Supporting Information

Logging disturbance shifts net primary productivity and its allocation in Bornean tropical forests

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Table S1. The proportion (% of basal area; % of number of stems >10 cm diameter) of species groups in each plot. The species were grouped into shared (found in both logged and old-growth forest plots) and unique (found only in one forest type) species and into pioneers[1] and non-pioneers. The logged plots are ranked from most to least intensively logged.

Plot	Shared Non-pioneer	Shared Pioneer	Unique Non-pioneer	Unique Pioneer
SAF-01 (Logged)	47.2; 44.0	2.0; 3.3	24.7; 25.3	26.1; 27.5
SAF-02 (Logged)	24.4; 24.5	2.3; 2.5	18.5; 16.2	54.9; 56.8
SAF-05 (Logged)	52.9; 44.0	4.1; 4.5	12.6; 15.2	30.4; 36.3
SAF-03 (Logged)	57.5; 52.4	0.5; 1.1	21.0; 22.7	21.0; 23.8
SAF-04 (Logged)	36.0; 42.2	1.8; 0.9	57.1; 48.6	5.1; 8.2
DAN-04 (Old-growth)	82.5; 61.7	0.7; 0.6	16.8; 37.8	0.0; 0.0
DAN-05 (Old-growth)	86.6; 74.2	0.1; 0.3	13.4; 25.5	0.0; 0.0
MLA-01 (Old-growth)	86.1; 79.6	0.2; 0.3	13.7; 20.1	0.0; 0.0
MLA-02 (Old-growth)	86.3; 73.3	1.7; 1.3	12.0; 25.1	0.0; 0.0
LAM-07 (Old-growth)	71.7; 47.7	0.1; 0.5	28.2; 51.8	0.0; 0.0
LAM-06 (Old-growth)	17.4; 28.6	0.3; 0.6	82.3; 70.9	0.0; 0.0

[1]Species classified as pioneers (based on Köhler *et al.,* 2000 and Saner *et al.*, 2012): *.Adinandra dumosa, Cratoxylum arborescens, Dendrocnide elliptica, Duabanga moluccana,*

Endospermum peltatum, Glochidiuon borneensis, G. lutescens, G. rubrum. Ludekia borneensis, Macaranga spp., *Mallotus lackeyi, M. mollissimus, M. paniculatus, Melicope lunu-ankenda, Neolamarckia cadamba, Octomeles sumatrana; Pterospermum elongatum, P. javanicum, Symplocos fasciculata.*

Table S2. Soil characteristics in each plot and the average by forest type (logged, n=5 and old-growth, n=6). Error represent standard errors of the mean (three replicates per plot, or all plots of each forest type). pH, nitrogen (N), carbon (C), phosphorus (P), aluminium (Al), calcium (Ca), potassium (K), magnesium (Mg) and sodium (Na) concentration and cation exchange capacity (eCEC).

Plot	pH (H_2O)	N (%)	C (%)	P (mg/kg)	Al^{3+} (mg/kg)	Ca^{2+} (mg/kg)	K^{+} (mg/kg)	Mg^{2+} (mg/kg)	Na^{+} (mg/kg)	eCEC ($mmol^{+}/kg$)
SAF-1 (Logged)	4.3 ± 0.08	0.14 ± 0.05	1.23 ± 0.56	273 ± 38.7	242 ± 82	404 ± 156	73.3 ± 9.6	124 ± 44.8	6.1 ± 1.7	59.4 ± 3.2
SAF-02 (Logged)	4.3 ± 0.19	0.06 ± 0.03	0.63 ± 0.38	122 ± 4.2	377 ± 29.5	70.0 ± 0.90	84.3 ± 18.2	42.3 ± 15.1	2.3 ± 0.3	51.1 ± 2.2
SAF-05 (Logged)	4.9 ± 0.25	0.20 ± 0.04	1.87 ± 0.33	386 ± 42.5	66.3 ± 59.1	398 ± 134	49.1 ± 1.4	315 ± 50.8	7.6 ± 2.8	54.7 ± 4.8
SAF-03 (Logged)	3.8 ± 0.18	0.10 ± 0.01	0.98 ± 0.43	158 ± 20.0	247 ± 50.6	28.0 ± 3.4	79.6 ± 25.2	20.8 ± 2.8	1.8 ± 0.28	32.7 ± 6.3
SAF-04 (Logged)	3.7 ± 0.57	0.16 ± 0.02	2.63 ± 0.97	61.5 ± 4.5	17.0 ± 9.00	31.6 ± 12.8	26.7 ± 7.3	15.6 ± 2.9	2.1 ± 0.62	5.5 ± 1.7
DAN-04 (Old-growth)	5.5 ± 0.20	0.09 ± 0.01	0.89 ± 0.12	433 ± 81.4	3.80 ± 3.50	566 ± 152	18.7 ± 9.6	400 ± 83.5	25.6 ± 9.2	63.2 ± 1.6
DAN-05 (Old-growth)	4.5 ± 0.23	0.11 ± 0.02	1.00 ± 0.37	201 ± 5.9	281 ± 63.1	62.9 ± 7.1	64.1 ± 3.6	157 ± 66.2	6.0 ± 1.5	49.2 ± 3.82
MLA-01 (Old-growth)	4.0 ± 0.08	0.08 ± 0.01	0.80 ± 0.25	149 ± 15.8	354 ± 62.1	22.6 ± 6.7	71.1 ± 7.6	30.6 ± 7.47	1.8 ± 0.16	44.9 ± 7.0
MLA-02 (Old-growth)	4.3 ± 0.29	0.13 ± 0.02	1.02 ± 0.22	210 ± 11.1	296 ± 81.1	90.4 ± 34.6	67.3 ± 13.6	87.7 ± 57.6	2.6 ± 0.26	46.4 ± 2.3
LAM-07 (Old-growth)	4.4 ± 0.16	0.10 ± 0.02	0.95 ± 0.07	127 ± NA	235 ± 85.8	22.1 ± 5.77	64.8 ± 21.3	76.0 ± 46.7	3.6 ± 0.94	35.2 ± 6.9
LAM-06 (Old-growth)	4.4 ± 0.03	0.08 ± 0.01	0.98 ± 0.08	73.4 ± NA	252 ± 75.5	4.4 ± 2.2	42.2 ± 10.4	9.6 ± 4.4	3.8 ± 0.95	30.3 ± 9.1
Logged Mean	4.2 ± 0.21	0.13 ± 0.02	1.47 ± 0.35	200 ± 57.9	190 ± 65.6	186 ± 87.9	62.6 ± 10.8	104 ± 56.2	4.0 ± 1.2	40.7 ± 9.9
Old-growth Mean	4.5 ± 0.21	0.10 ± 0.01	0.94 ± 0.03	199 ± 51.1	237 ± 49.6	128 ± 88.6	54.7 ± 8.3	127 ± 58.5	7.2 ± 3.7	44.9 ± 4.7

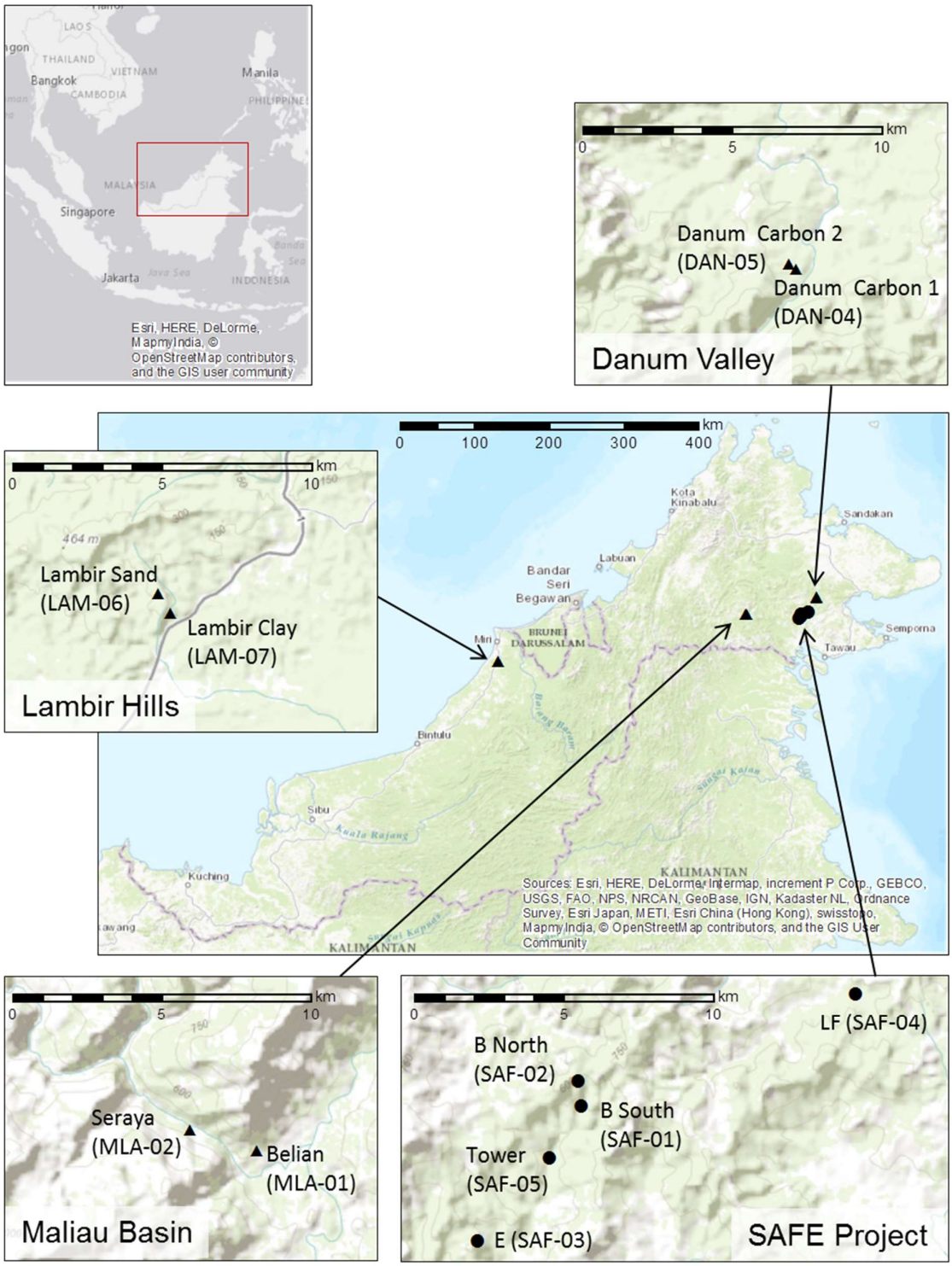

Figure S1. Map of the study plots in four sites in Malaysian Borneo. Logged plots are shown as circles and old-growth plots as triangles.

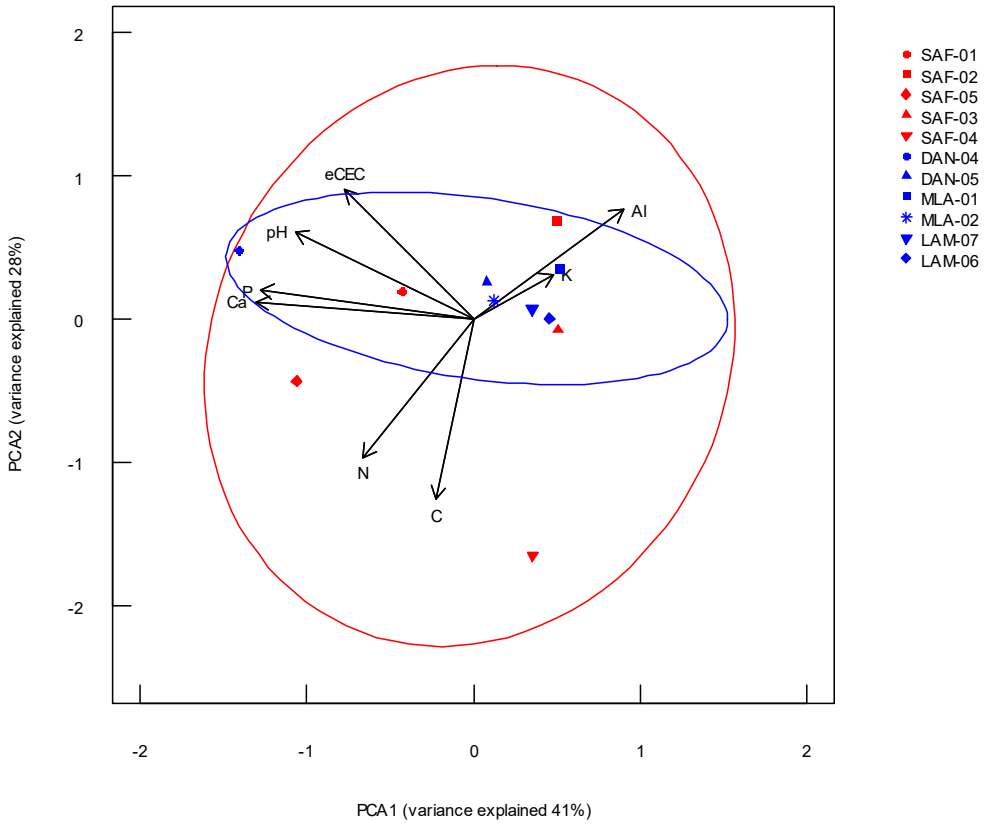

Figure S2. Principal component analysis of the soil properties (see Table S1) in logged plots (red) and old-growth plots (blue). Each plot had three replicates (omitted for visual clarity, only the plot centroid shown). The red and blue ellipses represent 90% confidence intervals for the logged and old-growth plots, respectively.

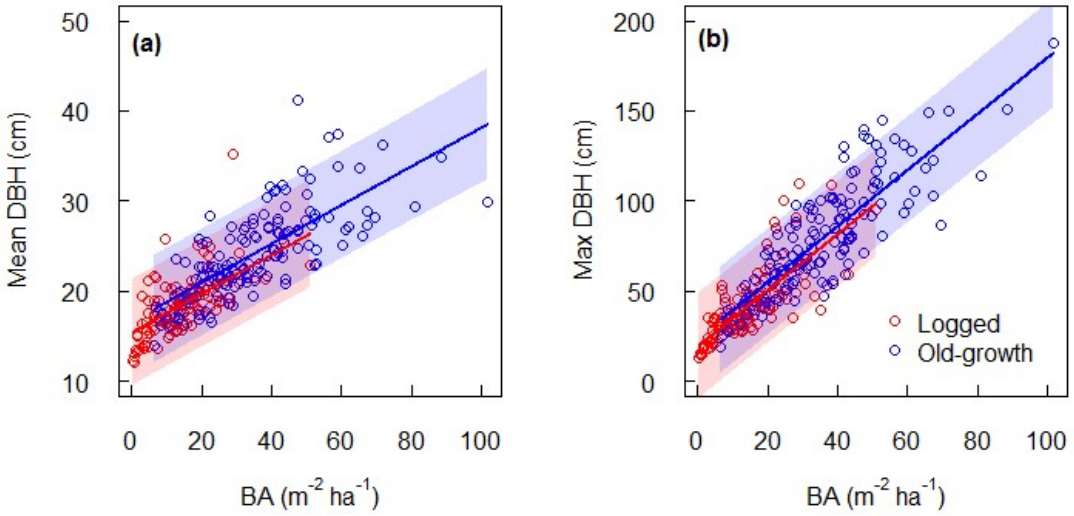

Figure S3. The relationship between a) mean and b) maximum diameter at breast height (DBH) and basal area (BA) in logged and old-growth forest. Each data point represents a 20 m × 20 m subplot, stems >10 cm DBH were included. A linear regression was fitted to the data, with the same slope (no difference between forest types, p=0.739 and p=0.545 for the mean DBH and maximum DBH model, respectively), but different intercept (significant difference between forest types, p=0.007 and p=0.047 for the mean DBH and maximum DBH model, respectively) for each forest type. The bands are 95% prediction intervals.

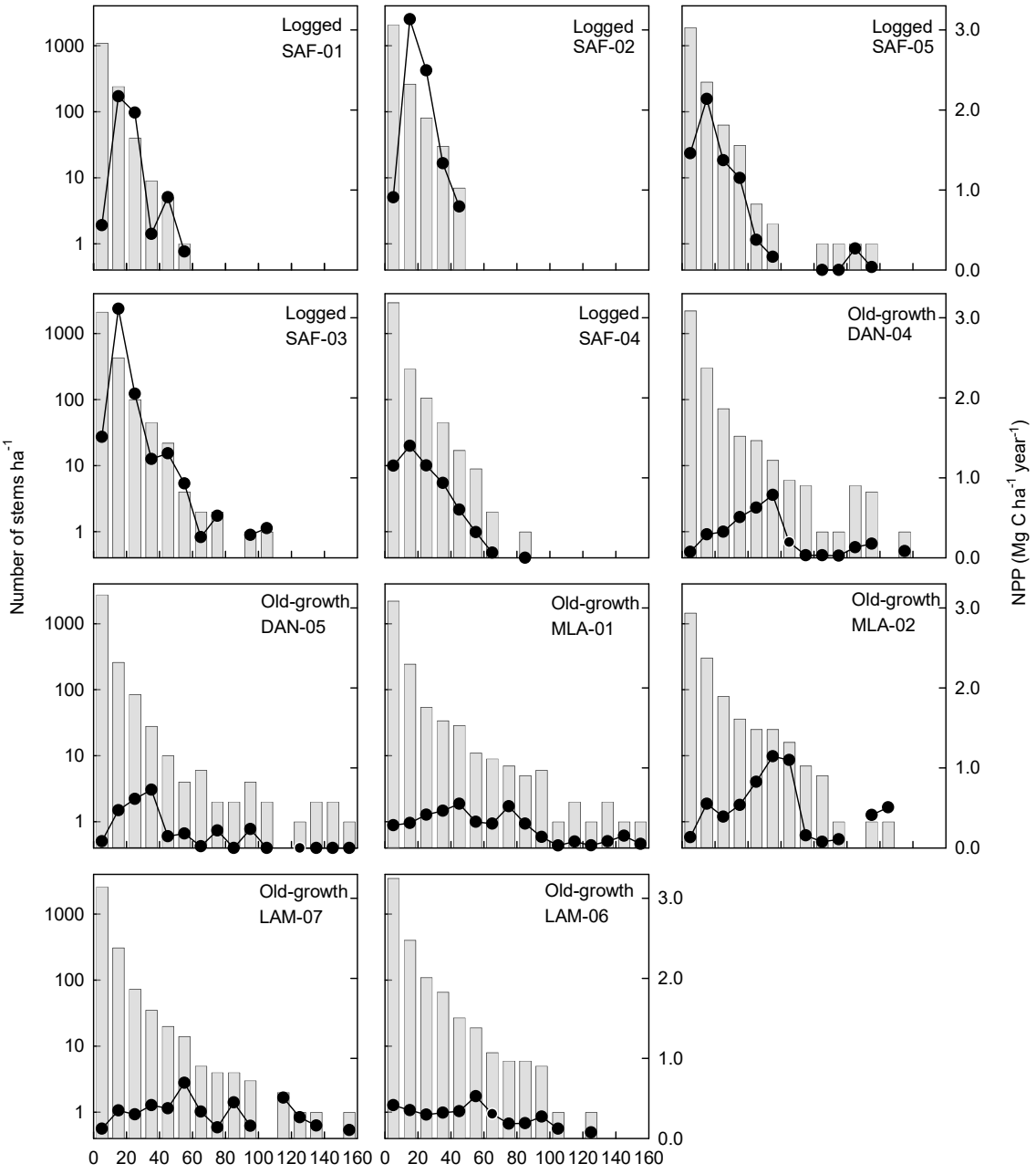

Figure S4. Diameter distribution (bars) and above-ground woody net primary productivity (NPP, lines) by diameter class in logged and old-growth forest plots. Logged plots have been ranked according to the level of disturbance, with the most heavily logged plot on the top left.

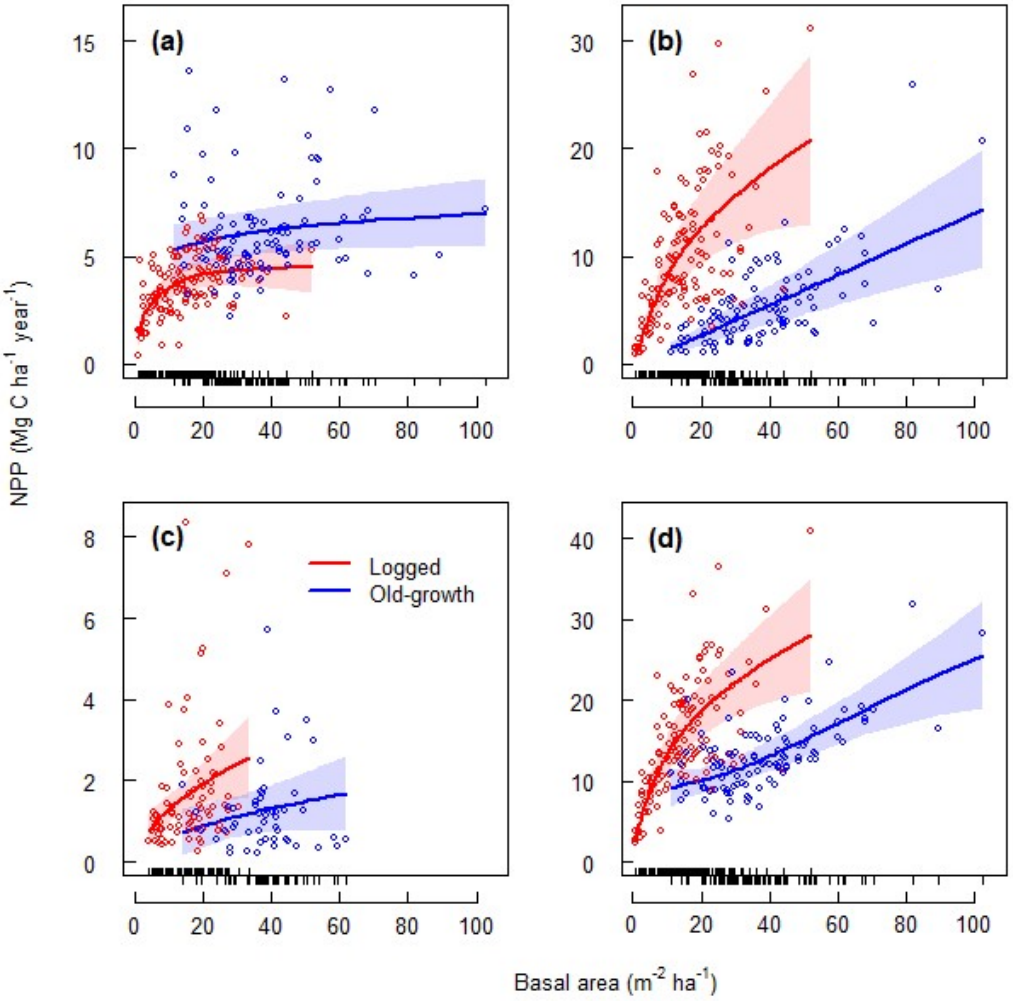

Figure S5. a) Canopy, **b)** woody, **c)** fine root and **d)** total net primary productivity (NPP) as a function of basal area of stems >10 cm diameter in logged and old-growth forest. The lines are cubic regression spline smoothers from general additive models and the grey bands are ± 95% confidence intervals. The inward and outward rugs on the x axes denote the distribution of the basal area data in logged and old-growth forest, respectively.

References

Köhler P, Ditzer T, Huth A (2000) Concepts of the aggregation of tropical tree species into functional types and the application to Sabah's lowland rain forests. Journal of Tropical Ecology, **16**, 591-602.

Saner P, Loh YY, Ong RC, Hector A (2012) Carbon Stocks and Fluxes in Tropical Lowland Dipterocarp Rainforests in Sabah, Malaysian Borneo. PLoS ONE, **7**, e29642. doi: 10.1371/journal.pone.0029642