



Supplementary Figure S1. Map of all grassland sampling locations. Dates established indicate date of prairie restoration. Inset: map of location of The Wilds within Ohio.

Supplementary Table S1: Individual grassland site history and soil characteristics.

Prairie name	Hect	Date	Latitude/ Longitude	Slope (%)	Aspect (degrees)	Bioma	Proportion	SOC <sup>b</sup>	SOC <sup>b</sup>	GOC <sup>c</sup>	GOC <sup>c</sup>	Respiration	Respiration
	ares (HA)	prairie planted <sup>a</sup>				ss (g m <sup>-2</sup> )	native cover	(%) 0-15 cm	(%) 15-30 cm	(%) 0-15 cm	(%) 15-30 cm	(mg C kg <sup>-1</sup> soil) 0-15 cm	(mg C kg <sup>-1</sup> soil) 15-30 cm
Bison Baseline (BB)	4		39.839066/ -81.738042	9	314		0.196	1.278	0.157	0.698	0.497	3.75	5.77
Butterfly Habitat Baseline (BHB)	3.2		39.826959/ -81.737725	3	175		0.129	1.838	0.683	0.477	0.565	52.45	10.17
Butterfly Habitat Expansion (BHE)	9.3	2008	39.824417/ -81.737583	11	158	294.58	0.559	2.06	0.228	0.811	0.506	70.1	6.36
Butterfly Habitat (BH)	4	2003	39.824833/ -81.740167	3	321	228.5	0.48	1.311	0.215	0.619	0.673	41.94	3.86
Bison Knoll (BK)	3.4	2014	39.840583/ -81.734639	3	156		0.555	1.506	0.024	0.884	0.61	55.93	4.32
Beetle Prairie (BP)	10.1	2010	39.836222/ -81.710222	9	209	256.42	0.365	1.473	0.151	0.682	0.573	67.46	6.53
Dip Baseline (DB)	2		39.840528/ -81.70733	9	63	196.17	0.129	1.305	0.176	1.009	0.83	20.54	3.84
Dip Prairie (DP)	9.3	2016	39.83792/ -81.705001	10	96	159.67	0.362	1.423	0.114	0.853	0.884	21.83	3.92
Hill 1 Prairie (H1P)	20.5	2014	39.838528/ -81.737778	2	284		0.203	1.851	0	1.136	0.835	53.89	7.41
Lake Trail (LTP)	2	2004	39.835028/ -81.738583	10	149	224.33	0.547	1.649	1.288	0.918	0.909	22.77	20.67
North Prairie (NP)	9	1999	39.859674/ -81.743337	6	336	343.83	0.656	1.152	0	1.063	0.805	13	3.79
Nomad Ridge (NRP)	5.8	2014	39.827722/ -81.737889	6	160	361.83	0.929	1.392	0.038	0.491	0.355	16.66	62.38
Overlook Prairie (OP)	2.3	2016	39.831889/ -81.730639	13	135	164.33	0.381	2.477	0.313	0.701	0.349	91.28	15.84
Zion Baseline (ZB)	10.1		39.855984/ -81.748289	6	303	124.5	0.065	0.454	0.297	0.937	0.906	43.92	7.16
Zion Prairie (ZP)	23.5	2016	39.850692/ -81.750195	9	289		0.443	1.54	0.011	0.703	0.591	19.43	3.44

- a. Baseline sites (shaded) have no date as prairie was not planted in these locations.
- b. SOC- soil organic carbon
- c. GOC- geogenic organic carbon

Supplementary Table S1 Continued.

Prairie name	TOC <sup>d</sup> (%) 0-15 cm	TOC <sup>d</sup> (%) 15-30 cm	GOC/ TOC 0-30	POM <sup>5</sup> (%) 0-30	P 0-15 cm	P 15-30 cm	K 0-15 cm	K 15-30 cm	FE 0-15 cm	FE 15-30 cm	Poxc <sup>e</sup> (mg kg <sup>-1</sup> soil) 0-15 cm	Poxc <sup>e</sup> (mg kg <sup>-1</sup> soil) 15-30 cm
Bison Baseline (BB)	1.976	0.654	0.454	0.023	18	9	208	102	128.9	95.8	457.2	13.4
Butterfly Habitat Baseline (BHB)	2.315	1.248	0.292	0.024	6	3	151	110	98.4	123.3	363.1	73.9
Butterfly Habitat Expansion (BHE)	2.871	0.734	0.365	0.012	10	5	130	103	120	121.9	585	53.7
Butterfly Habitat (BH)	1.93	0.888	0.458	0.025	10	4	184	131	134.2	148.9	477.4	67.2
Bison Knoll (BK)	2.39	0.634	0.494	0.013	13	6	191	131	122	126.2	383.3	53.7
Beetle Prairie (BP)	2.155	0.725	0.436	0.029	20	12	174	129	81.9	104.4	322.7	26.8
Dip Baseline (DB)	2.314	1.007	0.554	0.011	10	7	131	88	117.2	136.6	356.4	20.1
Dip Prairie (DP)	2.277	0.998	0.530	0.019	18	6	140	119	118.3	128.9	322.7	20.1
Hill 1 Prairie (H1P)	2.987	0.835	0.510	0.016	12	5	204	129	129.2	138.2	558.1	80.6
Lake Trail (LTP)	2.568	2.197	0.383	0.024	31	10	133	75	175.6	248.9	470.7	242
North Prairie (NP)	2.215	0.805	0.618	0.011	6	4	122	103	93.6	84.5	336.2	0
Nomad Ridge (NRP)	1.883	0.393	0.371	0.009	10	4	204	171	115	99.7	336.2	0
Overlook Prairie (OP)	3.178	0.663	0.273	0.008	16	10	150	109	91.8	100.2	490.9	60.5
Zion Baseline (ZB)	1.391	1.202	0.710	0.023	6	3	156	136	80.7	103.8	349.6	73.9
Zion Prairie (ZP)	2.243	0.602	0.454	0.029	5	3	156	131	86.8	84.5	248.8	0

d. TOC- Total organic carbon (GOC+SOC)

e. POC- Particulate organic matter

f. POXC- Permanganate-oxidizable carbon

Supplementary Table S2. Vegetation results by grassland in 2018.

Prairie name	Species Diversity 2018	Species Richness 2018	Native Cover proportion 2018	Total percent cover 2018 <sup>a</sup>
Bison Baseline (BB)	1.59±0.47	8.70±7.52	0.19±0.05	112.96±32.99
Butterfly Habitat Baseline (BHB)	1.52±0.25	6.78±4.26	0.13±0.02	135.89±41.88
Butterfly Habitat Expansion (BHE)	1.52±0.33	7.63±3.24	0.56±0.03	128.85±35.15
Butterfly Habitat (BH)	1.59±0.25	7.89±3.49	0.48±0.05	152.26±32.65
Bison Knoll (BK)	1.64±0.26	8.56±6.10	0.56±0.03	155.96±32.9
Beetle Prairie (BP)	1.49±0.38	7.56±4.49	0.37±0.05	120±48.59
Dip Baseline (DB)	1.71±0.23	8.85±4.52	0.13±0.01	154.93±23.97
Dip Prairie (DP)	1.78±0.28	9.56±6.95	0.36±0.03	141.52±28.67
Hill 1 Prairie (H1P)	1.87±0.22	10.52±5.18	0.20±0.02	144.48±33.18
Lake Trail (LTP)	1.27±0.32	5.78±3.33	0.55±0.05	125.89±28.01
North Prairie (NP)	1.12±0.25	6±1.15	0.66±0.02	135.33±24.34
Nomad Ridge (NRP)	1.29±0.21	5.89±2.26	0.93±0.01	119.85±21.72
Overlook Prairie (OP)	1.65±0.34	7.78±5.18	0.38±0.09	137.81±30.3
Zion Baseline (ZB)	1.58±0.25	7.63±3.63	0.07±0.01	141.11±22.48
Zion Prairie (ZP)	1.75±0.4	10.33±8.77	0.44±0.03	125.19±25.47

a. Total percent cover is over 100%, in most plots plants of different species overlapped.





	BB	BHB	BHE	BH	BKP	BP	DB	DP	H1P	LTP	NP	NRP	OP	ZB	ZP
<i>Plantago lanceolata</i>	0.19	0	0.04	0	0	0	0	0	0.04	0.11	0	0	0	0	0
<i>Ambrosia artemisiifolia</i>	0	0.26	0	0	0	0.07	0.04	0	0	0	0	0	0	0	0
<i>Carex spp.</i>	0	0	0	0	0.37	0	0	0	0	0	0	0	0	0	0
<i>Parthenocissus quinquefolia</i>	0	0	0	0	0	0	0	0	0	0.04	0	0	0.3	0	0
<i>Polygonum convolvulus</i>	0	0	0	0	0	0	0	0.3	0	0	0	0	0.04	0	0
<i>Rosa multiflora</i>	0	0	0.22	0	0	0	0	0.11	0	0	0	0	0	0	0
<i>Ageratina altissima</i>	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0
<i>Convolvulus arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3
<i>Juncus tenuis</i>	0	0	0	0	0	0	0	0	0	0.3	0	0	0	0	0
<i>Cichorium intybus</i>	0	0	0	0	0	0	0.26	0	0	0	0	0	0	0	0
<i>Erigeron canadensis</i>	0	0	0	0	0	0.22	0	0	0	0	0	0	0	0	0
<i>Eryngium yuccifolium</i>	0	0	0	0.22	0	0	0	0	0	0	0	0	0	0	0
<i>Aster spp.</i>	0	0	0.07	0	0	0	0.11	0	0	0	0	0	0	0	0
<i>Boermeria cylindrica</i>	0	0	0	0	0	0.15	0	0	0	0	0	0	0	0	0
<i>Tridens flavus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0
<i>Actinomeris alternifolia</i>	0	0	0.07	0	0	0	0	0	0	0	0	0	0	0	0
<i>Solidago erecta</i>	0	0	0	0.07	0	0	0	0	0	0	0	0	0	0	0
<i>Apocynum cannabinum</i>	0	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0
<i>Glechoma hederacea</i>	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0

- a. Only includes species found in at least 2 out of 3 years. Percent cover was averaged over 27 plots. Species are listed in order from most abundant to least abundant.
- b. Grasslands are listed by initials, full names can be seen in appendix 2. Shaded columns- grassland initials ending in "B"- are cool season baselines, unshaded columns are prairies.

Supplementary Table S4a. Table of averages and significant differences for soil microbial factors by various groupings for 0-15cm: upper soil layer.

Groupings <sup>A</sup>	General Bacteria	Actino-bacteria	Gram+ Bacteria	Gram- Bacteria	AMF	Saprophytic Fungi	Protozoa	Total Gram+	Total Bacteria	Total Fungi	Total FAME	Fungal/Bacterial Ratio	Glucosoidaise		
Grassland type															
<i>p value</i>	0.06	0.05*	0.04*	0.03	0.02*	0.05*	0.05*	0.04*	0.03*	0.02*	0.02*	0.13	0.09		
<b>Baseline</b>	14.81	50.38 A	100.46 A	130.58 A	56.28 A	123.95 A	7.00 A	150.83 A	296.22 A	180.24 A	483.46 A	1.73			
<b>Prairie</b>	18.11	63.63 B	123.32 B	161.06 B	74.79 B	157.86 B	9.03 B	186.95 B	366.13 B	232.66 B	607.82 B	1.93			
Prairie age (in 2018)															
<i>p value</i>	0.14	0.08	0.12	0.20	0.07	0.004**	0.17	0.10	0.12	0.01**	0.06	0.16	0.11		
<b>A 14-19 years</b>	19.78	67.32	125.36	162.45	79.80	202.90 A	9.92	192.68	374.92	282.70 A	667.53	2.42 A	4.86		
<b>B 8-10 years</b>	15.56	54.78	107.44	153.83	84.20	141.60 AB	9.03	162.21	331.61	<b>225.81</b> AB	566.45	1.91 AB	5.45		
<b>C 4 years</b>	19.47	72.57	137.47	172.24	74.49	140.38 B	9.38	210.04	401.76	214.87 AB	626.01	1.73 B	6.73		
<b>D years</b>	16.79	56.92	117.71	153.31	63.82	141.15 B	7.78	174.63	344.73	204.9698B AB	557.49	1.67 B	5.55		
<b>X Not prairie</b>	14.81	50.38	100.46	130.58	56.28	123.95 B	7.00	150.83	296.22	180.24 B	483.46	1.73 B	4.56		
Geographic location (within site)															
<i>p value</i>	3.40E-05***	1.5E-05***	6.8E-05***	3.6E-03**	0.06	0.04*	0.11	3.4E-05***	2.7E-04***	0.11	0.01**	0.03**	1.31E-04***		
<b>Central</b>	22.78 A	81.47 A	152.06 A	178.77 A	67.18	168.37 A	8.68	233.53 A	435.08 A	235.55	679.31 A	1.78 AB	7.04 A		
<b>East</b>	16.19 B	56.79 B	110.23 B	162.33 AB	82.95	145.25 AB	9.94	167.03 B	345.54 B	228.19	583.67 AB	1.82 AB	5.70 AB		
<b>North</b>	14.12 B	47.07 B	100.77 B	128.20 B	59.83	111.22 B	7.28	147.84 B	290.16 B	171.05	468.49 B	1.71 A	4.00 B		
<b>South</b>	14.69 B	50.14 B	98.88 B	127.57 B	61.64	166.31 AB	7.03	149.02 B	291.27 B	227.95	526.25 AB	2.28 B	3.96 B		
Mining Permit Area															
<i>p value</i>	0.47	0.28	0.37	0.88	0.30	0.44	0.33	0.33	0.52	0.83	0.63	0.32	0.48		
<b>B 1972-77</b>	18.10	64.19	123.41	153.76	64.17	157.48	7.82	187.60	359.46	221.65	588.93	1.96	5.59		
<b>C 1977-82</b>	16.86	57.19	113.62	151.78	72.08	144.94	8.75	170.81	339.44	217.02	565.21	1.84	5.16		
<b>Unmined</b>	14.97	58.86	108.94	157.22	86.26	127.91	10.36	167.79	339.98	214.16	564.51	1.76	5.71		
Proportion Native Vegetation in Grassland															
<i>p value</i>	0.23	0.14	0.24	0.20	0.08	0.005**	**	0.15	0.20	0.19	0.003**	**	0.03*	0.002**	0.90
<b>A 0-25%</b>	16.20	56.28	109.87	139.55	59.67	124.66 B	7.41	166.16	321.90	184.32 B	513.64 B	1.70 B	5.25		
<b>B 25-50%</b>	16.35	55.54	112.45	152.72	69.24	140.49 B	8.73	167.99	337.06	209.73 B	555.53 B	1.78 B	5.30		
<b>C &gt;50%</b>	19.14	68.48	129.34	166.53	80.67	181.31 A	9.33	197.82	383.49	261.98 A	654.80 A	2.16 A	5.55		

A. Highlighted numbers had ANOVA results with  $p \leq 0.05$ . AB letters indicate statistically significant differences between groups if more than 2 groups. Units for all group average n mol/g.



Supplementary Table S4b. Table of averages and significant differences for soil microbial factors by various groupings for 15-30cm: lower soil layer.

Groupings <sup>A</sup>	General Bacteria	Actino-bacteria	Gram+ Bacteria	Gram- Bacteria	AMF	Saprophytic Fungi	Protozoa	Total Gram+	Total Bacteria	Total Fungi	Total FAME	Fungal/Bacterial Ratio	Glucosoidaise
Grassland type													
<i>p value</i>	0.63	0.06	0.05	0.07	0.07	0.28	0.12	0.06	0.05*	0.04*	0.03*	0.16	0.46
<b>Baseline</b>	0.52	7.92	16.60	22.27	15.42	23.39	1.01	24.52	47.32 A	38.80 A	87.13 A	2.32	0.41
<b>Prairie</b>	0.75	10.91	22.12	28.43	23.06	31.38	1.65	33.04	62.21 B	54.44 B	118.30 B	2.66	0.47
Prairie Age (in 2018)													
<i>p value</i>	0.05	0.07	0.05	0.07	0.02**	0.01***	0.13	0.07	0.05	8.84E-04***	3.92E-04***	0.0002**	0.72
<b>A 14-19 years</b>	1.91	13.63	28.00	32.40	29.78 A	48.15 A	1.88	41.64	75.94 NS	77.94 A	155.75 A	3.38 A	0.51
<b>B 8-10 years</b>	0.44	8.27	19.84	30.43	28.36 AB	26.85 AB	2.32	28.11	58.97 NS	55.22 AB	116.51 AB	2.67 AB	0.45
<b>C 4 years</b>	0.17	11.70	22.25	29.01	22.19 AB	25.38 AB	1.59	33.94	63.12 NS	47.57 AB	112.29 AB	2.45 B	0.48
<b>D 2 years</b>	0.36	9.17	17.65	22.55	13.68 B	23.61 B	1.02	26.82	49.74 NS	37.29 B	88.04 B	2.13 B	0.44
<b>X Not prairie</b>	0.52	7.92	16.60	22.27	15.42 B	23.39 B	1.01	24.52	47.32 NS	38.80 B	87.13 B	2.32 B	0.41
Geographic Location (within site)													
<i>p value</i>	0.73	0.01*	4.16E-03**	3.48E-04***	0.03*	0.52	1.42E-03***	5.22E-03**	1.59E-03**	0.20	0.02*	0.35	0.0004**
<b>Central</b>	1.08	14.01 A	27.61 A	30.14 A	19.74 AB	36.96	1.16 B	41.61 A	72.83 A	56.70	130.69 A	2.58	0.57 A
<b>East</b>	0.36	9.24 AB	18.18 AB	23.91 AB	16.85 AB	24.81	1.47 AB	27.42 AB	51.69 AB	41.66	94.82 AB	2.32	0.37 AB
<b>North</b>	0.54	6.61 B	14.81 B	17.66 B	13.51 B	27.47	0.37 B	21.42 B	39.62 B	40.98	80.97 B	2.90	0.26 B
<b>South</b>	0.66	9.64 AB	20.07 AB	31.31 A	29.06 A	26.81	2.40 A	29.71 AB	61.68 A	55.86	119.94 AB	2.50	0.54 A
Mining Permit Area													
<i>p value</i>	0.24	0.43	0.34	0.01*	0.07*	0.82	0.02	0.39	0.13	0.34	0.18	0.44	0.13
<b>B 1972-77</b>	0.36	8.65	18.19	22.72 B	15.87 NS	26.63	0.83 NS	26.84	49.92	42.50	93.24	2.67	0.37
<b>C 1977-82</b>	1.02	11.16	22.87	29.96 A	24.21 NS	32.02	1.90 NS	34.03	65.01	56.23	123.14	2.49	0.51
<b>Unmined</b>	0.00	10.51	17.68	25.85 AB	26.51 NS	22.75	1.98 NS	28.19	54.04	49.26	105.28	2.55	0.48
Proportion Native Vegetation in Grassland													
<i>p value</i>	0.24	0.03*	0.02*	0.05	0.19	5.95E-04***	0.68	0.02*	0.02*	2.05E-03**	3.14E-03**	0.04*	0.30
<b>A 0-25%</b>	0.42	8.74 AB	18.03 AB	23.78 NS	17.09	23.04 A	1.25	26.77 AB	50.97 A	40.13 A	92.35 A	2.33 A	0.42
<b>B 25-50%</b>	0.50	8.39 A	17.71 A	25.03 NS	20.88	23.61 A	1.56	26.09 A	51.62 A	44.49 A	97.68 A	2.44 AB	0.41
<b>C &gt;50%</b>	1.14	13.22 B	26.21 B	31.55 NS	25.10	41.09 B	1.61	39.44 B	72.13 B	66.18 B	139.93 B	2.93 B	0.53

A. Highlighted numbers had ANOVA results with  $p \leq 0.05$ . AB letters indicate statistically significant differences between groups if more than 2 groups. Units for all group average n mol/g.