

# Contents

<b>1</b>	<b>The soil environment</b>	<b>1</b>
1.1	Introduction	1
1.2	Soil formation	1
1.3	Soil-forming factors	6
1.3.1	Parent material	7
1.3.2	Climate	8
1.3.3	Topography	9
1.3.4	Time	11
1.3.5	Human influences	16
1.4	Soil properties	17
1.4.1	Soil texture and structure	18
1.4.2	Soil organic matter	19
1.4.3	Soil water	21
1.4.4	Soil pH	21
1.5	Conclusions	23
<b>2</b>	<b>The diversity of life in soil</b>	<b>24</b>
2.1	Introduction	24
2.2	The soil biota	25
2.2.1	The primary consumers	26
2.2.2	Secondary and higher-level consumers	31
2.3	Patterns of soil biodiversity	38
2.3.1	Global patterns of soil biodiversity	39
2.3.2	Landscape patterns of soil biodiversity	41
2.3.3	Local patterns of soil biodiversity	47
2.4	Temporal patterns of soil biodiversity	52
2.5	Conclusion	55
<b>3</b>	<b>Organism interactions and soil processes</b>	<b>57</b>
3.1	Introduction	57
3.2	Microbial control of soil nutrient availability	58
3.2.1	Nitrogen mineralization	58
3.2.2	Nitrogen fixation	62
3.2.3	Microbial phosphorus mineralization	64
3.2.4	The role of mycorrhizal fungi in plant nutrient supply	69

3.3	Influence of animal–microbial interactions on nutrient availability	70
3.3.1	Selective feeding on microbes by soil animals	71
3.3.2	Effects of microbial-feeding fauna on nutrient cycling and plant growth	72
3.3.3	Non-nutritional effects of microbial grazers on plant growth	75
3.3.4	Multitrophic controls on soil processes	75
3.4	Effects of animals on biophysical properties of soil	77
3.4.1	Consumption of litter and the production of fecal pellets	77
3.4.2	Physical engineering of the soil structure	78
3.5	Functional consequence of biological diversity in soil	79
3.6	Conclusions	85
4	<b>Linkages between plant and soil biological communities</b>	86
4.1	Introduction	86
4.2	Individual plant effects on soil biological properties	86
4.2.1	Experimental evidence of effects of individual plants on soil biota	88
4.2.2	Hemiparasitic plants	90
4.2.3	A role for plant polyphenols	92
4.2.4	Theoretical framework for explaining plant species effects on soils	96
4.3	Plant diversity as a driver of soil biological properties	99
4.4	Influence of soil biota on plant community dynamics	103
4.4.1	Mycorrhizal associations and plant community dynamics	103
4.4.2	Nitrogen fixing organisms and plant community dynamics	105
4.4.3	Root pathogens and plant community dynamics	107
4.4.4	Root-feeding fauna and plant community dynamics	109
4.4.5	Macrofauna and plant community dynamics	112
4.4.6	Microbial–plant partitioning of nutrients	113
4.5	Plant–soil feedbacks and ecosystem development	116
4.6	Conclusions	117
5	<b>Above-ground trophic interactions and soil biological communities</b>	119
5.1	Introduction	119
5.2	Mechanisms	120
5.2.1	Effects of herbivores on resource quantity	120
5.2.2	Effects of herbivores on resource quality	122
5.2.3	Effects of herbivores on vegetation composition	124

5.3	Comparisons of ecosystems	126
5.3.1	Effects of herbivores on soil and ecosystem properties of grasslands	127
5.3.2	Effects of herbivores on soil and ecosystem properties of Arctic tundra	130
5.3.3	Effects of herbivores on soil and ecosystem properties of forests	135
5.4	Conclusions	138
<b>6</b>	<b>Soil biological properties and global change</b>	<b>140</b>
6.1	Introduction	140
6.2	Climate change	141
6.2.1	Elevated CO <sub>2</sub> and soil biota	142
6.2.2	Influence of elevated CO <sub>2</sub> on soil nutrient availability	146
6.2.3	Influence of soil N availability on ecosystem responses to elevated CO <sub>2</sub>	149
6.2.4	Elevated CO <sub>2</sub> and plant community composition	150
6.2.5	Effects of elevated temperature	152
6.2.6	Soil carbon sequestration	159
6.3	Atmospheric N deposition	162
6.3.1	Effects of N enrichment on plant and soil biological communities, and ecosystem C turnover	163
6.3.2	The retention and export of pollutant N	166
6.4	Invasive species	170
6.4.1	Above-ground invasive organisms	171
6.4.2	Below-ground invasive organisms	173
6.5	Land use transformation	177
6.6	Conclusions	181
<b>7</b>	<b>Conclusions</b>	<b>183</b>
	BIBLIOGRAPHY	190
	INDEX	232