frontiers

Supplementary Material

Responses of fine-root biomass and production to drying depend on wetness and site nutrient regime in boreal forested peatland

Maija Lampela, Kari Minkkinen, Petra Straková, Rabbil Bhuiyan, Wei He, Päivi Mäkiranta, Paavo Ojanen, Timo Penttilä, Raija Laiho*

*** Correspondence:** Raija Laiho: raija.laiho@luke.fi

2 Supplementary Tables

Supplementary Table S1. FRB and FRP means, standard errors (SE), and numbers of samples (N). Due to the hierarchical structure of the data, SEs were estimated with linear mixed models.

Site	FRB, mean	FRB, SE	FRB, N	FRP, mean	FRP, SE	FRP, N	FRP/FRB
DP	191.8	34.4	9	95.5	28.7	14	0.50
DPdr	179.9	27.7	9	92.7	13.3	16	0.52
TP	250.3	41.2	9	118.4	25.0	16	0.47
TPdr	120.6	17.6	9	119.9	11.2	18	0.99
VS	205.7	49.2	9	42.3	12.6	14	0.20
VSdr	267.3	26.8	9	70.0	14.5	16	0.26
HS	155.5	31.6	9	53.6	10.8	9	0.34
HSdr	342.2	104.2	9	30.6	7.3	17	0.09

Supplementary Table S2. Results of the t-tests.

S2a) The mean differences between the undrained and drained pairs of the same site type for FRB (diameter ≤ 0.5 mm), with independent samples t-tests. Results with $p < 0.05$ are marked with * ANOVA between sites for FRB showed a significant site effect ($F(7, 64) = 3.655$, $p = 0.002$).

FRB					**T-test**		
	N	**Mean**	**SD**	**SE**	**df**	**t**	**p**
DP	9	191.8	78.7	26.2			
DPdr	9	179.9	63.3	21.1	16	0.35	0.729
TP	9	250.3	123.5	41.2			
TPdr	9	120.6	39.8	13.3	16	3.00	0.008*
VS	9	205.7	131.2	43.7			
VSdr	9	267.3	80.5	26.8	16	-1.20	0.248
HS	9	155.5	94.7	31.6			
HSdr	9	342.2	193.0	64.3	16	-2.61	0.019*

S2b) The mean differences between the undrained and drained pairs of the same site type for biomass of different root diameter classes, with independent samples t-tests. Results with $p < 0.05$ are marked with *

FRB						T-test		
Site	**Diam. class**	**N**	**Mean**	**SD**	**SE**	**df**	**t**	**p**
DP	Other species ≤ 0.5 mm	9	68,16	37,61	12,54			
DPdr	Other species ≤ 0.5 mm	9	45,01	18,60	6,20	16	1,66	0,117
DP	Trees ≤ 0.5 mm	9	123,61	59,87	19,96			
DPdr	Trees ≤ 0.5 mm	9	134,89	69,02	23,01	16	-0,37	0,716
DP	Trees 0.5-1 mm	9	122,69	55,42	18,47			
DPdr	Trees 0.5-1 mm	9	71,42	29,68	9,89	16	2,45	0.026*
DP	Trees 1-2 mm	9	149,97	124,06	41,35			
DPdr	Trees 1-2 mm	9	113,31	44,58	14,86	16	0,83	0,416
DP	Altogether 0-2 mm	9	464,43	231,44	77,15			
DPdr	Altogether 0-2 mm	9	364,63	92,21	30,74	10.5[a)]	1,20	0,256
TP	Other species ≤ 0.5 mm	9	227,74	133,84	44,61			
TPdr	Other species ≤ 0.5 mm	9	15,88	23,70	7,90	8.5[a)]	4,68	0.001*
TP	Trees ≤ 0.5 mm	9	22,57	29,28	9,76			
TPdr	Trees ≤ 0.5 mm	9	104,71	45,31	15,10	16	-4,57	0.000*
TP	Trees 0.5-1 mm	9	14,11	17,11	5,70			
TPdr	Trees 0.5-1 mm	9	89,66	38,17	12,72	16	-5,42	0.000*
TP	Trees 1-2 mm	9	4,00	7,76	2,59			
TPdr	Trees 1-2 mm	9	76,57	35,17	11,72	8.8[a)]	-6,04	0.000*
TP	Altogether 0-2 mm	9	268,43	116,42	38,81			
TPdr	Altogether 0-2 mm	9	286,81	87,69	29,23	16	-0,38	0,710
VS	Other species ≤ 0.5 mm	9	39,76	32,75	10,92			
VSdr	Other species ≤ 0.5 mm	9	16,21	11,25	3,75	16	2,04	0,058
VS	Trees ≤ 0.5 mm	9	165,98	119,06	39,69			
VSdr	Trees ≤ 0.5 mm	9	251,04	72,39	24,13	16	-1,83	0,086
VS	Trees 0.5-1 mm	9	61,01	27,84	9,28			
VSdr	Trees 0.5-1 mm	9	130,15	32,45	10,82	16	-4,85	0.000*
VS	Trees 1-2 mm	9	91,05	46,16	15,39			
VSdr	Trees 1-2 mm	9	141,97	72,19	24,06	16	-1,78	0,094
VS	Altogether 0-2 mm	9	357,80	167,72	55,91			
VSdr	Altogether 0-2 mm	9	539,37	145,33	48,44	16	-2,45	0.026*
HS	Other species ≤ 0.5 mm	9	12,29	10,88	3,63			
HSdr	Other species ≤ 0.5 mm	9	3,64	5,31	1,77	11.6[a)]	2,15	0,054
HS	Trees ≤ 0.5 mm	9	143,22	95,89	31,96			
HSdr	Trees ≤ 0.5 mm	9	338,51	190,33	63,44	16	-2,75	0.014*
HS	Trees 0.5-1 mm	9	123,58	114,69	38,23			
HSdr	Trees 0.5-1 mm	9	144,41	81,15	27,05	16	-0,44	0,662
HS	Trees 1-2 mm	9	228,56	210,74	70,25			
HSdr	Trees 1-2 mm	9	188,34	87,06	29,02	16	0,53	0,604
HS	Altogether 0-2 mm	9	507,66	322,11	107,37			
HSdr	Altogether 0-2 mm	9	674,90	322,93	107,64	16	-1,10	0,288

a) equal variances not assumed

S2c) The mean differences between the undrained and drained pairs of the same site type for FRP with independent samples t-tests. No p-values < 0.05 were found. ANOVA between sites for FRP showed a significant site effect (F (7, 112) = 6.324, p = 0.001).

FRP						**T-test**		
	N	**Mean**	**SD**	**SE**		**df**	**t**	**p**
DP	14	95.45	82.26	21.98				
DPdr	16	92.67	42.83	10.71		28	0.12	0.907
TP	16	118.38	66.49	16.62				
TPdr	18	119.94	47.57	11.21		32	-0.08	0.937
VS	14	42.28	47.02	12.57				
VSdr	16	69.98	58.04	14.51		28	-1.42	0.166
HS	9	53.58	32.42	10.81				
HSdr	17	30.64	30.07	7.29		24	1.80	0.084

Supplementary Table S3. Results from linear mixed models comparing the FRB (diameter ≤ 0.5 mm) and FRP with environmental variables. The first five response variables for FRB are comparable to the five response variables for FRP (lower part of the table), while the following response variables for FRB were based on the more detailed species identification in the FRB data. The variables in this table are those that were included in the final models. For the full list of tested variables see text. Our intention was to keep all the three random variables corresponding to the clustered sampling procedure in all the models. In some cases, the plot-level part of the random structure prevented the model functioning and had to be removed. These cases are marked with "parameter not in the model".

Response variable	*Fixed effects estimates*		Subplot level:								Plot level:		*Random effects estimates*		
		Intercept	Pine basal area, m^2	Spruce basal area, m^2	Birch basal area, m^2	Alder basal area, m^2	Graminoids cov. %	Forbs cov. %	WT 2016&2017 July and August mean, cm	Soil temp. 5 cm, cum. mean 2016&2017	C/N ratio	K mg g^{-1}	site	plot nested within site	residual
FRB, all roots	Parameter	174.83				14.43							8555.74	1103.25	9753.84
	SE	39.41				5.05							6991.15	1942.51	2128.46
	p	0.01				0.01							0.22	0.57	0.00
FRB, Conifers	Parameter	222.58		-11.73									40720.76	783.51	5607.21
	SE	79.53		2.08									26469.08	1155.21	1223.59
	p	0.03		0.00									0.12	0.50	0.00
FRB, Shrubs and Broadleaf trees	Parameter	53.60			2.96	4.45	-1.53						189.91	parameter is redundant	738.65
	SE	8.99			0.97	1.45	0.55						206.64		156.37
	p	0.00			0.00	0.01	0.01						0.36		0.00
FRB, Graminoids	Parameter	-4.07					4.37						733.38	414.65	676.10
	SE	13.28					0.91						807.07	290.32	147.54
	p	0.77					0.00						0.36	0.15	0.00

Response variable	*Fixed effects estimates*		Subplot level:								Plot level:		*Random effects estimates*		
		Intercept	Pine basal area, m^2	Spruce basal area, m^2	Birch basal area, m^2	Alder basal area, m^2	Graminoids cov. %	Forbs cov. %	WT 2016&2017 July and August mean, cm	Soil temp. 5 cm, cum. mean 2016&2017	C/N ratio	K mg g^{-1}	site	plot nested within site	residual
FRB, Forbs	Parameter	5.15					1.04						parameter is redundant	parameter is redundant	1053.42
	SE	5.06					0.42								190.74
	p	0.31					0.02								0.00
FRB, Shrubs	Parameter	-184.72								0.09	1.81		44.25	parameter not in the model	384.43
	SE	66.49								0.04	0.51		59.97		79.38
	p	0.01								0.04	0.01		0.46		0.00
FRB, Pine	Parameter	-66.91	3.70								3.05		parameter is redundant	497.92	1581.54
	SE	24.41	0.79								0.88			360.55	345.12
	p	0.01	0.00								0.00			0.17	0.00
FRB, Spruce	Parameter	-18.99			7.35	20.96							16740.07	673.72	3392.87
	SE	51.19			2.75	3.76							10696.11	792.00	740.38
	p	0.72			0.02	0.00							0.12	0.40	0.00
FRB, Birch	Parameter	-22.28		0.90	3.57				-1.25				18.03	74.01	256.77
	SE	10.35		0.39	0.73				0.51				60.75	74.01	60.52
	p	0.07		0.05	0.00				0.05				0.77	0.32	0.00
FRB, Alder	Parameter	-45.76						-2.54				207.28	383.38	parameter not in the model	276.24
	SE	20.12						0.41				58.96	263.83		52.70
	p	0.07						0.00				0.02	0.15		0.00

Response variable	*Fixed effects estimates*	Subplot level:									Plot level:		*Random effects estimates*		
		Intercept	Pine basal area, m^2	Spruce basal area, m^2	Birch basal area, m^2	Alder basal area, m^2	Graminoids cov. %	Forbs cov. %	WT 2016&2017 July and August mean, cm	Soil temp. 5 cm, cum. mean 2016&2017	C/N ratio	K mg g^{-1}	site	plot nested within site	residual
FRP, all roots	Parameter	48.70	2.94										295.04	323.00	2524.17
	SE	13.25	0.92										362.63	304.12	385.43
	p	0.01	0.01										0.42	0.29	0.00
FRP, Conifers (FTIR)	Parameter	21.51	1.33										parameter is redundant	31.59	721.31
	SE	4.57	0.32											63.01	117.16
	p	0.00	0.00											0.62	0.00
FRP, Shrubs and Birch (FTIR)	Parameter	10.29	1.75										63.42	parameter not in the model	340.20
	SE	5.01	0.34										58.97		51.85
	p	0.08	0.00										0.28		0.00
FRP, Graminoids (FTIR)	Parameter	0.73					1.73						18.10	25.72	296.48
	SE	3.26					0.25						29.88	32.00	47.65
	p	0.83					0.00						0.55	0.42	0.00
FRP, Forbs (FTIR)	Parameter	2.88					0.44						1.76	3.25	66.65
	SE	1.32					0.10						5.15	6.21	10.71
	p	0.07					0.00						0.73	0.60	0.00