

Supplementary Materials for

Degradation and forgone removals increase the carbon impact of intact forest loss by 626%

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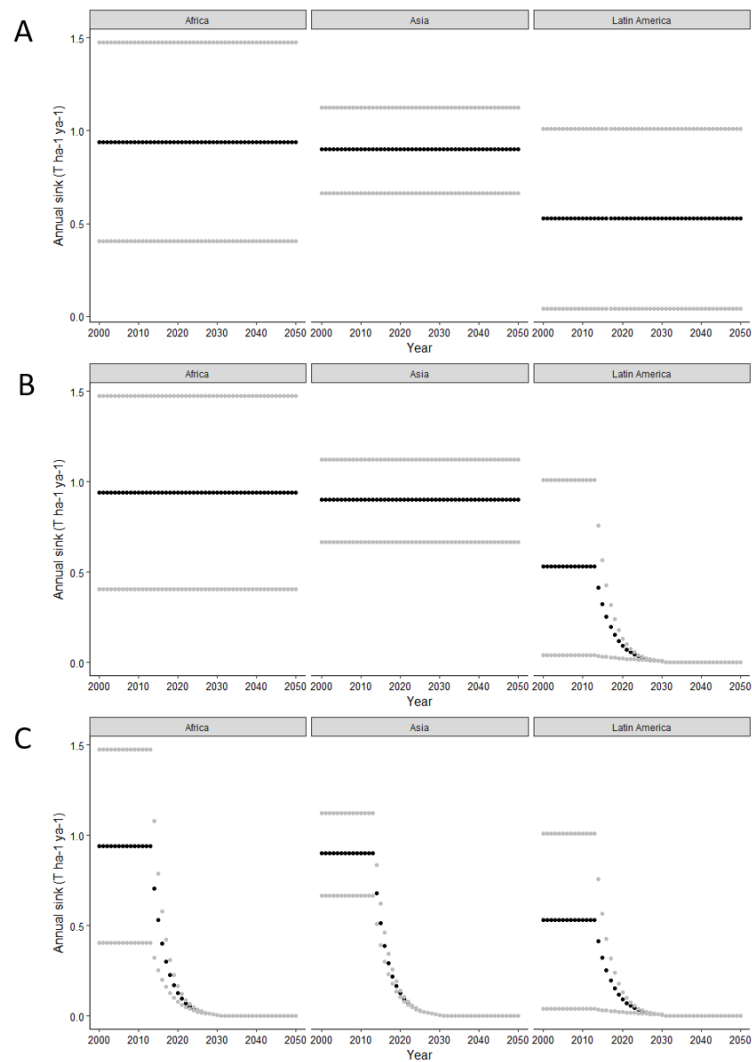


Fig. S1. Estimated annual rate of carbon sequestration inside intact forests under alternative scenarios. (A) sequestration rates continue at rates estimated for the 2000s; **(B)** intact forests located in Latin America will reach carbon saturation by 2030; and **(C)** all tropical intact forests will reach carbon saturation by 2030.

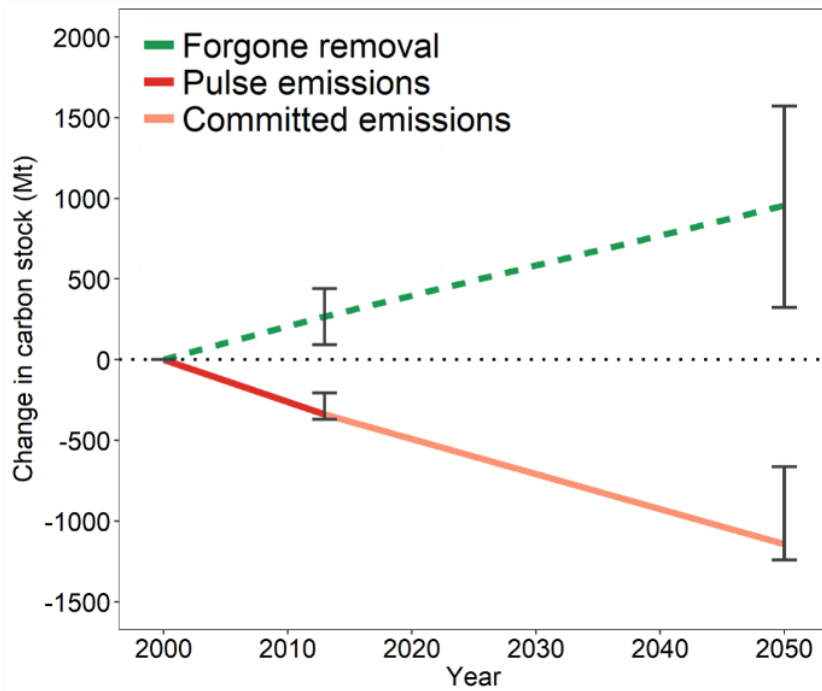


Fig. S2. Full accounting of the carbon impact of intact forest loss assuming the onset of carbon saturation in intact forests in Latin America by 2030.

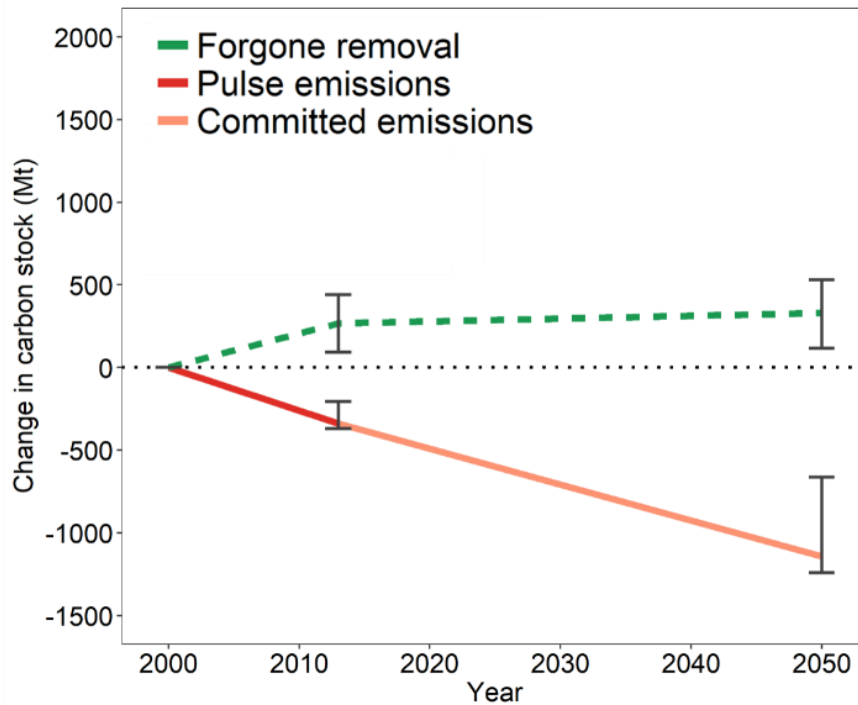


Fig. S3. Full accounting of the carbon impact of intact forest loss assuming the onset of carbon saturation in all tropical intact forests by 2030.

Table S1. Country-level estimates on the proportion of selective logging that employs responsible forest management techniques and emission factors for responsible and conventional logging practices. Proportional estimates of responsible logging were drawn from the International Tropical Timber Organisation⁵⁸. In cases where estimates were not available for a particular country, they were set to mean of estimates from countries in the same continent (denoted with *). Emission factors were drawn from a meta-analysis of retention of carbon stocks after selective logging of tropical forests²⁰. In cases where emission factors were not available for a particular country, they were set to median of estimates from countries in the same continent (denoted with *).

Country	Proportion of logging that is responsible	Emission factors			
		Responsible	Source	Conventional	Source
Angola	0.1*	0.06	*	0.05	*
Argentina	0.12*	0.09	*	0.18	*
Australia	0.12*	0.29	*	0.38	*
Belize	0.12*	0.09	*	0.18	*
Bhutan	0.12*	0.29	*	0.38	*
Bolivia	0.07	0.09	*	0.05	15,65
Brazil	0.02	0.09	25,66-69	0.24	15,25,66,70-73
Brunei Darussalam	0.12*	0.29	*	0.38	*
Cambodia	0	0.29	*	0.38	*
Cameroon	0.17	0.06	*	0.05	*
Central African Republic	0	0.06	*	0.05	*
Colombia	0.06	0.09	*	0.18	*
Costa Rica	0.12*	0.09	*	0.18	*
Côte d'Ivoire	0.1	0.06	*	0.05	*
DR Congo	0.16	0.06	*	0.05	*
Dominican Republic	0.12*	0.09	*	0.18	*
Ecuador	0.09	0.09	*	0.18	*
Equatorial Guinea	0.1*	0.06	*	0.05	*
Ethiopia	0.1*	0.06	*	0.05	*
French Guiana	0.1*	0.09	*	0.41	74
Gabon	0.23	0.06	75	0.06	75
Guatemala	0.55	0.09	*	0.18	*
Guyana	0.05	0.09	*	0.12	75
Honduras	0.25	0.09	*	0.18	*
Indonesia	0.08	0.29	*	0.20	75,76
Lao PDR	0.12*	0.29	*	0.38	*
Liberia	0	0.06	*	0.05	*
Madagascar	0.1*	0.06	*	0.05	*
Malaysia	0.02	0.28	77	0.51	77,78
Mexico	0.09	0.09	*	0.18	*
Myanmar	0.02	0.29	*	0.38	*
Nicaragua	0.12*	0.09	*	0.18	*
Nigeria	0.35	0.06	*	0.05	*
Panama	0.13	0.09	*	0.18	*
Papua New Guinea	0.02	0.31	79	0.29	80,81

Paraguay	0.12*	0.09	*	0.18	*
Peru	0.09	0.09	*	0.18	*
Philippines	0.02	0.29	*	0.48	82
Republic of Congo	0.16	0.06	*	0.03	75,83
Solomon Islands	0.12*	0.29	*	0.38	*
Suriname	0.05	0.09	*	0.18	*
Tanzania	0.1*	0.06	*	0.05	*
Thailand	0.04	0.29	*	0.38	*
Vanuatu	0.12*	0.29	*	0.38	*
Venezuela	0.04	0.09	*	0.18	*
Viet Nam	0.12*	0.29	*	0.38	*

Table S2. Intact forest landscape reduction between 2000 and 2013 in countries across the global tropics. Table also shows areas forest clearance and fire that occurred in lost IFLs between 2000 and 2013, and areas of new forest edges and selective logging that are expected to occur in lost IFLs between 2013 and 2050.

country	IFL area lost, 2000-2013 (ha)	Mean forest cover, 2000 (%)	Forest clearance (ha)	Burned area (ha)	New forest edges (ha)	Selective logging (ha)	Forest loss to edge ratio
Angola	13,266	88%	33	-	9,708	304	294
Argentina	43,152	87%	1,606	523	18,624	9,432	12
Australia	84,860	91%	4,580	637	48,608	-	11
Belize	19,876	97%	1,998	1	9,386	4,646	5
Bhutan	879	55%	11	-	133	454	12
Bolivia	4,405,968	95%	213,900	57,595	1,601,257	538,722	7
Brazil	14,944,849	99%	1,688,543	53,455	4,921,169	1,426,854	3
Brunei Darussalam	33,829	97%	1,503	-	16,037	1,433	11
Cambodia	43,913	86%	315	-	6,991	620	22
Cameroon	1,336,322	89%	3,921	-	397,123	377,745	101
Central African Republic	213,678	96%	454	1	47,739	63,010	105
Colombia	408,082	99%	16,130	28	201,370	5,466	12
Costa Rica	8,631	94%	60	-	4,091	-	68
Côte d'Ivoire	80,131	74%	1,693	-	47,270	4,820	28
Democratic Republic of the Congo	2,019,972	99%	132,145	1	930,342	414,579	7
Dominican Republic	23,083	91%	6,270	962	14,440	769	2
Ecuador	280,776	98%	1,421	-	72,677	23,013	51
Equatorial Guinea	193,131	89%	575	-	83,857	28,657	146
Ethiopia	21,361	79%	277	-	16,646	-	60
French Guiana	374,166	99%	3,309	-	118,966	45,600	36
Gabon	2,099,415	91%	7,277	-	467,264	1,006,076	64
Guatemala	75,253	96%	4,744	-	33,034	3,093	7
Guyana	1,637,140	99%	15,885	-	700,106	99,692	44

Honduras	191,976	98%	12,538	-	107,681	2,431	9
Indonesia	3,791,988	95%	112,735	57	1,710,168	181,018	15
Lao PDR	409,044	83%	13,007	230	188,860	28,130	15
Liberia	152,487	80%	593	-	41,871	46,102	71
Madagascar	303,238	96%	20,250	145	224,678	8,911	11
Malaysia	529,842	96%	55,595	-	292,906	87,534	5
Mexico	39,986	95%	2,143	-	21,725	4,883	10
Myanmar	1,442,515	85%	9,416	47,727	607,737	185,176	61
Nicaragua	392,828	97%	35,103	-	294,540	17,311	8
Nigeria	14,583	64%	571	-	10,782	1,421	19
Panama	285,104	98%	2,000	-	123,394	6,048	62
Papua New Guinea	2,098,828	95%	32,582	-	1,006,271	101,264	31
Paraguay	3,514,566	49%	223,470	32,065	1,437,984	350,675	6
Peru	3,408,460	98%	113,774	84	1,564,310	120,103	14
Philippines	36,094	93%	797	-	26,935	201	34
Republic of Congo	2,266,479	95%	16,453	-	515,588	940,989	31
Solomon Islands	414,032	96%	5,025	-	248,403	26,393	49
Suriname	616,106	99%	6,180	-	153,497	53,335	25
Tanzania	1,647	59%	26	208	1,390	-	53
Thailand	146,446	89%	3,152	20,760	79,311	8,234	23
Vanuatu	261	93%	-	-	-	-	NA
Venezuela	441,628	98%	12,141	26	242,836	11,099	20
Vietnam	103,816	92%	626	-	39,703	6,393	63

Table S3. Country-level statistics required to estimate carbon emissions from defaunation. Relative abundances of animal-dispersed tree species and differences in carbon stocks were derived from Osuri, et al.¹⁷. In cases where these data were not available for a country, they were set to median of estimates from countries in the same continent (denoted with *).

Country	Relative abundances (%) of animal-dispersed species at each site	Differences in median % change in carbon stocks between defaunation and species-based control scenarios (D-C2) at 100% extirpation levels	Source
Angola	93	-6.6	*
Argentina	82	-3.41	*
Australia	73	-0.52	¹⁷
Belize	82	-3.41	*
Bhutan	73	-0.52	*
Bolivia	82	-3.41	*
Brazil	82	-3.41	*
Brunei Darussalam	73	-0.52	*
Cambodia	73	-0.52	*
Cameroon	93	-13.85	¹⁷
Central African Republic	93	-6.6	*
Colombia	82	-3.41	*
Costa Rica	82	-2.55	¹⁷
Côte d'Ivoire	93	-6.6	*
DR Congo	93	-6.6	*
Dominican Republic	82	-3.41	*
Ecuador	82	-3.41	*
Equatorial Guinea	93	-6.6	*
Ethiopia	93	-6.6	*
French Guiana	82	-3.41	*
Gabon	93	-6.6	*
Guatemala	82	-3.41	*
Guyana	82	-3.41	*
Honduras	82	-3.41	*
Indonesia	67	-0.12	¹⁷
Lao PDR	73	-0.52	*
Liberia	93	-6.6	*
Madagascar	93	-6.6	*
Malaysia	73	-0.89	¹⁷
Mexico	82	-3.41	*
Myanmar	73	-0.52	*
Nicaragua	82	-3.41	*
Nigeria	93	-6.6	*
Panama	82	-3.41	¹⁷
Papua New Guinea	73	-0.52	*
Paraguay	82	-3.41	*
Peru	90	-5.51	¹⁷
Philippines	73	-0.52	*

Republic of Congo	92	-3.13	17
Solomon Islands	73	-0.52	*
Suriname	82	-3.41	*
Tanzania	98	-6.6	17
Thailand	73	-0.52	*
Vanuatu	73	-0.52	*
Venezuela	82	-3.41	*
Viet Nam	73	-0.52	*

Table S4. Regional carbon sequestration rates for intact forest areas and reforestation.

Region	Intact forest	Reforestation
Africa	0.94	1.47
Asia	0.9	3.53
South America	0.53	4.56

Table S5. Assumed time scales and trajectories of carbon dynamics from different forest processes.

Process	Time scale	Trajectory
Clearance	13 yrs	Linear, applied across 13 years
Regrowth	37 yrs	Linear, at rates observed in regrowing forests in the 2000s
Selective logging	37 yrs	Linear, applied across 37 years
Fragmentation	37 yrs	Linear, applied across 37 years
Defaunation	100 yrs	Linear, applied across 100 years
Intact sink, scenario one	50 yrs	Linear, at rates observed in intact forests in the 2000s
Intact sink, scenario two	50 yrs	Exponential decay, intact forests in Latin America reach saturation by 2030; Linear for all other regions, at rates observed in intact forests in the 2000s
Intact sink, scenario three	50 yrs	Exponential decay, all tropical intact forests reach saturation by 2030