

Supplementary Materials

Ouimet, R., Korboulewsky, N., and Bilger-Friedrich, I. Soil texture explains soil sensitivity to whole-tree harvesting in boreal forests. 2023. Soil Systems.

Table S1. Characteristics of the four soil provinces in Quebec included in the study.

Properties	Soil Province			
	B (Appalachians)	C (Laurentians)	D (Abitibi Low-lands)	E (Mistassini High-lands)
Main parent material	Glacial till or regolith made of sedimentary and metamorphic rock	Glacial till composed of igneous and metamorphic rocks of the Canadian Shield	Extensive glaciolacustrine clay deposit, glaciofluvial sand, and gravel deposits over	Glacial till composed of igneous, metamorphic, and volcanic rock
Geology	Sandstone, siltstone, shale, slate	Granite, gneiss	Interlayered clays	Granite, gneiss
Soils *	Brunisols to Podzols	Podzols	Gleysoils, Gleyic Podzols to Podzols	Podzols
Soil texture	Medium (loam)	Coarse (sand to sandy loam)	Fine (clay or silt)	Coarse (sand to sandy loam)
Altitude (m)	180–1300	180–1200	30–525	300–600
Topography	Alternating ridgelines and valleys	Rounded mountains, overgrown valleys	Low-shield terrane	Rounded hills and valleys
January temperature [†] (IQR, °C)	–2.9–14.1	–16.0–18.4	–17.3–18.6	–17.8–18.5
July temperature [†] (IQR, °C)	16.1–17.2	15.8–16.8	16.3–16.8	16.2–16.5
Annual precipitation [†] (IQR, mm)	1054–1113	964–1067	891–919	913–952
Degree days [†] (IQR)	1180–1350	950–1290	1030–1190	990–1110
Aridity index [‡] (IQR)	1.41–1.64	1.34–1.52	1.19–1.26	1.27–1.33
Nb. frost-free days [†] (d)	150	140	140	142
Vegetation	Mixed forest to balsam fir–white birch forest	Balsam fir–white birch to black spruce–feather moss forest	Balsam fir–white birch to black spruce–feather moss forest	Black spruce–feather moss forest

*Soil orders according to the Canadian System of Soil Classification [30]. [†]1961–1990 annual interquartile range (IQR) or average between 47° and 50° of latitude computed from New et al. [31]. [‡] 1970–2000 aridity index interquartile range (IQR) between 47° and 50° of latitude computed from Trabucco and Zomer [32].

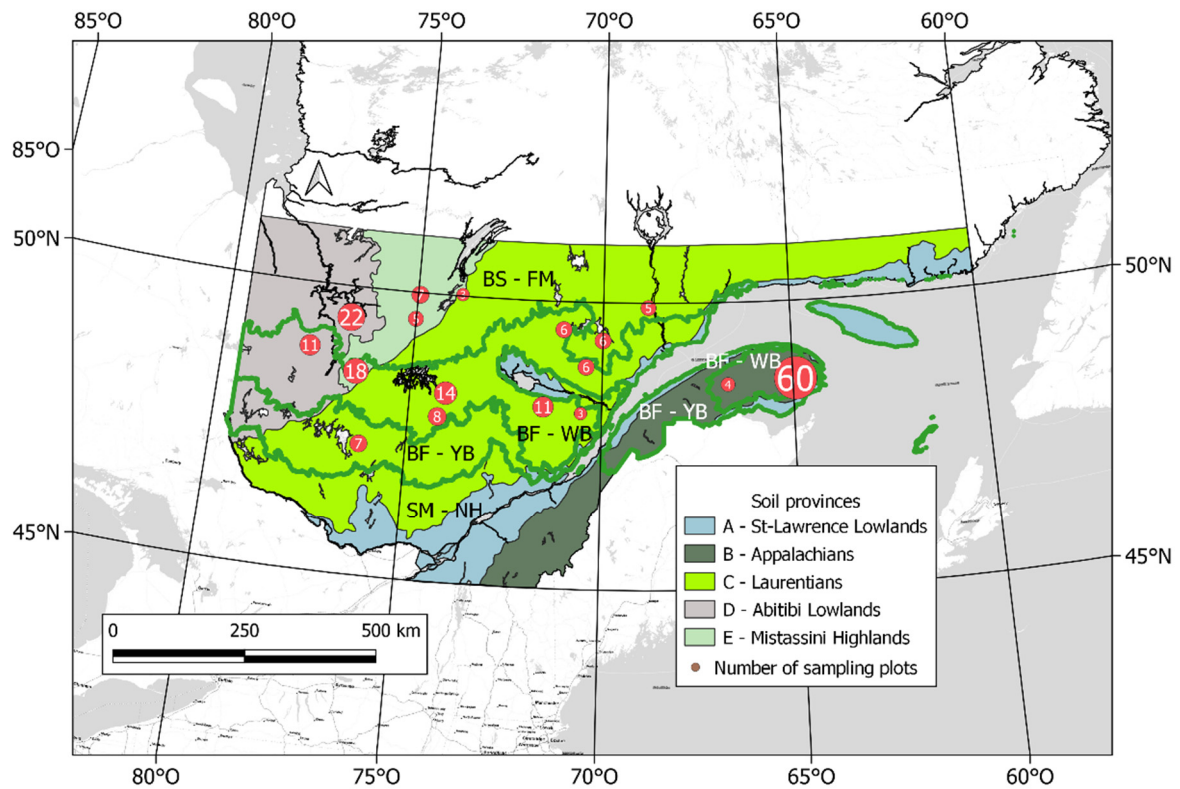


Figure S1. Map of sampling plot numbers and locations. Colored areas show the soil provinces in Quebec (Canada). Green lines delimit vegetation bioclimatic domains: SM-NH: sugar maple northern hardwoods; BF-YB: balsam fir–yellow birch domain; BF-WB: balsam fir–white birch domain; BS-FM: black spruce–feather moss domain.

Table S2. Parameter estimates of the relationship between soil bulk density (Db) and organic matter (OM) concentrations according to broad soil texture groups. No significant difference was found between the sand and the loam model ($F = -1.34, p = 1$), so these data were combined.

Parameter	Estimate	SE	t value	p
Sand and loam				
D_{bm}	1.532	0.049	31.2	<0.001
D_{bo}	0.111	0.006	18.6	<0.001
Residual standard error: 0.2335 on 522 d.f.; $R^2 = 0.38$				
Clay				
D_{bm}	2.152	0.253	8.5	<0.001
D_{bo}	0.109	0.011	10.2	<0.001
Residual standard error: 0.1438 on 39 d.f.; $R^2 = 0.66$				

NOTE: The modeled relationships are represented by the following equation (Federer *et al.*, 1993):

$$Db = \frac{D_{bm} \times D_{bo}}{F_o \times D_{bm} + (1 - F_o) \times D_{bo}} \quad (1)$$

Where Db: observed bulk density (g cm^{-3})

D_{bm} : Constant: bulk density of “pure” mineral soil (without organic matter) (g cm^{-3})

D_{bo} : Constant: bulk density of “pure” organic matter (without mineral matter) (g cm^{-3})

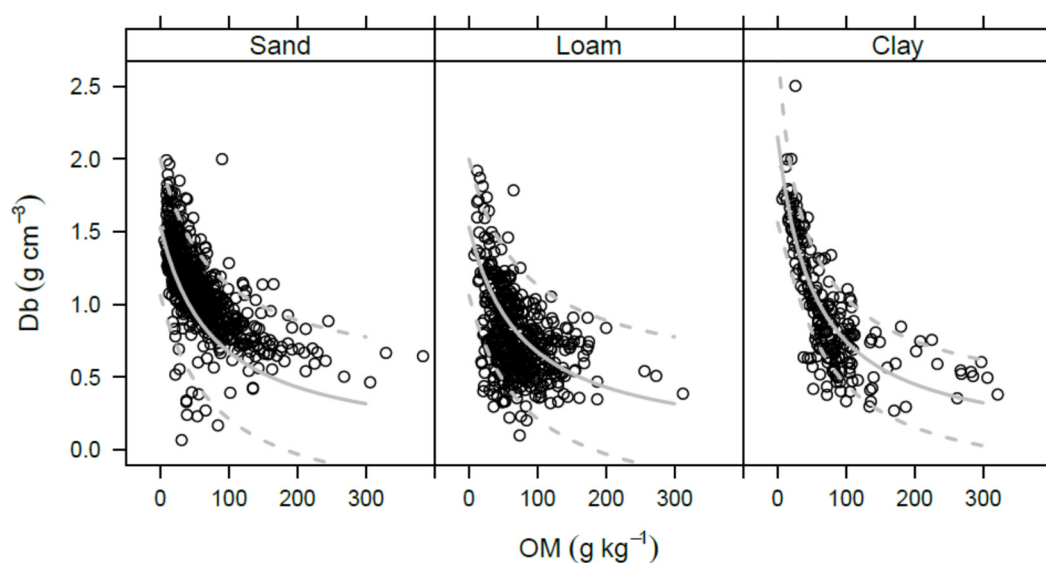


Figure S2. Relationship between soil bulk density (Db) and organic matter (OM) concentrations according to broad soil texture groups. Lines show model predicted values and 95% CI predictions.

Table S3. Total carbon (C) and total nitrogen (N) stocks in the first 60 cm of soil (forest floor excluded) as a function of harvesting treatment (stem-only harvesting (SOH) and whole-tree harvesting (WTH)) in four soil provinces in Quebec: B = Appalachians; C = Laurentians; D = Abitibi Lowlands; E = Mistassini Highlands. Data presented are model-adjusted means \pm SE.

Variable	Harvesting intensity	Soil province			
		B	C	D	E
C stocks (Mg ha^{-1})	SOH	63.7 ± 4.4	148.3 ± 9.8	86.4 ± 6.7	99.8 ± 15.3

N stocks (Mg ha ⁻¹)	WTH	71.3 ± 9.7	107.0 ± 12.3	82.9 ± 11.2	55.8 ± 12.8
	Difference	-7.6 ± 9.1	41.3 ± 14.3	3.6 ± 13.4	43.9 ± 12.0
	p-value	0.407	0.004	0.791	<0.001
	SOH	5.25 ± 0.28	6.23 ± 0.42	4.03 ± 0.38	4.81 ± 0.57
	WTH	5.49 ± 0.46	4.63 ± 0.53	3.88 ± 0.57	2.58 ± 0.44
	Difference	-0.23 ± 0.42	1.60 ± 0.58	0.15 ± 0.66	2.24 ± 0.53
	p-value	0.582	0.006	0.824	<0.001

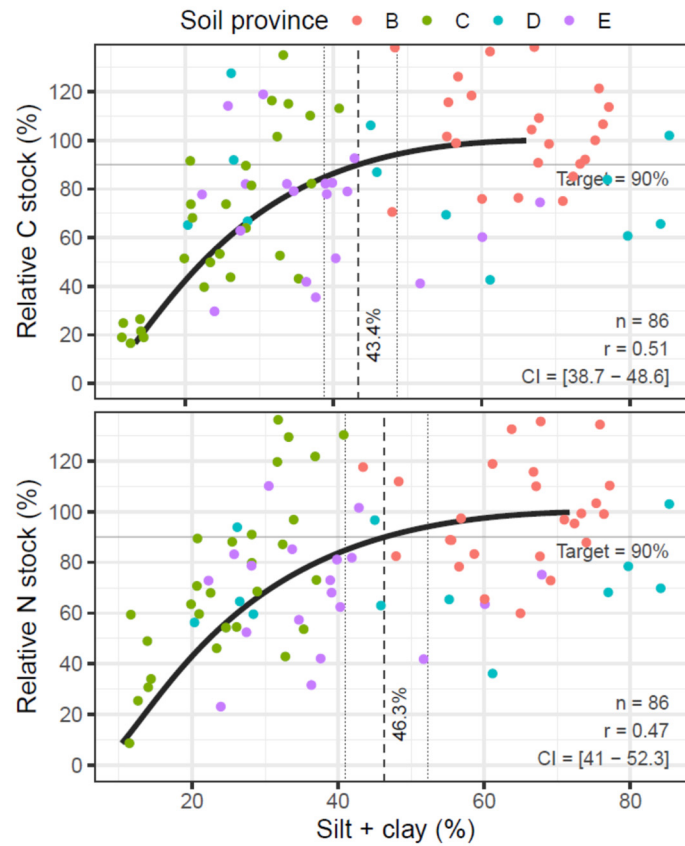


Figure S3. Relationship between the soil fine particle content (silt+clay) and the relative average soil C and N stocks (0–60 cm soil depth) after whole-tree harvesting (WTH) (relative to stem-only harvesting, SOH) by soil province. The dashed line represents the silt + clay content (and 95% confidence intervals (CI)) required to reach 90% of the soil C and N stocks after SOH with the arcsine–log calibration curve (Correndo *et al.*, 2017); r is the square root of the proportion of variation explained by the curve. Curves: relative soil C stocks = $100(\sin(-1.384 + 0.698 \ln(x))^2)$; relative soil N stocks = $100(\sin(-1.191 + 0.636 \ln(x))^2)$.

References

1. Correndo, A., A., Salvagiotti, F., García, F., O., Gutiérrez, Boem, F., H., 2017. A modification of the arcsine–log calibration curve for analysing soil test value–relative yield relationships. *Crop and Pasture Science* 68, 297–304.
2. Federer, C.A., Turcotte, D.E., Smith, C.T., 1993. The organic fraction–bulk density relationship and the expression of nutrient content in forest soils. *Can. J. For. Res.* 23, 1026–1032.