TD) r(.) F(.)	16395.35	0	1	45	16304.87
φ (a2 Diet)p(t TD) r(.) F(.)	16414.62	19.27	0	26	16362.46
φ (a2 AnnCatch)p(t TD) r(.) F(.)	16417.43	22.08	0	26	16365.27
φ (a2 Time to 50%)p(t TD) r(.) F(.)	16419.13	23.78	0	26	16366.96
φ (a2 SST(W))p(t TD) r(.) F(.)	16421.86	26.51	0	26	16369.7
φ (a2 ..)p(t TD) r(.) F(.)	16425.05	29.70	0	25	16374.9
φ (a2 SOI(W))p(t TD) r(.) F(.)	16425.11	29.76	0	26	16372.95
φ (a2 Biomass) p(t TD)r(.)F(.)	16425.39	30.05	0	26	16373.23