Appendix S3: Additional models results

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1. Models with traits

Specification of the models: We used `lme4` package to perform a GLMM with binomial (proportion) distribution. An example of the code for each dataset are as follows:

```
mhigh.spe <- glmer(cbind(occor, n.visit-occor) ~
                     forest_site400*lbody_size +
                     forest_site400*nest +
                     forest_site400*diet +
                     forest_site400*lower_stratum +
                     forest_land*lbody_size +
                     forest_land*nest +
                     forest_land*diet +
                     forest_land*lower_stratum +
                     (forest_site400 + forest_land|sp) +
                     (1|landscape:sp) + (1|site:sp) +
                     (lbody_size + nest + diet + lower_stratum|landscape) +
                     (lbody_size + nest + diet + lower_stratum|site),
                     family=binomial, data=high.spe,
                     nAGQ = 1, control = glmerControl(optimizer = "bobyqa",
                                    optCtrl = list(maxfun = 500000)))
```

We ran separate models for each assemblage and trait. Afterwards, we ran one model with the combination of the traits body mass, diet, nest type and % of lower strata use. Table S3.1 shows the marginal R^2 of all models terms.

2. Models coeficients

Tables S3.2, S3.3, S3.4, and S3.5 show the coefficients for each model.

Table S3.1: Overall and marginal R-squared of trait models in each dataset. For the marginal R-squared terms see Table 2 (main text).

Model	Total	trait*env	env|sp	lands:sp	site:sp	trait|lands	trait|site
Specialists							
High quality							
Combined	57.6	10.0	36.8	6.7	0.7	1.3	2.2
body mass	56.8	7.7	38.9	6.7	1.6	0.8	1.1
nest type	56.8	4.6	41.9	6.8	1.5	0.6	1.4
main diet	57.4	4.5	42.5	6.5	1.6	1.0	1.3
% frugivory	56.8	4.4	42.4	6.8	1.6	0.5	1.1
% insetivory	56.7	3.8	42.9	6.8	1.6	0.5	1.1
% lower strata	56.7	1.5	45.0	6.8	1.4	0.7	1.4
foraging stratum	56.7	2.0	44.5	6.5	1.5	0.8	1.3
hand-wing	56.6	1.6	44.9	6.8	1.2	0.5	1.6
Low quality							
Combined	71.9	22.2	39.9	3.8	1.0	0.9	4.0
body mass	70.5	15.8	45.6	3.8	2.4	0.1	2.7
nest type	71.0	17.3	44.5	3.9	2.2	0.0	3.1
main diet	71.4	18.4	43.8	3.7	2.5	0.4	2.5
% frugivory	71.3	17.2	45.1	3.8	2.6	0.0	2.6
% insetivory	71.3	18.4	44.0	3.8	2.6	0.1	2.5
% lower strata	71.1	15.5	46.2	3.8	1.9	0.4	3.2
foraging stratum	70.7	17.0	44.5	3.9	2.3	0.3	2.6
hand-wing	70.9	14.0	47.6	3.8	2.4	0.1	2.9
Generalists							
High quality							
Combined	46.2	7.4	31.9	1.3	0.9	1.6	3.1
body mass	44.7	0.2	37.8	1.6	2.9	0.6	1.5
nest type	44.6	0.6	37.4	1.7	3.1	0.6	1.1
main diet	45.8	5.2	33.7	1.5	1.7	1.1	2.7
% frugivory	44.5	0.5	37.4	1.5	3.6	0.7	0.8
% insetivory	44.4	3.2	34.8	1.2	3.7	0.9	0.7
% lower strata	44.5	1.3	36.7	1.5	3.6	0.7	0.7
foraging stratum	44.4	1.9	35.8	1.7	3.2	0.7	1.0
hand-wing	44.4	3.0	34.9	1.6	3.5	0.6	0.8
Low quality							
Combined	47.4	7.5	33.3	2.3	0.9	1.0	2.4
body mass	47.1	0.8	39.7	2.7	2.2	0.4	1.2
nest type	46.7	1.0	39.3	3.1	2.1	0.0	1.1
main diet	47.1	5.3	35.2	2.8	1.9	0.5	1.5
% frugivory	47.0	0.4	40.0	2.9	2.4	0.3	0.9
% insetivory	46.7	1.6	38.7	3.0	2.4	0.2	0.9
% lower strata	47.0	0.9	39.5	3.1	2.1	0.1	1.3
foraging stratum	47.0	1.2	39.2	2.9	2.4	0.1	1.1
hand-wing	46.7	2.5	37.8	3.0	2.4	0.1	0.9

Table S3.2: Fixed effects coefficients for the model of specialists in high-quality matrix landscapes.

effect	term	estimate	std.error	statistic	p.value
fixed	(Intercept)	-2.72	0.98	-2.78	0.01
fixed	forest_site400	0.83	0.33	2.49	0.01
fixed	lbody_size	-0.62	0.28	-2.22	0.03
fixed	nestclosed	0.32	0.67	0.48	0.63
fixed	nestopen_semi	-0.28	0.56	-0.50	0.62
fixed	dietinsectivorous	0.07	0.83	0.09	0.93
fixed	dietonivorous	-1.00	1.25	-0.81	0.42
fixed	lower_stratum	0.18	0.23	0.78	0.44
fixed	forest_land	-0.36	0.41	-0.87	0.38
fixed	forest_site400:lbody_size	-0.03	0.09	-0.30	0.76
fixed	forest_site400:nestclosed	-0.38	0.19	-1.98	0.05
fixed	forest_site400:nestopen_semi	-0.24	0.17	-1.36	0.17
fixed	forest_site400:dietinsectivorous	-0.28	0.29	-0.97	0.33
fixed	forest_site400:dietonivorous	-0.35	0.44	-0.80	0.42
fixed	forest_site400:lower_stratum	0.01	0.07	0.10	0.92
fixed	lbody_size:forest_land	0.00	0.10	0.04	0.97
fixed	nestclosed:forest_land	0.30	0.22	1.35	0.18
fixed	nestopen_semi:forest_land	0.31	0.19	1.61	0.11
fixed	dietinsectivorous:forest_land	-0.04	0.33	-0.11	0.91
fixed	dietonivorous:forest_land	0.45	0.47	0.95	0.34
fixed	lower_stratum:forest_land	0.00	0.08	-0.03	0.98

Table S3.3: Fixed effects coefficients for the model of specialists in low-quality matrix landscapes.

effect	term	estimate	std.error	statistic	p.value
fixed	(Intercept)	-5.46	1.03	-5.33	0.00
fixed	forest_site400	1.06	0.36	2.94	0.00
fixed	lbody_size	-0.21	0.32	-0.67	0.50
fixed	nestclosed	0.70	0.78	0.90	0.37
fixed	nestopen_semi	-0.12	0.69	-0.18	0.86
fixed	dietgranivorous	0.13	1.82	0.07	0.95
fixed	dietinsectivorous	1.27	0.82	1.54	0.12
fixed	lower_stratum	0.36	0.28	1.28	0.20
fixed	forest_land	1.42	0.44	3.22	0.00
fixed	forest_site400:lbody_size	0.05	0.09	0.51	0.61
fixed	forest_site400:nestclosed	-0.39	0.22	-1.78	0.07
fixed	forest_site400:nestopen_semi	-0.06	0.20	-0.29	0.77
fixed	forest_site400:dietgranivorous	-0.41	0.61	-0.67	0.50
fixed	forest_site400:dietinsectivorous	-0.40	0.28	-1.45	0.15
fixed	forest_site400:lower_stratum	0.02	0.09	0.18	0.86
fixed	lbody_size:forest_land	0.01	0.12	0.04	0.96
fixed	nestclosed:forest_land	-0.59	0.28	-2.10	0.04
fixed	nestopen_semi:forest_land	-0.16	0.27	-0.62	0.54
fixed	dietgranivorous:forest_land	-0.03	0.73	-0.04	0.96
fixed	dietinsectivorous:forest_land	-0.38	0.34	-1.10	0.27
fixed	lower_stratum:forest_land	-0.15	0.12	-1.24	0.22

Table S3.4: Fixed effects coefficients for the model of generalists in high-quality matrix landscapes.

effect	term	estimate	std.error	statistic	p.value
fixed	(Intercept)	-3.45	0.55	-6.29	0.00
fixed	forest_site400	0.37	0.19	2.01	0.04
fixed	lbody_size	0.08	0.27	0.29	0.77
fixed	nestclosed	0.20	0.61	0.32	0.75
fixed	nestopen_semi	0.20	0.53	0.38	0.71
fixed	dietgranivorous	-0.91	0.86	-1.06	0.29
fixed	dietinsectivorous	1.00	0.50	2.00	0.05
fixed	dietnectarivorous	-0.12	0.75	-0.16	0.88
fixed	dietonivorous	0.14	0.67	0.21	0.83
fixed	lower_stratum	0.36	0.17	2.06	0.04
fixed	forest_land	-0.11	0.22	-0.50	0.62
fixed	forest_site400:lbody_size	0.05	0.09	0.61	0.54
fixed	forest_site400:nestclosed	-0.43	0.20	-2.12	0.03
fixed	forest_site400:nestopen_semi	-0.22	0.17	-1.28	0.20
fixed	forest_site400:dietgranivorous	-0.61	0.35	-1.75	0.08
fixed	forest_site400:dietinsectivorous	-0.13	0.18	-0.75	0.46
fixed	forest_site400:dietnectarivorous	-0.16	0.27	-0.61	0.54
fixed	forest_site400:dietonivorous	-0.50	0.25	-2.04	0.04
fixed	forest_site400:lower_stratum	0.04	0.05	0.71	0.48
fixed	lbody_size:forest_land	-0.01	0.10	-0.09	0.93
fixed	nestclosed:forest_land	0.18	0.21	0.88	0.38
fixed	nestopen_semi:forest_land	0.07	0.17	0.38	0.71
fixed	dietgranivorous:forest_land	0.68	0.36	1.87	0.06
fixed	dietinsectivorous:forest_land	-0.13	0.19	-0.65	0.51
fixed	dietnectarivorous:forest_land	-0.11	0.28	-0.40	0.69
fixed	dietonivorous:forest_land	0.06	0.27	0.22	0.83
fixed	lower_stratum:forest_land	-0.03	0.06	-0.58	0.56

Table S3.5: Fixed effects coefficients for the model of generalists in low-quality matrix landscapes.

effect	term	estimate	std.error	statistic	p.value
fixed	(Intercept)	-4.23	0.49	-8.66	0.00
fixed	forest_site400	0.26	0.20	1.32	0.19
fixed	lbody_size	0.22	0.26	0.83	0.41
fixed	nestclosed	0.79	0.59	1.33	0.18
fixed	nestopen_semi	0.55	0.50	1.10	0.27
fixed	dietgranivorous	0.87	1.12	0.78	0.44
fixed	dietinsectivorous	1.06	0.48	2.20	0.03
fixed	dietnectarivorous	-0.19	0.76	-0.25	0.80
fixed	dietonivorous	0.39	0.64	0.62	0.54
fixed	lower_stratum	0.24	0.18	1.33	0.18
fixed	forest_land	0.04	0.18	0.25	0.81
fixed	forest_site400:lbody_size	0.03	0.10	0.32	0.75
fixed	forest_site400:nestclosed	-0.52	0.21	-2.45	0.01
fixed	forest_site400:nestopen_semi	-0.26	0.17	-1.49	0.14
fixed	forest_site400:dietgranivorous	0.55	0.39	1.41	0.16
fixed	forest_site400:dietinsectivorous	0.02	0.19	0.12	0.90
fixed	forest_site400:dietnectarivorous	0.09	0.30	0.30	0.77
fixed	forest_site400:dietonivorous	-0.05	0.23	-0.21	0.84
fixed	forest_site400:lower_stratum	-0.10	0.06	-1.62	0.11
fixed	lbody_size:forest_land	0.00	0.09	-0.05	0.96
fixed	nestclosed:forest_land	0.27	0.18	1.46	0.14
fixed	nestopen_semi:forest_land	0.20	0.15	1.37	0.17
fixed	dietgranivorous:forest_land	-0.48	0.34	-1.42	0.15
fixed	dietinsectivorous:forest_land	-0.21	0.17	-1.23	0.22
fixed	dietnectarivorous:forest_land	-0.26	0.28	-0.94	0.35
fixed	dietonivorous:forest_land	-0.25	0.20	-1.27	0.21
fixed	lower_stratum:forest_land	0.07	0.06	1.17	0.24

Table S3.6: Variance Inflation Factor index for combined traits models in each dataset.

	Specialists		Generalists	
parameter	High-quality	Low-quality	High-quality	Low-quality
forest.local	1.24	1.04	1.17	1.17
body_mass	1.23	1.08	1.15	1.15
nest_closed	1.78	1.43	2.37	2.37
nest_open_semi	2.15	1.99	1.96	1.96
diet_insectivorous	1.83	1.94	2.16	2.16
diet_onivorous	1.83	1.49	2.04	2.04
lower_strata	1.37	NA	2.22	2.22
diet_granivorous	1.18	1.19	1.15	1.15
forest.landscape	NA	1.16	1.20	1.20
diet_nectarivorous	NA	NA	2.46	2.46

3. Models diagnostic

Variance Inflation Factor of the model parameters for each dataset in Table S3.6.

Example of the residual diagnostic of the model with the combined traits (main diet, body mass, nest type and % of lower strata use) for the forest specialists in high-quality matrix landscapes. The models' diagnostics for the other assemblages were all similar and can be checked in this Rmd file.

Residual correlations among species and sites

Below we present the Kendall correlations for the residuals among species and sites for the models using the predictions for `site:sp` random effect (Observation Level Random Effect). For the residual correlations we followed the code provided by Miller, Damschen & Ives (2018).

Range of species correlations: -0.4, 0.43. Range of sites correlations: -0.3, 0.27.

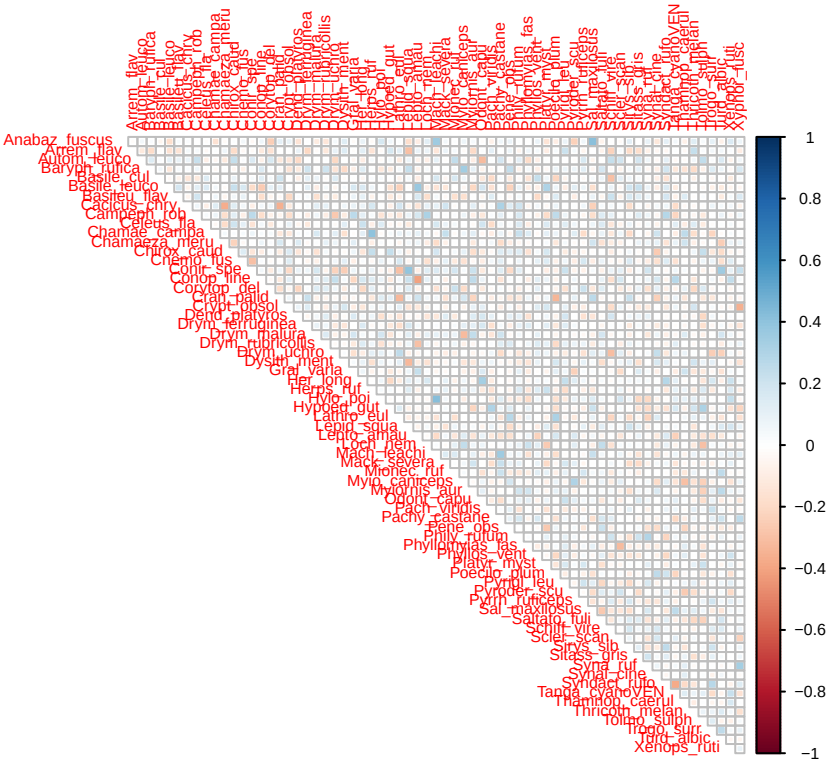

Figure S3.1: Species residual Kendall correlations for the specialist species in high-quality matrix landscapes.

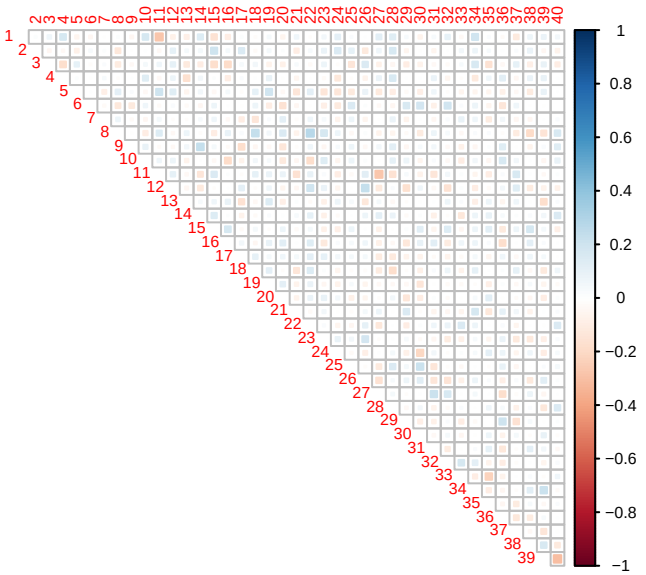

Figure S3.2: Sites residual Kendall correlations for the specialist species in high-quality matrixlandscapes.

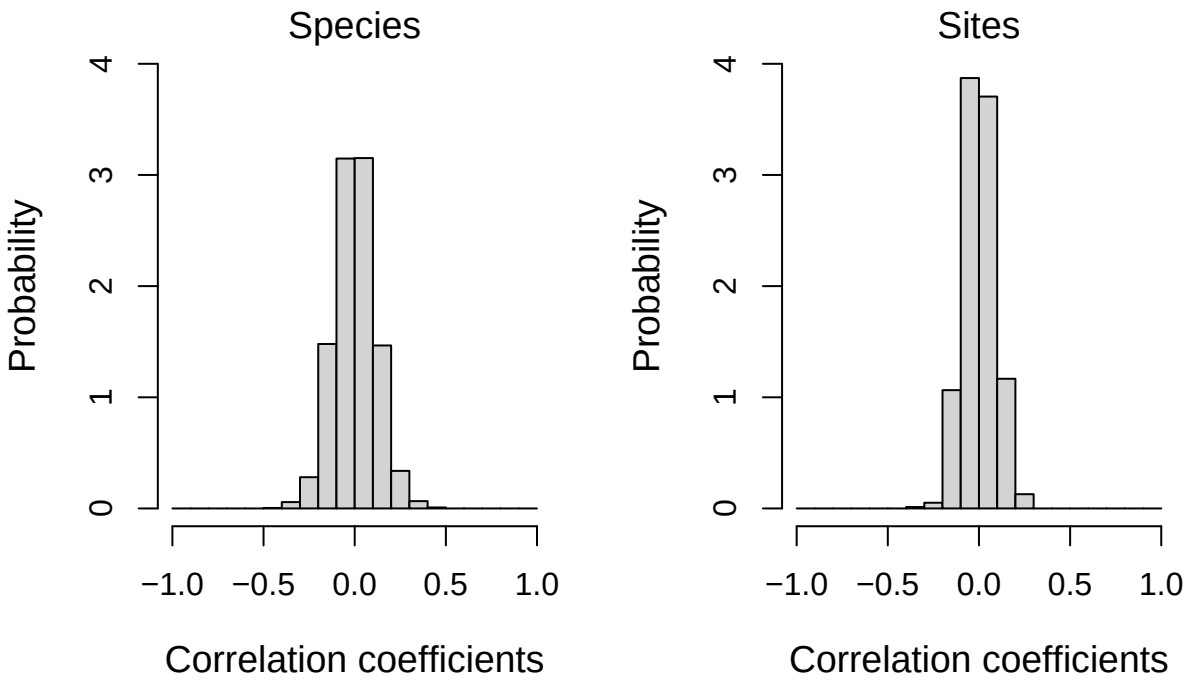

Figure S3.3: Histograms of the residual Kendall correlations for the specialists species in high-quality matrix landscapes.

Residual diagnostic

We used DHARMa package (Hartig (2018)) for the diagnostic of quantile residuals.

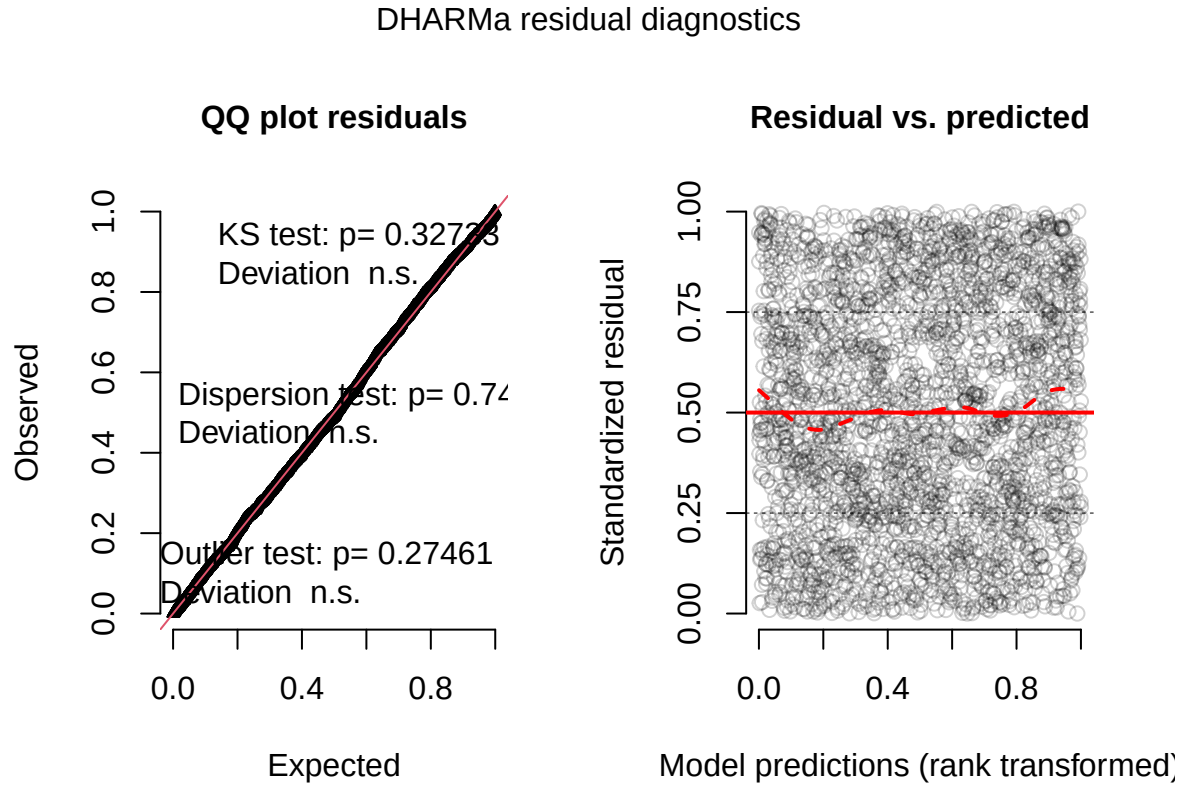

Figure S3.4: Plots for model diagnostic form DHARMa package.

Residuals against predictors:

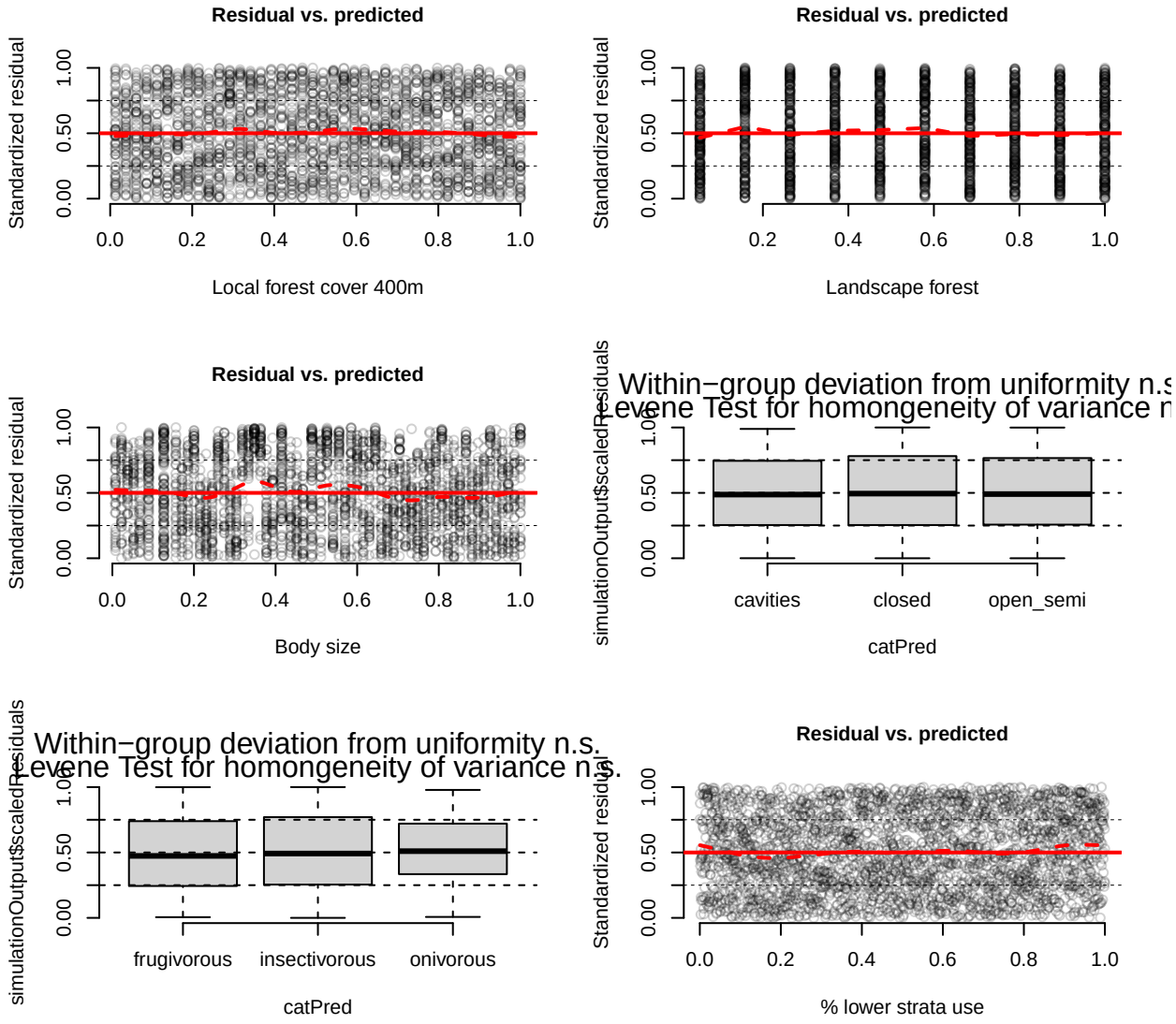

Figure S3.5: More for model diagnostic form DHARMa package.

Predictions for each species local forest cover

Landscape forest cover was fixed in 30%.

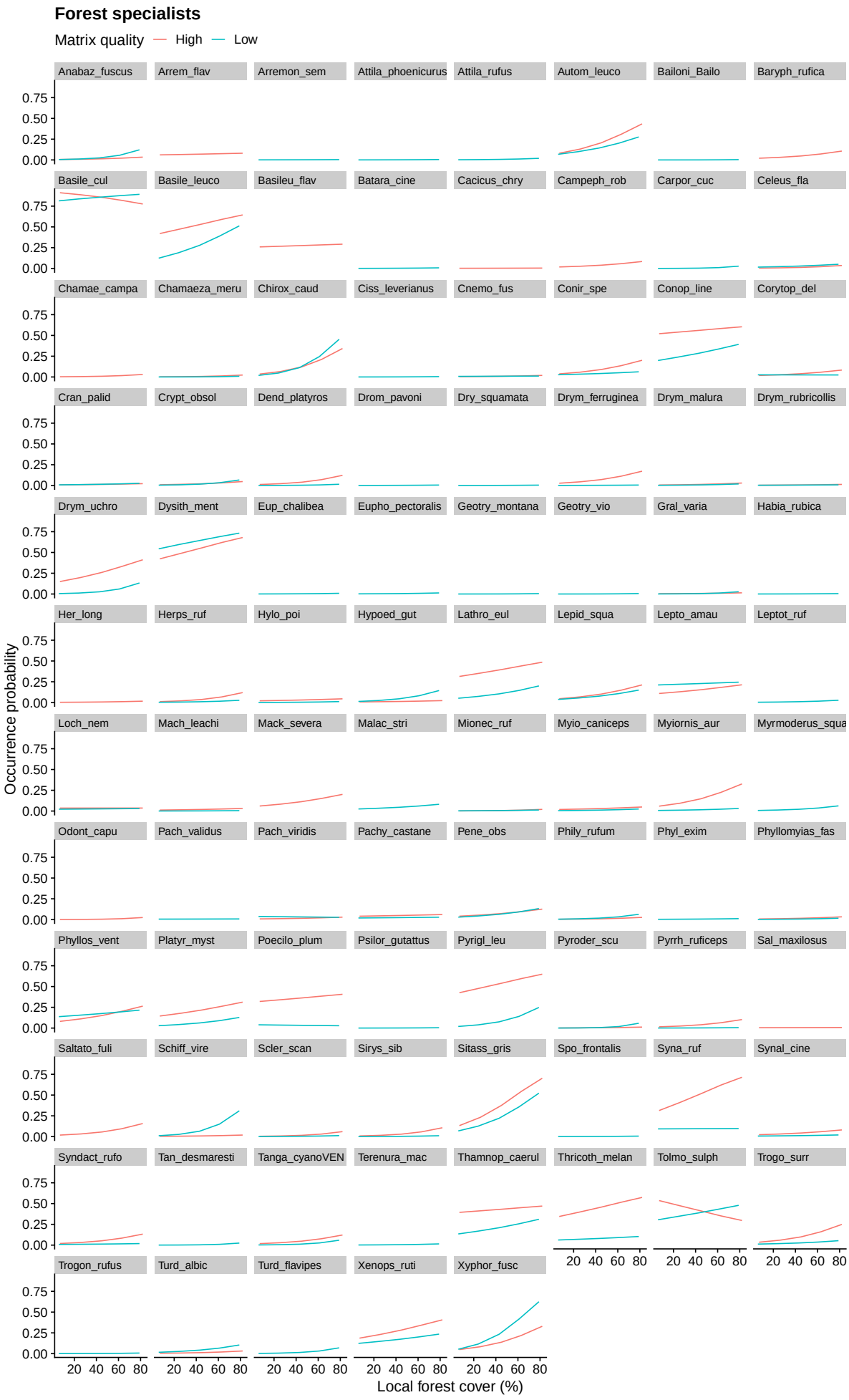

Figure S3.6: Forest specialist birds.

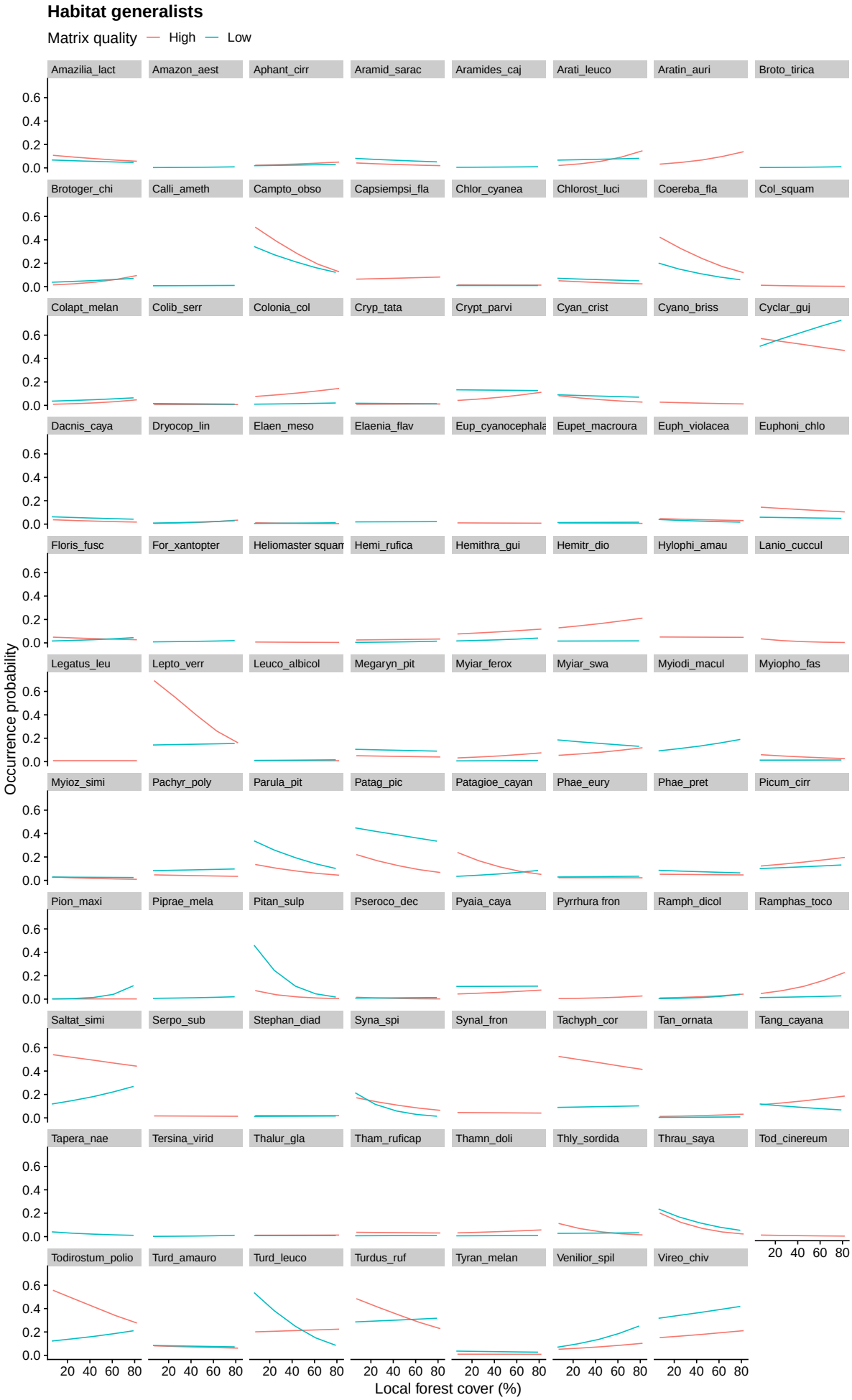

Figure S3.7: Forest specialist birds.

References

Hartig, F. (2018). DHARMa: Residual Diagnostics for Hierarchical (Multi-Level / Mixed) Regression Models.

Miller, J.E.D., Damschen, E.I. & Ives, A.R. (2018). Functional traits and community composition: A comparison among community-weighted means, weighted correlations, and multilevel models. *Methods in Ecology and Evolution* **0**.