Contents

Contributors Preface Acknowledgments	
1 Disturbance and Succession Educard A. Johnson and Kiyoko Miyanishi Introduction Disturbance as the Nemesis of Succession The Chronosequence Basis of Succession Coupling Disturbance and Vegetation Processes Conclusion	1 2 5 6 10
 2 The Turbulent Wind in Plant and Forest Canopies Jobn J. Finnigan Introduction The Structure of the Atmospheric Boundary Layer Over Land Characteristics of Turbulent Flow In and Above Plant Canopies Effects of Topography and Heterogeneity Implications of This Velocity Structure for Canopy Disturbance c c c	15 15 1 22 36 49
Summary	54

3	Microbursts and Macrobursts: Windstorms	-0
	and Blowdowns	59
	Mark R. Hjelmfelt	50
	Introduction	59
	Convective Storms and Downbursts	60
	Vertical Equation of Motion	68
	Climatology	71
	Downdrafts, Mesocyclones, and Outflows	75
	Microbursts	80
	Large-Scale Systems	87
	Summary	95
4	Understanding How the Interaction of Wind	
	and Trees Results in Windthrow, Stem Breakage,	
	and Canopy Gap Formation	103
	Christopher P. Quine and Barry A. Gardiner	
	Introduction	103
	Theoretical Core	107
	Applied Force	110
	Resistive Force	123
	Direct Consequences	128
	Subsequent Impact of Windthrow, Stem Breakage,	
	and Gap/Patch Formation	137
	Summary and Conclusions	141
	Appendix 1: Glossary and Definitions	153
5	Meteorological Conditions Associated with Ice	
	Storm Damage to Forests	157
	Kaz Higuchi and Amir Shabbar	
	Introduction	157
	Synoptic Conditions for Freezing Rain	158
	Climatology of Freezing Rain in Canada	167
	Meteorological Evolution of Ice Storm '98	169
	Possible Changes in Ice Storm Frequency Under	
	a Warming Climate	176
	Summary	177
6	The Effect of Icing Events on the Death and	
-	Regeneration of North American Trees	181
	David F. Greene, Kathleen F. Jones, and Olga J. Proulx	
	Introduction	181
	The Biomechanics of Branch Breakage During Ice	
	Events With and Without Wind	185

	Ice Measurements in the Field	200
	A Review of the Literature on Tree Damage Caused	
	By Icing Events	201
	The Population Consequences of Major Ice Events	206
7	Disturbance Processes and Dynamics in Coastal Dunes <i>Patrick A. Hesp and M. Luisa Martínez</i>	215
	Introduction	215
	Dune Types and Disturbance Types and Processes	216
	Conclusion	240
8	Coastal Dune Succession and the Reality of Dune	
	Processes	249
	Kiyoko Miyanishi and Edward A. Johnson	
	Introduction	249
	Traditional Dune Succession Hypothesis	252
	Problems with the Dune Succession Hypothesis	255
	Process-Response Alternative to Traditional Succession	
	Hypothesis	261
	Conclusion	273
9	Fluvial Geomorphic Disturbances and Life	
	History Traits of Riparian Tree Species	283
	Futoshi Nakamura and Satomi Inahara	
	Introduction	283
	Geomorphic Classification of Riparian Zones	
	and Disturbance Regimes in A Catchment	286
	Disturbance, Reliability of Regeneration Habitat, and	
	Life History of Dominant Tree Species	290
	Conclusion	304
10	Water Level Changes in Ponds and Lakes:	
	The Hydrological Processes	311
	Masaki Hayashi and Garth van der Kamp	
	Introduction	311
	Water Balance	312
	Case Study: Northern Prairie Wetlands	329
	Conclusions	334

11	Development of Post-Disturbance Vegetation	2.44
	in Prairie Wetlands	341
	Arnold G. van der Valk	341
	Introduction Wet-Dry Cycles	341
	• •	344
	Marsh Ecology Research Program Coenocline Development: Same Pre-	545
	and Post-Disturbance Water Levels	348
	Coenocline Development: Different Pre-	540
	and Post-Disturbance Water Levels	357
	Models of Coenocline Development	362
	Conclusions	362
	Conclusions	360
12	Modeling Heating Effects	371
	Geoffry N. Mercer and Rodney O. Weber	
	Introduction	371
	Conservation Laws	372
	Simple Examples	373
	Application to More Realistic Scenarios	382
	Case Study: A Model of Seed Survival	387
	Conclusion	392
	Appendix: Notation	393
13	Fire Effects on Grasslands	397
	Paul H. Zedler	
	Introduction	397
	The Grass Growth Form	399
	Regeneration from Seed	403
	Grasses as Fuel, Mulch, and Forage	405
	Drought Disturbance: A Primary Driver	413
	Direct Fire Effects	415
	Grassfire and Nutrients	424
	Grasses and Woody Plants	425
	A Final Caution—Grasses and Fires	430
14	Wildfire and Tree Population Processes	441
	Sheri L. Gutsell and Edward A. Johnson	
	Introduction	441
	Wildfire Processes and Characteristics	443
	Local Populations and Processes	455
	Regional Populations and Processes	471
	Conclusions	4

15		
	Northern Forest Ecosystems	487
	Barry J. Cooke, Vincent G. Nealis, and Jacques Régnière	
	Introduction	487
	Defoliating Insects as a Distinct Class of Forest	
	Disturbance	491
	The Process of Insect Disturbance	495
	Population Dynamics of Foliage-Grazers	502
	Conclusion	518
16	Dynamics of Mountain Pine Beetle Outbreaks	527
	Justin Heavilin, James Powell, and Jesse A. Logan	
	Introduction	527
	Derivation of the Red Top Model	531
	Results of the Fully Developed Model	547
	Discussion and Conclusion	550
17	Relationship Between Spruce Budworm Outbreaks	
• /	and Forest Dynamics in Eastern North America	555
	Hubert Morin, Yves Jardon, and Réjean Gagnon	
	Introduction	555
	History of Spruce Budworm Outbreaks Over the	
	Past 8600 Years	559
	Variation in Temporal and Spatial Dynamics of	
	Outbreaks: Reflection of Changes in Forest Structure	564
18	Impact of Beaver (Castor canadensis Kuhl) Foraging	
	on Species Composition of Boreal Forests	579
	Noble T. Donkor	-70
	Introduction	579
	Herbivory in Boreal Forests	581
	Temporal Changes in Beaver Populations	582
	Traditional Understanding of Beaver Foraging Impact on	- 0 -
	Plant Community Structure	585
	Understanding Beaver Foraging Impacts on	
	Composition and Dynamics of the Boreal Forest	588
	Conclusion	597

19 Beaver, Willow Shrubs, and Floods	603
J. Dungan Smith	
Introduction	603
Background	607
Theory for Interaction of Flow and Shrubs	622
Model Results	638
Discussion	648
Summary and Conclusions	667
Index	673