Rahel Sollmann, Beth Gardner, Richard B. Chandler, J. Andrew Royle, T. Scott Sillett.

Year. An open population hierarchical distance sampling model. *Ecology* XXX.

APPENDIX C. Simulation results for parameters associated with abundance and detection from Markov data analyzed with Markov and log-linear trend model.

Methods

We simulated island scrub-jay abundance under a Markovian model assuming temporal autocorrelation in abundance at sites across primary occasions, T, with population rates of change γ of 0.9 and 0.95 (Eq. 1). Conditional on these N_{jt} we generated distance sampling data, as described in Appendix A. We performed these simulations using all 307 sampling points, as well as random subsets of 200 and 100 points. We generated 100 data sets for each scenario and analyzed them with the data generating model and with the log-linear trend model (Eq. 3). This Appendix gives the average estimates of model parameters associated with abundance and detection, with root mean square error (rmse), average relative bias, and 95% Bayesian confidence interval.

Results

Correlated abundance data and Markov model

TABLE C1. Simulation results for estimating open population distance sampling parameters related to abundance (λ) and detection (σ) under two population rates of change (γ), using a Markovian model on abundance, with 307 sampling points; mean parameter estimate (Mean),

root mean square error (RMSE), relative bias (Bias), and 95% confidence interval coverage (CI coverage) across 100 simulations.

Parameter	γ	True value[c]	Mean	RMSE	Bias	CI coverage
λ (Intercept)	0.90	0.83	0.751	0.159	-0.091	92
	0.95		0.758	0.162	-0.082	95
λ (chap)[a]	0.90	1.43	1.377	0.165	-0.038	95
	0.95		1.352	0.191	-0.056	91
λ (chap^2)[a]	0.90	-0.38	-0.392	0.107	0.043	96
	0.95		-0.381	0.113	0.013	94
λ (elev)[b]	0.90	-0.23	-0.229	0.125	0.011	94
	0.95		-0.243	0.114	0.073	97
r	0.90	-1.03	-0.869	0.228	-0.147	30
	0.95		-0.891	0.195	-0.125	89
σ (Intercept)	0.90	4.68	4.698	0.032	0.004	85
	0.95		4.702	0.036	0.005	85
σ (chap)[a]	0.90	-0.20	-0.171	0.036	-0.141	78
	0.95		-0.172	0.034	-0.135	75

a. Percent chaparral in survey plot with 300-m radius

b. Elevation of survey plot

c. Values taken from Sillett et al. (2012)

TABLE C2. Simulation results for estimating open population distance sampling parameters related to abundance (λ) and detection (σ) under two population rates of change (γ), using a Markovian model, with 200 sampling points; mean parameter estimate (Mean), root mean square error (RMSE), relative bias (Bias), and 95% confidence interval coverage (CI coverage) across 100 simulations.

Parameter	γ	True value[c]	Mean	RMSE	Bias	CI coverage
λ (Intercept)	0.90	0.83	0.729	0.227	-0.118	91
	0.95		0.773	0.202	-0.064	93
λ (chap)[a]	0.90	1.43	1.393	0.212	-0.027	98
	0.95		1.384	0.188	-0.033	97
λ (chap^2) [a]	0.90	-0.38	-0.38	0.139	0.011	92
	0.95		-0.409	0.141	0.089	94
λ (elev)[b]	0.90	-0.23	-0.249	0.157	0.097	97
	0.95		-0.219	0.192	-0.036	86
r	0.90	-1.03	-0.855	0.264	-0.161	94
	0.95		-0.847	0.27	-0.168	91
σ (Intercept)	0.90	4.68	4.697	0.04	0.004	90
	0.95		4.698	0.035	0.004	90
σ (chap) [a]	0.90	-0.20	-0.171	0.041	-0.139	80
	0.95		-0.172	0.038	-0.135	82

a. Percent chaparral in survey plot with 300-m radius

b. Elevation of survey plot

c. Values taken from Sillett et al. (2012)

TABLE C3. Simulation results for estimating open population distance sampling parameters related to abundance (λ) and detection (σ) under two population rates of change (γ), using a Markovian model on abundance, with 100 sampling points; mean parameter estimate (Mean), root mean square error (RMSE), relative bias (Bias), and 95% confidence interval coverage (CI coverage) across 100 simulations.

Parameter	γ	True value[c]	Mean	RMSE	Bias	CI coverage
λ (Intercept)	0.90	0.83	0.721	0.321	-0.128	93
	0.95		0.735	0.306	-0.11	92
λ (chap)[a]	0.90	1.43	1.383	0.313	-0.035	94
	0.95		1.436	0.3	0.002	95
λ (chap^2) [a]	0.90	-0.38	-0.428	0.301	0.141	90
	0.95		-0.421	0.23	0.121	95
λ (elev)[b]	0.90	-0.23	-0.212	0.24	-0.065	94
	0.95		-0.258	0.268	0.139	92
r	0.90	-1.03	-0.799	0.432	-0.216	84
	0.95		-0.845	0.361	-0.171	92
σ (Intercept)	0.90	4.68	4.698	0.051	0.004	91
	0.95		4.7	0.049	0.004	91
σ (chap) [a]	0.90	-0.20	-0.166	0.052	-0.168	87
	0.95		-0.166	0.051	-0.166	90

a. Percent chaparral in survey plot with 300-m radius

b. Elevation of survey plot

c. Values taken from Sillett et al. (2012)

Correlated abundance data and log-linear trend model

TABLE C4. Simulation results for estimating open population distance sampling parameters related to abundance (λ) and detection (σ) under two population rates of change (γ), using an log-linear trend model on abundance data generated under the Markovian model, with 307 sampling points; mean parameter estimate (Mean), root mean square error (RMSE), relative bias (Bias), and 95% confidence interval coverage (CI coverage) across 100 simulations.

Parameter	γ	True value[c]	Mean	RMSE	Bias	CI coverage
λ (Intercept)	0.90	0.83	0.681	0.227	-0.176	70
	0.95		0.685	0.199	-0.171	75
λ (chap)[a]	0.90	1.43	1.397	0.21	-0.024	60
	0.95		1.414	0.178	-0.013	70
λ (chap^2)[a]	0.90	-0.38	-0.389	0.14	0.037	59
	0.95		-0.395	0.116	0.051	63
λ (elev)[b]	0.90	-0.23	-0.23	0.141	0.011	65
	0.95		-0.231	0.147	0.017	62
r	0.90	-1.03	-1.194	0.25	0.172	50
	0.95		-1.239	0.276	0.216	42
σ (Intercept)	0.90	4.68	4.719	0.049	0.009	66
	0.95		4.719	0.049	0.008	67
σ (chap)[a]	0.90	-0.20	-0.177	0.032	-0.11	87
	0.95		-0.182	0.03	-0.088	84

a. Percent chaparral in survey plot with 300-m radius

b. Elevation of survey plot

c. Values taken from Sillett et al. (2012)

TABLE C5. Simulation results for estimating open population distance sampling parameters related to abundance (λ) and detection (σ) under two population rates of change (γ), using a log-linear trend model on abundance data generated under the Markovian model, with 200 sampling points; mean parameter estimate (Mean), root mean square error (RMSE), relative bias (Bias), and 95% confidence interval coverage (CI coverage) across 100 simulations.

Parameter	γ	True value[c]	Mean	RMSE	Bias	CI coverage
λ (Intercept)	0.90	0.83	0.603	0.321	-0.27	64
	0.95		0.664	0.233	-0.197	82
λ (chap)[a]	0.90	1.43	1.425	0.214	-0.005	77
	0.95		1.464	0.246	0.022	60
λ (chap^2)[a]	0.90	-0.38	-0.382	0.152	0.018	66
	0.95		-0.433	0.159	0.153	65
λ (elev)[b]	0.90	-0.23	-0.279	0.195	0.228	59
	0.95		-0.243	0.202	0.069	58
r	0.90	-1.03	-1.225	0.314	0.203	49
	0.95		-1.265	0.331	0.241	43
σ (Intercept)	0.90	4.68	4.765	0.095	0.018	34
	0.95		4.77	0.1	0.019	25
σ (chap)[a]	0.90	-0.20	-0.009	0.194	-0.956	0
	0.95		-0.011	0.191	-0.943	0

a. Percent chaparral in survey plot with 300-m radius

b. Elevation of survey plot

c. Values taken from Sillett et al. (2012)

TABLE C6. Simulation results for estimating open population distance sampling parameters related to abundance (λ) and detection (σ) under two population rates of change (γ), using a log-linear trend model on abundance data generated under the Markovian model, with 100 sampling points; mean parameter estimate (Mean), root mean square error (RMSE), relative bias (Bias), and 95% confidence interval coverage (CI coverage) across 100 simulations.

Parameter	γ	True value[c]	Mean	RMSE	Bias	CI coverage
λ (Intercept)	0.90	0.83	0.623	0.363	-0.246	77
	0.95		0.625	0.369	-0.244	78
λ (chap)[a]	0.90	1.43	1.505	0.376	0.051	65
	0.95		1.584	0.426	0.106	67
λ (chap^2)[a]	0.90	-0.38	-0.423	0.239	0.126	62
	0.95		-0.451	0.271	0.202	57
λ (elev)[b]	0.90	-0.23	-0.201	0.242	-0.114	71
	0.95		-0.286	0.294	0.258	58
r	0.90	-1.03	-1.129	0.27	0.108	72
	0.95		-1.148	0.28	0.127	67
σ (Intercept)	0.90	4.68	4.829	0.163	0.032	23
	0.95		4.835	0.167	0.033	13
σ (chap)[a]	0.90	-0.20	0.003	0.209	-1.014	4
	0.95		0.006	0.21	-1.028	0

a. Percent chaparral in survey plot with 300-m radius

b. Elevation of survey plot

c. Values taken from Sillett et al. (2012)

LITERATURE CITED

Sillett, S., R. B. Chandler, J. A. Royle, M. Kéry, and S. A. Morrison. 2012. Hierarchical distance

sampling models to estimate population size and habitat-specific abundance of an island

endemic. Ecological Applications 22:1997–2006.