1   **Supplementary material**

2   We used a random walk study design as opposed to a hummock-hollow stratified sampling design

3   because one of our hypotheses was that elevation above water table—not just microsite category—

4   is an important predictor of understory richness (and overstory biomass and soil chemistry). Hence,

5   a random walk design allowed us to sample the entire site elevation distribution instead of a

6   potentially bimodal, clustered elevation distribution. To create the plot-level random walk design,

7   we generated a sequence of 12 random integers between 1 and 10 that represented the number of

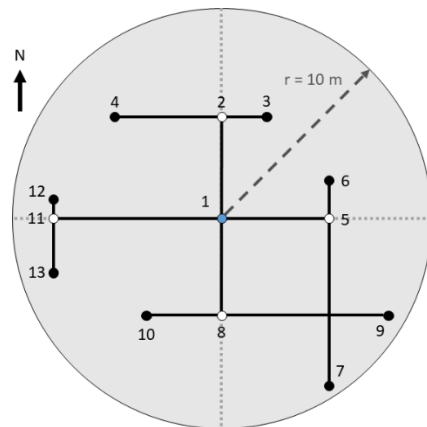
8   steps to take between sampling points. Sampling point 1 was always the plot center, from which

9   we proceeded to sample at a central point in the northern half of the plot (point 2 in S1). We then

10   sampled at points orthogonal to this central point (e.g., points 3 and 4 in S1), and repeated this

11   clockwise in cardinal directions (i.e., sample point at a central point along cardinal direction with

12   two sample points orthogonal to the central point). To summarize, we randomly sampled 13 points

13   per plot, with three plots per site, for 39 samples per site, and 390 points across all sites.

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15   *Figure S1 Example of plot-level (3 per site) quasi-random walk sampling design with 13*
16   *sampling points per plot. Points are the samples (numbers are the sequential sampling order)*
17   *and black, solid line segments refer to walking path, where path length was determined by a*
18   *sequence of 12 random generated integers. White points indicate central points along cardinal*
19   *directions and blue point indicates plot center and first sampling point. Dotted lines demarcate*
20   *circle quadrants, which this design allowed us to sample approximately equally.*

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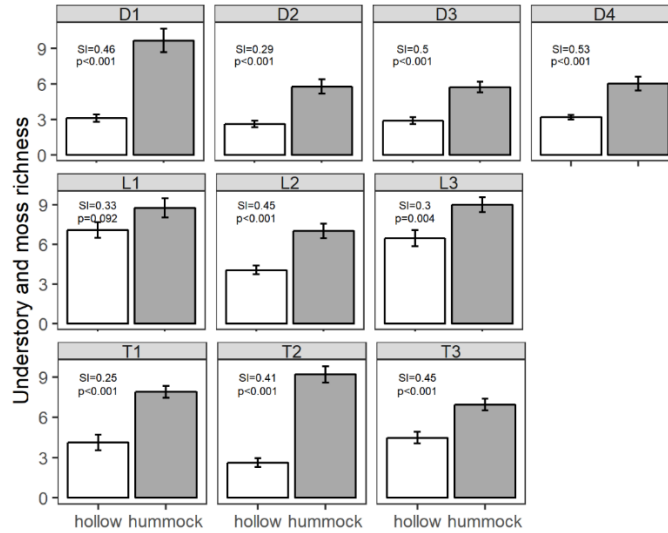
Figure S2 Combined vascular and moss richness hummock and hollow comparison. Text values indicate Sorensen dissimilarity indices and Welch's two sample t-test results. Sorensen dissimilarity indices have opposite interpretation of Bray-Curtis dissimilarity indices: the closer to 0, the more dissimilar, and the closer to 1, the more similar.

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Table S1 Results of indicator species analysis for hummocks and hollows

Microsite	Species	Specificity	Sensitivity	IV	p-val
	Climacium dendroides	0.91	0.59	0.53	0.001
	Rhizomnium magnifolium	0.83	0.60	0.50	0.001
	Rubus pubescens	0.83	0.42	0.35	0.001
	Funaria hygrometrica	0.84	0.40	0.34	0.001
	Carex trisperma	0.86	0.31	0.27	0.001
	Galium triflorum	0.89	0.24	0.22	0.001
	Aster lateriflorus	0.80	0.24	0.20	0.001
	Carex bromoides	0.91	0.16	0.14	0.001
	Acer rubrum	0.93	0.11	0.10	0.001
Hummock	Sphagnum angustifolium	0.97	0.11	0.10	0.001
	Maianthemum canadense	1.00	0.09	0.09	0.001
	Calla palustris	0.95	0.09	0.08	0.001
	Dryopteris carthusiana	1.00	0.08	0.08	0.001
	Pleurozium schreberi	0.98	0.08	0.08	0.001
	Carex retorsa	0.94	0.08	0.08	0.003
	Circaea alpina	0.93	0.08	0.07	0.001
	Trientalis borealis	0.89	0.05	0.04	0.005
	Corylus cornuta	0.95	0.04	0.04	0.006
	Rubus idaeus	0.99	0.04	0.04	0.004
Hollow	Calliergon cordifolium	0.72	0.61	0.44	0.001
	Lemna minor	0.98	0.27	0.27	0.001

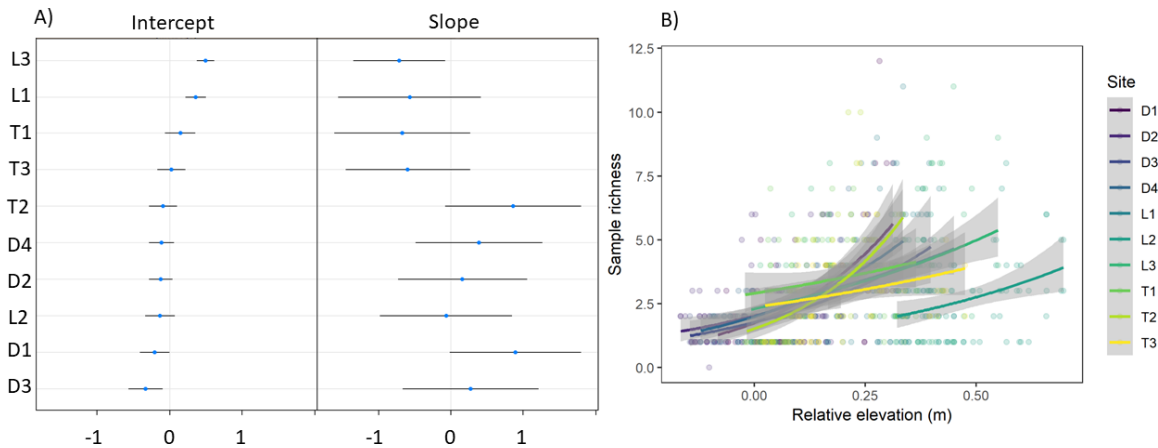
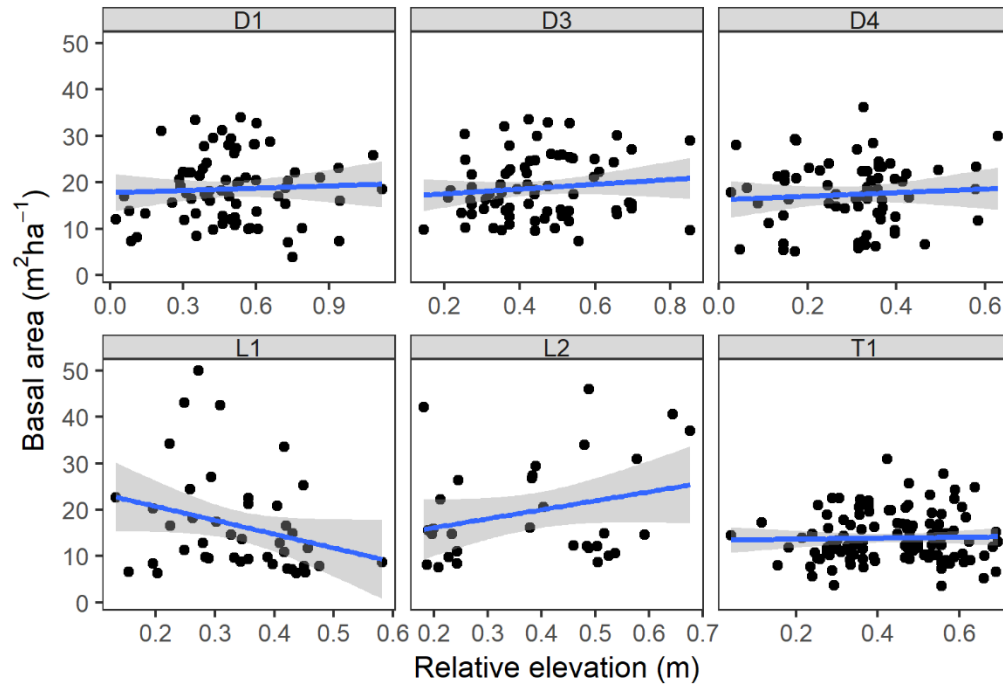



Figure S3 a) site-level random effects for intercept and slope for the richness-elevation GLMM , and b) raw data of overall (vascular and moss) richness-elevation relationships for each site with GLMMs fitted.

Table S2 Forestry and hydrology metrics for sites

Site	Midstory basal area (m² ha⁻¹)	Midstory Fraxinus fraction	Overstory basal area (m² ha⁻¹)	Overstory *Fraxinus* fraction	Mean daily water table (m)	Median daily water table (m)	Mean conf. layer depth (cm)	Trees per hectare
L1	2.60	0.70	46.74	0.97	-0.26	-0.05	28.8	729
L2	1.60	0.45	44.79	0.92	-0.35	-0.05	19.6	650
L3	2.77	0.48	46.44	0.98	-0.37	-0.08	24.5	683
D1	1.12	0.4	39.59	0.98	0.01	0.09	28.9	1425
D2	2.94	0.95	39.97	0.97	-0.01	0.04	27.7	1600
D3	1.25	0.25	37.79	0.76	0.05	0.14	69.8	1067
D4	1.83	0.29	27.67	0.76	-0.01	0.00	60.6	700
T1	6.42	0.66	26.87	0.44	0.00	0.03	>150	1038
T2	1.53	0.52	25.69	0.91	-0.05	0.04	80.2	756
T3	3.10	0.48	23.31	0.74	-0.07	0.02	53.6	781

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34 *Figure S4 Site-scale individual tree base elevation versus individual tree basal area.*

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Table S3 Paired Levene tests for variance in soil chemistry concentrations among hydrogeomorphic categories. Bolded values are significant at p=0.05 level. Note that for most analytes, lowland sites (L) have lower variance than D or T sites.

Analyte	Comparison	Estimated differences in variances	Lower 95% confidence interval	Upper 95% confidence interval	Adjusted p-value
Ca^{2+}	L-D	-0.056	-0.931	0.819	0.987
	T-D	-0.182	-1.116	0.751	0.889
	T-L	-0.126	-1.021	0.768	0.941
Cl^-	L-D	-0.305	-0.473	-0.138	**0.000**
	T-D	-0.032	-0.206	0.141	0.901
	T-L	0.273	0.106	0.441	**0.000**
Mg^{2+}	L-D	0.283	-0.055	0.621	0.120
	T-D	0.771	0.418	1.125	**0.000**
	T-L	0.488	0.147	0.829	**0.002**
NO_3^--N	L-D	0.505	0.324	0.687	**0.000**
	T-D	-0.069	-0.262	0.123	0.672
	T-L	-0.575	-0.754	-0.396	**0.000**
PO_4^{3-}-P	L-D	-0.453	-0.739	-0.167	**0.001**
	T-D	-0.309	-0.609	-0.009	**0.042**
	T-L	0.144	-0.144	0.432	0.467
SO_4^{2-}	L-D	0.788	0.045	1.530	**0.035**
	T-D	0.131	-0.652	0.913	0.918
	T-L	-0.657	-1.409	0.095	0.100
%C	L-D	0.900	-0.981	2.782	0.497
	T-D	-2.266	-4.240	-0.292	**0.020**
	T-L	-3.166	-5.039	-1.293	**0.000**
%N	L-D	-0.163	-0.300	-0.026	**0.015**
	T-D	-0.232	-0.374	-0.089	**0.000**
	T-L	-0.069	-0.206	0.068	0.464
C:N	L-D	-0.846	-1.266	-0.426	**0.000**
	T-D	-0.548	-0.985	-0.112	**0.009**
	T-L	0.298	-0.127	0.722	0.224

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55 *Table S4 Average (±standard deviation) soil extraction concentrations for hummocks and hollows across sites. Values are in mg L^{-1} except for %C, %N, and C:N, which are unitless.*

Site	Microsite	%C	Ca^{2+}	Cl$^-$	C:N	Mg^{2+}	%N	NO$_3^-$-N	PO$_4^{3-}$-P	SO$_4^{2-}$
D1	hol (18)	39.4±7.7	9.8±3.8	1±0.6	16.7±2.1	1.9±0.9	2.2±0.9	0.3±0.27	2.13±1.38	7.3±3.1
D1	hum (8)	38.2±11.2	10.2±5	1.3±0.7	15.8±2.4	2.2±0.8	2.3±1	0.33±0.59	2.69±1.58	7.4±3.3
D2	hol (7)	33.2±8.2	12.8±2.7	1.3±0.6	15±0.5	3.1±0.7	2.2±0.5	0.06±0.03	1.96±1.05	9.7±3.2
D2	hum (7)	38±8.1	13.2±4	1.8±0.8	15.4±1	3.2±0.8	2.5±0.6	0.06±0.05	2.9±1.03	9.6±2
D3	hol (3)	45±0.5	13.7±0.9	2.7±1.4	14.1±0.9	3.3±0.7	3.2±0.2	0.18±0.08	2.97±0.6	9.5±1.6
D3	hum (10)	45.4±2.1	14.6±2.8	2.5±0.8	17±2	4.1±1.1	2.7±0.2	0.1±0.12	3.82±0.76	9.4±2.4
D4	hol (7)	45.4±2.4	14.7±2	1.1±0.5	16.9±2.6	2.8±0.6	2.7±0.4	0.15±0.11	2.67±1.61	7.9±0.9
D4	hum (6)	48.2±1.2	12.9±3	2.5±0.7	19.2±2.2	4±0.5	2.5±0.3	0.03±0.01	5.83±1.33	7.3±2.2
L1	hol (18)	38±3.8	19.2±2.6	1.3±0.5	14.2±0.6	8±0.9	2.7±0.3	0.63±0.52	2.24±0.83	10.8±2.7
L1	hum (8)	38.7±3.1	23.4±2.6	1.3±0.3	14.1±0.5	8.9±0.7	2.7±0.2	0.53±0.25	2.62±0.83	9.8±2.4
L2	hol (12)	26.1±9.7	14.7±2.7	0.8±0.3	13.3±0.7	5.4±1	2±0.7	1.71±1.06	1.25±0.66	6.3±1.7
L2	hum (13)	32.5±12.8	15.1±6.4	1±0.4	13.3±1.1	5.5±2.1	2.1±0.6	1.51±1.33	1.33±0.82	5.4±2.6
L3	hol (17)	37.8±3.5	19.2±1.4	1.1±0.4	13.9±1	9±0.8	2.7±0.3	0.97±0.72	2.76±0.9	14.5±4.1
L3	hum (9)	39.9±5.6	20.8±2.4	1±0.3	14.8±2.2	9.4±0.9	2.7±0.2	0.5±0.54	3.09±0.82	10.5±5
T1	hol (14)	47.2±0.9	20.6±3	1.3±0.3	16.5±0.9	8.7±1.7	2.9±0.2	0.15±0.06	3.21±0.65	10.3±2.5
T1	hum (12)	46.4±1	22.6±2.5	2.6±0.6	18.2±2.4	10±2	2.5±0.4	0.15±0.13	3.65±0.93	8.6±2.1
T2	hol (15)	44.9±3.3	27.8±3.4	1.4±0.5	14.9±0.9	7.9±1.2	3±0.2	0.11±0.05	3.15±0.78	11.7±2.9
T2	hum (11)	39.4±4.5	31.7±2	2.3±0.6	15.2±0.8	9.2±1.2	2.6±0.3	0.1±0.04	4.63±1.03	10.8±2.9
T3	hol (6)	43.2±1	15.5±4.6	1.4±0.7	16±1.1	3.5±2	2.7±0.1	0.12±0.04	3.54±1.54	10.6±1.9
T3	hum (7)	43.5±1.7	16.1±1.6	1.5±0.3	17.4±1.6	5.9±2.2	2.4±0.3	0.09±0.07	3.99±0.84	9.1±1.1

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66 *Table S5 Linear mixed effect model results for soil chemistry analytes versus relative elevation*
67 *above water table with site as a random effect.*

Solute	Effect	Term	Estimate	SE	Z-score	P(Z>z)
%C	Fixed	Intercept	42.9	1.51	28.45	<0.001
		z	-7.7	4.93	-1.56	0.120
	Random	SD Intercept	2.9			
		SD z	9.6			
Ca^{2+}	Fixed	Intercept	15.9	1.73	9.19	<0.001
		z	3.9	4.19	0.94	0.350
	Random	SD Intercept	4.8			
		SD z	10.4			
Cl^-	Fixed	Intercept	1	0.23	4.27	<0.001
		z	2	0.6	3.36	0.001
	Random	SD Intercept	0.6			
		SD z	1.3			
C:N	Fixed	Intercept	14.4	0.61	23.72	<0.001
		z	4.5	1.99	2.27	0.025
	Random	SD Intercept	1.5			
		SD z	5.2			
Mg^{2+}	Fixed	Intercept	4.8	0.79	6.12	<0.001
		z	3.5	1.4	2.48	0.014
	Random	SD Intercept	2.3			
		SD z	3.2			
%N	Fixed	Intercept	2.8	0.13	21.71	<0.001
		z	-1.0	0.28	-3.54	0.001
	Random	SD Intercept	0.3			
		SD z	0.0			
NO_3^--N	Fixed	Intercept	0.8	0.34	2.25	<0.001
		z	-1	0.6	-1.64	0.103
	Random	SD Intercept	1			
		SD z	1.4			
$PO_4^{3-}-P$	Fixed	Intercept	2.6	0.18	14.39	<0.001
		z	3	1.41	2.16	0.032
	Random	SD Intercept	0.2			
		SD z	4			
SO_4^{2-}	Fixed	Intercept	11.9	1.04	11.45	<0.001
		z	-8.1	1.77	-4.57	<0.001
	Random	SD Intercept	2.7			
		SD z	0			

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Figure S5 Scaled soil extract concentrations versus relative elevation above water table for all sites and analytes. Concentrations were scaled and centered to allow easy comparison across sites and geomorphic categories. Best-fit linear regressions with 95% confidence shading are shown. Site are split by geomorphic category in columns and by analyte in rows.