APPENDICES

Appendix S1. Study site conditions

Appendix S2. Census interval corrections

Appendix S3. Individual tree growth

APPENDIX 1.

Table S1: Description of 28 study plots and census periods in north-western Amazonia and northern Borneo. Latitude and longitude in decimal degrees. Climatic data: mean annual temperature in °C (MAT), mean annual precipitation in mm (MAP), mean solar radiation in MJ m^{-2} d^{-1} (SR). Soil data: sum of bases ($\sum_B$) (cmol kg^{-1}) and total P (mg kg^{-1}), C:N is ratio of total N to C (%). These data, along with plot-level wood production data can be accessed from the permanent archive held at: http://dx.doi.org/10.5521/FORESTPLOTS.NET/2014_3.

Country	Plot code	Lat.	Long.	Plot area (ha)	MAT	MAP	SR	$\sum_B$	Total P	C:N	First – Last census (plot-level analysis; no. of censuses)	Census interval (stem-level analysis)
Western Amazonia												
Ecuador	BOG-01	-0.699	-76.482	1	24.90	3166	10.72	8.98	415.7	7.96	1995.5 – 2007.1 (3)	2002.5 – 2007.1
Ecuador	JAS-02	-1.070	-77.616	1	23.88	3654	10.63	2.04	167.3	9.82	1987.6 – 2007.1 (5)	2002.0 – 2007.1
Ecuador	JAS-03	-1.077	-77.610	1	23.72	3869	10.63	1.12	150.9	10.06	1988.9 – 2007.1 (5)	2002.0 – 2007.1
Ecuador	JAS-05	-1.063	-77.621	1	23.73	3869	10.63	8.18	668.5	9.05	1989.4 – 2002.0 (4)	1998.7 – 2002.0
Ecuador	TIP-03	-0.638	-76.144	1	25.29	3009	10.72	7.11	336.0	7.49	1998.5 – 2007.2 (3)	2002.5 – 2007.2
Peru	ALP-11	-3.949	-73.434	0.44	26.31	2772	11.40	0.40	110.3	11.07	1990.9 – 2009.3 (6)	2001.0 – 2005.1
Peru	ALP-12	-3.948	-73.436	0.4	26.30	2772	11.40	0.13	140.9	12.70	1990.9 – 2009.3 (6)	2001.0 – 2005.1
Peru	ALP-21	-3.953	-73.437	0.48	26.31	2772	11.40	0.17	34.0	14.19	1990.9 – 2009.3 (6)	2001.0 – 2005.1
Peru	ALP-22	-3.951	-73.439	0.44	26.30	2772	11.40	1.08	110.2	10.77	1990.9 – 2009.3 (6)	2001.0 – 2005.1
Peru	ALP-30	-3.954	-73.427	1	26.31	2772	11.40	0.42	37.6	13.47	2001.3 – 2009.1 (4)	2001.3 – 2005.7
Peru	SUC-01	-3.252	-72.907	1	26.30	2799	11.39	0.79	305.3	9.35	1992.1 – 2009.2 (6)	2001.1 – 2005.1

Country	Plot code	Lat.	Long.	Plot area (ha)	MAT	MAP	SR	$\sum_B$	Total P	C:N	First – Last census (plot-level analysis; no. of censuses)	Census interval (stem-level analysis)
Peru	SUC-02	-3.251	-72.904	1	26.30	2799	11.39	0.54	263.9	10.62	1992.1 – 2009.2 (6)	2001.1 – 2005.1
Peru	SUC-03	-3.247	-72.922	1	26.40	2813	11.39	0.61	-	12.50	2001.1 – 2006.1 (3)	2001.1 – 2005.2
Peru	SUC-04	-3.251	-72.892	1	26.30	2799	11.39	0.37	-	-	2001.2 – 2009.2 (4)	2001.2 – 2005.2
Peru	SUC-05	-3.262	-72.892	1	26.30	2799	11.39	0.46	-	-	2001.1 – 2009.2 (4)	2001.1 – 2005.2
Peru	YAN-01	-3.440	-72.846	1	26.20	2809	11.39	6.88	352.8	8.91	1983.5 – 2009.1 (8)	2001.0 – 2005.1
Peru	YAN-02	-3.434	-72.843	1	26.20	2809	11.39	5.07	477.3	8.34	2001.1 – 2009.2 (3)	2001.1 – 2005.1
Regional average (s.d.)					25.71 (1.0)	3003 (395)	11.18 (0.3)	2.61 (3.20)	255.1 (182.8)	10.42 (2.04)		
Northern Borneo												
Brunei	AND-01	4.657	114.546	0.96	27.29	2989	13.60	0.41	63.7	12.58	1992.5 – 2005.5 (2)	1992.5 – 2005.5
Brunei	BAD-01	4.568	114.415	0.96	27.21	3040	13.34	0.51	17.9	35.37	1992.5 – 2008.0 (2)	1992.5 – 2008.0
Brunei	BEL-01	4.540	115.154	1	25.59	3387	13.68	0.89	309.9	9.14	1991.5 – 2005.5 (4)	2000.5 – 2005.5
Sabah, Malaysia	SEP-01	5.856	117.932	1	26.69	3098	13.63	2.43	227.0	7.75	2000.0 – 2007.8 (2)	1998.9 – 2007.8
Sabah, Malaysia	SEP-02	5.854	117.939	1	26.69	3098	13.63	0.37	39.2	13.42	2000.0 – 2007.8 (2)	2001.1 – 2007.8
Sabah, Malaysia	SEP-03	5.855	117.963	1	26.69	3098	13.63	0.45	16.9	20.63	2000.0 – 2007.8 (2)	2001.4 – 2007.8
Sarawak, Malaysia	GMU-01	4.018	114.804	1	26.74	3798	13.44	0.41	108.0	14.08	1985.9 – 2008.4 (5)	1999.5 – 2008.4
Sarawak,	GMU-02	4.049	114.860	1	25.84	3634	13.44	0.25	93.5	12.92	1985.9 – 2008.4 (5)	1999.5 – 2008.3

Country	Plot code	Lat.	Long.	Plot area (ha)	MAT	MAP	SR	$\sum_B$	Total P	C:N	First – Last census (plot-level analysis; no. of censuses)	Census interval (stem-level analysis)
Malaysia												
Sarawak, Malaysia	GMU-03	4.148	114.888	1	25.70	3571	13.44	0.21	22.1	29.39	1985.9 – 2008.4 (5)	1999.5 – 2008.4
Sarawak, Malaysia	LMB-06	4.187	114.017	1	26.45	2932	13.34	0.45	39.2	13.01	1993.3 – 2002.8 (3)	1997.8 – 2002.8
Sarawak, Malaysia	LMB-07	4.187	114.017	1	26.50	2932	13.34	2.68	16.9	10.23	1991.9 – 2003.5 (3)	1997.4 – 2003.5
Regional average (s.d.)					26.49 (0.6)	3234 (308)	13.50 (0.1)	0.82 (0.88)	101.2 (93.2)	16.23 (8.74)		

Fig S1. Plot-level height-diameter relationships using function form $H = a - b\exp(-cD)$. Amazonian plots (black lines); Bornean plots (blue lines); curves represent diameter range for which height data were available. Further methodological details are available in Banin *et al.* (2012); original height-diameter data are from Baker (unpublished) and Banin (2010).

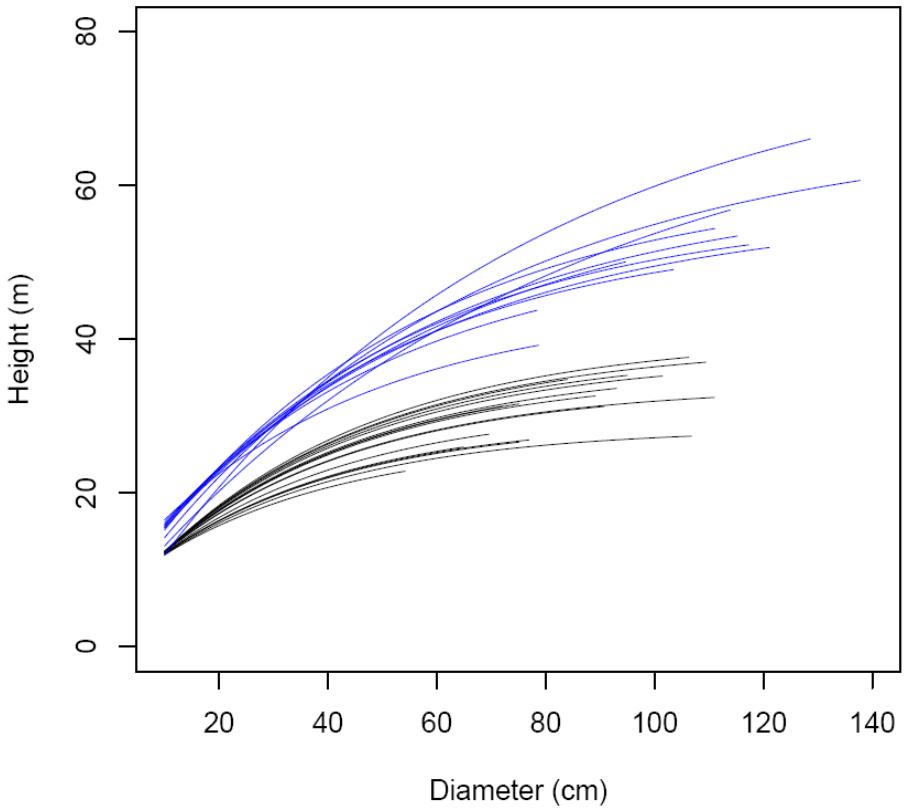
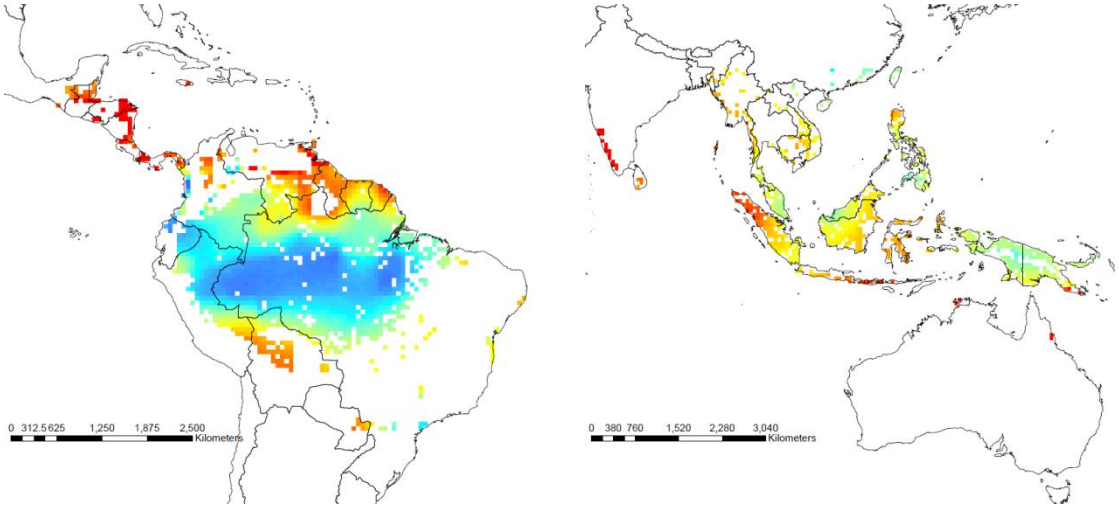


Fig S2. Maps of mean solar radiation, calculated from standardised sunshine hours and/or cloud cover data, for the tropical forest regions of Central/South America and South/East Asia. Interpolations of climate station data (sunshine hours and/or cloud cover) are from the Climate Research Unit (CRU; New *et al.* 1999) at 0.5° resolution. Shaded regions represent regions predicted to support tropical forest based on climatic criteria (<6 months dry season) and satellite-derived Global Land Cover 2000 classes: 1, broadleaved evergreen closed to open trees; 2, broadleaved deciduous closed to open trees; 7, broadleaved evergreen closed to open trees on flooded land and; 17, mosaic cultivated/managed terrestrial areas and closed-open trees (Eva *et al*. 2004; Mayaux *et al*. 2004).



Continent	Mean	SD	Max.	Min.
America	12.0	1.6	17.5	9.9
Asia	13.4	1.0	17.5	11.2

Table S2: Summary of Principal Components Analysis for plot-level mean topsoil (0-30cm) values. Influential variables (loading scores >3 or <-3) within each component are emboldened.

Axis	1	2	3
Proportion (cumulative) variation explained	0.566	0.152 (0.718)	0.088 (0.806)
Loadings			
ln[pH]	0.225	-0.262	-0.213
Exchangeable Al	0.073	**0.592**	0.225
ln[Exchangeable Ca]	0.286	-0.253	-0.165
Exchangeable K	0.205	**0.427**	-0.165
ln[Exchangeable Mg]	0.290	-0.113	**-0.314**
ln[Exchangeable Na]	0.245	-0.125	-0.124
ln[$\sum_B$]	**0.310**	-0.163	-0.252
ECEC	0.297	0.172	-0.087
ln[total N]	0.279	-0.150	**0.432**
1-1/[totalC]	0.082	**-0.328**	**0.567**
1-1/[C:N]	**-0.310**	-0.068	0.015
Sand	**-0.302**	-0.171	-0.175
Silt	0.234	0.292	-0.025
Clay	0.267	-0.020	**0.327**
ln[total P]	**0.306**	-0.012	0.135
Component definition	Fertility: $\sum_B$, Total P, C:N, Sand (inverse)	Al, K, C	Mg, N, C, clay

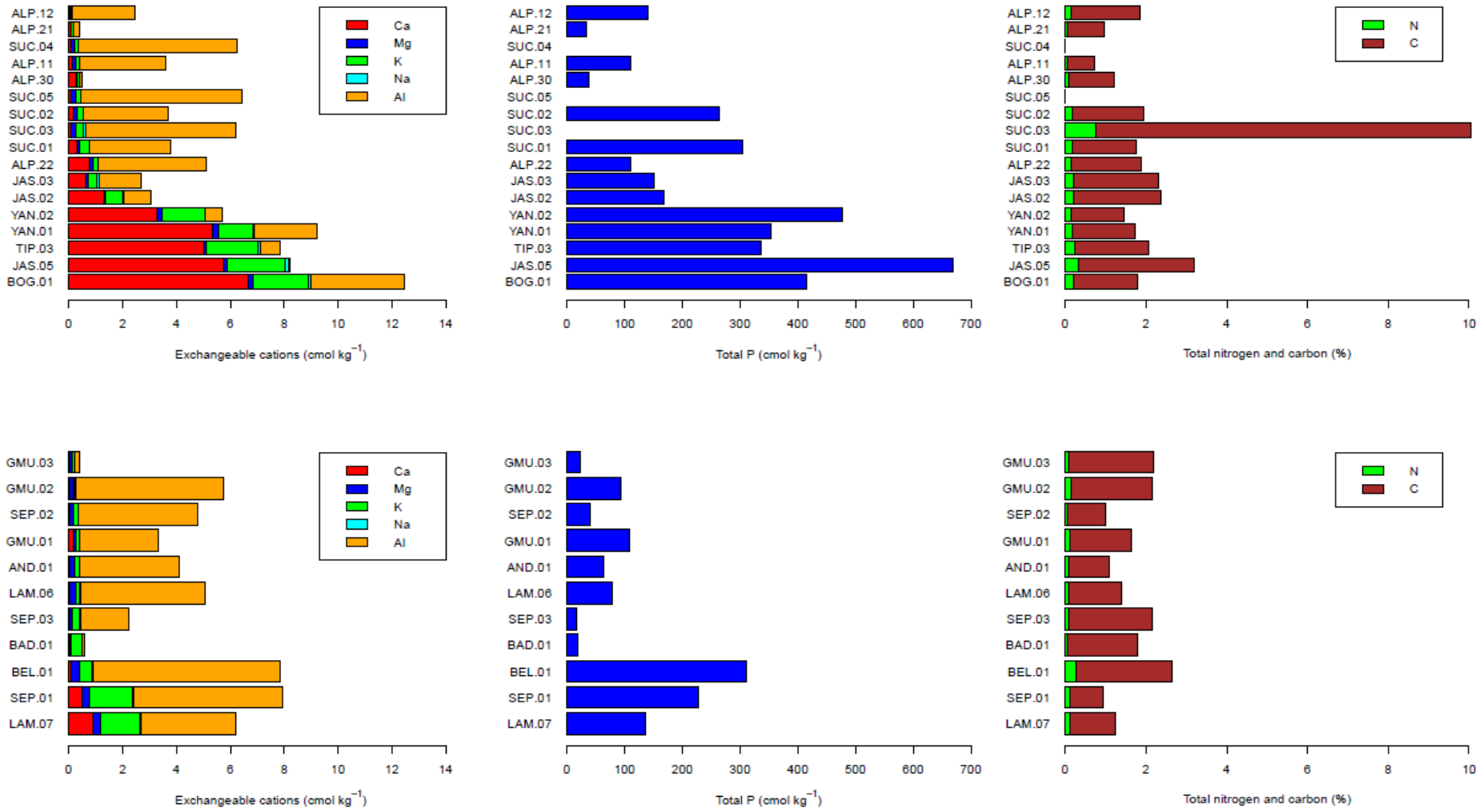


Fig S3. Topsoil (0-30 cm) properties by plot. Top panel presents data for Amazonian plots and bottom panel, Bornean plots. All plots are ordered in decreasing sum of bases ($\sum_B$) from bottom to top of plots. From left to right: mean concentrations of base cations (Ca, Mg, K, Na and Al in cmol kg^{-1}); total P (mg kg^{-1}); total N and C(%).

APPENDIX 2.

Census Interval Correction for forest growth and production

Method

Multi-census data are used to estimate plot-level growth and AGWP by measuring the growth of surviving trees between the initial and subsequent census, plus the in-growth of new stems. This estimate excludes at least two further contributions to growth and AGWP: i) stems that continue to grow but die before the second census and ii) stems that reach the minimum size class after the first census but die before the second (Malhi et al. 2004). As census length increases, the underestimation of growth and AGWP increases, and since census intervals vary between sites (and crucially in the context of this study, between regions) these differences should be corrected for. Malhi et al. 2004 develop a procedure whereby the total census period (first to last census) is partitioned into nested census periods, and the basal area growth rate for those sub-periods is averaged in order to produce a plot-specific correction slope. The correction slope is then used to correct the annual basal area growth for each census interval individually, and then these corrected values are averaged to produce the plot-level growth rate. The proportional difference of corrected: uncorrected basal area growth rate (correction %) is then applied to uncorrected AGWP values for each census interval to arrive at a corrected AGWP value.

Five plots in this study only had two censuses (AND-01, BAD-01 and SEP-01 to 03, all in Borneo) and one plot (SUC-03) did not exhibit a linear trend across varying census periods. Since plot-level correction slopes cannot be derived in these instances, the relationship between corrected basal area growth rate (the intercept of correction slope at zero years) and the correction slope is used to estimate the correction slope for plots with fewer than three censuses. The procedure was originally developed for Amazonian plots (Malhi et al 2004). We reproduced the relationship between basal area growth rate and correction slope to include data from Asian plots (Figure S3) and developed a new relationship (with the same assumption that the regression curve passes through the 0,0 origin), testing for significant difference in the relationship between regions (including continent as a factor). The relationship was not significantly different between regions, and the common relationship (Eq.S1) was derived from the data in this study, with $R^2 = 0.871$; contrary to the regression model provided in Malhi et al. 2004, the linear term did not provide significant improvement to the model and was thus excluded. Following the iterative procedure described in Malhi et al. 2004, the corrected basal area growth rate can be calculated for each census interval and averaged in a similar way as with other plots.

Eq. S1 Correction slope = 0.0135(BA growth rate)^2

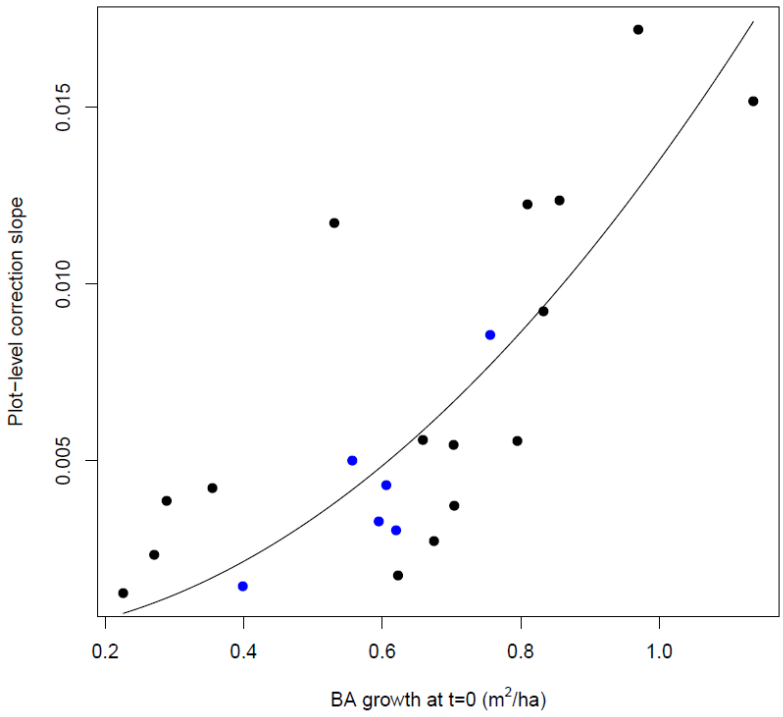


Fig S4. The relationship between plot-level corrected basal area growth rate (intercept of correction curves) and correction slopes, derived from growth calculated from nested census periods for each plot. Curve is best quadratic regression model given in Eq.1.

Table S3: Summary of census intervals, plot-specific corrections for basal area (BA) growth (m^2 ha^{-1} yr^{-1}) and above-ground wood production (AGWP) with height (Mg ha^{-1} yr^{-1}). Corrections were calculated for AGWP without height too but are not shown. 'ms' (in correction slope) denotes plots for which the mean relationship between growth rate and correction slope were used to derive the correction slope. These data, along with site description data can be accessed from the permanent archive held at: http://dx.doi.org/10.5521/FORESTPLOTS.NET/2014_3.

Plot	First census	Last census	No. censuses	Mean shortest interval	BA growth, uncorrected	BA growth, corrected	Correction slope	Correction factor	AGWP with height uncorrected	AGWP with height corrected
Amazonia										
ALP-11	1990.87	2009.33	6	4.61	0.277	0.291	0.004	0.052	4.641	4.997
ALP-12	1990.87	2009.33	6	4.61	0.223	0.227	0.001	0.022	4.814	4.837
ALP-21	1990.87	2009.33	6	4.61	0.335	0.350	0.004	0.047	5.737	6.131
ALP-22	1990.87	2009.33	6	4.61	0.266	0.275	0.002	0.033	4.707	4.958
ALP-30	2001.26	2009.11	4	3.93	0.499	0.530	0.012	0.061	4.263	4.535
BOG-01	1995.5	2007.13	3	5.82	0.870	0.970	0.017	0.115	7.672	8.842
JAS-02	1987.62	2007.07	5	4.86	0.809	0.869	0.012	0.074	6.042	6.785
JAS-03	1988.87	2007.08	5	4.55	0.778	0.803	0.006	0.033	6.254	6.387
JAS-05	1989.38	2002.04	4	4.22	1.062	1.125	0.015	0.060	8.371	9.067
SUC-01	1992.13	2009.17	6	4.26	0.720	0.738	0.005	0.026	6.728	7.200
SUC-02	1992.13	2009.16	6	4.26	0.643	0.662	0.006	0.030	6.129	6.417
SUC-03	2001.08	2006.14	3	2.53	0.493	0.502	0.003 (ms)	0.018	4.855	4.749

Plot	First census	Last census	No. censuses	Mean shortest interval	BA growth, uncorrected	BA growth, corrected	Correction slope	Correction factor	AGWP with height uncorrected	AGWP with height corrected
SUC-04	2001.16	2009.16	4	4	0.626	0.630	0.002	0.007	6.365	6.409
SUC-05	2001.12	2009.16	4	4.02	0.669	0.676	0.003	0.011	6.437	6.503
TIP-03	1998.5	2007.15	3	4.33	0.779	0.832	0.012	0.068	7.688	8.100
YAN-01	1983.46	2009.14	8	5.14	0.814	0.847	0.009	0.042	7.388	7.570
YAN-02	2001.13	2009.15	3	4.01	0.689	0.704	0.004	0.022	7.337	7.497
Regional mean (s.d.)				4.375 (0.671)	0.621 (0.239)	0.649 (0.257)			6.202 (1.239)	6.528 (1.410)

Table S3 continued.

Plot	First census	Last census	No. censuses	Mean shortest interval	BA growth, uncorrected	BA growth, corrected	Correction slope	Correction factor	AGWP with height uncorrected	AGWP with height corrected
Borneo										
AND-01	1992.5	2005.5	2	13.0	0.630	0.721	0.007 (ms)	0.145	9.741	11.152
BAD-01	1992.5	2008	2	15.5	0.593	0.693	0.006 (ms)	0.169	6.848	8.004
BEL-01	1991.5	2005.5	4	4.67	0.716	0.756	0.009	0.056	11.605	12.710
GMU-01	1985.88	2008.35	5	5.62	0.549	0.577	0.005	0.051	6.912	7.714
GMU-02	1985.88	2008.335	5	5.61	0.615	0.633	0.003	0.028	9.301	9.703
GMU-03	1985.87	2008.365	5	5.62	0.588	0.606	0.003	0.032	8.458	8.942
LMB-06	1993.26	2002.84	3	4.79	0.392	0.399	0.001	0.018	6.179	6.333
LMB-07	1991.89	2003.46	3	5.79	0.581	0.606	0.004	0.043	8.876	9.330
SEP-01	1998.90	2007.79	2	8.90	0.659	0.721	0.007 (ms)	0.095	10.597	11.601
SEP-02	2001.14	2007.79	2	6.65	0.694	0.744	0.007 (ms)	0.072	10.480	11.232
SEP-03	2001.40	2007.79	2	6.40	0.836	0.906	0.011 (ms)	0.084	9.555	10.360
Regional mean (s.d.)				7.504 (3.564)	0.623 (0.111)	0.669 (0.129)			8.959 (1.724)	9.734 (1.908)

Implications of census correction to research findings

As would be expected, mean basal area growth and AGWP rates were higher for all plots and due to the longer census intervals in Bornean plots, corrections yielded an average 7% increase for those plots, and corrections in Amazonian plots added, on average, 4% to growth and production rates. The main text reports results using the corrected values, as these were deemed more accurate but, qualitatively, results did not differ whether the corrected or uncorrected values were analysed.

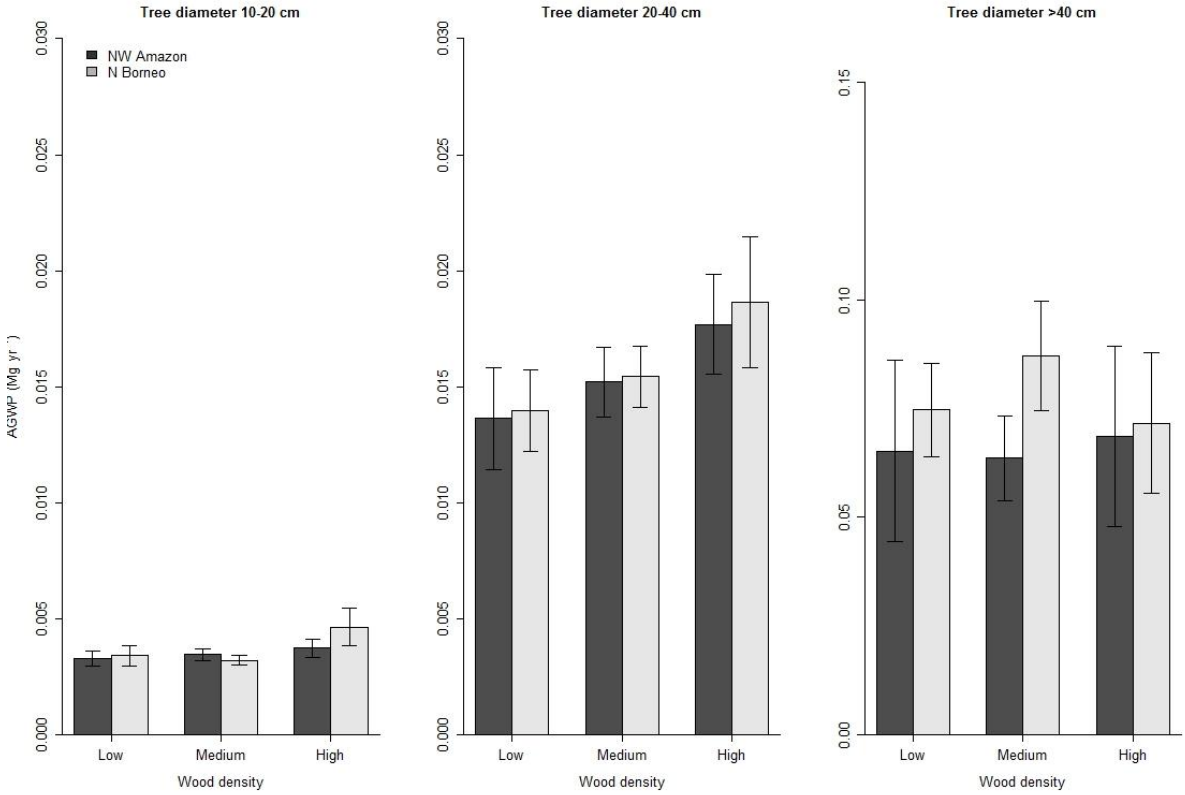
Census interval corrections are needed to remove biases associated to census length, particularly since there was a systematic difference between Bornean and Amazonian sites in terms of interval length. The analyses showed that the results of the study are robust regardless of whether census interval length is corrected for or not.

APPENDIX 3.

Table S4. Model-estimated individual tree diameter growth (mm yr^{-1}) and above-ground wood production (AGWP, Mg C yr^{-1}). Tree growth and AGWP were estimated for each region and for dipterocarps and non-dipterocarps in Borneo using functions derived from mixed-effects models (Table 3). Estimations were made from a range of diameter size classes (100, 200, 400, 600 mm), and the lower and upper quartile values for wood density (g cm^3) and soil fertility (PCA1; unitless). Estimates have been back-transformed to original units.

Tree diameter	Wood density	PCA1	Amazon, growth	Borneo, growth	Amazon, AGWP	Borneo, AGWP	Dipterocarp growth	Non-dipterocarp growth	Dipterocarp, AGWP	Non-dipterocarp, AGWP
Low fertility										
100	0.510	-1.985	1.399	1.062	-0.004	-0.002	1.226	1.110	-0.008	-0.017
200	0.510	-1.985	1.976	1.859	-0.006	-0.004	2.651	1.818	-0.007	-0.014
400	0.510	-1.985	3.437	2.873	0.028	0.030	3.902	2.577	0.033	0.011
600	0.510	-1.985	4.894	3.592	0.066	0.068	4.483	3.045	0.077	0.037
100	0.679	-1.985	1.183	0.858	-0.006	-0.004	0.872	0.919	-0.010	-0.019
200	0.679	-1.985	1.741	1.628	-0.007	-0.005	2.217	1.604	-0.009	-0.016
400	0.679	-1.985	3.153	2.608	0.027	0.029	3.397	2.340	0.031	0.009
600	0.679	-1.985	4.561	3.302	0.065	0.067	3.945	2.793	0.074	0.035
High fertility										
100	0.510	2.91	1.540	1.196	-0.001	0.001	1.519	1.006	0.006	-0.003
200	0.510	2.91	2.130	2.010	-0.002	0.000	3.012	1.702	0.007	-0.001
400	0.510	2.91	3.623	3.046	0.032	0.034	4.322	2.448	0.048	0.025
600	0.510	2.91	5.112	3.781	0.070	0.072	4.931	2.908	0.092	0.051
100	0.679	2.91	1.320	0.987	-0.002	0.000	1.149	0.818	0.004	-0.006
200	0.679	2.91	1.889	1.774	-0.004	-0.002	2.557	1.492	0.005	-0.003
400	0.679	2.91	3.332	2.775	0.031	0.033	3.793	2.215	0.046	0.023
600	0.679	2.91	4.771	3.485	0.069	0.071	4.367	2.661	0.090	0.049

Fig S5.


Tree diameter 10-20 cm
Tree diameter 20-40 cm
Tree diameter >40 cm
NW Amazon
N Borneo
AGWP (Mg yr⁻¹)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.00
0.05
0.10
0.15
Low
Medium
High
Wood density