Supplementary material

All code used in statistical analysis can be found at https://github.com/PhilAMartin/SecFor

Appendix S1 – Details of methods used to search for literature and calculate soil carbon stocks

The online databases Web of Knowledge, Wiley Blackwell and Science Direct were searched, along with the Society for Ecological Restoration International website, and the internet search engine Google. Search terms were combinations of the keywords: tropical AND (*forest* OR wood* OR jungle*) AND (restor* OR reforest* OR recov* OR rehabilitat* OR secondary OR swidden OR slash* OR degrad*) AND (plant* OR carbon OR biomass OR litter OR rich* OR biodiversity OR function* OR service*). Records of all studies were downloaded to an Endnote database and the last date of access was 17th October 2012.

Irrelevant articles were excluded, first if titles were deemed irrelevant, and then by examining abstracts. The remaining articles were read and retained only if they met the inclusion criteria. Where there was evidence that relevant data had been collected but were not presented in the publications, data were requested from the authors. Data on aboveground biomass, belowground biomass, soil carbon, plant species richness and plant community composition were extracted from the retained studies and stored in a database.
Where data were presented in tables they were simply transferred to the database, but when data were graphical the program datathief (vIII) [1] was used to extract them.

Where a range was given for the age of a forest the median value was recorded. Where soil carbon was given as % organic matter or % soil carbon this was converted to Mg ha^{-1} using standard equations [2, 3]. Where soil bulk density (required to calculate carbon stocks) was not reported we used equations from [3] and multiplied organic matter content by 0.5 to estimate carbon concentrations [2].

Appendix S2 – Peer-reviewed studies from which data were collated for the meta-analysis of recovery of carbon pools and plant biodiversity in tropical secondary forests

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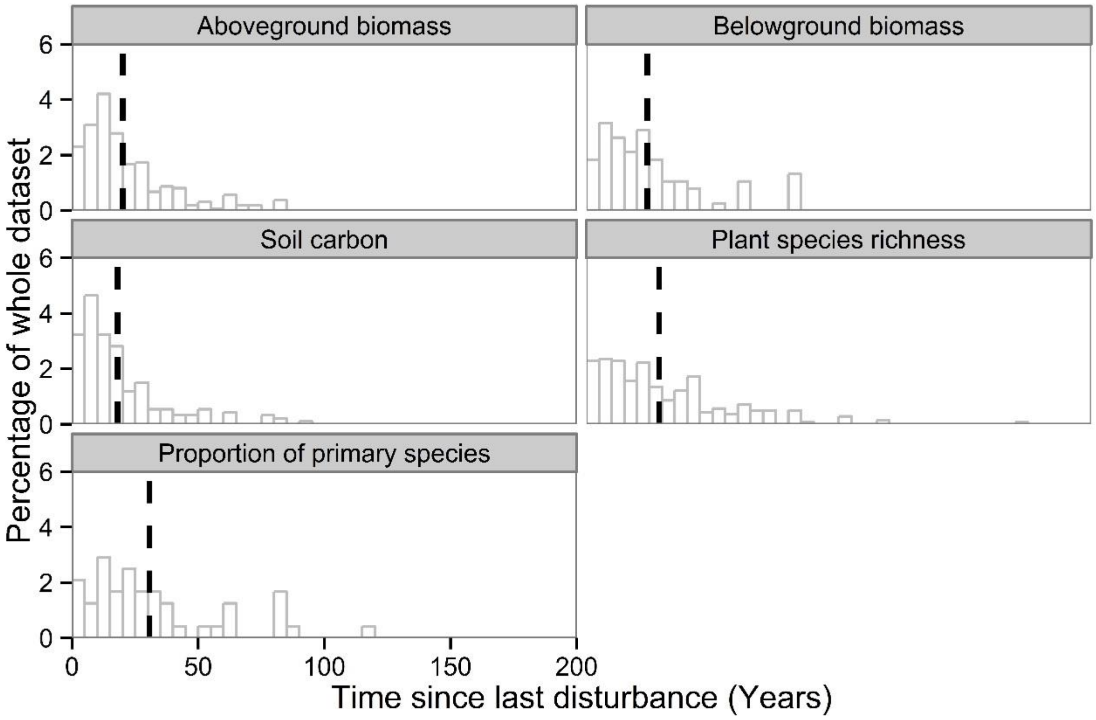

Figure S1 –Distribution of forest ages by metric for the 678 sites represented in the meta-analysis. Vertical dashed lines represent mean ages for each metric type.

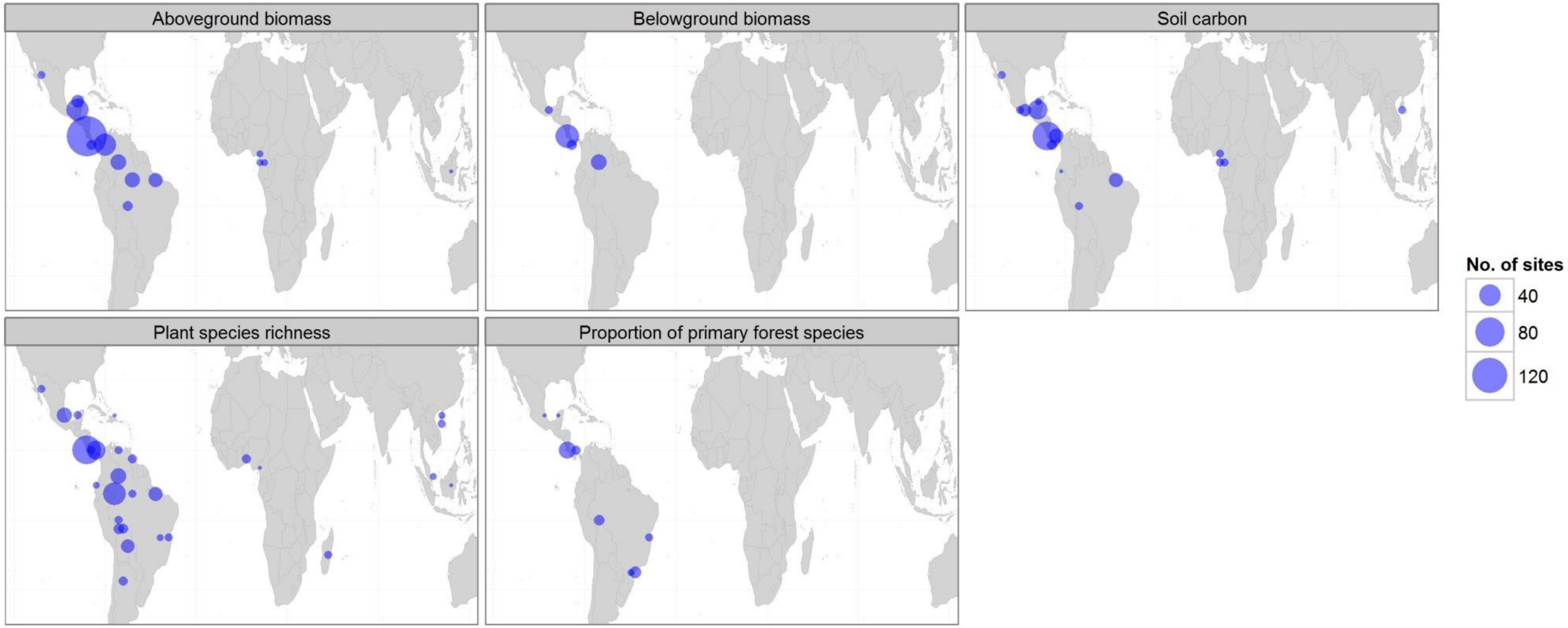

Figure S2 – Geographic distribution of the 607 sites represented in the meta-analysis. Each panel represents the sites where data on the metric in question was available.

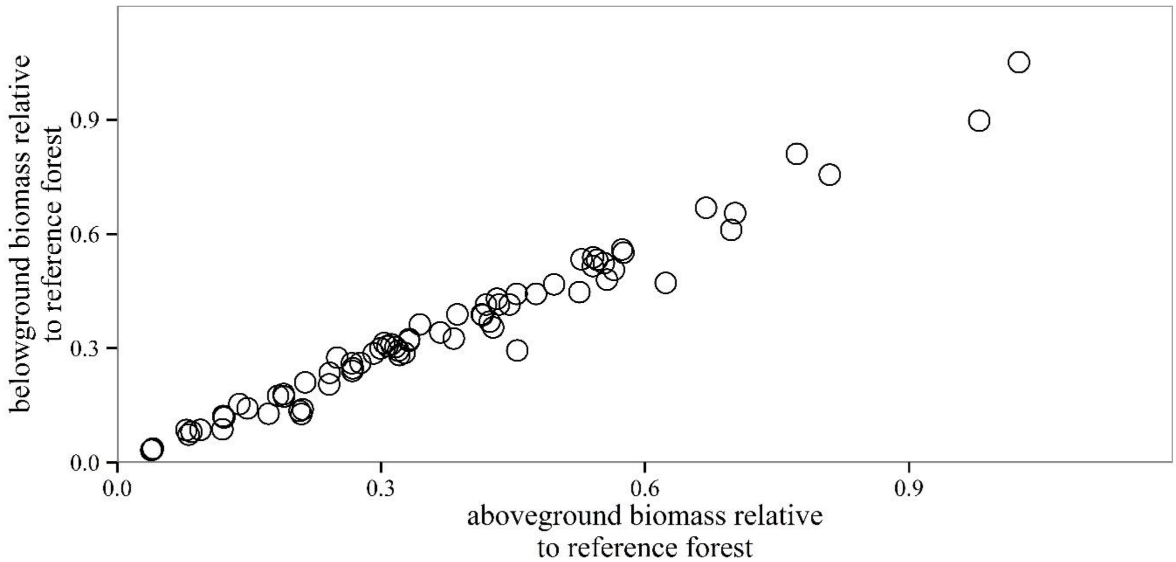

Figure S3 – Relationship between relative above and relative belowground biomass in locations where both measures were available.

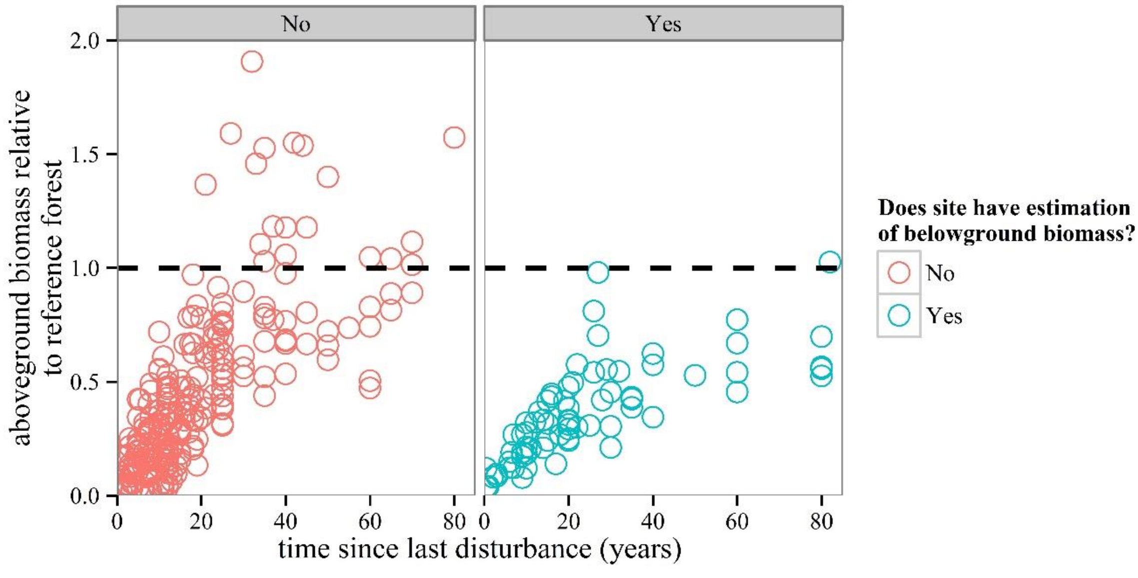

Figure S4 – Change of aboveground biomass over time since disturbance showing relative difference between studies that had information on belowground biomass and those that did not

Table S1 – Number of sites for each metric used in this study including the number of sites shared between different metrics

	Aboveground biomass	Belowground biomass	Soil carbon	Species richness	Shared species
Aboveground biomass	326				
Belowground biomass	73	76			
Soil carbon	104	54	185		
Species richness	111	19	0	283	
Shared species	5	0	0	23	50

Table S2 – Variables included in models of aboveground biomass recovery with Δ AICc <7, models are ranked by AICc with weight representing the likelihood that individual models are the most parsimonious

Variables included in model	**df**	**AICc**	**Δ AICc**	**Weight**	**Marginal R^2**
Intercept+log(Age)	7	654.32	0	0.57	0.56
Intercept+log(Age)+Disturbance	9	655.34	1.01	0.35	0.56
Intercept+log(Age)*Disturbance	11	659.11	4.78	0.05	0.56
Intercept+log(Age)+Forest type	10	660.29	5.97	0.03	0.56

Table S3 – Variables included in models of belowground biomass recovery with Δ AICc <7, models are ranked by AICc with weight representing the likelihood that individual models are the most parsimonious

Variables included in model	**df**	**AICc**	**Δ AICc**	**Weight**	**Marginal R^2**
Intercept+log(Age)	6	125.66	0	0.47	0.64
Intercept+log(Age) +Disturbance	7	125.83	0.17	0.43	0.61
Intercept+log(Age)*Disturbance	8	128.8	3.14	0.1	0.61

Table S4 – Variables included in models of soil carbon recovery with Δ AICc <7, models are ranked by AICc with weight representing the likelihood that individual models are the most parsimonious

Variables included in model	**df**	**AICc**	**Δ AICc**	**Weight**	**Marginal R^2**
Intercept only (null model)	6	334.23	0	0.43	0
Intercept+Age+Age^2	8	335.85	1.62	0.19	0.01
Intercept+Age	7	336.18	1.95	0.16	<0.01
Intercept+ Disturbance	8	337.28	3.05	0.09	0.01
Intercept+Age+Age^2 +Disturbance	10	337.84	3.62	0.07	0.03
Intercept+Age*Disturbance	9	338.64	4.41	0.05	0.02
Intercept+Age+Disturbance	6	334.23	0	0.43	<0.01

Table S5 – Variables included in models of tree species richness recovery with Δ AICc <7, models are ranked by AICc with weight representing the likelihood that individual models are the most parsimonious

Variables included in model	**df**	**AICc**	**Δ AICc**	**Weight**	**Marginal R^2**
Intercept+log(Age)	6	499.1	0	0.7	0.25
Intercept +log(Age+Disturbance	8	501.61	2.51	0.2	0.26
Intercept+log(Age)+log(Age)^2	7	503.83	4.73	0.07	0.23
Intercept+log(Age)+log(Age)^2 +Disturbance	9	505.57	6.47	0.03	0.26

Table S6 – Variables included in models of epiphyte species richness recovery with Δ AICc <7, models are ranked by AICc with weight representing the likelihood that individual models are the most parsimonious

Variables included in model	df	AICc	Δ AICc	Weight	Marginal R^2
Intercept+log(Age)	6	150.75	0	0.56	0.07
Intercept only (null mode)	5	152.31	1.56	0.26	0
Intercept+log(Age)+log(Age)^2	7	152.96	2.22	0.18	0.09

Table S7 – Variables included in models of primary forest species recovery with Δ AICc <7, models are ranked by AICc with weight representing the likelihood that individual models are the most parsimonious

Variables included in model	df	AICc	Δ AICc	Weight	Marginal R^2
Intercept only (Null model)	2	13.52	0	0.42	0
Intercept+Age	3	14.6	1.08	0.24	0.13
Intercept+Disturbance	3	15.77	2.25	0.14	0.03
Intercept+Age+Disturbance	4	16.95	3.43	0.08	0.15
Intercept+Type	4	17.07	3.55	0.07	0.02
Intercept+Age+Type	5	18.78	5.26	0.03	0.17
Intercept+Disturbance+Type	5	19.56	6.04	0.02	0.04

Table S8- Parameter estimates for models of aboveground biomass with delta≤7 calculated by multiplying the estimates for individual models which contain parameters by their weights. Note that units represent the transformation used for model fitting

Parameter	Estimate	Standard error of estimate	Lower confidence interval	Upper confidence interval
Intercept	-4.08	0.29	-4.65	-3.52
Log(Age)	0.85	0.07	0.7	0.99
Disturbance - Pasture	-0.01	0.24	-0.49	0.46
Disturbance - Shifting agriculture	0.19	0.28	-0.36	0.74
Disturbance – Pasture*logAge	0.07	0.2	-0.31	0.46
Disturbance - Shifting agriculture*logAge	0.16	0.22	-0.28	0.6
Type - Moist	0.06	0.19	-0.31	0.43
Type - Montane	-0.11	0.75	-1.58	1.36
Type - Wet	-0.04	0.16	-0.35	0.26

Table S9- Parameter estimates for models of belowground biomass with with delta≤7 calculated by multiplying the estimates for individual models which contain parameters by their weights. Note that units represent the transformation used for model fitting

Parameter	Estimate	Standard error of estimate	Lower confidence interval	Upper confidence interval
(Intercept)	-3.48	0.23	-3.93	-3.02
Disturbance - Shifting agriculture	-0.65	0.64	-1.91	0.6
log(Age)	0.68	0.06	0.56	0.8
Disturbance - Shifting agriculture*log(Age)	0.11	0.34	-0.55	0.76

Table S10- Parameter estimates for models of soil carbon with delta≤7 calculated by multiplying the estimates for individual models which contain parameters by their weights. Note that units represent the transformation used for model fitting

Parameter	Estimate	Standard error of estimate	Lower confidence interval	Upper confidence interval
(Intercept)	-0.2	0.2	-0.6	0.2
Age	0.01	0.01	-0.01	0.02
Age^2	0	0	0	0
DisturbancePasture	0.18	0.21	-0.23	0.58
DisturbanceShifting agriculture	0.34	0.25	-0.15	0.82

Table S11- Parameter estimates for models of tree species richness with delta≤7 calculated by multiplying the estimates for individual models which contain parameters by their weights. Note that units represent the transformation used for model fitting

Parameter	Estimate	Standard error of estimate	Lower confidence interval	Upper confidence interval
(Intercept)	-3.41	0.34	-4.08	-2.73
log(Age)	0.88	0.12	0.65	1.11
Disturbance - Pasture	0.17	0.21	-0.24	0.59
Disturbance - Shifting agriculture	-0.2	0.23	-0.65	0.26
log(Age)^2	-0.06	0.04	-0.15	0.02

Table S12- Parameter estimates for models of epiphyte species richness with delta≤7 calculated by multiplying the estimates for individual models which contain parameters by their weights. Note that units represent the transformation used for model fitting

Parameter	Estimate	Standard error of estimate	Lower confidence interval	Upper confidence interval
(Intercept)	-1.91	1.04	-3.94	0.13
log(Age)	0.39	0.31	-0.22	0.99
Log(Age)^2	0.06	0.1	-0.13	0.25

Table S13- Parameter estimates for models of primary forest species with delta≤7 calculated by multiplying the estimates for individual models which contain parameters by their weights. Note that units represent the transformation used for model fitting

Parameter	Estimate	Standard error of estimate	Lower confidence interval	Upper confidence interval
(Intercept)	-1.01	0.88	-2.73	0.7
Age	0.01	0.01	-0.01	0.04
Disturbance - Shifting agriculture	-0.02	0.69	-1.37	1.33
Type - Tropical moist forest	-0.1	2.15	-4.32	4.12
Type - Tropical rainforest	-0.85	2.07	-4.9	3.2

Table S14 – Importance values for explanatory variables in corresponding models. These values are the sum of the AICc weight for different models with Δ AICc <7

	Model name					
Explanatory variable	Aboveground biomass	Belowground biomass	Soil Carbon	Tree species richness	Epiphyte species richness	Proportion of undisturbed forest species
Age – linear	0	0	0.47	0	0	0.35
Age – quadratic	0	0	0.26	0	0	0
log(Age)	1	1	0	1	0.74	0
log(Age - quadratic	0	0	0	0.093	0.18	0
Disturbance type	0.40	0.52	0.21	0.22	0	0.23
Forest type	0.02	0	0	0	0	0.12

Table S15 – Minimum diameter at breast height (DBH) of individuals considered for sites where tree species richness was assessed. N/A indicates sites where this information was not available

Minimum DBH of individual considered (cm)	Number of sites
N/A	28
1	34
2	7
2.5	4
3	3
5	50
10	88

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