

Supplementary Fig. 1. Design of the sampling scheme used for collecting data at the SAFE Project in Malaysian Borneo. Here, we used data collected from sample blocks in primary forest (Blocks OG1 and OG2) and from twice-logged forest that was continuous at the time of data collection, but will become isolated forest fragments in the future (Blocks A-F). Displayed sample sites are second-order points. Figure reproduced from Ewers et al.¹

Supplementary Table 1. Mixed effects modelling of the effects of logging on three ecosystem process rates: (a) leaf litter decomposition rate, (b) seed disturbance rate and (c) invertebrate predation rate.

Ecosystem function:	(a) Decomposition ra	ate	(b) Seed disturbance	rate	(c) Invertebrate pred	dation rate
	Linear mixed model		Binomial mixed mode	l (logit link)	Binomial mixed mod	lel (logit link)
Model name	Null model	Full model	Null model	Full model	Null model	Full model
Fixed effects	b [95% CI]	b [95% CI]	<i>b</i> [95% CI]	b [95% CI]	<i>b</i> [95% CI]	b [95% CI]
Intercept	-0.2 [-0.22, -0.19]	-0.19 [-0.21, -0.18]	-2.88 [-3.96, -1.79]	-1.54 [-2.87, -0.22]	-0.08 [-0.55, 0.38]	0.2 [-0.51, 0.91]
Habitat (logged)	-	-0.03 [-0.06, -0.01]	-	-1.87 [-3.38, -0.35]	-	-0.48 [-1.42, 0.45]
Random effects	VC	VC	VC	VC	VC	VC
1st order	-	-	-	-	0.0000	0.0157
2nd order	-	-	1.8414	1.9500	0.0259	0.2041
3rd order	0.0004	0.0002	0.9049	0.7033	0.0000	0.0000
Block	-	-	0.4997	0.0000	-	-
Residuals (additive dispersion)	0.0006	0.0006	-	-	-	-
Fixed factors	-	0.0003	-	0.6031	-	0.0575
PCV _[1st order]		-		-		-28067878.53%
PCV _[2nd order]		-		-5.90%		-688.34%
PCV _[3rd order]		53.58%		22.28%		99.40%
PCV _[Block]		-		100.00%		-
PCV _[Residuals]		2.59%		-		-
$R^2_{GLMM(m)}$		27.19%		9.21%		1.61%
$R^2_{GLMM(c)}$		44.57%		49.74%		7.77%
AIC	-92.7	-89.2	1554.9	1553.0	148.4	149.4
BIC	-89.0	-84.4	1568.9	1570.4	158.9	162.5
Spatial autocorrelation (residuals)						
x-intercept		-1.22 [-68.21, 1.16]		-0.49 [-4.93, 0.19]		-40.48 [-44.72, 0.57]
y-intercept		-0.14 [-0.98, 0.34]		-0.08 [-0.2, 0]		-0.01 [-0.2, 0.22]

Supplementary Table 2. Mixed effects modelling testing for an interaction effect between logging and experimental treatment on three ecosystem process rates: (a) leaf litter decomposition rate, (b) seed disturbance rate and (c) invertebrate predation rate.

Ecosystem function:	(a) Decomposition rate	9	(b) Seed disturbance r		(c) Invertebrate preda	
Model name	Linear mixed model Null model	Full model	Binomial mixed mode Null model	Full model	Binomial mixed mode Null model	Full model
		-				
Fixed effects	<i>b</i> [95% CI]	<i>b</i> [95% CI]	<i>b</i> [95% CI]	<i>b</i> [95% CI]	<i>b</i> [95% CI]	<i>b</i> [95% CI]
Intercept	-0.21 [-0.23, -0.19]	-0.23 [-0.25, -0.21]	-1.74 [-2.74, -0.74]	-1.5 [-2.5, -0.5]	0.08 [-0.52, 0.67]	0.21 [-0.47, 0.9]
Treatment (no inverts)	0.05 [0.04, 0.07]	0.09 [0.08, 0.1]	2.91 [2.78, 3.03]	2.81 [2.58, 3.03]	-2.21 [-2.98, -1.44]	-4.13 [-6.35, -1.91]
Treatment (no other)	0 [-0.01, 0.02]	0 [-0.01, 0.02]	0.7 [0.58, 0.82]	0.13 [-0.08, 0.34]	-1.47 [-2.12, -0.83]	-1.23 [-2.15, -0.31]
Habitat (logged)	0.02 [-0.01, 0.04]	0.03 [0.01, 0.06]	-0.79 [-1.95, 0.37]	-1.16 [-2.33, 0.01]	-0.28 [-0.97, 0.41]	-0.51 [-1.41, 0.39]
Treatment (no inverts) : Habitat (logged)	-	-0.06 [-0.08, -0.04]	-	0.19 [-0.08, 0.46]	-	2.65 [0.26, 5.03]
Treatment (no other : Habitat (logged)	-	0 [-0.02, 0.02]	-	0.84 [0.57, 1.1]	-	-0.54 [-1.86, 0.78]
Random effects	VC	VC	VC	VC	VC	VC
1st order	-	-	-	-	0.48	0.05
2nd order	0.00013	0.00023	0.74	0.74	0.00	0.00
3rd order	0.00018	0.00018	0.20	0.20	0.00	0.00
Block	-	-	0.11	0.11	-	-
Residuals (additive dispersion)	0.00049	0.00021	-	-	-	-
Fixed factors	-	0.00080	-	1.63	-	1.60
PCV _[1st order]		-		-		73.28%
PCV _[2nd order]		NA	NA	-59.28%	NA	NA
PCV _[3rd order]		-5.77%	NA	-20.48%	NA	NA
PCV _[Block]		-	NA	37.58%	-	-
PCV _[Residuals]		82.81%	NA	-	-	-
$R^2_{GLMM(m)}$	44.39%	56.49%	26.48%	27.37%	18.74%	29.66%
$R^2_{GLMM(c)}$	65.98%	85.25%	44.30%	44.85%	29.02%	39.13%
AIC	-278.97	-299.06	6927.9	7608.63	321.96	315.19
BIC	-263.04	-278.57	6979.56	7649.33	348.03	348.70
Spatial autocorrelation (residuals)						
x-intercept		-0.5 [-67.64, 3]		-0.27 [-1.98, -0.14]		-0.06 [-0.19, 0.28]
y-intercept		-0.21 [-0.21, 0.14]		-0.02 [-0.15, -0.05]		-0.03 [-0.14, 0.13]

Supplementary Table 3. Mixed effects modelling testing for the effects of logging on seven aspects of invertebrate community composition: (a) beetle abundance, (b) termite occupancy, (c) litter and wood termite occupancy, (d) termite genus richness, (e) earthworm abundance, (f) earthworm biomass and (g) total invertebrate biomass.

Response:	(a) Beetle abundance Poisson mixed model (log link)	(b) Termite occupancy Binomial mixed model (l	(b) Termite occupancy Binomial mixed model (logit link)		(c) Litter and wood termite occupancy Binomial mixed model (logit link)	
Model name	Null model	Full model	Null model	Full model	Null model	Full model	
Fixed effects	b [95% CI]	b [95% CI]	<i>b</i> [95% CI]	b [95% CI]	<i>b</i> [95% CI]	b [95% CI]	
Intercept	2.04 [1.53, 2.56]	2.74 [2.43, 3.05]	-2.16 [-3.13, -1.19]	-1.07 [-2.01, -0.14]	-2.74 [-3.54, -1.93]	-1.79 [-2.49, -1.1]	
Habitat (logged)	-	-1.14 [-1.52, -0.75]	-	-1.56 [-2.66, -0.45]	-	-1.34 [-2.16, -0.52]	
Random effects	VC	VC	VC	VC	VC	VC	
1st order	-	-	-	-	-	-	
2nd order	0.031	0.302	0.596	0.603	0.495	0.050	
3rd order	0.000	0.000	0.175	0.169	0.046	0.000	
Block	0.316	0.018	0.576	0.060	0.338	0.000	
Residuals (additive dispersion)	-	-	-	-	-	-	
Fixed factors	-	0.258	-	0.416	-	0.416	
PCV _[1st order]		-		-		-	
PCV _[2nd order]		-879.26%		-1.21%		89.84%	
PCV _[3rd order]		NA		3.32%		100.00%	
$PCV_{[Block]}$		94.35%		89.63%		100.00%	
$PCV_{[Residuals]}$		-		-		-	
$R^2_{GLMM(m)}$		37.06%		9.17%		7.56%	
$R^2_{GLMM(c)}$		NA		27.49%		19.82%	
AIC	1664.8	1655.9	478.7	476.6	344.2	340.4	
BIC	1677.9	1672.3	496.7	499.0	362.2	362.8	
Spatial autocorrelation (residuals)							
x-intercept		-0.75 [-4.7, -0.14]		-0.43 [-3.25, 1.57]		-0.42 [-2.76, 1]	
y-intercept		-0.09 [-0.16, -0.01]		-0.02 [-0.06, 0.06]		-0.02 [-0.06, 0.04]	

Supplementary Table 3 cont.

Response:	(d) Termite genus richne			(e) Earthworm abundance Poisson mixed model (log link)		
Model name	Poisson mixed model (log link) Null model Full model		Null model	Full model	Linear mixed model Null model	Full model
Fixed effects	b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]
Intercept	-2.22 [-3.06, -1.38]	-1.3 [-2.01, -0.59]	1.35 [1.09, 1.6]	1.22 [0.79, 1.66]	8.49 [4.68, 12.29]	12.29 [8.85, 15.73]
Habitat (logged)	-	-1.33 [-2.19, -0.48]	-	0.18 [-0.35, 0.71]	-	-5.71 [-9.92, -1.49]
Random effects	VC	VC	VC	VC	VC	VC
1st order	-	-	-	-	-	-
2nd order	0.451	0.458	0.375	0.367	1.060	0.253
3rd order	0.039	0.046	0.000	0.000	0.000	0.000
Block	0.446	0.034	0.000	0.000	8.147	0.000
Residuals (additive dispersion)	-	-	-	-	109.806	109.806
Fixed factors	-	0.305	=	0.007	-	7.302
PCV _[1st order]		-		-		-
PCV _[2nd order]		-1.48%		2.19%		76.11%
PCV _[3rd order]		-16.64%		NA		NA
PCV _[Block]		92.43%		NA		100.00%
PCV _[Residuals]		-		-		0.00%
$R^2_{GLMM(m)}$		9.64%		1.49%		6.22%
$R^2_{GLMM(c)}$		NA		NA		6.44%
AIC	543.0	540.5	780.2	781.8	824.6	819.0
BIC	562.9	560.9	790.9	795.2	838.0	835.1
Spatial autocorrelation (residuals)						
x-intercept		-0.23 [-1.63, 1.64]		-0.58 [-8.86, 8.75]		-1.36 [-9.13, 1.42]
y-intercept		-0.03 [-0.05, 0.05]		-0.13 [-0.1, 0.11]		-0.04 [-0.27, 0.11]

Supplementary Table 3 cont.

Response:	(g) Invertebrate biomass	
	Linear mixed model	
Model name	Null model	Full model
Fixed effects	b [95% CI]	b [95% CI]
Intercept	0.22 [0.14, 0.31]	0.11 [0.05, 0.18]
Habitat (logged)	-	0.18 [0.1, 0.25]
Random effects	VC	VC
1st order	-	-
2nd order	0.000	0.000
3rd order	0.000	0.000
Block	0.008	0.000
Residuals (additive dispersion)	0.055	0.055
Fixed factors	-	0.006
PCV _[1st order]		-
PCV _[2nd order]		NA
PCV _[3rd order]		NA
PCV _[Block]		100.00%
$PCV_{[Residuals]}$		0.63%
$R^2_{GLMM(m)}$		10.14%
$R^2_{GLMM(c)}$		10.14%
AIC	12.0	8.9
BIC	28.4	28.6
Spatial autocorrelation (residuals)		
x-intercept		-3.91 [-6.23, 1.92]
y-intercept		-0.02 [-0.11, 0.06]

Supplementary Table 4. Mixed effects modelling testing for the effects of logging on five aspects of the physical and biotic environment: (a) leaf area index, (b) maximum air temperature, (c) minimum relative humidity, (d) fungal hyphae abundance and (e) fruiting and flowering.

Response:	(a) Leaf Area Index Linear mixed model		(b) Maximum air tempe Linear mixed model	erature	(c) Minimum relative h	umidity
Model name	Null model	Full model	Null model	Full model	Null model	Full model
Fixed effects	b [95% CI]	b [95% CI]	<i>b</i> [95% CI]	b [95% CI]	<i>b</i> [95% CI]	b [95% CI]
Intercept	3.95 [3.77, 4.12]	4.31 [3.97, 4.65]	27.69 [27.16, 28.22]	26.56 [25.55, 27.58]	85.34 [83.69, 86.99]	89.31 [86.06, 92.55]
Habitat (logged)	-	-0.46 [-0.84, -0.08]	-	1.4 [0.28, 2.51]	-	-4.89 [-8.41, -1.36]
Random effects	VC	VC	VC	VC	VC	VC
1st order	-	-	-	-	-	-
2nd order	-	-	0.1254	0.1255	1.9180	2.2300
3rd order	0.0713	0.0577	0.8491	0.8094	9.4830	7.6170
Block	0.0150	0.0000	0.5927	0.1371	1.9440	0.0000
Residuals (additive dispersion)	0.4306	0.4300	2.2110	2.2145	53.3450	53.5600
Fixed factors	-	0.0348	-	0.0265	-	3.4647
PCV _[1st order]		-		-		-
PCV _[2nd order]		-		-0.08%		-16.27%
PCV _[3rd order]		19.10%		4.68%		19.68%
PCV _[Block]		100.00%		76.87%		100.00%
$PCV_{[Residuals]}$		0.13%		-0.16%		-0.40%
$R^2_{GLMM(m)}$		6.66%		7.67%		5.18%
$R^2_{GLMM(c)}$		17.70%		37.79%		19.90%
AIC	227.8	226.0	963.9	960.0	1641.2	1633.9
BIC	238.3	239.1	981.4	981.0	1658.5	1654.6
Spatial autocorrelation (residuals)						
x-intercept		-9.63 [-10.71, 4]		-1.43 [-5.46, 1.33]		-1.37 [-5.78, 3.59]
y-intercept		-0.04 [-0.17, 0.1]		-0.06 [-0.13, 0.01]		-0.03 [-0.11, 0.04]

Supplementary Table 4 cont.

Response:	(d) Fungal hyphae	abundance	(e) Fruiting and flower	ing
	Poisson mixed mo	del	Binomial mixed model	
Model name	Null model	Full model	Null model	Full model
Fixed effects	b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]
Intercept	2 [1.52, 2.48]	2.8 [1.96, 3.64]	0.54 [-0.2, 1.29]	-0.83 [-2.17, 0.5]
Habitat (logged)	-	-1.03 [-1.98, -0.08]	-	1.72 [0.23, 3.22]
Random effects	VC	VC	VC	VC
1st order	-	-	-	-
2nd order	-	-	-	-
3rd order	0.3676	0.3636	0.0000	0.0000
Block	0.3994	0.2398	0.7633	0.3175
Residuals (additive dispersion)	-	-	-	-
Fixed factors	-	0.1320	=	0.3848
PCV _[1st order]		-		-
PCV _[2nd order]		-		-
PCV _[3rd order]		1.09%		NA
PCV _[Block]		39.96%		58.40%
PCV _[Residuals]		-		-
$R^2_{GLMM(m)}$		15.30%		9.64%
$R^2_{GLMM(c)}$		NA		17.59%
AIC	844.5	842.7	138.4	135.9
BIC	852.6	853.5	146.4	146.5
Spatial autocorrelation (residuals)				
x-intercept		-2.21 [-8.62, 1.02]		-8.46 [-9.21, 4.13]
y-intercept		-0.12 [-0.32, 0.02]		-0.01 [-0.16, 0.16]

Supplementary Table 5. Mixed effects modelling testing for the effects of logging on six aspects of the functional composition of invertebrate communities: (a) foraging ant abundance, (b) foraging ant species richness, (c) foraging ant body size, (d) abundance of beetle predators, (e) abundance of foraging ant specialist predators and (f) abundance of invertebrate herbivores.

	Response:	(a) Foraging ant abund Poisson mixed model ((b) Foraging ant spec Poisson mixed mode		(c) Foraging ant body size Linear mixed model	ze
Model name		Null model	Full model	Null model	Full model	Null model	Full model
Fixed effects		b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]
Intercept		3.99 [3.81, 4.18]	3.96 [3.44, 4.49]	1.3 [1.21, 1.4]	1.61 [1.4, 1.82]	0.21 [0.14, 0.27]	0.37 [0.22, 0.53]
Habitat (logged)		-	0.03 [-0.53, 0.6]	-	-0.34 [-0.56, -0.12]	-	-0.19 [-0.36, -0.02]
Random effects		VC	VC	VC	VC	VC	VC
1st order		-	-	-	-	-	-
2nd order		0.219	0.219	0.000	0.000	0.010	0.010
3rd order		0.000	0.000	0.000	0.000	0.000	0.000
Block		0.047	0.047	0.007	0.000	0.006	0.003
Residuals (additive dispersion)		-	-	-	-	0.038	0.038
Fixed factors		-	0.000	-	0.009	-	0.003
PCV _[1st order]			-		-		-
PCV _[2nd order]			0.00%		NA		-1.45%
PCV _[3rd order]			NA		NA		79.67%
PCV _[Block]			0.21%		100.00%		50.41%
PCV _[Residuals]			-		-		-0.06%
$R^2_{GLMM(m)}$			0.03%		3.72%		5.32%
$R^2_{GLMM(c)}$			NA		NA		30.30%
AIC		4230.3	4232.3	776.2	789.6	-20.9	-20.0
BIC		4243.7	4249.0	770.6	787.3	-4.2	0.0
Spatial autocorrelation (residuals)							
x-intercept			-0.96 [-4.85, -0.43]		3.5 [-4.44, 7.08]		-4.72 [-5.49, 2.04]
y-intercept			-0.11 [-0.2, -0.03]		0.02 [-0.08, 0.13]		-0.05 [-0.13, 0.04]

Supplementary Table 5 cont.

	Response:	(d) Beetle predators Poisson mixed model (log link)	(e) Foraging ant specia Poisson mixed model ((f) Invertebrate herbi	
Model name		Null model	Full model	Null model	Full model	Poisson mixed model Null model	Full model
Fixed effects		b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]
Intercept		1.49 [1.13, 1.84]	2 [1.65, 2.35]	-0.38 [-1.19, 0.43]	1.67 [-0.5, 3.85]	2.48 [2.21, 2.76]	1.81 [1.16, 2.45]
Habitat (logged)		-	-0.68 [-1.09, -0.28]	-	-2.24 [-4.54, 0.05]	-	0.78 [0.09, 1.46]
Random effects		VC	VC	VC	VC	VC	VC
1st order		-	-	-	-	-	-
2nd order		0.412	0.413	2.988	3.123	-	-
3rd order		0.023	0.015	2.657	2.488	0.242	0.230
Block		0.096	0.003	0.279	0.043	0.071	0.019
Residuals (additive dispersion)		-	=	-	-	-	-
Fixed factors		=	0.094	=	0.400	-	0.061
PCV _[1st order]			-		-		-
PCV _[2nd order]			-0.31%		-4.51%		NA
PCV _[3rd order]			32.90%		6.36%		0.048704792
PCV _[Block]			97.05%		84.55%		0.732465351
PCV _[Residuals]			-		-		-
$R^2_{GLMM(m)}$			12.87%		5.75%		0.1558346
$R^2_{GLMM(c)}$			NA		NA		NA
AIC		1495.8	1492.7	1330.2	1328.8	2738.8	2736.9
BIC		1508.9	1509.1	1343.5	1345.5	2746.9	2747.6
Spatial autocorrelation (residuals)							
x-intercept			-0.77 [-4.76, -0.01]		-1.17 [-4.62, -0.09]		-1.81 [-7.58, 8.45]
y-intercept			-0.08 [-0.16, 0]		-0.08 [-0.16, 0]		-0.1 [-0.1, 0.09]

Supplementary Table 6. Mixed effects modelling testing for the effects of logging on five aspects of the functional composition of vertebrate communities: (a) small mammal capture rate, (b) frog occupancy, (c) insectivorous bird abundance, (d) granivorous bird occupancy and (e) insectivorous bat abundance.

Respo	onse: (a) Small mammal captu Linear mixed model	re rate	(b) Frog occupancy Binomial mixed model	(logit link)	(c) Insectivorous bird a Poisson mixed model (
Model name	Null model	Full model	Null model	Full model	Null model	Full model
Fixed effects	<i>b</i> [95% CI]	b [95% CI]	<i>b</i> [95% CI]	<i>b</i> [95% CI]	<i>b</i> [95% CI]	b [95% CI]
Intercept	0.26 [0.16, 0.35]	0.14 [0.03, 0.24]	-3.56 [-5.38, -1.73]	-34.47 [-521.26, 452.32]	2.83 [2.75, 2.91]	2.61 [2.47, 2.75]
Habitat (logged)	-	0.18 [0.06, 0.29]	-	31.84 [-454.95, 518.63]	-	0.27 [0.12, 0.42]
Random effects	VC	VC	VC	VC	VC	VC
1st order	0.0004	0.0004	-	-	-	-
2nd order	0.0014	0.0014	2.782	1.107	-	-
3rd order	0.0087	0.0094	0.000	0.000	0.0084	0.0056
Block	0.0100	0.0008	0.000	0.000	0.0068	0.0000
Residuals (additive dispersion)	0.0398	0.0398	-	-	-	-
Fixed factors	-	0.0053	-	202.749	-	0.0098
PCV _[1st order]		-3.76%		-		-
PCV _[2nd order]		-1.84%		60.21%		-
PCV _[3rd order]		-7.44%		100.00%		33.27%
PCV _[Block]		92.07%		100.00%		100.00%
PCV _[Residuals]		0.01%		-		-
$R^2_{GLMM(m)}$		9.30%		97.88%		13.48%
R ² _{GLMM(c)}		30.22%		98.41%		NA
AIC	-377.0	-375.9	106.4	100.8	668.7	660.7
BIC	-346.2	-340.0	119.6	117.2	679.7	674.4
Spatial autocorrelation (residuals)						
x-intercept		-0.54 [-4.1, 0.36]		-0.48 [-2.97, 53.5]		-0.69 [-8.43, 4.67]
y-intercept		-0.02 [-0.04, 0.01]		-0.03 [-0.11, 0.07]		-0.01 [-0.15, 0.14]

Supplementary Table 6 cont.

	Response:	(d) Granivorous bird occupa	incy	(e) Insectivorous bat abundance		
		Binomial mixed model (logi	t link)	Poisson mixed model (log	g link)	
Model name		Null model	Full model	Null model	Full model	
Fixed effects		b [95% CI]	b [95% CI]	b [95% CI]	b [95% CI]	
Intercept		3.61 [2.46, 4.76]	0 [0, 0]	0.75 [0.52, 0.98]	0.98 [0.33, 1.64]	
Habitat (logged)		-	0 [0, 0]	-	-0.26 [-0.96, 0.44]	
Random effects		VC	VC	VC	VC	
1st order		-	-	-	-	
2nd order		=	-	-	-	
3rd order		0.0000	0.0000	0.2431	0.2427	
Block		0.0000	0.0000	0.0000	0.0000	
Residuals (additive dispersion)		-	-	-	-	
Fixed factors		-	-	-	0.0076	
PCV _[1st order]			-		-	
PCV _[2nd order]			-		-	
PCV _[3rd order]			100.00%		0.16%	
$PCV_{[Block]}$			NA		NA	
PCV _[Residuals]			-		-	
$R^2_{GLMM(m)}$			97.68%		1.19%	
R ² _{GLMM(c)}			97.68%		NA	
AIC		33.7	0.0	419.5	421.0	
BIC		42.0	0.0	427.1	431.2	
Spatial autocorrelation (residuals)						
x-intercept			0 [0, 0]		-2.28 [-9.42, 5.5]	
y-intercept			0 [0, 0]		-0.11 [-0.21, 0.07]	

Supplementary Reference

1

Ewers, R. M. et al. A large-scale forest fragmentation experiment: the Stability of Altered Forest

Ecosystems Project. Philos. Trans. R. Soc. B-Biol. Sci. 366, 3292-3302, (2011).