

Supplementary Materials

Appendix S1. Median parameter estimates and 95% confidence limits from our Model 3 of probabilities of occupancy in 23 native forest bird taxa (species) in 2155 squares of 10×10 km across New Zealand. Estimates are shown on the logit scale of the data, and the medians and confidence limits are derived from the mean parameter estimates in 1000 iterations of the model, each using a different draw from the posterior distribution of local occupancy estimates for each species (Walker & Monks 2018). Time = a contrast between our second measurement period (1999–2004) and the first (1969–1979); bs(Forest)1, bs(Forest)2, and bs(Forest)3 = the three terms of a basis function, which is a generalised additive model with a 3 df regression spline smooth of indigenous forest cover; Temperature = median mean annual temperature across land in the square; Endemism = an ordinal variable of four integers representing the following levels (1 = non-endemic, 2 = species-level endemic, 3 = genus-level endemic and 4 = deep endemic (endemic at subfamily, family or order levels)).

Term	Median estimate	Lower 95% CL	Upper 95% CL
(Intercept)	-2.34	-2.40	-2.29
Time	-0.20	-0.26	-0.14
bs(Forest)1	1.30	1.19	1.41
bs(Forest)2	0.69	0.59	0.78
bs(Forest)3	1.56	1.47	1.64
Temperature	-0.35	-0.38	-0.31
Endemism	-0.75	-0.81	-0.69
Time:bs(Forest)1	-0.14	-0.29	0.01
Time:bs(Forest)2	-0.17	-0.30	-0.03
Time:bs(Forest)3	-0.25	-0.37	-0.14
Time:Temperature	0.10	0.05	0.15
bs(Forest)1:Temperature	-0.18	-0.28	-0.07
bs(Forest)2:Temperature	-0.06	-0.18	0.05
bs(Forest)3:Temperature	0.03	-0.08	0.14
Time:Endemism	-0.30	-0.37	-0.24
bs(Forest)1:Endemism	0.28	0.18	0.38
bs(Forest)2:Endemism	0.11	0.03	0.20
bs(Forest)3:Endemism	0.27	0.19	0.35
Temperature:Endemism	-0.17	-0.21	-0.14
Time:bs(Forest)1:Temperature	-0.21	-0.36	-0.07
Time:bs(Forest)2:Temperature	-0.13	-0.28	0.02
Time:bs(Forest)3:Temperature	-0.30	-0.45	-0.14
Time:bs(Forest)1:Endemism	-0.26	-0.41	-0.12
Time:bs(Forest)2:Endemism	0.14	0.02	0.26
Time:bs(Forest)3:Endemism	-0.18	-0.30	-0.07
Time:Temperature:Endemism	-0.03	-0.08	0.02
bs(Forest)1:Temperature:Endemism	-0.01	-0.09	0.10
bs(Forest)2:Temperature:Endemism	-0.13	-0.23	-0.03
bs(Forest)3:Temperature:Endemism	0.08	-0.01	0.18
Time:bs(Forest)1:Temperature:Endemism	-0.11	-0.25	0.03

Appendix S2. Median parameter estimates and 95% confidence limits from our Model 6 of probabilities of occupancy in 23 native forest bird taxa (species) in 2155 squares of 10×10 km across New Zealand. Estimates are shown on the logit scale of the data, and the medians and confidence limits are derived from the mean parameter estimates in 1000 iterations of the model, each using a different draw from the posterior distribution of local occupancy estimates for each species (Walker & Monks 2018). Time = a contrast between our second measurement period (1999–2004) and the first (1969–1979); Cavnest, Bodymass and Mobility = terms representing obligate cavity nesting, mean adult body mass, and mobility respectively; bs(Forest)1, bs(Forest)2, and bs(Forest)3 = the three terms of a basis function, which is a generalised additive model with a 3 df regression spline smooth of indigenous forest cover; Temperature = median mean annual temperature; Endemism level = an ordinal variable of four integers (1 = non-endemic, 2 = species-level endemic, 3 = genus-level endemic and 4 = deep endemic (endemic at subfamily, family or order levels)).

Term	Median estimate	Lower 95% CL	Upper 95% CL
(Intercept)	-2.71	-2.86	-2.54
Time	-0.58	-0.73	-0.43
Cavnest	-1.64	-1.93	-1.34
Bodymass	-1.83	-2.03	-1.66
Mobility	1.55	1.35	1.71
bs(Forest)1	0.71	0.44	0.99
bs(Forest)2	1.51	1.27	1.77
bs(Forest)3	1.80	1.59	2.02
Temperature	-0.89	-0.98	-0.80
Time:Cavnest	-0.13	-0.44	0.18

Appendix S2. Continued.

Term	Median estimate	Lower 95% CL	Upper 95% CL
Time:Bodymass	-0.66	-0.81	-0.51
Cavnest:Bodymass	1.94	1.69	2.24
Time:Mobility	0.81	0.64	0.98
Cavnest:Mobility	-0.51	-0.85	-0.17
Bodymass:Mobility	0.86	0.64	1.14
Time:bs(Forest)1	0.02	-0.33	0.39
Time:bs(Forest)2	-0.05	-0.35	0.27
Time:bs(Forest)3	-0.41	-0.70	-0.14
Cavnest:bs(Forest)1	0.54	0.03	1.09
Cavnest:bs(Forest)2	-1.17	-1.60	-0.72
Cavnest:bs(Forest)3	-0.41	-0.83	0.03
Bodymass:bs(Forest)1	-0.90	-1.16	-0.60
Bodymass:bs(Forest)2	-0.06	-0.31	0.18
Bodymass:bs(Forest)3	-0.44	-0.64	-0.24
Mobility:bs(Forest)1	1.00	0.69	1.29
Mobility:bs(Forest)2	-1.19	-1.48	-0.91
Mobility:bs(Forest)3	-0.28	-0.52	-0.04
Time:Temperature	0.10	-0.03	0.22
Cavnest:Temperature	0.42	0.25	0.58
Bodymass:Temperature	-0.08	-0.17	0.01
Mobility:Temperature	0.88	0.78	0.97
bs(Forest)1:Temperature	-0.14	-0.42	0.14
bs(Forest)2:Temperature	0.03	-0.29	0.32
bs(Forest)3:Temperature	0.12	-0.17	0.41
Time:Endemism	-0.12	-0.20	-0.05
Time:Cavnest:Bodymass	0.58	0.32	0.83
Time:Cavnest:Mobility	-0.72	-1.11	-0.30
Time:Bodymass:Mobility	0.47	0.30	0.64
Cavnest:Bodymass:Mobility	-0.33	-0.66	0.01
Time:Cavnest:bs(Forest)1	-0.32	-1.02	0.45
Time:Cavnest:bs(Forest)2	0.33	-0.34	0.89
Time:Cavnest:bs(Forest)3	0.18	-0.40	0.74
Time:Bodymass:bs(Forest)1	-0.04	-0.42	0.30
Time:Bodymass:bs(Forest)2	0.28	-0.06	0.59
Time:Bodymass:bs(Forest)3	-0.33	-0.58	-0.06
Cavnest:Bodymass:bs(Forest)1	1.47	1.08	1.90
Cavnest:Bodymass:bs(Forest)2	-0.27	-0.58	0.05
Cavnest:Bodymass:bs(Forest)3	0.67	0.36	1.00
Time:Mobility:bs(Forest)1	-0.33	-0.73	0.06
Time:Mobility:bs(Forest)2	-0.27	-0.63	0.09
Time:Mobility:bs(Forest)3	0.09	-0.24	0.40
Cavnest:Mobility:bs(Forest)1	-1.43	-2.17	-0.72
Cavnest:Mobility:bs(Forest)2	1.92	1.29	2.59
Cavnest:Mobility:bs(Forest)3	0.43	-0.16	0.99
Bodymass:Mobility:bs(Forest)1	1.21	0.89	1.49
Bodymass:Mobility:bs(Forest)2	0.04	-0.23	0.30
Bodymass:Mobility:bs(Forest)3	0.96	0.72	1.19
Time:Cavnest:Temperature	0.07	-0.18	0.32
Time:Bodymass:Temperature	-0.06	-0.19	0.06
Cavnest:Bodymass:Temperature	0.44	0.31	0.57
Time:Mobility:Temperature	0.00	-0.13	0.14
Cavnest:Mobility:Temperature	-1.22	-1.44	-1.00
Bodymass:Mobility:Temperature	-0.07	-0.17	0.03
Time:bs(Forest)1:Temperature	-0.14	-0.50	0.25
Time:bs(Forest)2:Temperature	-0.06	-0.43	0.34
Time:bs(Forest)3:Temperature	-0.37	-0.73	0.03
Cavnest:bs(Forest)1:Temperature	0.16	-0.35	0.63
Cavnest:bs(Forest)2:Temperature	-0.48	-1.00	0.05
Cavnest:bs(Forest)3:Temperature	0.26	-0.26	0.74
Bodymass:bs(Forest)1:Temperature	0.30	0.04	0.57
Bodymass:bs(Forest)2:Temperature	-0.63	-0.89	-0.36
Bodymass:bs(Forest)3:Temperature	-0.08	-0.32	0.18
Mobility:bs(Forest)1:Temperature	-0.05	-0.35	0.25
Mobility:bs(Forest)2:Temperature	0.01	-0.30	0.36
Mobility:bs(Forest)3:Temperature	-0.05	-0.40	0.26
Time:Cavnest:Bodymass:Mobility	-0.08	-0.46	0.31
Time:Cavnest:Bodymass:bs(Forest)1	0.13	-0.42	0.69
Time:Cavnest:Bodymass:bs(Forest)2	0.01	-0.44	0.48

Appendix S2. Continued.

Term	Median estimate	Lower 95% CL	Upper 95% CL
Time:Cavnest:Bodymass:bs(Forest)3	0.43	0.02	0.84
Time:Cavnest:Mobility:bs(Forest)1	0.69	-0.31	1.73
Time:Cavnest:Mobility:bs(Forest)2	-0.28	-1.19	0.72
Time:Cavnest:Mobility:bs(Forest)3	0.12	-0.70	0.96
Time:Bodymass:Mobility:bs(Forest)1	-0.13	-0.51	0.28
Time:Bodymass:Mobility:bs(Forest)2	0.04	-0.29	0.40
Time:Bodymass:Mobility:bs(Forest)3	0.10	-0.18	0.40
Cavnest:Bodymass:Mobility:bs(Forest)1	-0.81	-1.52	-0.14
Cavnest:Bodymass:Mobility:bs(Forest)2	-0.68	-1.32	0.06
Cavnest:Bodymass:Mobility:bs(Forest)3	-0.89	-1.46	-0.35
Time:Cavnest:Bodymass:Temperature	0.09	-0.10	0.29
Time:Cavnest:Mobility:Temperature	-0.15	-0.49	0.19
Time:Bodymass:Mobility:Temperature	0.03	-0.11	0.17
Cavnest:Bodymass:Mobility:Temperature	0.20	-0.01	0.43
Time:Cavnest:bs(Forest)1:Temperature	0.16	-0.58	0.84
Time:Cavnest:bs(Forest)2:Temperature	-0.40	-1.18	0.40
Time:Cavnest:bs(Forest)3:Temperature	-0.04	-0.83	0.66
Time:Bodymass:bs(Forest)1:Temperature	0.30	-0.06	0.66
Time:Bodymass:bs(Forest)2:Temperature	0.09	-0.25	0.44
Time:Bodymass:bs(Forest)3:Temperature	0.07	-0.28	0.41
Cavnest:Bodymass:bs(Forest)1:Temperature	0.37	-0.03	0.75
Cavnest:Bodymass:bs(Forest)2:Temperature	0.08	-0.31	0.46
Cavnest:Bodymass:bs(Forest)3:Temperature	0.48	0.10	0.84
Time:Mobility:bs(Forest)1:Temperature	-0.21	-0.62	0.21
Time:Mobility:bs(Forest)2:Temperature	0.16	-0.32	0.56
Time:Mobility:bs(Forest)3:Temperature	0.11	-0.32	0.55
Cavnest:Mobility:bs(Forest)1:Temperature	0.14	-0.51	0.82
Cavnest:Mobility:bs(Forest)2:Temperature	0.46	-0.26	1.19
Cavnest:Mobility:bs(Forest)3:Temperature	-0.61	-1.32	0.13
Bodymass:Mobility:bs(Forest)1:Temperature	0.00	-0.30	0.27
Bodymass:Mobility:bs(Forest)2:Temperature	0.62	0.34	0.92
Bodymass:Mobility:bs(Forest)3:Temperature	0.43	0.13	0.71
Time:Cavnest:Bodymass:Mobility:bs(Forest)1	0.26	-0.65	1.21
Time:Cavnest:Bodymass:Mobility:bs(Forest)2	-0.34	-1.33	0.55
Time:Cavnest:Bodymass:Mobility:bs(Forest)3	0.05	-0.76	0.81
Time:Cavnest:Bodymass:Mobility:Temperature	0.09	-0.25	0.42
Time:Cavnest:Bodymass:bs(Forest)1:Temperature	-0.55	-1.09	-0.01
Time:Cavnest:Bodymass:bs(Forest)2:Temperature	0.04	-0.53	0.53
Time:Cavnest:Bodymass:bs(Forest)3:Temperature	-0.17	-0.72	0.33
Time:Cavnest:Mobility:bs(Forest)1:Temperature	-0.36	-1.29	0.55
Time:Cavnest:Mobility:bs(Forest)2:Temperature	-0.13	-1.16	0.85
Time:Cavnest:Mobility:bs(Forest)3:Temperature	-0.41	-1.41	0.64
Time:Bodymass:Mobility:bs(Forest)1:Temperature	-0.46	-0.90	-0.06
Time:Bodymass:Mobility:bs(Forest)2:Temperature	0.13	-0.25	0.51
Time:Bodymass:Mobility:bs(Forest)3:Temperature	-0.33	-0.73	0.07
Cavnest:Bodymass:Mobility:bs(Forest)1:Temperature	-0.84	-1.48	-0.18
Cavnest:Bodymass:Mobility:bs(Forest)2:Temperature	-0.77	-1.45	0.00
Cavnest:Bodymass:Mobility:bs(Forest)3:Temperature	-0.64	-1.36	0.03
Time:Cavnest:Bodymass:Mobility:bs(Forest)1:Temperature	1.42	0.47	2.34
Time:Cavnest:Bodymass:Mobility:bs(Forest)2:Temperature	-0.48	-1.47	0.55
Time:Cavnest:Bodymass:Mobility:bs(Forest)3:Temperature	1.30	0.35	2.25
Endemism	-0.10	-0.19	-0.02
bs(Forest)1:Endemism	0.19	0.05	0.32
bs(Forest)2:Endemism	0.18	0.06	0.31
bs(Forest)3:Endemism	0.13	0.02	0.24
Temperature:Endemism	-0.13	-0.17	-0.09
Time:bs(Forest)1:Endemism	-0.23	-0.41	-0.04
Time:bs(Forest)2:Endemism	-0.06	-0.23	0.10
Time:bs(Forest)3:Endemism	-0.16	-0.30	-0.01
Time:Temperature:Endemism	-0.03	-0.09	0.03
bs(Forest)1:Temperature:Endemism	-0.02	-0.15	0.11
bs(Forest)2:Temperature:Endemism	-0.02	-0.16	0.12
bs(Forest)3:Temperature:Endemism	-0.05	-0.19	0.07
Time:bs(Forest)1:Temperature:Endemism	-0.20	-0.38	-0.01
Time:bs(Forest)2:Temperature:Endemism	0.05	-0.13	0.24
Time:bs(Forest)3:Temperature:Endemism	-0.14	-0.31	0.06