

Contents

Section 1 History, Environment and Plant Science

1	History and Environment of the Nordic Mountain Birch . .	3
	F.E. WIELGOLASKI	
1.1	History–Zonation–Taxonomy–Distribution	3
1.2	Present Tree Line	4
1.3	Climate	7
1.4	Nutrient Conditions – Browsing	12
	References	15
2	Soils and Nutrients in Northern Birch Forests: A Case Study from Finnmarksvidda, Northern Norway . . .	19
	K.-D. MEIER, D. THANNHEISER, J. WEHBERG and V. EISENMANN	
2.1	Introduction	19
2.2	Study Area	20
2.3	Soil Classification	21
2.4	Soil Distribution	23
2.5	Soil Properties	28
2.6	Conclusions	31
	References	32
3	Vegetation of the Mountain Birch Forest in Northern Fennoscandia	35
	J. WEHBERG, D. THANNHEISER and K.-D. MEIER	
3.1	Introduction	35
3.2	Study Site	36

3.3	Dendrochronological Characteristics of the Northern Mountain Birch Forests in the Máze-Kautokeino Area	36
3.4	Plant Sociological Studies	40
3.4.1	The Communities of the Mountain Birch Forest on the Finnmarksvidda	41
3.4.1.1	The Crowberry Birch Forest: <i>Empetro-Betuletum pubescentis</i> (Nordhagen 1943)	44
3.4.1.2	The Lingonberry Birch Forest: <i>Vaccinio vitis-idaeae-Betuletum</i> (prov.)	45
3.4.1.3	The Lingonberry Birch Forest: <i>Vaccinio vitis-idaeae-Betuletum</i> (prov.)	46
3.4.1.4	The Dwarf Cornel Birch Forest: <i>Corno-Betuletum</i> (Aune 1973)	46
3.4.1.5	The Meadow Birch Forest: <i>Geranio-Betuletum</i> (Nordhagen 1928, 1943 emend. Dierßen and Dierßen 1982)	47
3.4.1.6	The Cloudberry Birch Forest: <i>Rubo chamaemorei-Betuletum</i> (prov.)	48
3.5	Mountain Birch Forests in Northern Fennoscandia	49
3.6	Conclusions	49
	References	51

4	Biomass and Production on a Landscape Level in the Northern Mountain Birch Forests	53
	H. TØMMERVIK, F.E. WIELGOLASKI, S. NEUVONEN, B. SOLBERG and K.A. HØGDA	
4.1	Introduction	53
4.1.1	Live Aboveground Biomass Estimations	55
4.1.2	Biomass and Leaf Area Index at Individual Tree or Stand Levels	56
4.1.3	Biomass on Landscape and Regional Level Using Remote Sensing	57
4.2	Methods	58
4.3	Results	61
4.3.1	Change in the Biomass Production on a Regional Level	61
4.3.2	Biomass Estimations on a Landscape Level	62
4.4	Discussion	64
4.4.1	Biomass Changes	64
4.4.2	Remote Sensing Data – Are They Robust?	66
	References	67

5	Mountain Birch Growth in Relation to Climate and Herbivores	71
	P.S. KARLSSON, M. WEIH and C. BORG	
5.1	Introduction	71
5.2	Seedling Establishment and Growth	72
5.2.1	Abiotic and Biotic Environment During the Growing Season	72
5.2.2	Winter Conditions	74
5.2.3	Genetic Aspects	74
5.3.1	Sapling Growth	75
5.4.	Mature Trees	76
5.4.1	Tree Growth and Climate	76
5.4.2	Effects of <i>Epirrita</i> Defoliation on Tree Growth	77
5.5.	Forest Structure, Stand Biomass and Productivity	79
5.6.	Effects of Changing Climate on Mountain Birch Growth . .	81
5.6.1	Empirical Evidence	81
5.6.2	Model Predictions	82
5.7	Conclusions	82
	References	83
 6	 Responses of Temperature Changes on Survival and Growth in Mountain Birch Populations	 87
	O. SKRE, J. NILSEN, M. NAESS, B. IGELAND, K. TAULAVUORI, E. TAULAVUORI and K. LAINE	
6.1	Introduction	87
6.2	Results and Discussion	89
6.2.1	Field and Greenhouse Experiments at Different Temperatures	89
6.2.2	Winter Temperature and CO ₂ Experiments	93
6.2.3	Dormancy and Frost Hardiness in Mountain Birch Provenances as Influenced by Winter Temperatures .	94
6.3	Conclusions	96
	References	96

7	Phenology and Performance of Mountain Birch Provenances in Transplant Gardens: Latitudinal, Attitudinal and Oceanity–Continentality Gradients	99
	J. OVASKA, J. NILSEN, F.E. WIELGOLASKI, H. KAUMANEN, R. PARTANEN, S. NEUVONEN, L. KAPARI, O. SKRE and K. LAINE	
7.1	Introduction	99
7.2	Material and Methods	101
7.3	Results and Discussion	101
7.3.1	Transplantation Stress and Seedling Survival	101
7.3.2	Spring Phenology (Bud Burst)	103
7.3.3	Autumn Phenology	106
7.3.4	Growth Forms and Growth Rates	108
7.4	Conclusions and Future Prospects	113
	References	114
8	A Dynamic Forest in a Changing Environment	117
	P.S. KARLSSON and F.E. WIELGOLASKI	
	References	121

Section 2 Herbivory

9	Forest Defoliation Risks in Birch Forests by Insects Under Different Climate and Land Use Scenarios in Northern Europe	125
	S. NEUVONEN, H. BYLUND and H. TØMMERVIK	
9.1	Introduction	125
9.2	Geometrid Outbreaks on Birch in Fennoscandia	126
9.3	Monitoring (Detecting/Quantifying) Insect Outbreaks in Mountain Birch Woodlands	127
9.4	Modelling the Outbreak/Defoliation Risks	129
9.4.1	Population Dynamics of Geometrid Moths	129
9.4.2	Modelling the Regional and Topographic Patterns in Outbreaks Risks	131
9.5	Forest Defoliation Risks Under Different Climatic Scenarios and Their Relationships to Land Use	134
	References	136

10	Birch Sapling Responses to Severity and Timing of Domestic Herbivore Browsing – Implications for Management	139
	A.J. HESTER, K. LEMPA, S. NEUVONEN, K. HØGH, J. FEILBERG, S. ARNTHÓRSDÓTTIR and G. IASON	
10.1	Introduction	139
10.2	Case Studies and Experimental Designs	141
10.3	Birch Responses to Timing and Severity of Browsing Damage	141
10.3.1	Severity of Browsing	142
10.3.2	Timing of Browsing	145
10.3.3	Locational Effects	145
10.3.4	Implications for the Management of Herbivore Grazing Within Birch Areas of Northern Europe	146
10.4	Theory Versus Reality: Case-Study Example of Sheep Impacts in Greenland	147
10.4.1	Economics	150
10.5	Current Activities to Improve Grazing Management in Birch Forest Areas	151
10.6	Conclusions	152
	References	153
11	Effects of Reindeer Grazing on Pastures in a Mountain Birch Ecosystem	157
	K. LEMPA, S. NEUVONEN and H. TØMMERVIK	
11.1	Introduction	157
11.2	Climatic Variability	158
11.3	Trends and Patterns in Reindeer Population Densities in Northern Fennoscandia	159
11.4	Protection of Pastures in the Mountain Birch Zone	160
11.4.1	Analysis and Synthesis of the Effects of Reindeer Grazing on Different Vegetation Components	160
11.4.2	Northernmost Norway as a Case Study of the Overall Effects of Reindeer Grazing on Vegetation	163
	References	164

12	Long-Term Influence of Herbivores on Northern Birch Forests	165
	O. TENOW, H. BYLUND, A.C. NILSEN and P.S. KARLSSON	
12.1	Introduction	165
12.2	Lake Torneträsk–Abisko Valley Area: A Case Study	166
12.2.1	Outbreak in a Heath Birch Forest	166
12.2.2	Outbreak in a Meadow Birch Forest	168
12.3	Northern Fennoscandia	169
12.3.1	Forest Age and Outbreaks	170
12.3.2	Forest Damage and Recovery	170
12.3.3	Interaction with Reindeer and Sheep	172
12.4	Generalization	173
12.4.1	A Conceptual Model	174
12.4.2	Forests Without Outbreaks	175
12.4.3	Mountain Birch Forest Regeneration Cycles in a Warmer Future	176
	References	178
 13	 Herbivory in Northern Birch Forests	 183
	S. NEUVONEN and F.E. WIELGOLASKI	
13.1	Introduction	183
13.2	Insect Outbreaks	185
13.3	Mammalian Herbivores	186
13.4	Implications for Sustainable Management	187
13.5	References	188
 Section 3 Human Impact		
 14	 Rates and Processes of Natural Regeneration in Disturbed Habitats	 193
	B. FORBES, A. TOLVANEN, F.E. WIELGOLASKI and K. LAINE	
14.1	Introduction	193
14.2	Processes of Regeneration	195
14.3	Rates of Regeneration	197
14.4	Conclusion	199
	References	199

15	Recreation at the Tree Line and Interactions with Other Land Use Activities	203
	A. TOLVANEN, B. FORBES, S. WALL and Y. NOROKORPI	
15.1	Introduction	203
15.2	Case Study Areas	205
15.3	Monitoring Studies on the Impact of Recreation on the Environment in Lapland	207
15.4	Interaction of Recreation with Other Land-Use Activities . .	209
15.4.1	Recreation vs. Nature Conservation	210
15.4.2	Recreation vs. Forestry	211
15.4.3	Recreation vs. Traditional Livelihoods	211
15.4.4	Recreation vs. Recreation	213
15.5	Sustainable Tourism	213
	References	214
16	Economic Limits and Possibilities for Sustainable Utilization of Northern Birch Forests	219
	B. SOLBERG, H. TØMMERVIK, D. THANNHEISER and S. NEUVONEN	
16.1	Introduction	219
16.2	Some Theoretical Aspects	219
16.2.1	Goals	220
16.2.2	Sustainable Utilization	220
16.2.3	Identify Utilization Alternatives	221
16.2.4	Select the Best Utilization (Management) Alternative	221
16.2.5	Implementation of the Best Alternatives	221
16.3	Empirical Results	222
16.3.1	Birch Area and Productivity	222
16.3.1.1	Máze	223
16.3.1.2	Målselv	225
16.3.1.3	Other Areas	225
16.3.2	Reindeer Husbandry	226
16.3.3	Other Limiting Factors	228
16.3.4	Profitability, Value Added and Markets	228
16.4	Conclusions	231
	References	232

17	The Vegetation Changes and Recent Impact on the Mountain Birch Forest During the Last 40 Years . . .	235
	D. THANNHEISER, H. TØMMERVIK and J. WEHBERG	
17.1	Introduction	235
17.1.1	Research Areas	236
17.1.2	Methodological Considerations	236
17.2	Vegetation Changes in the Máze Region	237
17.2.1	The Lichen-Rich <i>Empetrum</i> (Crowberry) Birch Forest (<i>Empetro-Betuletum pubescentis</i> ; see Chap. 3) .	237
17.2.2	The Moss-Rich <i>Empetrum</i> (Crowberry) Birch Forest (<i>Empetro-Betuletum pubescentis</i> , see Chap. 3)	240
17.2.3	The Lichen-Rich <i>Myrtillus</i> (Bilberry) Birch Forest (<i>Vaccinio myrtilli-Betuletum</i> ; see Chap. 3)	240
17.2.4	The Moss-Rich <i>Myrtillus</i> (Bilberry) Birch Forest (<i>Vaccinio myrtilli-Betuletum</i> ; see Chap. 3)	241
17.2.5	The <i>Cornus-Myrtillus</i> (Dwarf Cornel-Bilberry) Birch Forest (<i>Corno-Betuletum</i> ; see Chap. 3)	241
17.2.6	Monitoring Vegetation Change in the Máze Region	241
17.2.7	Monitoring Vegetation Change in Målselv	244
17.2.8	Discussion	246
17.3	Linear and Localized Development on the Finnmarksvidda	250
	References	252
 18	 Sámi Approaches to Mountain Birch Utilization in Northern Sápmi (Finland and Norway)	 255
	M.S. AIKIO and L. MÜLLER-WILLE	
18.1	Introduction: Control, Access and Sustainability of Mountain Birch Forests	255
18.2	Human-Birch Relations: Holistic Approach to the Environment	257
18.3	Knowledge and Values: The Meaning and Use of Mountain Birch	259
18.3.1	Birch Firewood: Securing Heat and Warmth	260
18.3.2	The Proper Mountain Birch Wood for Art and Handicraft .	262
18.4	The Human Factor: Future Management of Mountain Birch Resources	264
18.5	Outlook: Prospects and Policy Recommendations	266
	References	268

19	Sustainable Reindeer Herding in the Mountain Birch Ecosystem	269
	K. LEMPA, S. NEUVONEN and H. TØMMERVIK	
19.1	Introduction	269
19.2	History	269
19.3	Cultural Background	270
19.4	Social and Economical Factors	271
19.5	Suggestions	272
	References	273
20	Competition over Nature, Space, Resources, and Management in the Northern Mountain Birch Forest Ecosystem: A Synthesis	275
	D. THANNHEISER, L. MÜLLER-WILLE, F.E. WIELGOLASKI and K.-D. MEIER	

Section 4 Modelling Dynamics of Mountain Birch Forests, Management and Future

21	Landscape-Scale Model Relating the Nordic Mountain Birch Forest Spatio-temporal Dynamics to Various Anthropogenic Influences, Herbivory and Climate Change	283
	A.O. GAUTESTAD, F.E. WIELGOLASKI and I. MYSTERUD	
21.1	Introduction	283
21.2	Complexity Aspects in the Northern Birch Forest Ecosystem	284
21.2.1	Aspect 1: Challenges from Quantity of Interactions – System Complexity	284
21.2.2	Aspect 2: Processes in Linear Superposition – Scale-Specific Spatio-Temporal Interactions	285
21.2.3	Aspect 3: Beyond Superposition – Spatio-Temporal Effects from Non-Linear Responses	288
21.3	The HIBECO Model	289
21.3.1	The Model Arena	290
21.3.2	Implementation of Landscape Heterogeneity	291
21.3.3	Management Regimes and Perturbations	292
21.3.4	Climate Change Scenarios	293
21.4	Simulation Examples	295
21.5	Discussion and Conclusions	298
	References	299

22	Scenarios for Future Development of the Mountain Birch Ecosystem	301
	A.O. GAUTESTAD, F.E. WIELGOLASKI, B. SOLBERG and I. MYSTERUD	
22.1	Introduction	301
22.2	Logging Practices and the Shifting Forest Mosaic	302
22.3	Scenarios for Various Long-Term Management Practices	305
22.4	Discussion and Conclusion	310
	References	311
 23	 Managing the Mountain Birch Ecosystem: Local Communities and the State in Finland's Forestry	 313
	L. MÜLLER-WILLE, M.S. AIKIO and V. LUHTA	
23.1	Introduction: Resource for Wood and Energy	313
23.2	Forests and Wood: Issues of Power and Control	316
23.3	Current Practices and Perceptions of Mountain Birch Utilization	317
23.3.1	Management and Production of Private Birch Woodlots	319
23.3.2	Management and Production of Public Birch Forests	320
23.3.3	Perception and Assessment of Mountain Birch Forest Management	322
23.4	The Mountain Birch – A Resource in the Future?	324
	References	326
 24	 Policies and Developing Plans Towards Sustainability #of Mountain Birch Ecosystems in Scandinavia	 327
	L. BÄCK, B. SOLBERG, H. TØMMERVIK and F.E. WIELGOLASKI	
24.1	Introduction	327
24.2	Suggestions for Sustainable Reindeer Management	328
24.3	The Mountain Birch Forest from a Multi-User Perspective	329
24.4	The Human View on Mountain Nature	333
24.5	Visitor Frequency in Nature	334
25.6	Different Planning Strategies for Sustainable Development in the Mountains	334
24.7	The Need for Scientific Pluralism	335
24.8	Suggestions for Sustainable Forest Management	338
	References	339

Section 5 Integration and Conclusion

25	The Nordic Mountain Birch Ecosystem-Challenges to Sustainable Management	343
	F.E. WIELGOLASKI, P.S. KARLSSON, S. NEUVONEN, D. THANNHEISER, H. TØMMERVIK and A.O. GAUTESTAD	
25.1	Introduction	343
25.2	Man and Mountain Birch Forest Interactions in the Perspective of a Changing Climate	345
25.3	Considerations for Sustainable Mountain Birch Forest Management	347
25.4	Considerations for a Sustainable Reindeer Management . .	353
25.5	Final Remarks	354
	References	355
	Subject Index	357
CD-ROM	containing additional material to Chapters 2, 3, 7, 10, 11, 18, 21, and 22 enclosed at the end of the book	

Plant Ecology, Herbivory, and Human Impact in Nordic
Mountain Birch Forests

Wielgolaski, F.E. (Ed.)

2005, XXIV, 370 p. With CD-ROM., Hardcover

ISBN: 978-3-540-22909-4