

Supplementary Material

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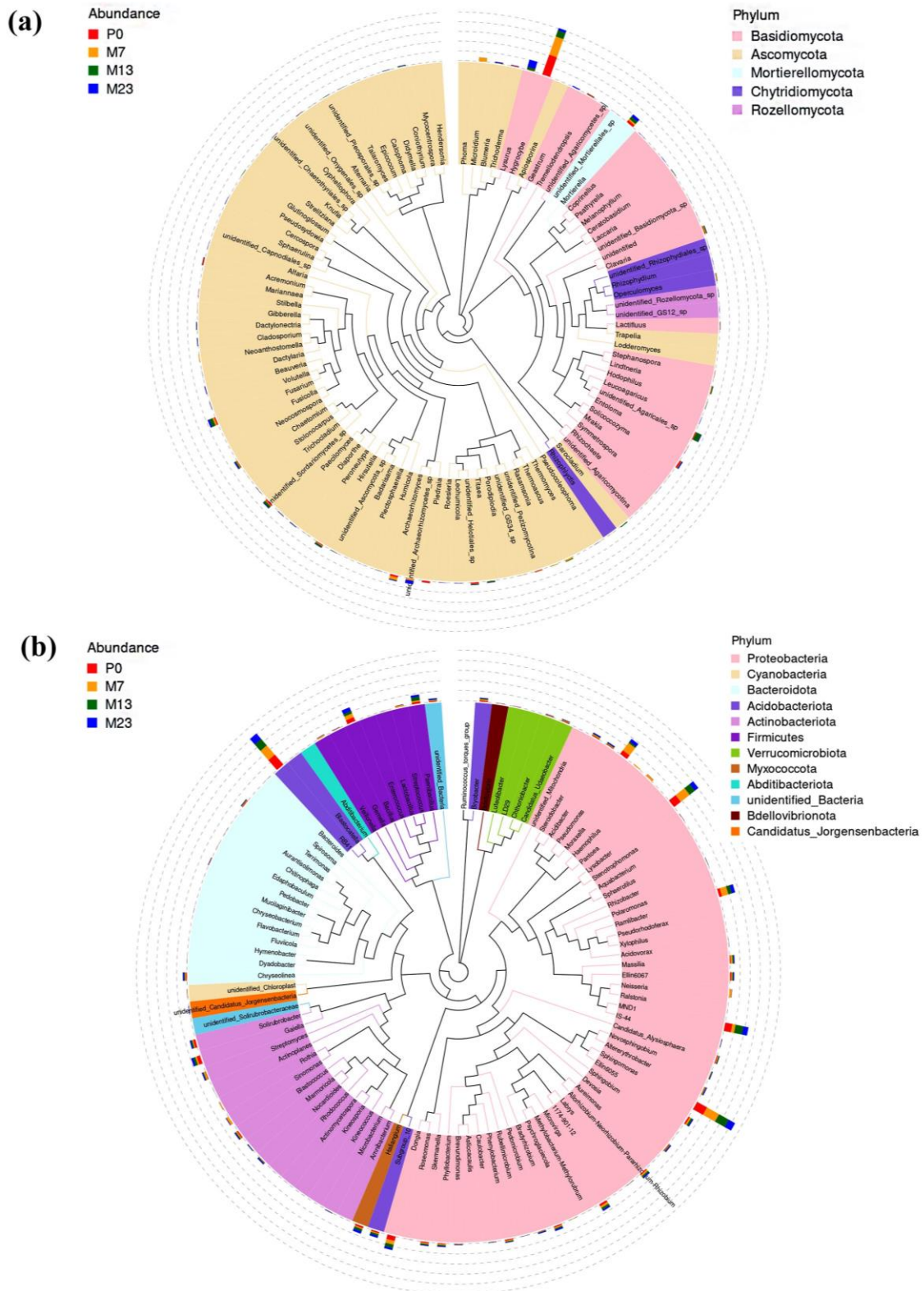


Fig. S1. The phylogenetic trees of (a) Fungi and (b) Bacteria at the genus level. The fan-shaped colors of the phylogenetic tree indicate the corresponding phylum, and the accumulation histogram outside the fan ring indicates the abundance of the genus in different stands.

Table S1 Experimental site information of each plot. R: *Robinia pseudoacacia*;P: *Platycladus orientalis*

Plot number	Stand types	Mixed proportion	Elevation (m)	Slope aspect (°)	Tree height (m)	DBH (cm)	Crown diameter (m)	
P0-1	The pure forest of <i>P. orientalis</i> stands	-	1150	38°	6.12	7.25	1.99	
P0-2			1151	38°	6.49	7.21	2.02	
P0-3			1155	39°	5.91	7.18	1.86	
M7-1	The mixed forest of <i>R. pseudoacacia</i> / <i>P. orientalis</i> stands		1164	42°	R:3.88	R:3.17	R:2.01	
M7-2					6:4	P:6.51	P:7.18	P:1.96
						R:3.86	R:3.19	R:2.20
M7-3			1158	40°	P:6.55	P:7.21	P:1.88	
					R:3.79	R:3.06	R:2.07	
M13-1				1140	38°	P:6.54	P:7.33	P:2.08
						R:7.24	R:6.55	R:2.56
P:5.74						P:7.45	P:2.22	
M13-2			6:4	1143	23°	R:7.94	R:6.74	R:2.59
	P:5.68					P:7.34	P:2.04	
M13-3			1145	38°	R:7.32	R:6.64	R:2.65	
					P:5.48	P:7.99	P:2.69	
M23-1				1155	32°	R:7.95	R:6.75	R:3.05
						P:5.51	P:5.28	P:2.32
R:8.11		R:7.23				R:3.24		
M23-2		6:4	1157	38°	P:5.64	P:5.32	P:2.21	
					R:8.03	R:7.02	R:3.03	
M23-3			1160	43°	P:5.55	P:5.36	P:2.12	

Table S2 Understory detail information of each forest stand.

Stand types	Species	Common name	Number of stems	Coverage (cm)	Frequency	Native or non-native
P0	<i>Herb</i>					
	<i>Tripogon chinensis</i>	/	68	138	9	Native
	<i>Carex lanceolata</i>	/	51	134	9	Native
	<i>Dendranthema morifolium</i>	Chrysanthemum	40	63	5	Native
	<i>Artemisia gmelinii</i>	Russian wormwood	67	67	5	Native
	<i>Potentilla chinensis</i>	/	41	37	8	Native
	<i>Leontopodium leontopodioides</i>	/	49	21	7	Native
	<i>Agropyron cristatum</i>	Crested wheat grass	29	63	3	Native
	<i>Patrinia scabiosifolia</i>	/	14	15	5	Native
	<i>Glycyrrhiza uralensis</i>	Chinese licorice	9	27	4	Native
	<i>Artemisia argyi</i>	/	30	15	2	Native
	<i>Youngia japonica</i>	Oriental false hawkweed	24	8	2	Native
	<i>Astragalus scaberimus</i>	Astragale	11	8	2	Native
	<i>Viola betonicifolia</i>	/	7	4	3	Native
	<i>Agrimonia pilosa</i>	Hairy agrimony	2	2	2	Native

	<i>Pulsatilla chinensis</i>	/	6	3	1	Native
	<i>Phragmites australis</i>	Common reed	3	3	1	Native
	<i>Rubia cordifolia</i>	Indian madder	3	1	1	Native
	Shrub					
	<i>Lespedeza bicolor</i>	Shrub lespedeza	277	115	9	Native
	<i>Lespedeza cuneata</i>	Chinese bushclover	57	29	5	Native
	<i>Amorpha fruticosa</i>	False indigo	6	21	3	Non-Native
M7	Herb					
	<i>Tripogon chinensis</i>	/	61	114	9	Native
	<i>Carex lanceolata</i>	/	28	79	6	Native
	<i>Potentilla chinensis</i>	Chinese cinquefoil	43	53	9	Native
	<i>Glycyrrhiza uralensis</i>	Chinese licorice	47	44	7	Native
	<i>Patrinia scabiosifolia</i>	/	27	35	3	Native
	<i>Dendranthema morifolium</i>	Chrysanthemum	36	28	3	Native
	<i>Leontopodium leontopodioides</i>	/	38	16	4	Native
	<i>Artemisia gmelinii</i>	Russian wormwood	24	19	6	Native
	<i>Agropyron cristatum</i>	Crested wheat grass	14	23	4	Native
	<i>Phragmites australis</i>	Common reed	13	14	5	Native
	<i>Astragalus melilotoides</i>	/	12		4	Native

	<i>Astragalus scaberrimus</i>	Astragale	11	11	4	Native
	<i>Viola betonicifolia</i>	/	4	3	3	Native
	<i>Pulsatilla chinensis</i>	/	5	8	2	Native
	<i>Oxytropis fetissoyii</i>	/	5	12	1	Native
	<i>Artemisia argyi</i>	/	10	5	1	Native
	<i>Aster tataricus</i>	Tatarian aster	6	7	1	Native
	<i>Youngia japonica</i>	Oriental false hawksbear d	7	5	1	Native
	<i>Heteropappus altaicus</i>	/	2	3	1	
	Shrub					
	<i>Lespedeza bicolor</i>	Shrub lespedeza	150	111	9	Native
	<i>Lespedeza cuneata</i>	Chinese eushclover	193	94	7	Native
M13	Herb					
	<i>Tripogon chinensis</i>	/	38	125	6	Native
	<i>Artemisia gmelinii</i>	Russian wormwood	59	83	7	Native
	<i>Leymus secalinus</i>	Wildrye	37	66	8	Native
	<i>Aster tataricus</i>	Tatarian aster	38	63	6	Native
	<i>Patrinia scabiosifolia</i>	/	66	37	7	Native
	<i>Fragaria vesca</i>	Alpine strawberry	30	36	6	Native
	<i>Leontopodium</i>	/	29	28	5	Native

leontopodioides

<i>Rubia cordifolia</i>	Indian madder	19	16	8	Native
<i>Dendranthema morifolium</i>	Chrysanthemum	26	28	2	Native
<i>Viola betonicifolia</i>	/	11	16	6	Native
<i>Orychophragmus violaceus</i>	Violet orychofragmus	5	11	5	Native
<i>Carex lanceolata</i>	/	5	7	2	Native
<i>Glycyrrhiza uralensis</i>	Chinese licorice	3	8	2	Native
<i>Agrimonia pilosa</i>	Hairy agrimony	5	4	1	Native
<i>Potentilla chinensis</i>	Chinese cinquefoil	2	3	1	Native
<i>Youngia japonica</i>	Oriental false hawksbeard	1	0.5	1	Native

Shrub

<i>Rubus parvifolius</i>	Native raspberry	53	62	8	Native
<i>Lespedeza bicolor</i>	Shrub lespedeza	41	38	6	Native
<i>Rubus innominatus</i>	/	19	28	6	Native
<i>Lespedeza cuneata</i>	Chinese bushclover	4	3	2	Native

M23

Herb

<i>Aster tataricus</i>	Tatarian aster	31	75	6	Native
<i>Patrinia scabiosifolia</i>	/	45	36	7	Native

<i>Tripogon chinensis</i>	/	42	44	7	Native
<i>Fragaria vesca</i>	Alpine strawberry	20	15	3	Native
<i>Calamagrostis epigejos</i>	Bush grass	27	13	2	Native
<i>Artemisia selengensis</i>	/	14	30	2	Native
<i>Dendranthema morifolium</i>	Chrysanthemum	27	16	3	Native
<i>Vicia sepium</i>	Bush vetch	13	17	1	Native
<i>Agrimonia pilosa</i>	Hairy agrimony	3	14	2	Native
<i>Rubia cordifolia</i>	Indian madder	2	12	2	Native
<i>Carex lanceolata</i>	/	5	11	2	Native
<i>Humulus scandens</i>	Japanese hops	4	5	1	Native
<i>Leymus secalinus</i>	Wildrye	3	5	1	Native
<i>Bupleurum chinense</i>	/	3	4	1	Native
<i>Cirsium setosum</i>	Field thistle	1	2	1	Native
<i>Viola betonicifolia</i>	/	1	1	1	Native
Shrub					
<i>Rubus parvifolius</i>	Native raspberry	193	226	7	Native
<i>Rubus innominatus</i>	/	56	85	7	Native
<i>Lespedeza bicolor</i>	Shrub lespedeza	26	43	2	Native

Table S3 Dominant understory species with their ecotypes in different stand types.

Stand types	Species	Family	Genus	Ecotypes	Importance value
P0	Herb				
	<i>Tripogon chinensis</i>	Gramineae	Tripogon	xerophyte	0.2075
	<i>Carex lanceolata</i>	Cyperaceae	Carex	xerophyte	0.1570
	<i>Dendranthema morifolium</i>	Asteraceae	Chrysanthemum	xerophyte	0.1262
	<i>Artemisia gmelinii</i>	Asteraceae	Artemisia	xero-mesophyte	0.1070
	<i>Potentilla chinensis</i>	Rosaceae	Potentilla	xerophyte	0.0859
	<i>Leontopodium leontopodioides</i>	Asteraceae	Leontopodium	mesophyte	0.0764
	<i>Agropyron cristatum</i>	Poaceae	Agropyron	xerophyte	0.0712
	<i>Patrinia scabiosifolia</i>	Caprifoliaceae	Patrinia	mesophyte	0.0453
	<i>Glycyrrhiza uralensis</i>	Fabaceae	Glycyrrhiza	xerophyte	0.0409
	<i>Artemisia argyi</i>	Asteraceae	Artemisia	xero-mesophyte	0.0375
	Shrub				
	<i>Lespedeza bicolor</i>	Fabaceae	Lespedeza	xerophyte	0.1397
	<i>Lespedeza cuneata</i>	Fabaceae	Lespedeza	xerophyte	0.0674
<i>Amorpha fruticosa</i>	Fabaceae	Amorpha	mesophyte	0.0468	
M7	Herb				
	<i>Tripogon chinensis</i>	Gramineae	Tripogon	xerophyte	0.1734
	<i>Carex lanceolata</i>	Cyperaceae	Carex	xerophyte	0.1294
	<i>Potentilla chinensis</i>	Rosaceae	Potentilla	xerophyte	0.1208
	<i>Glycyrrhiza uralensis</i>	Leguminosae	Glycyrrhiza	xerophyte	0.1079
	<i>Patrinia scabiosifolia</i>	Caprifoliaceae	Patrinia	mesophyte	0.0776
	<i>Dendranthema morifolium</i>	Compositae	Dendranthema	xerophyte	0.0670
	<i>Leontopodium leontopodioides</i>	Compositae	Leontopodium	mesophyte	0.0644
	<i>Artemisia gmelinii</i>	Compositae	Ajania	xero-mesophyte	0.0640
	<i>Agropyron cristatum</i>	Gramineae	Agropyron	xerophyte	0.0488
	<i>Phragmites australis</i>	Gramineae	Phragmites	xero-mesophyte	0.0458
	<i>Astragalus melilotoides</i>	Fabaceae	Astragalus	xero-mesophyte	0.0400
	<i>Astragalus scaberrimus</i>	Leguminosae	Astragalus	xerophyte	0.0370
	Shrub				

	<i>Lespedeza bicolor</i>	Fabaceae	Lespedeza	xerophyte	0.2740
	<i>Lespedeza cuneata</i>	Fabaceae	Lespedeza	xerophyte	0.2658
M13	Herb				
	<i>Tripogon chinensis</i>	Gramineae	Tripogon	xerophyte	0.1707
	<i>Artemisia gmelinii</i>	Compositae	Artemisia	xero-mesophyte	0.1421
	<i>Leymus secalinus</i>	Gramineae	Leymus	xero-mesophyte	0.1142
	<i>Aster tataricus</i>	Compositae	Aster	mesophyte	0.1044
	<i>Patrinia scabiosifolia</i>	Caprifoliaceae	Patrinia	mesophyte	0.0971
	<i>Fragaria vesca</i>	Rosaceae	Fragaria	mesophyte	0.0706
	<i>Leontopodium leontopodioides</i>	Compositae	Leontopodium	mesophyte	0.0682
	<i>Rubia cordifolia</i>	Rubiaceae	Rubia	xero-mesophyte	0.0638
	<i>Dendranthema morifolium</i>	Compositae	Dendranthema	xerophyte	0.0522
	<i>Viola betonicifolia</i>	Violaceae	Viola	mesophyte	0.0474
	<i>Orychophragmus violaceus</i>	Cruciferae	Orychophragmus	mesophyte	0.0340
	Shrub				
	<i>Rubus parvifolius</i>	Rosaceae	Rubu	mesophyte	0.3395
	<i>Lespedeza bicolor</i>	Fabaceae	Lespedeza	xerophyte	0.2406
	<i>Rubus innominatus</i>	Rosaceae	Rubus	mesophyte	0.1670
	<i>Lespedeza cuneata</i>	Fabaceae	Lespedeza	xerophyte	0.0373
M23	Herb				
	<i>Aster tataricus</i>	Compositae	Aster	mesophyte	0.1305
	<i>Patrinia scabiosifolia</i>	Caprifoliaceae	Patrinia	mesophyte	0.1000
	<i>Tripogon chinensis</i>	Gramineae	Tripogon	xerophyte	0.0862
	<i>Fragaria vesca</i>	Rosaceae	Fragaria	mesophyte	0.0560
	<i>Calamagrostis epigeios</i>	Gramineae	Calamagrostis	mesophyte	0.0560
	<i>Artemisia selengensis</i>	Compositae	Artemisia	xero-mesophyte	0.0511
	<i>Dendranthema morifolium</i>	Compositae	Dendranthema	xerophyte	0.0409
	<i>Vicia sepium</i>	Leguminosae	Vicia	mesophyte	0.0300
	Shrub				
	<i>Rubus parvifolius</i>	Rosaceae	Rubus	mesophyte	0.5773
	<i>Rubus innominatus</i>	Rosaceae	Rubus	mesophyte	0.2827
	<i>Lespedeza bicolor</i>	Fabaceae	Lespedez	xerophyte	0.1100

Table S4 Relative abundance values of the dominant groups of fungal and bacterial communities at the phylum level.

	P0	M7	M13	M23	F	P
Fungal phyla						
Basidiomycota	0.56±0.1a	0.45±0.12b	0.39±0.05c	0.31±0.07c	1.406	0.009
Ascomycota	0.3±0.08b	0.42±0.09a	0.42±0.02a	0.44±0.05a	0.872	0.010
Mortierellomycota	0.05±0.02a	0.03±0.01a	0.06±0.01a	0.06±0.01a	0.905	0.480
Bacterial phyla						
Proteobacteria	0.29±0.04c	0.33±0.05b	0.34±0.02b	0.41±0.03a	2.019	0.003
Acidobacteria	0.15±0.02a	0.12±0.01b	0.12±0.01b	0.11±0.01b	0.755	0.035
Actinobacteria	0.10±0.01a	0.09±0.02a	0.10±0.01a	0.12±0b	1.507a	0.025
Bacteroidetes	0.03±0.002a	0.03±0.002a	0.03±0.003a	0.02±0a	0.261	0.851
Firmicutes	0.03±0.01b	0.05±0.01a	0.03±0.01b	0.04±0.01ab	0.664	0.007
Chloroflexi	0.03±0.002b	0.02±0.01b	0.03±0b	0.05±0.01a	2.89	0.012
Myxococcota	0.02±0ab	0.02±0ab	0.03±0.002a	0.03±0.001a	2.164	0.17

The values were mean ± standard error (n=3). Different letters indicated that variables significantly differed from stand types at $p < 0.05$.

Table S5 Principal component analysis of all ecological index. Loadings >0.8 were shown in bold.

	PC1	PC2	PC3	PC4
MBC	0.95	-0.07	0.01	-0.18
SOC	0.94	0.06	0.01	-0.24
NH ₄ ⁺ -N	0.93	-0.03	-0.11	-0.19
CD	0.92	0.1	0.26	-0.1
NO ₃ ⁻ -N	0.88	0.12	0.16	0.28
TC	0.84	-0.23	-0.25	0.34
<i>H_{bacteria}</i>	0.80	-0.31	-0.17	0.36
TN	0.79	0.18	0.35	0.13
<i>S_{fungi}</i>	0.79	0.48	-0.17	-0.1
<i>H_{fungi}</i>	0.67	0.1	-0.39	-0.05
<i>S_{bacteria}</i>	0.57	-0.57	-0.01	0.54
<i>H_{plant}</i>	0.35	0.73	-0.16	0.26
<i>S_{plant}</i>	0.18	0.86	0.36	0.14
LB	0.13	-0.68	0.48	0.14
SM	-0.14	0.53	0.04	0.4
BD	-0.50	0.34	-0.59	0.22
pH	-0.78	0.11	0.45	0.28
TP	-0.87	0.26	0.32	0.01
C/N	-0.88	-0.16	-0.33	0.11
Eigenvalue	11.11	3.03	1.68	1.19
Proportion Var	0.56	0.15	0.08	0.06
Cumulative Var	0.56	0.71	0.79	0.85
Proportion Explained	0.65	0.18	0.1	0.07
Cumulative Proportion	0.65	0.83	0.93	1

Table S6 The relevant parameters of regression analysis. In each equation, x was for age, and y was for each index.

Model	Equation	R ²	P value
CD~Age	$y=0.0096x+0.48$	0.9700	<0.0001
NO ₃ ⁻ -N~Age	$y=0.0029x^2-0.026x+3.9$	0.9500	<0.0001
SOC~Age	$y=0.0085x^2-0.0105x+5.7424$	0.9291	<0.0001
MBC~Age	$y=0.26x^2-0.51x+105$	0.9200	<0.0001
TC~Age	$y=0.024x^2-0.31x+33$	0.8300	0.0004
TN~Age	$y=-0.001x^2+0.061x+1.3$	0.8200	<0.0001
TP~Age	$y=-0.00027x^2+0.0033x+0.57$	0.7600	0.0016
<i>S_{fungi}</i> ~Age	$y=-0.63x^2+44x+1026$	0.6800	0.0062
pH~Age	$y=-0.00069x^2+0.0057x+8.3$	0.6800	0.0060
<i>H_{bacteria}</i> ~Age	$y=0.0026x^2-0.03x+8.9$	0.6300	0.0110
NH ₄ ⁺ -N~Age	$y=-0.0004x^2+0.045x+1.3$	0.5600	0.0250
<i>S_{plant}</i> ~Age	$y=-0.0032x^2+0.086x+1.1$	0.5600	0.0240
C/N~Age	$y=-0.34x+24$	0.4500	0.0180
<i>H_{fungi}</i> ~Age	$y=0.073x+5.2$	0.3700	0.0370
BD~Age	-	0.3300	0.0510
<i>S_{bacteria}</i> ~Age	-	0.2700	0.2500
<i>H_{plant}</i> ~Age	-	0.2500	0.0970
LB~Age	-	0.0160	0.6900
SM~Age	-	0.0037	0.8518