

1 **Supporting Information**

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3 **Supplementary Table S1**

4 Variance inflation factor (VIF) results for confirming multicollinearity: A VIF value of ≥ 2 is considered
5 correlated. Each values indicates the response variable for linear regression to calculate the VIF. The row
6 of numbers indicates the exoplanetary variables. DBH indicates the diameter at breast height. PBF
7 indicates the proportion of broad-leaved forests and Edge indicates the edge length of broad-leaved
8 forests, designated 200 ha for large woodpeckers and 50 hectares for small woodpeckers. Diversity
9 indicates the tree diversity of the study plot.

Model	DBH	Diversity	PBF	Edge
S	1.24	1.47	1.93	1.57
L	1.22	1.60	1.37	1.05

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12 **Supplementary Table S2**

13 Used data of each plot. Census indicates the number of censuses conducted by us. Treeall indicates the
 14 total number of trees. Treefall indicates the number of trees that have fallen. Cavity indicates the number
 15 of tree cavities. AWP indicates the number of all woodpeckers. SWP indicates the number of small
 16 woodpeckers. LWP indicates the number of large woodpeckers. EDG200 indicates the edge length of
 17 broad-leaved forests within 200ha buffer in the center of the forests. EDG50 indicates the edge length of
 18 broad-leaved forests within 50ha buffer in the center of the forest. PBF200 indicates the proportion of
 19 broad-leaved forests within 200ha buffer in the center of the forest. PBF50 indicates the proportion of
 20 broad-leaved forests within 50ha buffer in the center of the forest. Diversity indicates the Shannon's
 21 diversity. DBH indicates the diameter at breast height.

ID	Census	Treeall	Treefall	Cavity	AWP	LWP	SWP	edg200	PDF200	EDG50	PDF50	Diversity	DBH
1	33	79	7	9	56	33	23	86	8183	504.6	90	0.91	26.32
2	33	70	3	10	24	9	15	54.7	16275	4359	64.3	0.90	26.25
3	33	260	9	3	7	1	6	58	12761	1712	66.7	0.78	12.59
4	33	243	17	11	29	15	14	59.2	16476	3379	62.1	0.81	20.37
5	33	382	8	4	9	4	5	38.4	17296	4518	42.7	0.91	13.89
6	19	55	8	9	21	11	10	33.3	12807	4305	37	0.86	22.67
7	19	107	0	4	8	4	4	26.8	18009	4232	26.5	0.86	23.22
8	19	163	13	6	13	10	3	36.6	17470	2971	32.7	0.74	15.69
9	19	186	5	1	1	1	0	15.7	12604	4322	16.2	0.72	16.79
10	26	143	7	4	19	13	6	10004	24.5	2798	35.7	0.62	20.15
11	26	143	8	8	7	3	4	7836	16.2	2363	15.2	0.83	18.53
12	26	122	19	8	15	12	3	12782	47.4	2072	59.7	0.88	18.03
13	17	179	3	4	13	6	7	14442	49.7	3713	46	0.88	18.36
14	26	195	9	5	15	10	5	11027	48.2	1649	51.3	0.84	18.59

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26 **Supplementary Table S3**

27 Results of path analysis of the assumed model. Path indicates the relationship between two variables. Est.
 28 Error represents the estimation error. Q5 and Q95 indicate the lower and upper limits of the 90%
 29 confidence interval, respectively. Bold font indicates significance when 90% confidence interval include
 30 0. AWP indicates the average number of woodpeckers per site. Cave indicates the average number of tree
 31 cavities in trees per site. Treefall indicates the average number of tree falls per site. DBH indicates the
 32 diameter at breast height. PBF indicates the proportion of broad-leaved forests and EDG indicates the
 33 edge length of broad-leaved forests, designated 200 ha for large woodpeckers and 50 ha for small
 34 woodpeckers. Diversity indicates the tree diversity of the plot.

Model	Path To	From	Estimate	Est. Error	Q5	Q95	
S	AWP	DBH	0.32	0.12	0.14	0.52	
		PBF	0.35	0.16	0.09	0.63	
		EDG	0.07	0.12	-0.13	0.26	
	Cave	diversity	-0.04	0.15	-0.28	0.20	
		AWP	0.40	0.13	0.18	0.62	
		DBH	0.44	0.15	0.19	0.69	
		Treefall	Cave	0.75	0.32	0.27	1.29
			DBH	-0.26	0.31	-0.77	0.21
			PBF	-0.30	0.28	-0.75	0.15
			EDG	-0.22	0.31	-0.74	0.27
L	AWP	DBH	0.47	0.29	0.02	0.97	
		PBF	0.42	0.28	-0.03	0.89	
		Edge	0.01	0.24	-0.38	0.41	
		diversity	-0.34	0.27	-0.80	0.09	
	Cave	AWP	0.27	0.11	0.09	0.46	
		DBH	0.58	0.14	0.35	0.81	
	Treefall	Cave	0.88	0.36	0.35	1.52	
		DBH	-0.47	0.35	-1.07	0.05	
		PBF	-0.12	0.25	-0.55	0.27	
		EDG	-0.33	0.26	-0.78	0.07	

36 **Supplementary Table S4**

37 The results of the selection by Fisher’s C value with the best models (Shipley, 2013), using the lowest
 38 leave-one-out cross-validation information criterion (LOOIC) (Lindenmayer et al., 2018). AWP indicates
 39 the average number of woodpeckers per site. Cave indicates the average number of tree cavities in the
 40 living trees per site. Treefall indicates the average number of tree falls per site. DBH indicates the
 41 diameter at breast height. PBF indicates the proportion of broad-leaved forests and Edge indicates the
 42 edge length of broad-leaved forests, designated 200 ha for large woodpeckers and 50 ha for small
 43 woodpeckers. SE represents the standard error.

Model	Response	Variable	Distribution	Fisher’s C	P-value	LOOIC	SE
S	AWP	PBF + DBH	Poisson	11.7	0.30	241.0	13.4
	Cave	AWP+DBH	Poisson				
	Treefall	Cave	Nbinom				
L	AWP	DBH	Nbinom	12.1	0.73	264.3	12.8
	Cave	AWP+DBH	Poisson				
	Treefall	Cave	Nbinom				

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45 **Supplementary Table S5**

46 The result of exact one-sample Kolmogorov-Smirnov test. This shows the difference between probability
 47 density of our estimate from the MCMC chain and our starting priors. The starting priors are normal
 48 distributions with a mean of 0 and a standard deviation of 10.

Intercept	sd	mean	D-value	P-value	
LWP		0.10	-1.20	0.54	2.92E-12
SWP		0.11	-1.45	0.55	1.05E-12

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54 **Supplementary Table S6**

55 **The results of the chi-squared test comparing observed and predicted covariance matrices are as**
56 **follows. Chi-square represents the chi-squared value, Df indicates the degrees of freedom, and P-**
57 **value assesses the hypothesis that the observed and predicted covariance matrices are equal.**

model	Chi-squared	Df	P-value
LWP	11.01	6.00	0.09
SWP	10.32	6.00	0.11

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