

# Contents

## Part A    Introduction

<b>1</b>	<b>The Functional Significance of Forest Diversity: The Starting Point . . . . .</b>	<b>3</b>
	M. SCHERER-LORENZEN, CH. KÖRNER, and E.-D. SCHULZE	
1.1	Introduction . . . . .	3
1.2	Applying a New Ecological Framework . . . . .	3
1.3	The Road from Weidenberg to Weimar . . . . .	5
1.4	Aims and Topics . . . . .	7
References . . . . .		9
<b>2</b>	<b>An Introduction to the Functional Diversity of Temperate Forest Trees . . . . .</b>	<b>13</b>
	CH. KÖRNER	
2.1	Introduction . . . . .	13
2.2	Successional Stage . . . . .	17
2.3	Variation in Gas Exchange Capacity and Associated Leaf Traits . . . . .	18
2.4	Tree Stature, Crowns, and Roots . . . . .	22
2.5	Growth and Reproduction . . . . .	26
2.6	Species Specific Responses to Global Environmental Change	29
2.7	Outlook . . . . .	32
References . . . . .		33

**Part B Productivity and Growth**

<b>3</b>	<b>Diversity and Productivity in Forests: Evidence from Long-Term Experimental Plots . . . . .</b>	<b>41</b>
	H. PRETZSCH	
3.1	Introduction . . . . .	41
3.2	Theoretical Considerations . . . . .	43
3.3	Empirical Considerations . . . . .	48
3.4	Discussion and Conclusions . . . . .	57
References . . . . .		61
<b>4</b>	<b>Confounding Factors in the Observed Productivity-Diversity Relationship in Forests . . . . .</b>	<b>65</b>
	M. VILÀ, P. INCHAUSTI, J. VAYREDA, O. BARRANTES, C. GRACIA, J.J. IBÁÑEZ, and T. MATA	
4.1	Introduction . . . . .	65
4.2	Covariant Factors Determining the Forest Diversity-Productivity Relationship . . . . .	68
4.3	The Ecological and Forest Inventory of Catalonia (IEFC) . . . . .	71
4.4	Discussion . . . . .	81
4.5	Conclusions . . . . .	83
References . . . . .		83
<b>5</b>	<b>Genetic Diversity Parameters Associated with Viability Selection, Reproductive Efficiency and Growth in Forest Tree Species . . . . .</b>	<b>87</b>
	G. MÜLLER-STARCK, M. ZIEHE, and R. SCHUBERT	
5.1	Introduction . . . . .	87
5.2	Methodological Considerations . . . . .	90
5.3	Case Studies of Genetic Diversity in Forest Trees . . . . .	91
5.4	Conclusions . . . . .	103
References . . . . .		105

**Part C Biogeochemical Cycles**

<b>6</b>	<b>Functioning of Mixed-species Stands: Evidence from a Long-Term Forest Experiment . . . . .</b>	111
	H.E. JONES, N. McNAMARA, and W.L. MASON	
6.1	Introduction . . . . .	111
6.2	Background of the Gisburn Experiment . . . . .	112
6.3	Tree Performance . . . . .	115
6.4	Underlying Mechanisms Linked with Mixture Effects . . . . .	119
6.5	Conclusions . . . . .	126
	References . . . . .	127
<b>7</b>	<b>The Role of Biodiversity on the Evaporation of Forests . . . . .</b>	131
	D.D. BALDOCCHI	
7.1	Introduction . . . . .	131
7.2	Leaf Scale . . . . .	133
7.3	Tree Scale . . . . .	136
7.4	Canopy Scale . . . . .	138
7.5	Conclusions . . . . .	144
	References . . . . .	145
<b>8</b>	<b>Effects of Tree Species Diversity on Litter Quality and Decomposition . . . . .</b>	149
	S. HÄTTENSCHWILER	
8.1	Introduction . . . . .	149
8.2	Variation in Litter Traits and Decomposition Rates . . . . .	150
8.3	Litter Diversity Effects on Decomposition . . . . .	155
8.4	Conclusions . . . . .	161
	References . . . . .	162
<b>9</b>	<b>The Effect of Biodiversity on Carbon Storage in Soils . . . . .</b>	165
	G. GLEIXNER, C. KRAMER, V. HAHN, and D. SACHSE	
9.1	Introduction . . . . .	165
9.2	Formation of Soil Carbon . . . . .	165
9.3	Consequences of Plant Diversity on the Quality of Carbon Input . . . . .	167

9.4	Distribution of Carbon and Nitrogen and Their Stable Isotopes in Soil Profiles . . . . .	172
9.5	Dynamic of Soil Organic Matter . . . . .	174
9.6	Molecular Turnover of Soil Organic Matter . . . . .	177
9.7	Conclusion . . . . .	180
	References . . . . .	180

<b>10</b>	<b>Silviculture and Its Interaction with Biodiversity and the Carbon Balance of Forest Soils . . . . .</b>	<b>185</b>
	M. MUND and E.-D. SCHULZE	
10.1	Introduction . . . . .	185
10.2	Overview of Silvicultural Systems, Terms and Definitions . .	186
10.3	Methodological Restrictions . . . . .	188
10.4	Effects of Species Composition and Species Identity Effects	190
10.5	Effects of Conversions of Primary Forests to Managed Forests . . . . .	192
10.6	Effects of Silvicultural Practices . . . . .	195
10.7	Conclusions . . . . .	201
	References . . . . .	202

#### **Part D Animals, Pests, and Disturbances**

<b>11</b>	<b>Linkages Between Tree Diversity, Soil Fauna and Ecosystem Processes . . . . .</b>	<b>211</b>
	S. SCHEU	
11.1	Introduction . . . . .	211
11.2	Plant (Tree) Diversity as Determinant of the Belowground Food Web . . . . .	212
11.3	Effects of Soil Fauna on Ecosystem Processes . . . . .	221
11.4	Feedbacks of Belowground Community Composition on Plant Community Structure . . . . .	223
11.5	Conclusions . . . . .	225
	References . . . . .	226

<b>12</b>	<b>A Test of the Biodiversity–Stability Theory: Meta-analysis of Tree Species Diversity Effects on Insect Pest Infestations, and Re-examination of Responsible Factors . . . . .</b>	235
	H. JACTEL, E. BROCKERHOFF, and P. DUELLI	
12.1	Introduction . . . . .	235
12.2	Comparing Insect Pest Damage in Pure vs. Mixed Stands of Trees: A Meta-analysis . . . . .	237
12.3	Effect of Tree Species Diversity on Stand Resistance to Pest Insects: The Main Ecological Hypotheses . . . . .	241
12.4	Tree Species Diversity and Pest Damage at the Landscape Level . . . . .	249
12.5	Conclusions . . . . .	252
	References . . . . .	256
<b>13</b>	<b>Susceptibility to Fungal Pathogens of Forests Differing in Tree Diversity . . . . .</b>	263
	M. PAUTASSO, O. HOLDENRIEDER, and J. STENLID	
13.1	Terms of the Issue . . . . .	263
13.2	Susceptibility as a Function of Tree Diversity . . . . .	264
13.3	Reversing the Terms . . . . .	275
13.4	Conclusions . . . . .	277
	References . . . . .	279
<b>14</b>	<b>Implication of Forest Diversity in Resistance to Strong Winds . . . . .</b>	291
	J.-F. DHÔTE	
14.1	Introduction . . . . .	291
14.2	Species-Specific Susceptibility to Wind Damage . . . . .	296
14.3	Effect of Location, Developmental Stage, and Canopy Closure . . . . .	298
14.4	Analyzing Stability in Complex Forest Structures . . . . .	299
14.5	Conclusion . . . . .	304
	References . . . . .	306

<b>15</b>	<b>Fire Regime and Tree Diversity in Boreal Forests: Implications for the Carbon Cycle . . . . .</b>	<b>309</b>
C. WIRTH		
15.1	Introduction . . . . .	309
15.2	Methods . . . . .	311
15.3	Patterns of Functional Diversity and Fire Regime . . . . .	313
15.4	The Significance of Fire PFTs for Carbon Cycling . . . . .	327
15.5	Discussion . . . . .	332
15.6	Conclusions . . . . .	335
References . . . . .		336
 <b>Part E Perspectives</b>		
<b>16</b>	<b>The Design of Experimental Tree Plantations for Functional Biodiversity Research . . . . .</b>	<b>347</b>
M. SCHERER-LORENZEN, C. POTVIN, J. KORICHEVA, B. SCHMID, A. HECTOR, Z. BORNIK, G. REYNOLDS, and E.-D. SCHULZE		
16.1	Introduction, or “Why Do We Need Diversity Experiments with Trees?” . . . . .	347
16.2	Experimental Approaches . . . . .	348
16.3	Methodological and Design Considerations . . . . .	359
16.4	Response Variables . . . . .	369
16.5	Major Caveats . . . . .	370
16.6	Outlook . . . . .	372
References . . . . .		373
<b>17</b>	<b>The Functional Significance of Forest Diversity: A Synthesis . . . . .</b>	<b>377</b>
M. SCHERER-LORENZEN, CH. KÖRNER, and E.-D. SCHULZE		
17.1	A Lack of Functional Biodiversity Research in Forests? . . . . .	377
17.2	Mechanisms of Mixture Effects, or: Are There Differences Between Grasslands and Forests? . . . . .	378
17.3	Research Needs . . . . .	382
17.4	Conclusions . . . . .	384
References . . . . .		386
Taxonomic Index (Genera) . . . . .		391
Subject Index . . . . .		394