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Philip J. Harrison, Ilkka Hanski, and Otso Ovaskainen. 2011. Bayesian state-space modeling of metapopulation dynamics in the Glanville fritillary butterfly. *Ecological Monographs* 81:581–598.

Appendix F. MCMC (Markov chain Monte Carlo) mixing and correlations between parameters.

For the mark-recapture model we ran the MCMC for 10,000 iterations, out of which we ignored the first 1,000 as a transient. For the final results of fitting the main SSMs to the data, five independent chains were run from dispersed starting values (based on independent random draws from the joint prior distribution). The Gelman and Rubin's convergence diagnostic (Gelman and Rubin 1992), implemented in R Version 2.6.2 (R Development Core Team 2008), was applied to ensure that the chains had adequately converged to the stationary distribution. The results of the chains were then joined together for the final inference. The mixing within the chains was somewhat slower for the IBM than the SPOM, and we therefore took a conservative approach whereby for the IBM we had an adaptive phase of 100,000 iterations, after which we ran each chain for another 1,000,000 iterations and thinned the output by saving every 2,000th iteration. The final results were thus based on 2,500 draws from the posterior. For the SPOM the adaptive phase was 2,000 iterations, after which each chain was run for 5,000 iterations and thinned by saving every 100th iteration. The iteration plots for the final draws for the IBM and the SPOM, showing the mixing of the chains, can be seen in Figs. F1 and F2, respectively. The matrices below show the correlations between model parameters in the posterior distributions for the IBM and SPOM respectively.

Correlations between the main parameters in the IBM:

	ϕ	e_{μ}	e_{σ}	n_h^0	t_{μ}^*	t_{σ}^*	p_{μ}	p_{σ}	q_k	D_1	D_2	m	k_{μ}	q_{μ}	q_r	q_e
ϕ	1	-0.003	0.001	0	0.148	0.019	0.039	-0.003	-0.032	-0.04	-0.05	-0.043	-0.055	-0.007	-0.065	-0.008
e_{μ}	-0.003	1	0.108	-0.091	-0.016	0.019	0.033	0.015	0.006	0.027	-0.024	0.003	0.017	-0.04	0.016	0.028
e_{σ}	0.001	0.108	1	0.247	-0.009	0.028	0.016	-0.03	-0.069	-0.086	0.025	-0.005	-0.077	0.026	0	-0.041
n_h^0	0	-0.091	0.247	1	0.158	0.04	-0.029	0.146	-0.175	-0.369	0.028	-0.08	-0.358	0.023	-0.064	0.125
t_{μ}^*	0.148	-0.016	-0.009	0.158	1	0.155	-0.176	0.057	0.293	0.188	0.121	0.045	0.266	0.145	0.18	0.102
t_{σ}^*	0.019	0.019	0.028	0.04	0.155	1	-0.073	0.004	-0.053	-0.053	0.023	0.043	-0.054	0.049	0.031	0.003
p_{μ}	0.039	0.033	0.016	-0.029	-0.176	-0.073	1	0.122	0.032	0.145	-0.028	-0.068	0.099	-0.23	-0.078	0.013
p_{σ}	-0.003	0.015	-0.03	0.146	0.057	0.004	0.122	1	-0.068	-0.07	-0.007	-0.036	-0.088	0.046	-0.021	0.048
q_k	-0.032	0.006	-0.069	-0.175	0.293	-0.053	0.032	-0.068	1	0.445	-0.06	-0.009	0.353	-0.139	0.098	0.023
D_1	-0.04	0.027	-0.086	-0.369	0.188	-0.053	0.145	-0.07	0.445	1	-0.078	0.423	0.932	-0.249	0.04	0.101
D_2	-0.05	-0.024	0.025	0.028	0.121	0.023	-0.028	-0.007	-0.06	-0.078	1	-0.113	0.032	-0.003	0.036	0.085
m	-0.043	0.003	-0.005	-0.08	0.045	0.043	-0.068	-0.036	-0.009	0.423	-0.113	1	0.495	0.002	0.123	0.099
k_{μ}	-0.055	0.017	-0.077	-0.358	0.266	-0.054	0.099	-0.088	0.353	0.932	0.032	0.495	1	-0.229	0.081	0.141
q_{μ}	-0.007	-0.04	0.026	0.023	0.145	0.049	-0.23	0.046	-0.139	-0.249	-0.003	0.002	-0.229	1	-0.647	-0.124
q_r	-0.065	0.016	0	-0.064	0.18	0.031	-0.078	-0.021	0.098	0.04	0.036	0.123	0.081	-0.647	1	-0.142
q_e	-0.008	0.028	-0.041	0.125	0.102	0.003	0.013	0.048	0.023	0.101	0.085	0.099	0.141	-0.124	-0.142	1

Correlations between the main parameters in the SPOM:

	ϕ	e_{μ}	e_{σ}	n_h^0	t_{μ}^*	t_{σ}^*	z	ρ	q_k	D_1	D_2	m	k_{μ}	q_{μ}	q_r	q_e
ϕ	1	-0.001	0.022	-0.017	-0.024	-0.005	0.035	-0.017	0.019	-0.015	0.016	0.019	-0.008	-0.057	-0.041	-0.012
e_{μ}	-0.001	1	0.085	-0.022	0.019	0.096	-0.05	-0.052	0.003	0.037	-0.025	0.042	0.034	-0.054	-0.039	-0.034
e_{σ}	0.022	0.085	1	-0.045	-0.009	-0.267	0.013	0.029	0.049	-0.001	0.029	-0.013	-0.003	0.029	0.028	-0.002
n_h^0	-0.017	-0.022	-0.045	1	0.111	0.023	0.057	-0.136	-0.015	-0.077	0.051	-0.002	-0.073	-0.171	-0.116	-0.074
t_{μ}^*	-0.024	0.019	-0.009	0.111	1	0.026	0.021	0.15	-0.034	0.05	0.027	0.026	0.066	0.205	0.092	0.071
t_{σ}^*	-0.005	0.096	-0.267	0.023	0.026	1	-0.012	-0.034	0.005	0.019	-0.002	-0.072	0	-0.007	-0.062	-0.004
z	0.035	-0.05	0.013	0.057	0.021	-0.012	1	0.13	0.128	-0.211	0.095	0.065	-0.137	0.041	-0.034	0.053
ρ	-0.017	-0.052	0.029	-0.136	0.15	-0.034	0.13	1	0.005	-0.133	0.033	0.01	-0.131	-0.432	-0.225	-0.131
q_k	0.019	0.003	0.049	-0.015	-0.034	0.005	0.128	0.005	1	0.111	0.051	-0.014	0.118	0.011	-0.067	0.034
D_1	-0.015	0.037	-0.001	-0.077	0.05	0.019	-0.211	-0.133	0.111	1	-0.218	0.283	0.918	-0.103	-0.092	-0.065
D_2	0.016	-0.025	0.029	0.051	0.027	-0.002	0.095	0.033	0.051	-0.218	1	-0.108	-0.072	-0.041	0.017	0.049
m	0.019	0.042	-0.013	-0.002	0.026	-0.072	0.065	0.01	-0.014	0.283	-0.108	1	0.409	-0.005	0.002	0.077
k_{μ}	-0.008	0.034	-0.003	-0.073	0.066	0	-0.137	-0.131	0.118	0.918	-0.072	0.409	1	-0.108	-0.1	-0.022
q_{μ}	-0.057	-0.054	0.029	-0.171	0.205	-0.007	0.041	-0.432	0.011	-0.103	-0.041	-0.005	-0.108	1	-0.23	-0.107
q_r	-0.041	-0.039	0.028	-0.116	0.092	-0.062	-0.034	-0.225	-0.067	-0.092	0.017	0.002	-0.1	-0.23	1	-0.098
q_e	-0.012	-0.034	-0.002	-0.074	0.071	-0.004	0.053	-0.131	0.034	-0.065	0.049	0.077	-0.022	-0.107	-0.098	1

LITERATURE CITED

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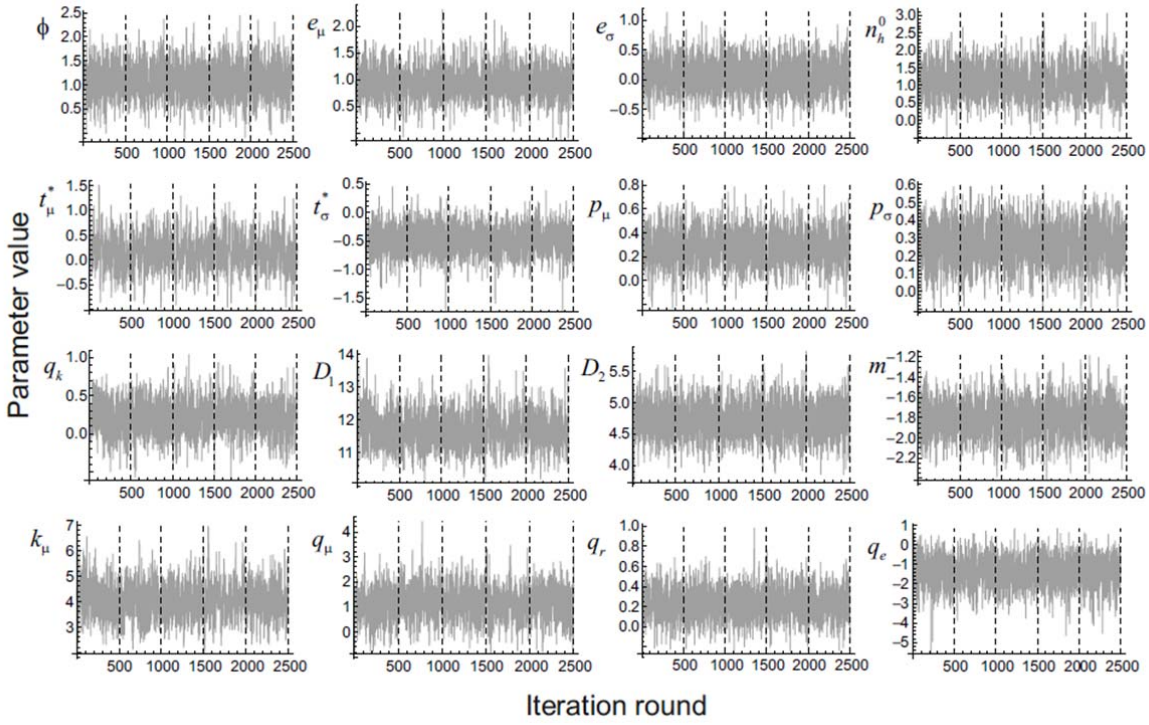

FIG. F1. Iteration plots showing the mixing of the MCMC chains for the main model parameters for the IBM. The dotted black lines demark the results for the five independent chains that were run. Distributions on the logit scale for ϕ and the log scale for all other parameters except those on the real scale (e_μ ,t_μ^*, k_μ, q_μ, q_r and p_μ). Parameter descriptions are given in Table A1.

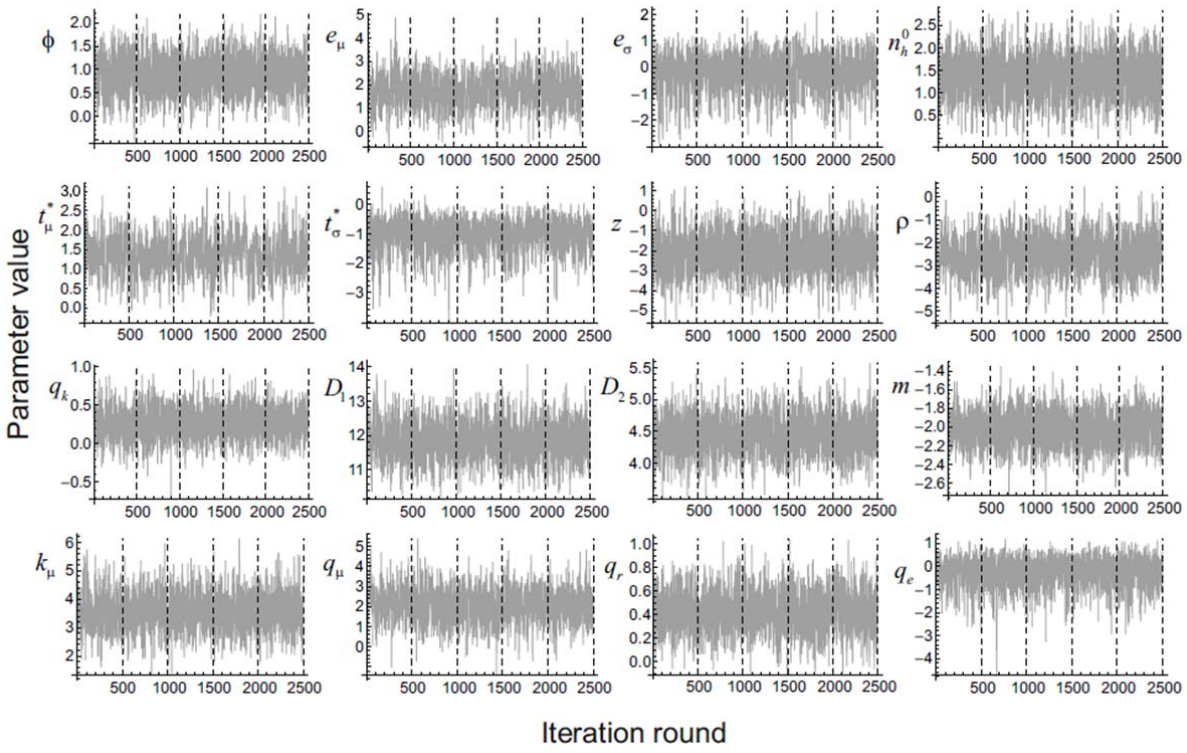

FIG. F2. Iteration plots showing the mixing of the MCMC chains for the main model parameters for the SPOM. The dotted black lines demark the results for the five independent chains that were run. Distributions on the logit scale for ϕ and z and the log scale for all other parameters except those on the real scale (e_μ , t^*_μ, k_μ, q_μ and q_r). Parameter descriptions are given in Table A1.