

Cambridge University Press

0521800765 - Primary Succession and Ecosystem Rehabilitation

Lawrence R. Walker and Roger Del Moral

Table of Contents

[More information](#)

Contents

<i>Preface and acknowledgements</i>	<i>page xi</i>
1 Introduction	1
1.1 Why learn about primary succession?	1
1.1.1 Humans and disturbance	2
1.1.2 Human interest in ecosystem recovery	5
1.2 Definitions	5
1.3 Methods	9
1.4 Questions that still remain	12
2 Denudation: the creation of a barren substrate	14
2.1 Concepts	14
2.1.1 Physical environment and disturbance	14
2.1.2 Definitions	15
2.1.3 Plants and animals as agents of disturbance	17
2.1.4 Patch dynamics	17
2.2 Types of disturbance that initiate primary succession	19
2.2.1 Earth	19
2.2.2 Air	33
2.2.3 Water	36
2.2.4 Fire	41
2.2.5 Humans	42
2.2.6 Disturbance interactions	48
2.2.7 Summary of disturbance types	50
3 Successional theory	52
3.1 Introduction	52
3.2 Early observations	54
3.3 Holism	55
3.4 Neo-holism	60
3.5 Phytosociology	62

Cambridge University Press

0521800765 - Primary Succession and Ecosystem Rehabilitation

Lawrence R. Walker and Roger Del Moral

Table of Contents

[More information](#)vi · **Contents**

3.6 Reductionism	63
3.7 Neo-reductionism	65
3.8 Ecosystem assembly	68
3.9 Models	70
3.9.1 Verbal models	72
3.9.2 Mathematical models	83
3.10 New directions	86
4 Soil development	88
4.1 Background	88
4.2 Environmental controls	89
4.2.1 Climate	90
4.2.2 Parent material	91
4.2.3 Topography	92
4.2.4 Erosion	93
4.3 Physical and chemical properties	95
4.3.1 Texture	95
4.3.2 Compaction	98
4.3.3 Water content	100
4.3.4 pH and cations	102
4.3.5 Nitrogen	105
4.3.6 Phosphorus	108
4.4 Soil biota	112
4.4.1 Plants	112
4.4.2 Soil microbes	113
4.4.3 Mycorrhizae	115
4.4.4 Animals	117
4.5 Soil processes	118
4.5.1 Nitrogen fixation	118
4.5.2 Organic matter	123
4.6 Spatial patterns	127
4.7 Summary	129
5 Life histories of early colonists	133
5.1 Introduction	133
5.2 Pre-dispersal considerations	133
5.2.1 Pollination and seed set	134
5.2.2 Seed banks	136
5.2.3 Vegetative reproduction	139

Cambridge University Press

0521800765 - Primary Succession and Ecosystem Rehabilitation

Lawrence R. Walker and Roger Del Moral

Table of Contents

[More information](#)**Contents . . . vii**

5.3 Dispersal	141
5.3.1 Dispersal parameters	142
5.3.2 Dispersal mechanisms and their consequences	145
5.3.3 Barriers	156
5.3.4 Predictability	160
5.3.5 Dispersal conclusions	163
5.4 Establishment	164
5.4.1 Germination	164
5.4.2 Growth	170
5.5 Persistence and longevity	177
5.5.1 Persistence	177
5.5.2 Longevity	179
5.6 Successional consequences of dispersal and establishment	181
5.6.1 Under-saturated early successional communities	181
5.6.2 Under-saturated late successional communities	181
5.6.3 Novel species assemblages	183
5.6.4 Priority effects	184
5.6.5 Disharmonic communities	184
5.6.6 Biogeographical effects	186
5.6.7 Establishment conclusions	187
6 Species interactions	189
6.1 Introduction	189
6.2 Plant–soil and animal–soil interactions	191
6.2.1 Plant impacts on soils	191
6.2.2 Animal disturbances	198
6.3 Interactions among plants	198
6.3.1 Facilitation	199
6.3.2 Inhibition	209
6.4 Interactions between plants and other organisms	217
6.4.1 Mutualisms	217
6.4.2 Herbivores	218
6.4.3 Parasitism	223
6.5 Interactions between animals	224
6.6 Net effects of interactions	226

Cambridge University Press

0521800765 - Primary Succession and Ecosystem Rehabilitation

Lawrence R. Walker and Roger Del Moral

Table of Contents

[More information](#)viii · **Contents**

7 Successional patterns	232
7.1 Types of trajectory	232
7.1.1 Converging trajectories	235
7.1.2 Diverging trajectories	240
7.1.3 Trajectory networks	243
7.1.4 Parallel trajectories	245
7.1.5 Deflected trajectories	246
7.1.6 Cyclic patterns and fluctuations	249
7.1.7 Retrogressive trajectories	249
7.1.8 Arrested trajectories	250
7.1.9 Trajectory summary	251
7.2 Temporal dynamics	252
7.2.1 Definitions	253
7.2.2 Methods of measuring rates	254
7.3 Changes in biodiversity and biomass	258
7.3.1 Biodiversity	258
7.3.2 Stability	259
7.3.3 Biomass and allocation	259
7.4 Environmental feedback	261
7.4.1 Moisture	262
7.4.2 Temperature	264
7.4.3 Nutrients	266
7.4.4 Salinity	270
7.4.5 Landscape factors	273
7.4.6 Chronic disturbance	273
7.4.7 Pollution	275
7.5 Summary	276
8 Applications of theory for rehabilitation	282
8.1 Theory of rehabilitation ecology	282
8.1.1 Introduction and definitions	282
8.1.2 Interdependency between rehabilitation and ecological theory	284
8.2 Rehabilitation processes	287
8.2.1 Conceptual framework	287
8.2.2 Planning	292
8.3 Implementation	295
8.3.1 Dispersal	296
8.3.2 Establishment	297

Cambridge University Press

0521800765 - Primary Succession and Ecosystem Rehabilitation

Lawrence R. Walker and Roger Del Moral

Table of Contents

[More information](#)

Contents . ix

8.3.3 Monitoring	300
8.3.4 Maintenance	301
8.4 Overcoming adverse conditions	301
8.4.1 Drought	302
8.4.2 Hydric conditions	303
8.4.3 Infertility and toxicity	306
8.4.4 Salinity	311
8.4.5 Extreme pH values	312
8.4.6 Low temperatures	313
8.4.7 Unstable substrates	314
8.4.8 Alien plants	315
8.4.9 Grazing	317
8.4.10 Air pollution	318
8.4.11 Overcoming adversity: a summary	319
8.5 Feedback between theory and practice	322
8.5.1 Increasing restoration rates	322
8.5.2 Improving the aim	323
8.5.3 Enlarging the target	325
8.5.4 Summary of feedback between theory and practice	326
8.6 Politics	327
9 Future directions	328
9.1 Paradigm shifts	328
9.2 Development of standard protocols	331
9.2.1 Permanent plots	331
9.2.2 Removal experiments	332
9.2.3 Chronosequence studies	332
9.3 Questions for the future	333
9.3.1 The end of succession	333
9.3.2 Trajectories	335
9.3.3 Predictions	336
9.4 Missing data and poorly studied habitats	337
9.5 Conclusions	340
<i>Glossary</i>	343
<i>Illustration credits</i>	355
<i>References</i>	357
<i>Index</i>	429