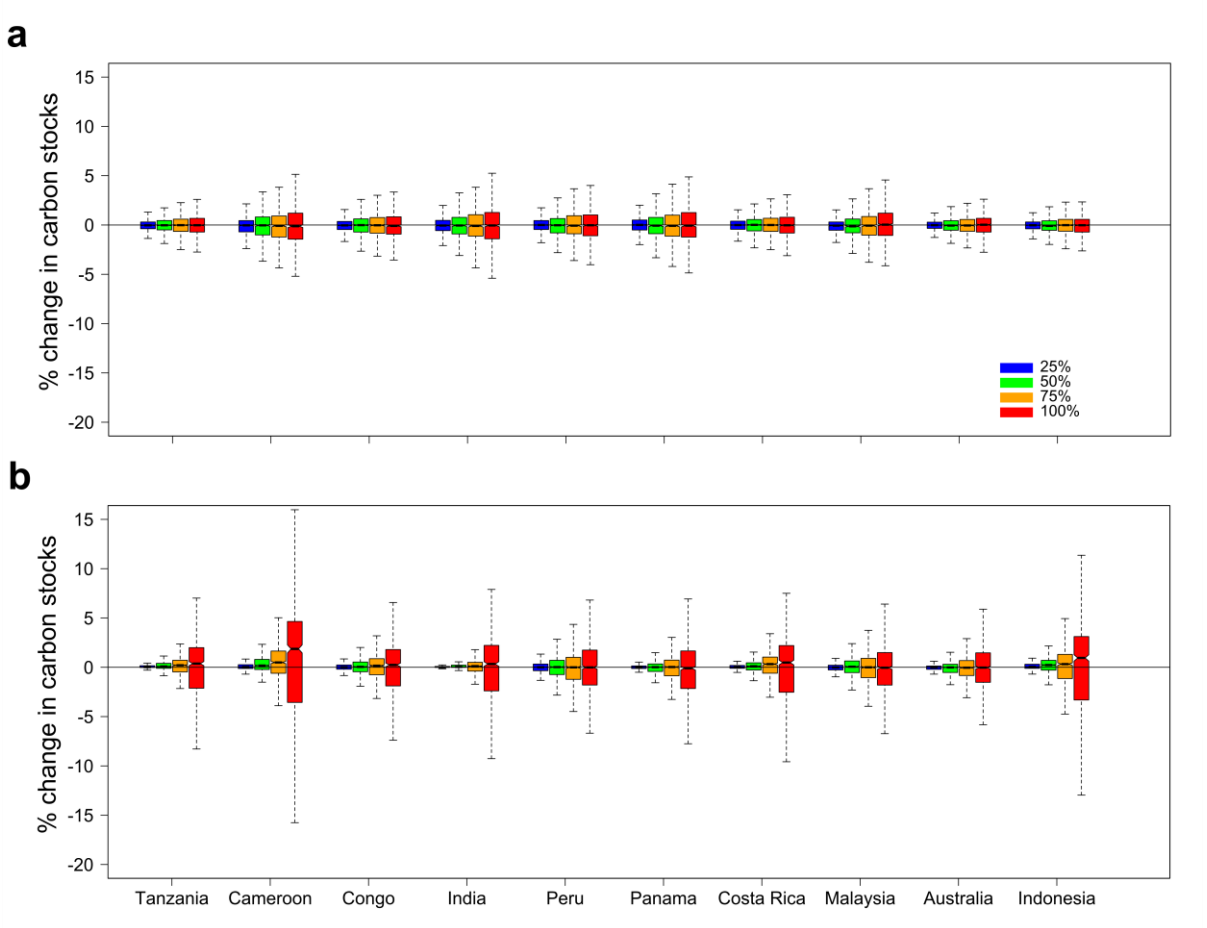
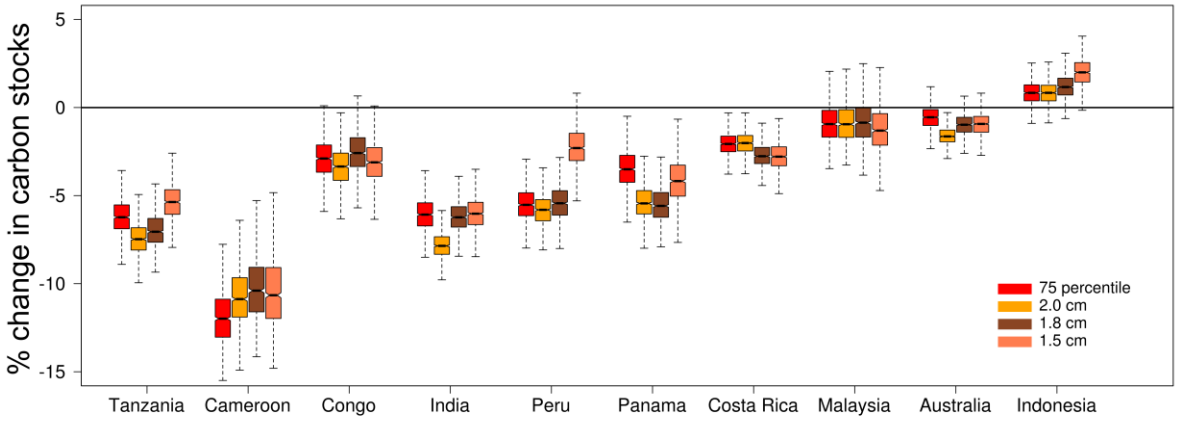
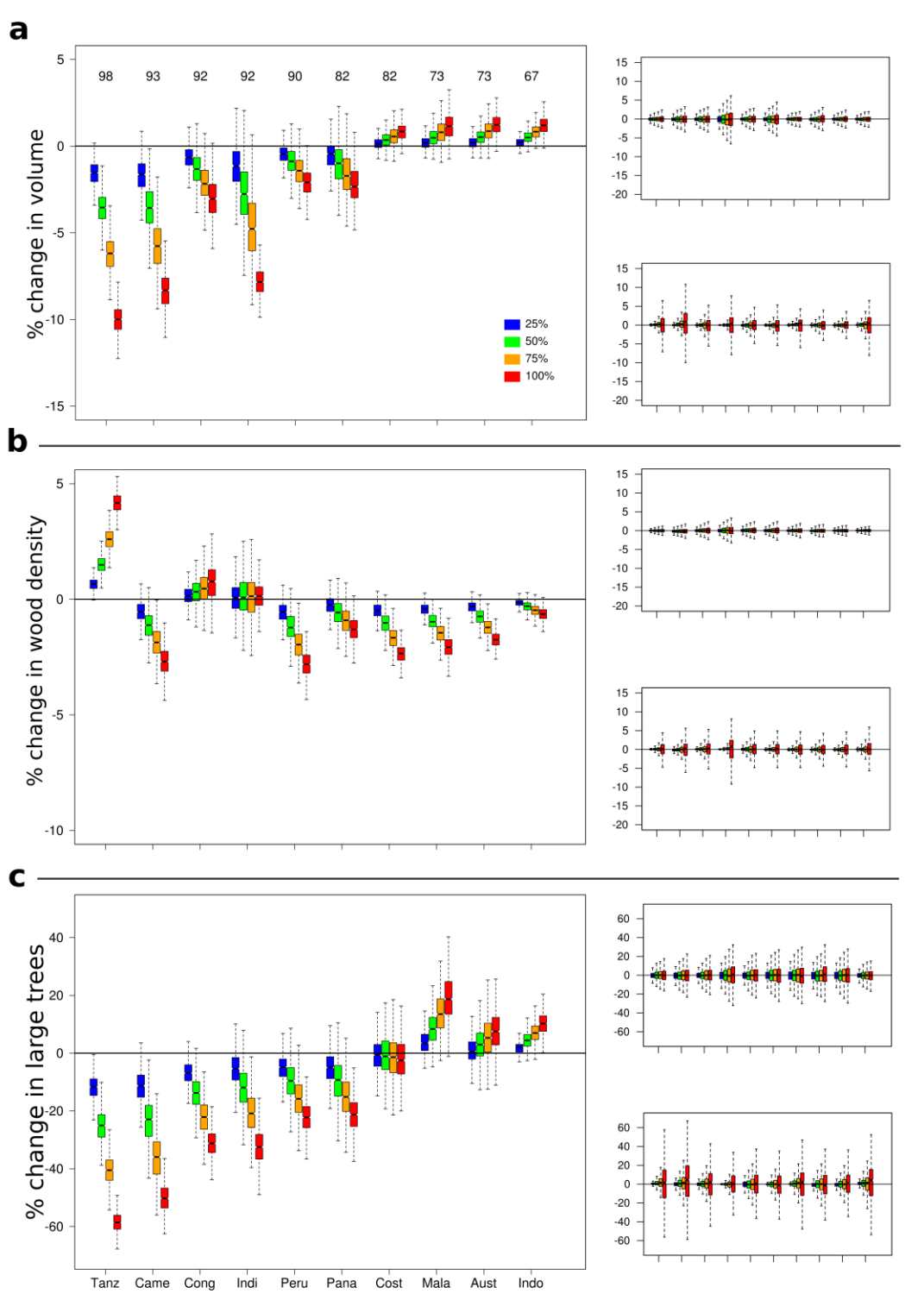
Supplementary Figures



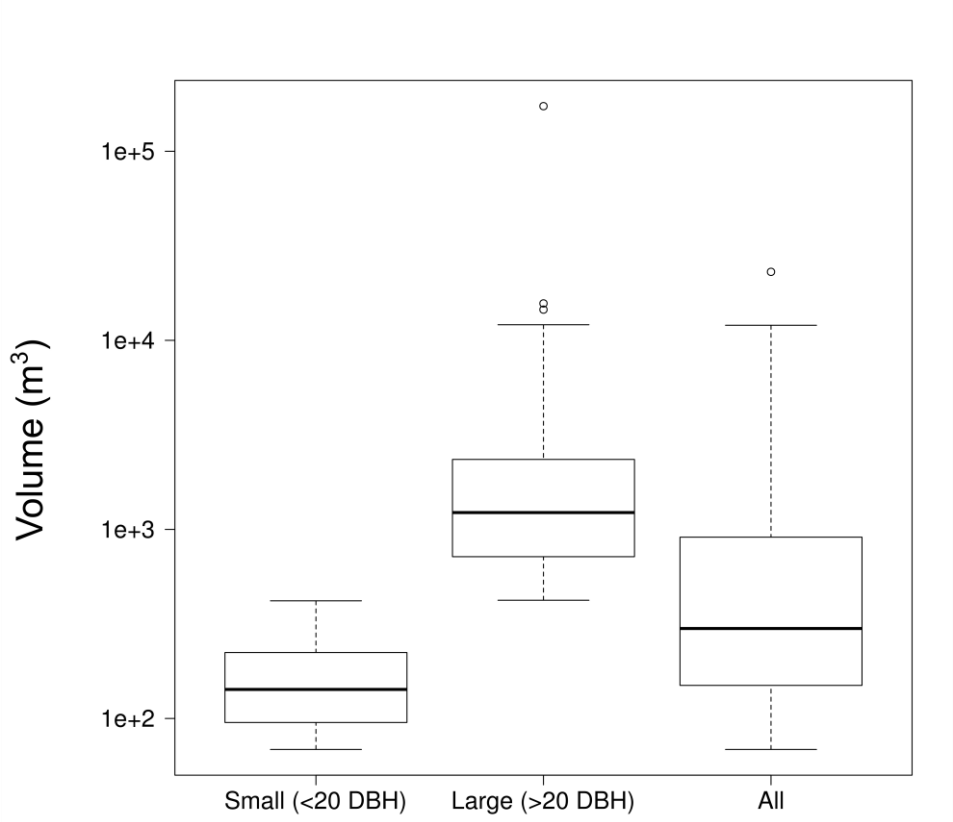
Supplementary Figure 1. Changes in carbon stocks in two control scenarios in which equal numbers of (**a**) individuals and (**b**) species as those extirpated in the 25%, 50%, 75% and 100% levels of the defaunation scenarios (manuscript Fig. 1) were removed



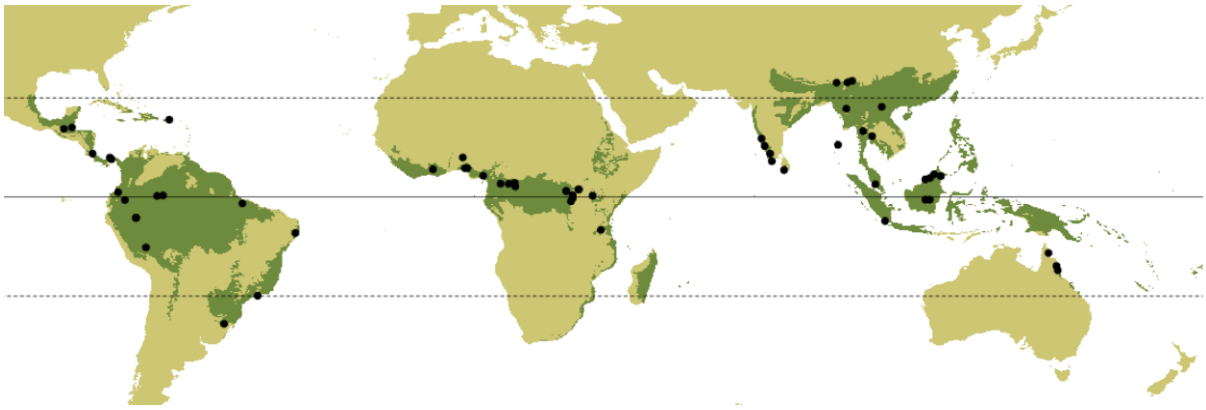
Supplementary Figure 2. Sensitivity of carbon storage responses to the threshold seed size used to define large-seeded species. Boxes represent change in carbon stocks for 100% removal of large-seeded animal-dispersed species using different seed length thresholds to define large-seeded species, namely, the 75th percentile seed length for each community, 2.0 cm, 1.8 cm and 1.5 cm. Simulations using different definitions consistently produced similar results



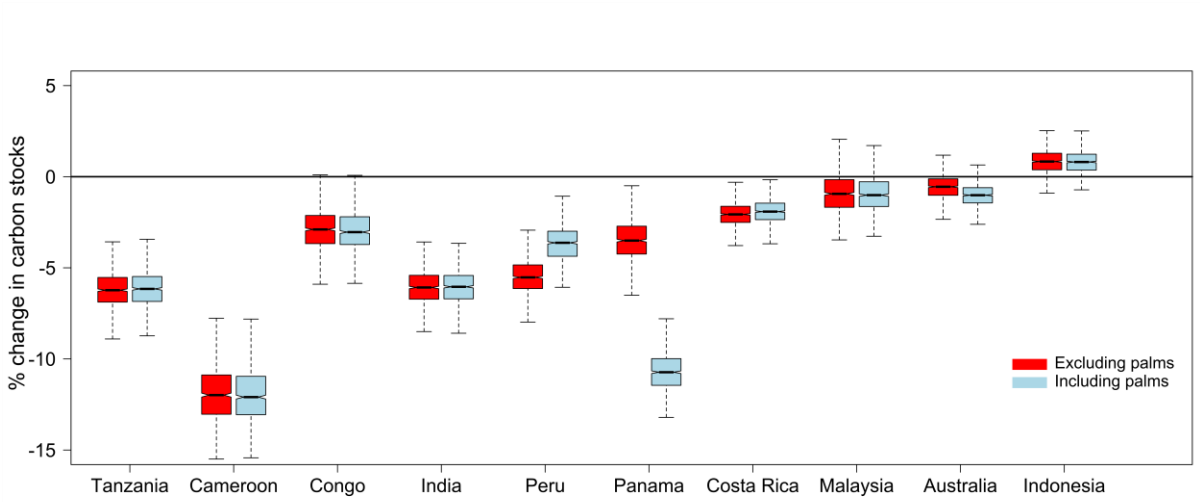
Supplementary Figure 3. Changes in (a) stand volumes, (b) community-weighted wood densities and (c) relative abundance of large trees (≥70 cm DBH) relative to original values for 1000 simulation runs following removal of 25%, 50%, 75% and 100% of individuals belonging to large-seeded animal-dispersed tree species. The small plots towards the right of each panel represent corresponding responses in control scenarios in which equal numbers of individuals (above) and species (below) as those extirpated in the defaunation scenarios were removed



Supplementary Figure 4. Boxplots showing that for a given basal area ($30m^2$ ha^{-1}), forest stands comprising only small trees (<20 cm DBH) have less volume than stands comprising large trees (>20 cm DBH) or mixed stands with small and large trees (All). Equal basal area stands were assembled through simulations by randomly drawing individuals from the pool of small trees, large trees and all trees within the overall pool



Supplementary Figure 5. Map showing the locations of 59 tree community datasets that were used to assess the prevalence of animal-dispersed tree species across tropical forest regions (also see Fig. 4 of the main text and Supplementary References 1-44). Regions shaded green depict "Tropical and subtropical moist broadleaf forests" as defined in WWF's Terrestrial Ecoregions of the World[78], downloaded from http://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world



Supplementary Figure 6. Sensitivity of carbon storage responses to exclusion of palms from the simulations. Boxes represent simulated changes in carbon stocks following removal of all large-seeded animal-dispersed species from tree communities with palms either excluded (red) or included (blue). Simulations excluding and including palms consistently produced similar results

Supplementary Tables

Supplementary Table 1: Simulated defaunation effects on carbon stocks, volume, wood density and relative abundances of large trees. Differences in median % change between defaunation and individual-based control scenarios (D-C1) and defaunation and species-based control scenarios (D-C2) for these responses at different extirpation levels are presented

Response	Country	25% removal		50% removal		75% removal		100% removal	
		D-C1	D-C2	D-C1	D-C2	D-C1	D-C2	D-C1	D-C2
Carbon stocks	Tanzania	-0.91	-0.96	-2.15	-2.26	-3.88	-4.10	-6.21	-6.60
	Cameroon	-2.37	-2.44	-5.13	-5.34	-8.21	-8.78	-11.86	-13.85
	Congo	-0.55	-0.60	-1.20	-1.26	-2.04	-2.23	-2.80	-3.13
	India	-0.79	-0.84	-2.00	-2.09	-3.52	-3.73	-6.03	-6.41
	Peru	-1.12	-1.12	-2.31	-2.35	-3.78	-3.84	-5.50	-5.51
	Panama	-0.66	-0.66	-1.51	-1.59	-2.55	-2.65	-3.44	-3.41
	Costa Rica	-0.45	-0.47	-0.95	-1.05	-1.52	-1.84	-2.04	-2.55
	Malaysia	-0.21	-0.26	-0.36	-0.55	-0.64	-0.70	-0.97	-0.89
	Australia	-0.12	-0.14	-0.20	-0.25	-0.37	-0.37	-0.58	-0.52
	Indonesia	+0.14	+0.07	+0.39	+0.07	+0.57	+0.23	+0.86	-0.12

Volume	Tanzania	-1.52	-1.55	-3.52	-3.60	-6.18	-6.37	-9.98	-10.02
	Cameroon	-1.59	-1.63	-3.51	-3.66	-5.72	-6.00	-8.21	-9.19
	Congo	-0.61	-0.65	-1.27	-1.35	-2.08	-2.24	-2.97	-3.01
	India	-1.10	-1.14	-2.67	-2.76	-4.60	-4.80	-7.79	-8.19
	Peru	-0.43	-0.45	-0.85	-0.85	-1.40	-1.34	-2.07	-2.06
	Panama	-0.42	-0.44	-0.97	-1.00	-1.60	-1.70	-2.23	-2.03
	Costa Rica	+0.16	+0.13	+0.37	+0.26	+0.53	+0.34	+0.91	+0.38
	Malaysia	+0.25	+0.20	+0.57	+0.45	+0.86	+0.81	+1.08	+1.23
	Australia	+0.21	+0.19	+0.57	+0.51	+0.88	+0.90	+1.22	+1.22
	Indonesia	+0.24	+0.17	+0.56	+0.34	+0.87	+0.61	+1.22	+0.71
Relative abundance of large trees	Tanzania	-11.52	-11.79	-25.12	-25.45	-40.69	-42.17	-58.48	-60.03
	Cameroon	-11.14	-11.31	-22.55	-23.53	-35.92	-37.37	-50.19	-54.94
	Congo	-6.93	-6.88	-13.5	-14.07	-22.02	-22.77	-31.36	-33.14
	India	-4.99	-5.39	-12.05	-11.93	-20.29	-20.95	-33.19	-32.70
	Peru	-4.97	-4.83	-9.10	-9.33	-15.58	-15.56	-22.44	-22.57
	Panama	-4.83	-4.96	-9.32	-9.42	-15.37	-15.04	-21.45	-20.41
	Costa Rica	-0.68	-0.76	-1.23	-1.65	-1.72	-2.66	-1.62	-4.43
	Malaysia	+3.87	+3.48	+8.82	+8.17	+13.79	+13.39	+17.97	+19.83
	Australia	+0.94	+0.66	+3.30	+2.81	+5.20	+5.36	+7.30	+6.53
	Indonesia	+2.20	+1.87	+4.70	+3.17	+7.05	+5.52	+10.39	+6.10
Wood density	Tanzania	+0.64	+0.64	+1.51	+1.45	+2.62	+2.50	+4.17	+4.07
	Cameroon	-0.43	-0.51	-0.99	-1.05	-1.72	-1.86	-2.53	-2.93
	Congo	+0.15	+0.14	+0.30	+0.25	+0.43	+0.37	+0.74	+0.57
	India	+0.07	+0.05	+0.05	+0.03	+0.05	+0.01	+0.21	-0.64
	Peru	-0.59	-0.56	-1.29	-1.30	-2.02	-1.95	-2.90	-2.85
	Panama	-0.26	-0.25	-0.58	-0.56	-0.91	-0.89	-1.35	-1.44
	Costa Rica	-0.50	-0.48	-1.04	-1.01	-1.68	-1.63	-2.36	-2.34
	Malaysia	-0.37	-0.37	-0.92	-0.93	-1.43	-1.41	-2.03	-2.01
	Australia	-0.32	-0.32	-0.73	-0.73	-1.22	-1.18	-1.73	-1.64
	Indonesia	-0.18	-0.17	-0.33	-0.30	-0.52	-0.45	-0.68	-0.68

Supplementary Table 2: The percentage of simulation runs in which carbon stocks reduced following simulated extirpations of large-seeded animal-dispersed trees at each site, along with corresponding values for the two control scenarios

Site	**% of simulation runs in which carbon stocks were reduced**											
	Defaunation (Large-seeded species removed)				**Control-1 (Equal numbers of individuals removed at random)**				**Control-2 (Equal numbers of species removed at random)**			
	25%	**50%**	**75%**	**100%**	**25%**	**50%**	**75%**	**100%**	**25%**	**50%**	**75%**	**100%**
Tanzania	92	99	100	100	53	51	52	51	51	33	38	44
Cameroon	95	99	100	100	52	51	52	53	42	38	36	39
Congo	79	90	96	99	52	51	51	53	48	46	45	48
India	83	93	99	100	52	52	52	51	63	37	37	46

Peru	91	97	99	100	50	51	52	51	49	50	50	50
Panama	79	87	94	100	50	51	52	51	54	48	48	51
Costa Rica	78	87	94	100	50	50	50	51	43	41	39	45
Malaysia	70	74	76	79	55	56	52	49	53	47	50	52
Australia	61	66	71	80	52	52	52	49	49	51	52	51
Indonesia	37	23	15	10	51	54	50	51	39	38	40	40

Supplementary Table 3: Output of linear mixed effects model comparing species' maximum diameters, maximum attainable heights and wood densities across seed size and dispersal groups (fixed effects) with site included as a grouping term in the random part of the models.

Seed dispersal category	**Maximum diameter (cm) Mean (±1SE)**	**Maximum attainable height (m) Mean (±1SE)**	**Wood density ($g.cm^{-3}$) Mean (±1SE)**
Small-seeded animal-dispersed	35.25 (±1.40)	22.51 (±0.62)	0.60 (±0.01)
Large-seeded animal - dispersed	43.61 (±2.98)	28.45 (±1.22)	0.63 (±0.02)
Abiotically-dispersed	50.92 (±1.78)	32.19 (±0.81)	0.59 (±0.01)

Supplementary Table 4: Dataset and site details for the ten tree community plot data used for simulations

Sl. No.	Country	Location	Dataset identifier	Sampling year	Latitude	Longitude	No. of plots	Plot size (ha)	Plot IDs	Mean annual precipitation (mm)
1	Australia	Mount Lewis, Agapetes, Whyanbeel, Oliver Creek and Fantail	Ecological Archives E095-209 http://dx.doi.org/10.1890/14-0458R.1	2012/ 2013	-16.3	145.2	6	0.5	ep18, ep30, ep35, ep40,ep41,ep44	2600
2	Cameroon	Korup National Park	TEAM-DataPackage-20140701065026_1902	2013	5.06	8.85	6	1	VG-KRP-1 to VG-KRP-6	5300
3	Panama	Barro Colorado Nature Monument - Soberania National Park	TEAM-DataPackage-20140701042113_1315	2011	9.156	-79.78	6	1	VG-BCI-1 to VG-BCI-6	2900
4	Indonesia	Bukit Barisan	TEAM-DataPackage-20140701043656_1496	2012	-5.65	104.44	6	1	VG-BBS-1 to VG-BBS-6	2950
5	Malaysia	Pasoh Forest Reserve	TEAM-DataPackage-20140701070537_1695	2013	3.03	102.13	6	1	VG-PSH-1 to VG-PSH-6	2050
6	Costa Rica	Volcán Barva	TEAM-DataPackage-20140701071921_1728	2013	10.29	-84.06	5	1	VG-VB-1 to VG-VB-4 and VG-VB-9	4000
7	Congo	Nouabalé Ndoki	TEAM-DataPackage-20140701070319_1368	2013	2.5	16.49	6	1	VG-NNN-1 to VG-NNN-6	1670
8	Tanzania	Udzungwa Mountains National Park	TEAM-DataPackage-20140701071705_1335	2013	-7.77	36.87	6	1	VG-UDZ-1 to VG-UDZ-6	2000
9	Peru	Cocha Cashu - Manu National Park	TEAM-DataPackage-20140701045947_1389	2013	-11.91	-71.36	6	1	VG-COU-1 to VG-COU-6	2100
10	India	Central Western Ghats	Ecological Archives E091-216-D1	1997	13.63	75.02	5	1	BSP69, BSP73, BSP74, BS75, BSP104	6750

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