Supplementary Materials:

Table S1. Aboveground phytomass (g/m²) of ground cover plants

Types of ground cover vegetation:	Parcels*:							
	DT	DS	ID	DT	DS	DT	DS	ID
	SPF			**EZ**		**CPF**		
Vaccinium vitis-idaea L.	2.6±0.4	4.0±1.0	4.2±0.8	2.6±0.5	11.9±3.3	2.4±0.5	0.0	0.0
Calluna vulgaris (L.) Hill	10.8±1.1	1.7±0.2	8.5±1.1	0.0	0.0	0.0	0.0	0.0
Vaccinium myrtillus L.	0.0	0.0	14.5±3.0	0.0	3.4±0.8	8.7±1.0	1.8±0.1	1.4±0.1
Calamagrostis arundinacea L.	21.3±4.2	36.3±5.0	27.0±3.9	20.4±3.3	43.1±4.1	13.7±1.9	3.1±0.6	1.0±0.2
Festuca ovina L.	11.0±1.8	2.5±0.6	6.1±1.8	0.0	0.4±0.1	0.0	0.0	0.0
Motley grass	2.5±0.3	4.9±0.8	11.2±2.6	12.1±1.8	9.1±1.3	17.2±2.0	8.5±1.2	29.1±4.1
Lamium galeobdolon L.	0.0	0.0	0.0	3.6±0.2	2.4±0.2	8.8±1.6	10.4±1.3	12.5±2.0
Aegopodium podagraria L.	0.0	0.0	0.0	0.0	0.0	0.0	3.7±0.4	8.9±1.8
Mercurialis perennis L.	0.0	0.0	0.0	0.4±0.1	0.0	6.1±2.1	7.9±1.7	3.6±0.9
Corydalis bulbosa (L.) DC.	0.0	0.0	0.0	0.5±0.1	0.0	3.6±0.7	3.2±0.7	3.9±0.6
Pleurozium schreberi (Willd.)	175.6±9.2	40.6±3.3	69.1±3.9	4.8±0.4	0.0	15.7±1.8	21.5±3.3	0.0
Dicranum polysetum Sw.	136.4±7.7	206.6±10.5	202.2±9.8	0.0	15.2±2.6	0.0	0.0	0.0
Polytrichum juniperinum Hedw.	66.6±5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brachythecium starkei (Brid.)	0.0	12.8±2.2	0.0	9.3±2.3	13.6±2.6	11.6±2.8	9.7±2.2	1.7±0.2
Total phytomass of herbs:	**48.2**	**49.4**	**71.5**	**39.6**	**67.9**	**60.5**	**38.6**	**60.4**
Total phytomass of mosses:	**378.6**	**260.0**	**271.3**	**14.1**	**28.8**	**27.3**	**31.2**	**1.7**
Total phytomass:	**426.8**	**309.4**	**342.8**	**53.7**	**96.7**	**87.8**	**69.8**	**62.1**

*Parcels: dune tops (DT), slopes (DS), interdune depressions (ID); here and after **SPF, CPF, EZ** are simple pine forest, complex pine forest and ecotone zone between them, respectively.

Table S2. Chemical composition of dry phytomass of ground cover plants

Types of ground cover vegetation:	Content of chemical elements (% of dry mass):							
	N	P	K	Al	Mg	Ca	Mn	Fe
Vaccinium vitis-idaea L.	1.26	0.42	0.71	0.11	0.26	0.35	0.23	0.018
Calluna vulgaris (L.) Hill	1.29	0.19	0.75	0.13	0.27	0.55	0.24	0.045
Vaccinium myrtillus L.	1.34	0.34	0.71	0.08	0.21	1.04	0.33	0.022
Calamagrostis arund. L.	1.85	0.61	2.99	0.03	0.26	0.11	0.33	0.005
Festuca ovina L.	1.14	0.31	1.35	0.02	0.09	0.04	0.07	0.008
Motley grass	1.59	0.52	2.42	0.1	0.41	0.99	0.3	0.007
Lamium galeobdolon L.	1.51	0.65	5.02	0.06	0.61	0.76	0.17	0.007
Aegopodium podagraria L.	1.79	0.53	4.92	0.07	0.47	0.46	0.11	0.013
Mercurialis perennis L.	1.58	0.56	4.89	0.07	0.48	1.4	0.07	0.005
Corydalis bulbosa (L.) DC.	1.15	0.19	0.49	0.57	0.41	4.07	0.61	0.050
Mosses	1.34	0.38	0.72	1.02	0.09	0.13	0.19	1.004
Motley grass	1.96	0.72	4.71	0.08	0.54	0.67	0.3	0.006

Table S3. Particle size distributions and physical properties of sandy soils in the studied pine ecosystems

Parcels:	Soil hori-zon	Particle size, mm						S_{BET}, m^2/g	ρ_b g/cm^3	ρ_s g/cm^3	P_t, %
		>0.25	0.25 – 0.05	0.05 – 0.01	0.01 – 0.005	0.005 - 0.001	<0.001				
SPF											
DT	A1E	88.03	6.89	0.08	1.82	1.44	1.74	8.38	1.31	2.62	50.0
	B	90.90	5.42	0.56	1.00	0.48	1.64	6.28	1.59	2.67	40.4
	C	94.8	3.84	0.48	0.14	0.08	0.66	2.69	1.58	2.66	40.6
DS	A1E	89.82	4.42	1.12	2.14	1.52	0.98	6.84	1.33	2.62	49.2
TD	A1E	95.08	0.56	1.00	1.14	1.04	1.18	5.93	1.36	2.62	48.1
EZ											
DS	A1e	85.07	10.37	0.44	0.36	1.16	2.6	9.47	1.09	2.62	58.4
	B	90.73	6.73	0.08	0.32	1.5	0.64	5.13	1.56	2.66	41.4
DS	A1	nd	nd	nd	nd	nd	nd	8.76	1.18	2.60	54.6
	B	nd	nd	nd	nd	nd	nd	5.13	1.53	2.66	42.5
CPF											
DT	A1	79.54	13.00	1.08	1.4	1.9	3.08	12.2	1.15	2.61	55.9
	E	94.17	4.07	0.04	0.16	0.04	0.92	3.22	1.42	2.64	46.2
	$B_{h,fe}$	86.05	11.13	0.12	0.7	0.04	2.28	6.91	1.69	2.69	37.2
DT	A1	83.68	1.52	2.02	1.84	4.81	6.12	24.5	0.80	2.56	68.8
	E	82.78	15.4	0.32	0.24	0.58	0.68	3.85	1.36	2.62	48.1
	$B_{h,fe}$	87.78	9.62	0.12	0.74	0.44	1.30	5.11	1.64	2.67	38.6
	C	92.87	4.78	1.418	0.16	0.18	0.53	2.45	1.57	2.66	41.0
ID	A1	78.67	8.55	3.36	1.76	2.78	4.88	18.3	0.87	2.60	66.5
Simple fescue-green moss pine forest on Arenosol (70 years of primary succession)											
DT	A1E	40.73	46.47	8.00	1.40	1.40	2.00	11.0	1.42	2.62	45.8
	B	46.06	47.94	3.40	0.87	1.00	0.80	6.26	1.49	2.67	44.2
	C	50.32	44.88	2.40	0.70	0.70	1.00	6.17	1.49	2.67	44.2

Note: here and after DT, DS, ID – see legend for Table 1; S_{BET}, ρ_b, ρ_s ,and P_t – specific surface area, according to the Brunauer-Emmett-Teller (BET) method, density of soil and its solid phase, and total soil porosity.

Table S4. Some chemical properties of sandy soils of the studied pine ecosystems

Parcels:	Soil hori-zon	SOM %	N %	P_2O_5 %	Exchangeable, $cmol_c \cdot kg^{-1}$		pH in water
					Ca^{2+}	Mg^{2+}	
SPF							
DT	L	nd	0.36	0.09	14.0	3.6	3.5
	A1E	2.22	0.08	0.10	1.5	1.3	3.9
	B	0.36	0.01	0.02	1.0	0.6	5.5
	C	0.07	tr	0.03	1.2	0.4	5.8
DS	L	nd	0.42	0.11	13.5	6.5	3.6
	A1E	2.35	0.12	0.09	1.4	1.9	3.9
EZ							
DS	L	nd	0.54	0.17	14.1	4.0	3.7
	A1e	2.96	0.13	0.10	1.5	1.2	4.0
DT	A0	nd	0.66	0.10	18.5	5.6	4.3
	A1	2.36	0.18	0.1	1.6	0.9	4.0
CPF							
DT	L	nd	0.95	0.19	18.7	5.6	4.9
	A1	3.40	0.27	0.12	2.1	1.2	4.4
DT	A1	4.36	0.50	0.14	3.3	2.6	5.2
	E	0.34	tr	0.03	0.3	0.4	4.9
	$B_{h,fe}$	0.66	0.06	0.05	0.8	0.5	5.0

	C	0.10	0.02	0.02	1.0	0.8	5.7
ID	L	nd	0.68	0.12	31.3	7.3	5.8
	A1	4.12	0.42	0.11	3.1	1.2	5.5
Simple fescue-green moss pine forest on Arenosol (70 years of primary succession)							
DT	L	nd	0.39	0.10	16.3	4.1	4.4
	A1E	2.66	0.08	0.06	2.1	2.2	4.0
	B	0.60	0.03	0.02	1.1	1.5	4.4
	C	nd	0.02	0.01	1.3	2.0	5.0

Table S5. Dry mass and fractional composition of autumn litterfall of pine ecosystems

Parcels:	Mass of litterfall, Mg/ha	Fractions, %				
		Pine needles	Branches, cones, bark	Foliage		Other*
				oak	linden	
SPF						
DT	3.6±0.6	67.3	29.3	0.7	0.0	2.7
DS	3.1±0.7	82.3	5.2	0.0	0.0	12.5
ID	2.3±1.0	86.9	9.6	0.7	0.0	2.8
EZ						
DT	3.9±0.8	65.9	4.4	9.7	0.0	20.0
DS	3.5±0.5	65.4	5.8	6.1	8.9	14.1
CPF						
DT	5.5±0.7	66.5	10.6	4.4	18.1	0.4
DS	3.5±0.6	47.6	12.4	29.1	8.9	2.0
ID	4.5±0.1	43.1	6.7	32.1	14.5	3.6

*Other – birch foliage, falling grasses.

Table S6. Approximation parameters of the exponential model [34] for carbon dioxide gross production as a function of soil depth

Indicators:	Model: $U_z=U_f+a\times\exp(-bz)$,				
	U_f, Mg/(ha year)	a, Mg/(ha year)	b, cm^{-1}	R^2	s, Mg/(ha·year)
SPF					
Average	0.059±0.011	8.225±0.314	0.340±0.014	0.9999	0.018
p-value	0.0296	0.0016	0.0014		
EZ					
Average	0.049±0.031	5.900±0.230	0.219±0.012	0.9993	0.048
p-value	0.0383	0.0015	0.0031		
CPF					
Average	0.110±0.034	6.802±0.257	0.219±0.012	0.9987	0.054
p-value	0.0497	0.0014	0.0029		