

Table S1 Average environmental characteristics \pm standard errors along upland-to-lowland transects by season

	Cover (%)	Soil Temp (C°)	Soil Temp (C°)	Water Table Depth (cm)	Water Table Depth (cm)	Volumetric Moisture Content (%)	Volumetric Moisture Content (%)
	GS	GS	NGS	GS	NGS	GS	NGS
Upland position	39 ^a \pm 7	17 ^a \pm 0.4	7 ^a \pm 0.5	-38 ^b \pm 3	-46 ^a \pm 3	0.30 ^a \pm 0.05	0.23 ^a \pm 0.02
Transition position	34 ^a \pm 8	16 ^a \pm 0.4	6 ^a \pm 0.5	-20 ^a \pm 6	-35 ^a \pm 5	0.35 ^{ab} \pm 0.05	0.24 ^a \pm 0.04
Lowland position	21 ^a \pm 8	17 ^a \pm 0.3	6 ^a \pm 0.5	-3 ^c \pm 5	-18 ^b \pm 6	0.50 ^b \pm 0.03	0.38 ^b \pm 0.04

Seasons are defined as either growing season (GS) or non-growing season (NGS).

Soil temperature and volumetric moisture content were taken at 10cm soil depth.

Letter designations are Tukey's honestly significance test results. Different letter designations indicate a p-value of < 0.05 .

Table S2 Average soil redox potentials \pm standard error along upland-to-lowland transects by season

	E _h (mV)	E _h (mV)
	GS	NGS
Upland		
A	494 ^c \pm 44	595 ^a \pm 23
B	457 ^{bc} \pm 59	605 ^a \pm 42
C	393 ^{bc} \pm 60	618 ^a \pm 36
Transition		
A	243 ^{ab} \pm 77	581 ^a \pm 23
B/C	139 ^a \pm 51	484 ^a \pm 47
Cg	191 ^{ab} \pm 71	476 ^a \pm 47
Lowland		
A	95 ^a \pm 34	414 ^a \pm 97
C	71 ^a \pm 23	453 ^a \pm 61
Cg	73 ^a \pm 33	435 ^a \pm 83

Seasons are defined as either growing season (GS) or non-growing season (NGS).

Mean redox values were assigned to soil horizons using an equal area spline function based on redox values measured at 15-, 30-, and 45 cm depths.

Letter designations are Tukey's honestly significance test results.

Different letter designations indicate a p-value of < 0.05 .

Table S3 Fixed effect parameters from the linear mixed models along upland-to-lowland transects

Variable	Degrees of freedom	Regression Coefficient \pm standard error	F - value	Prob > F	Landscape Position Prob >F
A-horizon					
Root Biomass	19	0.21 \pm 0.14	0.00	NS	<0.05
Fe _o	20	0.07 \pm 0.19	0.96	NS	NS
Al _o	20	0.72 \pm 0.26	3.71	NS	<0.05
Clay	19	0.01 \pm 0.27	0.13	NS	NS
E _h	24	-0.30 \pm 0.24	6.32	<0.05	NS
B/C-horizon					
Root Biomass	19	-0.17 \pm 0.11	5.41	<0.05	NS
Fe _o	20	0.26 \pm 0.14	0.71	NS	<0.01
Al _o	20	0.38 \pm 0.11	6.05	<0.05	<0.05
Clay	19	0.30 \pm 0.13	7.01	<0.01	<0.05
E _h	24	0.11 \pm 0.12	0.06	NS	<0.05
C/Cg-horizon					
Root Biomass	19	0.01 \pm 0.2	2.90	NS	<0.05
Fe _o	20	0.004 \pm 0.02	0.08	NS	NS
Al _o	20	0.09 \pm 0.03	16.10	<0.01	NS
Clay	19	0.01 \pm 0.03	3.65	NS	<0.05
E _h	24	-0.05 \pm 0.04	2.84	NS	<0.01

Model parameters with p-values > 0.05 are denoted as not-significant with the letters NS.

Table S4 Average relative abundance \pm standard error of carbon functional groups of solid samples identified by C NEXAFS along upland-to-lowland transects

	Phenolic	Aromatic	Aliphatic	Carboxylic & Amide	Alkyl-OH	Carbonyl	Carboxylic : aromatic
Upland							
A	12 ^{ab} \pm 0.6	14 ^{ab} \pm 1.3	7 ^{ac} \pm 0.6	29 ^{abcd} \pm 0.8	20 ^{abc} \pm 0.9	19 ^{ab} \pm 0.5	2.24 ^{ab} \pm 0.23
B	8 ^{ab} \pm 1.9	8 ^a \pm 1.3	5 ^c \pm 1.2	37 ^e \pm 0.8	24 ^a \pm 1.4	19 ^{ab} \pm 0.2	5.77 ^a \pm 1.63
C	9 ^{ab} \pm 0.7	11 ^{ab} \pm 1.9	5 ^c \pm 1.6	34 ^{cde} \pm 1.7	22 ^{abc} \pm 1.3	19 ^{ab} \pm 1.3	3.96 ^{ab} \pm 0.97
Transition							
A	12 ^a \pm 0.5	15 ^b \pm 1.2	10 ^{ab} \pm 0.5	26 ^{ab} \pm 1.1	19 ^{bc} \pm 0.5	19 ^{ab} \pm 0.4	2.00 ^b \pm 0.27
C	10 ^{ab} \pm 0.6	12 ^{ab} \pm 1.4	6 ^{ac} \pm 0.9	35 ^{de} \pm 2.2	22 ^{abc} \pm 0.5	15 ^a \pm 2.5	3.33 ^{ab} \pm 0.48
Cg	7 ^b \pm 1.3	12 ^{ab} \pm 3.3	4 ^c \pm 0.8	32 ^{bcd} \pm 1.9	22 ^{abc} \pm 2.3	23 ^a \pm 0.5	3.31 ^{ab} \pm 1.10
Lowland							
A	12 ^a \pm 0.6	16 ^b \pm 0.8	12 ^a \pm 0.3	24 ^a \pm 0.8	19 ^c \pm 0.5	18 ^{ab} \pm 0.4	1.52 ^b \pm 0.19
C	11 ^{ab} \pm 0.4	13 ^{ab} \pm 0.8	10 ^a \pm 1.2	28 ^{abc} \pm 1.3	21 ^{abc} \pm 0.9	18 ^{ab} \pm 0.4	2.26 ^{ab} \pm 0.27
Cg	10 ^{ab} \pm 0.7	8 ^a \pm 2.4	3 ^c \pm 1.3	37 ^{de} \pm 1.4	24 ^{ab} \pm 1.9	19 ^{ab} \pm 0.6	6.51 ^a \pm 2.87

Letter designations are Tukey's post hoc honesty test results. Different letter designations indicate a p-value of < 0.05 .

Table S5 FT-ICR-MS metrics \pm standard error of water extracts by position and horizon

	Total Peaks	O:C	H:C	DBE	NOSC	AImod	Molecular Weight
Upland							
A	422 ^a \pm 30	0.38 ^a \pm 0.02	1.46 ^a \pm 0.03	3.67 ^a \pm 0.39	-0.60 ^{ab} \pm 0.07	0.16 ^a \pm 0.02	183 ^{ab} \pm 22
B	372 ^a \pm 17	0.34 ^a \pm 0.02	1.51 ^a \pm 0.06	3.19 ^a \pm 0.20	-0.80 ^a \pm 0.12	0.12 ^a \pm 0.01	153 ^{ab} \pm 16
C	392 ^a \pm 32	0.37 ^a \pm 0.03	1.47 ^a \pm 0.06	3.84 ^a \pm 0.38	-0.65 ^{ab} \pm 0.11	0.13 ^{ab} \pm 0.02	158 ^{ab} \pm 27
Transition							
A	744 ^a \pm 180	0.40 ^a \pm 0.02	1.45 ^a \pm 0.03	2.72 ^a \pm 0.33	-0.55 ^{ab} \pm 0.05	0.19 ^{ab} \pm 0.02	211 ^{ab} \pm 22
C	385 ^a \pm 55	0.41 ^a \pm 0.02	1.38 ^a \pm 0.04	3.28 ^a \pm 0.34	-0.48 ^{ab} \pm 0.06	0.16 ^{ab} \pm 0.02	177 ^{ab} \pm 25
Cg	783 ^a \pm 278	0.36 ^a \pm 0.03	1.42 ^a \pm 0.05	3.79 ^a \pm 0.59	-0.64 ^{ab} \pm 0.09	0.14 ^{ab} \pm 0.03	157 ^{ab} \pm 23
Lowland							
A	990 ^a \pm 265	0.42 ^a \pm 0.02	1.46 ^a \pm 0.03	3.35 ^a \pm 0.23	-0.56 ^{ab} \pm 0.08	0.23 ^b \pm 0.02	238 ^b \pm 18
C	626 ^a \pm 304	0.44 ^a \pm 0.02	1.32 ^a \pm 0.05	2.91 ^a \pm 0.36	-0.36 ^b \pm 0.09	0.14 ^{ab} \pm 0.02	139 ^a \pm 17
Cg	382 ^a \pm 41	0.39 ^a \pm 0.02	1.42 ^a \pm 0.05	3.40 ^a \pm 0.29	-0.60 ^{ab} \pm 0.09	0.14 ^{ab} \pm 0.01	149 ^{ab} \pm 13

Letter designations are Tukey's post hoc honesty test results. Different letter designations indicate a p-value of < 0.05 .