Appendix C: Spawner and Non-Spawner Chlorophyll Analysis

Table C1. Model selection tests of Chlorophyll-a as an explanatory variable for the catch during spawning months (Jul-Sep) using 1998 to 2014 data. The data range is determined by the years for which CHL was available. S_t is the catch during Jul-Sep of season t. V_t is the covariate in the current season which spans two calendar years from July to June in the next year. V_{t-1} is the covariate in the prior Jul-Jun season. For Oct-Dec and Jan-Mar only Chlorophyll-a in the prior season is used since these months are after spawning in the current season. Non-linearity is modeled as a 2nd-order polynomial due to data constraints and appears as $p()$ in the model equations. The non-spawner catch is modeled as a function of non-spawner catch in the prior year only, without spawner catch 2-years prior as in the other covariate analyses (Appendix B). This is done due to data constraints. The models are nested; the roman numeral indicates the level of nestedness. Models at levels II and higher are shown with the component that is added to the base level model (M1) at top.

Model	Residual df	Residual deviance	F	p value	AIC
I-M1: $ln(S_t) = \alpha + p(ln(N_{t-1})) + \epsilon$	14	1.97			19.6
($R^2 adj$ = 14%, Var(ϵ) = 0.14)					
V = Jul-Sep Chlorophyll					
II: $ln(S_t) = M1 + \beta V_t$	13	1.68	0.74	0.41	18.93
($R^2 adj$ = 26%, Var(ϵ) = 0.13)					
III: $ln(S_t) = M1 + p(V_t)$	12	1.68	0.02	0.878	20.89
($R^2 adj$ = 20%, Var(ϵ) = 0.14)					
IV: $ln(S_t) = M1 + p(V_t) + \beta V_{t-1}$	11	1.67	0.08	0.781	22.76
($R^2 adj$ = 13%, Var(ϵ) = 0.15)					
V: $ln(S_t) = M1 + p(V_t) + p(V_{t-1})$	10	1.64	0.16	0.694	24.48
($R^2 adj$ = 6%, Var(ϵ) = 0.16)					
V = Oct-Dec Chlorophyll					
II: $ln(S_t) = M1 + \beta V_{t-1}$	13	1.79	0.12	0.733	19.95
($R^2 adj$ = 21%, Var(ϵ) = 0.14)					
III: $ln(S_t) = M1 + p(V_{t-1})$	12	1.68	0.73	0.408	20.94
($R^2 adj$ = 20%, Var(ϵ) = 0.14)					
V = Jan-Mar Chlorophyll					
II: $ln(S_t) = M1 + \beta V_{t-1}$	13	1.79	0.07	0.798	20.02
($R^2 adj$ = 21%, Var(ϵ) = 0.14)					
III: $ln(S_t) = M1 + p(V_{t-1})$	12	1.77	0.13	0.721	21.83
($R^2 adj$ = 15%, Var(ϵ) = 0.15)					

Table C2. Model selection tests of Chlorophyll-a as an explanatory variable for the catch during the non-spawning months (Oct-Jun) using 1998 to 2014 data. The data range is determined by the years for which CHL was available. N_t is the catch during Oct-Jun of season t. V_t is the covariate in the current season which spans two calendar years from July to June in the next year. V_{t-1} is the covariate in the prior Jul-Jun season. Non-linearity is modeled as a 2nd-order polynomial due to data constraints and appears as $p()$ in the model equations. The non-spawner catch is modeled as a function of non-spawner catch in the prior year only, without spawner catch 2-years prior as in the other covariate analyses (Appendix B). This is done due to data constraints. The models are nested; the roman numeral indicates the level of nestedness. Models at levels II and higher are shown with the component that is added to the base level model (M1) at top.

Model	Residual df	Residual deviance	F	p value	AIC
I-M1: $ln(N_t) = \alpha + p(ln(N_{t-1})) + \epsilon$ ($R^2adj = 14\%$, Var(ϵ) = 0.14)	14	1.97			19.6
V = Jul-Sep Chlorophyll					
II: $ln(N_t) = M1 + \beta V_t$ ($R^2adj = 8\%$, Var(ϵ) = 0.15)	13	1.96	0.06	0.815	21.52
III: $ln(N_t) = M1 + p(V_t)$ ($R^2adj = 5\%$, Var(ϵ) = 0.16)	12	1.87	0.54	0.478	22.69
II: $ln(N_t) = M1 + \beta V_{t-1}$ ($R^2adj = 10\%$, Var(ϵ) = 0.15)	13	1.92	0.32	0.582	21.17
III: $ln(N_t) = M1 + p(V_{t-1})$ ($R^2adj = 4\%$, Var(ϵ) = 0.16)	11.6	1.87	0.22	0.731	22.75
V = Oct-Dec Chlorophyll					
II: $ln(N_t) = M1 + \beta V_t$ ($R^2adj = 11\%$, Var(ϵ) = 0.14)	13	1.88	0.77	0.402	20.84
III: $ln(N_t) = M1 + p(V_t)$ ($R^2adj = 13\%$, Var(ϵ) = 0.14)	12	1.71	1.55	0.241	21.17
IV: $ln(N_t) = M1 + p(V_t) + \beta V_{t-1}$ ($R^2adj = 36\%$, Var(ϵ) = 0.1)	11	1.14	4.99	0.05	16.37
V: $ln(N_t) = M1 + p(V_t) + p(V_{t-1})$ ($R^2adj = 31\%$, Var(ϵ) = 0.11)	10	1.13	0.12	0.733	18.16
II: $ln(N_t) = M1 + \beta V_{t-1}$ ($R^2adj = 29\%$, Var(ϵ) = 0.12)	13	1.5	4.32	0.063	16.96
III: $ln(N_t) = M1 + p(V_{t-1})$ ($R^2adj = 33\%$, Var(ϵ) = 0.11)	10.3	1.2	1.03	0.409	17.14
V = Jan-Mar Chlorophyll					
II: $ln(N_t) = M1 + \beta V_t$ ($R^2adj = 7\%$, Var(ϵ) = 0.15)	13	1.97	0	0.972	21.6
III: $ln(N_t) = M1 + p(V_t)$ ($R^2adj = 7\%$, Var(ϵ) = 0.15)	12	1.82	0.93	0.358	22.23
II: $ln(N_t) = M1 + \beta V_{t-1}$ ($R^2adj = 21\%$, Var(ϵ) = 0.13)	13	1.67	2.14	0.171	18.78
III: $ln(N_t) = M1 + p(V_{t-1})$ ($R^2adj = 14\%$, Var(ϵ) = 0.14)	11	1.63	0.12	0.884	21.25

Table C3. Model selection tests of Chlorophyll-a as an explanatory variable for the catch during the non-spawning months (Oct-Jun) using box 5.

Model	Residual df	Residual deviance	F	p value	AIC
I-M1: $ln(N_t) = \alpha + p(ln(N_{t-1})) + \epsilon$ (R^2adj = 14%, Var(ϵ) = 0.14)	14	1.97			19.6
V = Jul-Sep Chlorophyll					
II: $ln(N_t) = M1 + \beta V_t$ (R^2adj = 21%, Var(ϵ) = 0.13)	13	1.67	2.01	0.187	18.76
III: $ln(N_t) = M1 + p(V_t)$ (R^2adj = 15%, Var(ϵ) = 0.14)	12	1.66	0.05	0.836	20.69
II: $ln(N_t) = M1 + \beta V_{t-1}$ (R^2adj = 10%, Var(ϵ) = 0.15)	13	1.91	0.46	0.512	21.04
III: $ln(N_t) = M1 + p(V_{t-1})$ (R^2adj = 15%, Var(ϵ) = 0.14)	10.5	1.53	1.09	0.383	21.19
V = Oct-Dec Chlorophyll					
II: $ln(N_t) = M1 + \beta V_t$ (R^2adj = 27%, Var(ϵ) = 0.12)	13	1.55	4.22	0.067	17.57
III: $ln(N_t) = M1 + p(V_t)$ (R^2adj = 31%, Var(ϵ) = 0.11)	12	1.35	2.11	0.177	17.13
IV: $ln(N_t) = M1 + p(V_t) + \beta V_{t-1}$ (R^2adj = 44%, Var(ϵ) = 0.09)	11	1	3.51	0.091	14.1
V: $ln(N_t) = M1 + p(V_t) + p(V_{t-1})$ (R^2adj = 40%, Var(ϵ) = 0.1)	10	0.98	0.18	0.684	15.8
II: $ln(N_t) = M1 + \beta V_{t-1}$ (R^2adj = 35%, Var(ϵ) = 0.11)	13	1.37	5.15	0.044	15.47
III: $ln(N_t) = M1 + p(V_{t-1})$ (R^2adj = 29%, Var(ϵ) = 0.12)	11	1.35	0.11	0.895	17.89
V = Jan-Mar Chlorophyll					
II: $ln(N_t) = M1 + \beta V_t$ (R^2adj = 25%, Var(ϵ) = 0.12)	13	1.59	3.35	0.097	17.92
III: $ln(N_t) = M1 + p(V_t)$ (R^2adj = 20%, Var(ϵ) = 0.13)	12	1.57	0.17	0.692	19.72
II: $ln(N_t) = M1 + \beta V_{t-1}$ (R^2adj = 19%, Var(ϵ) = 0.13)	13	1.72	2.78	0.125	19.33
III: $ln(N_t) = M1 + p(V_{t-1})$ (R^2adj = 46%, Var(ϵ) = 0.09)	10.4	0.98	3.25	0.071	13.58