

## Online Supporting Information

Table S1: Counts and size characteristics of the concessions included in the study area, differentiated by country.

Country	Total Number of concessions	Number of Operating companies	Number of certified concessions	Concession size (mean and range in km <sup>2</sup> )	Average size of concession area operated by one company (mean and range in km <sup>2</sup> )
Republic of Congo	9	7	4	3799 (351 – 12100)	5427 (351-20640)
Cameroon	48	11	10	627 (217 – 1475)	2317 (365-5260)
Central African Republic	7	4	0	1345 (246 – 2346)	2422 (411-5909)
Total	64	20	14	1197 (217 – 12100)	3209 (351 – 20640)

Table S2: Changes in the median empty space function  $\tilde{F}$  for the road networks in each of four management categories during two time periods (years 1999-2007 and 2007-2015).  $P$  values for  $t$  tests comparing  $\tilde{F}$  of different individual categories are shown ( $P$  values  $< 0.05$  are treated as significant). IFL = intact forest landscapes in 2000; FSC = certified by the Forest Stewardship Council from 2006 onwards. National Parks were not included because no change was detected over time.

Period		IFL, FSC	IFL, no FSC	no IFL, FSC
1999 - 2007	IFL, no FSC	$< 0.001$		
	no IFL, FSC	$< 0.001$	$< 0.001$	
	no IFL, no FSC	$< 0.001$	$< 0.001$	0.894
2007 - 2015	IFL, no FSC	$< 0.001$		
	no IFL, FSC	$< 0.001$	0.204	
	no IFL, no FSC	$< 0.001$	0.633	0.633

Table S3:  $t$  test statistics and 95% confidence intervals comparing changes in roadless space over time between management categories. Inputs are the median values of the empty space function  $F$  for the road networks in 1999, 2007 and 2015. The  $t$  statistic is interpreted as the change intensity. IFL = inside intact forest landscapes in 2000; FSC = certified by the Forest Stewardship Council from 2006 onwards; no FSC = not certified by FSC; CI = confidence intervals. National Parks were not included because no change was detected over time.

Category		Compared years	Change intensity	2.5% CI	97.5% CI
outside IFL	FSC	1999 / 2007	-0.024	-0.030	-0.018
		2007 / 2015	0.009	0.007	0.011
	no FSC	1999 / 2007	-0.028	-0.035	-0.022
		2007 / 2015	-0.008	-0.010	-0.006
inside IFL	FSC	1999 / 2007	0.394	0.324	0.464
		2007 / 2015	0.384	0.336	0.432
	no FSC	1999 / 2007	0.765	0.706	0.823
		2007 / 2015	-0.022	-0.026	-0.018

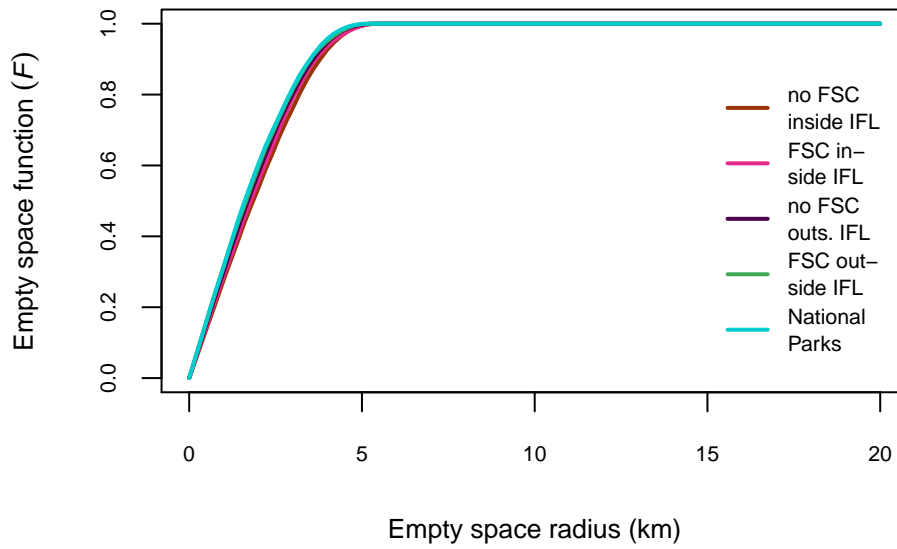


Figure S1: River network analysis: median curves of the empty space function  $F$  (probability that from any point in the observed domain there is a river at distance  $r$ ) against radius  $r$  in the five different management/protection categories.

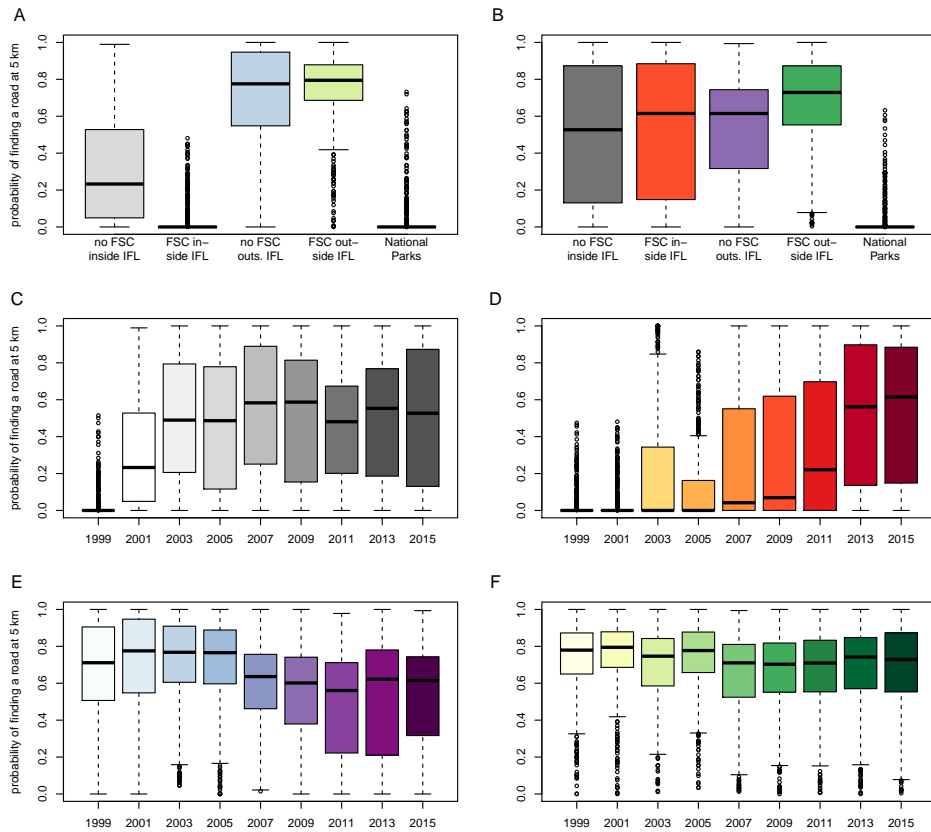


Figure S2: Boxplots for the envelopes of empty space curves for the probability of intersecting a road within a distance of 5 km. (A) is the combined situation in 2001 and (B) in 2015 for five different forest management/protection categories. (C) Non-certified concessions inside intact forest landscapes (IFL), (D) FSC-certified concessions inside IFL, (E) non-certified concessions outside IFL and (F) FSC-certified concessions outside IFL. Panels (C)-(F) show two-year steps from 1999 to 2015.

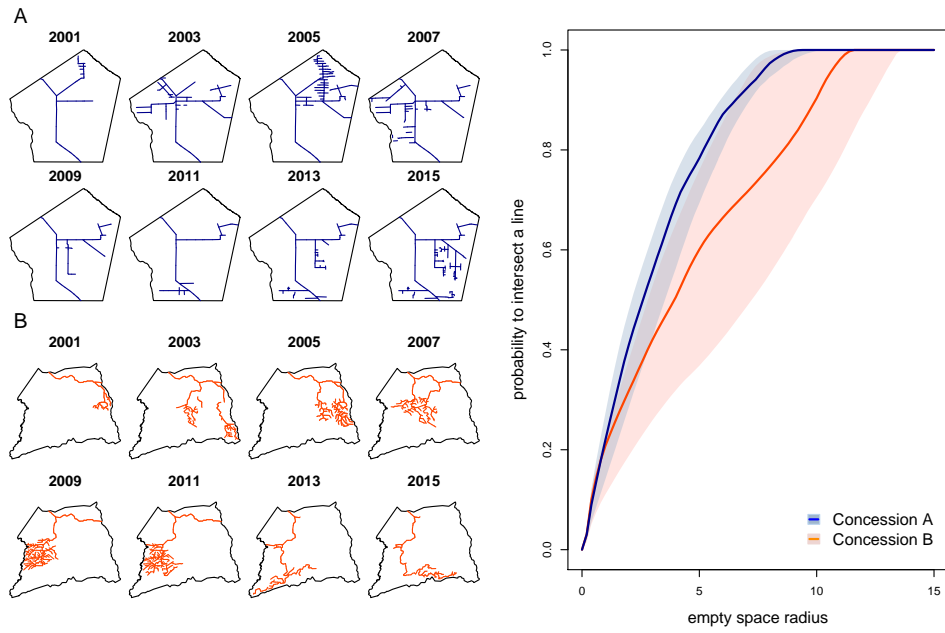


Figure S3: The effect on roadless space at two-year intervals during the period 2001-2015 of two contrasting road network development strategies that were implemented during timber harvesting, respectively, in two logging concessions one (A) in Republic of Congo and one (B) in Cameroon. The two concessions were selected to be matched as closely as possible in logging history, site characteristics and area, however their boundaries are slightly modified for this modelling so that they have the same area ( $1227 \text{ km}^2$ ) and regular shape with a diagonal extent of ca. 50 km. The average road length for the eight sample years is 139 km for concession A and 144 km for concession B. The curves on the right show the median Empty-Space Function for all years as a solid line and the 5-95% ranges amongst the eight sample years are shaded, indicating that overall roadless space was greater in concession B.