

## Contents

<i>List of Contributors</i>	<i>page x</i>
<i>Preface</i>	xi
<i>Acknowledgments</i>	xiv
1 The Need for Restoration	1
1.1 The Problem	1
1.2 Human Modifications	4
1.3 Values, Goods, and Services of Beaches and Dunes	6
1.4 Approaches for Restoring and Maintaining Natural Landforms and Habitats	8
1.5 Definitions	12
1.6 Categories of Restoration	13
1.7 The Elusiveness of a Time-Dependent Target State	16
1.8 Types of Restoration Project	19
1.9 Scope of Book	22
2 Beach Nourishment and Impacts	26
2.1 The Potential for Restoration	26
2.2 General Design Considerations	30
2.3 Mega Nourishments	32
2.4 Sediment Characteristics	35
2.5 Potential Negative Impacts of Nourishment Operations	37
2.5.1 Loss of Habitat and Displacement of Mobile Species in Offshore Borrow Areas	38
2.5.2 Disturbance by Burial and Turbidity	40
2.5.3 Change in Beach Morphology and Dynamics	41

2.5.4	Introduction of Noncompatible Sediment	42
2.5.4.1	Effect of Mineralogy	46
2.5.4.2	Coarse Sediment	46
2.5.4.3	Fine Sediment	48
2.5.5	Effect of Equipment Use	49
2.5.6	Aesthetic and Recreational Problems	49
2.5.7	Increasing Incentives for Constructing Buildings and Infrastructure	51
2.5.8	Unknown Long-Term Implications for Biota	51
2.6	Alternative Practices to Minimize Environmental Losses and Enhance Values	52
2.6.1	Addressing Adverse Effects	52
2.6.2	Improving Habitat	54
2.7	Alternative Designs for Beach Fills	59
2.7.1	Changing Shapes	59
2.7.2	Changing Project Size or Spatial Aspects	60
2.8	Restoring Sediment Characteristics	61
2.9	Monitoring and Adaptive Management	63
2.10	Concluding Statement	64
3	Dune Building Practices and Impacts	65
3.1	Characteristics of Human-Altered Dunes	65
3.2	Dunes Built by Aeolian Transport from Nourished Beaches	66
3.3	Building Dunes by Deposit of Fill from External Sources	68
3.4	Building Dunes by Beach Scraping	71
3.5	Building Dunes Using Sand Fences	74
3.6	Building Dunes Using Vegetation	79
3.7	Building Dunes Using Multiple Strategies	86
3.8	Concluding Statement	87
4	Restoring Processes, Structure, and Functions	88
4.1	Increasing Complexity and Dynamism	88
4.2	The Issue of Dynamism	90
4.3	Restricting Beach Raking	93
4.3.1	The Value of Wrack	93
4.3.2	The Problem of Raking	94
4.4	Restricting Driving on Beaches and Dunes	95
4.5	Remobilizing Dunes	96
4.5.1	Case Studies	97

*Contents*

vii

4.6	Removing or Altering Sand-Trapping Fences	100
4.7	Protecting Endangered Species	102
4.8	Altering Growing Conditions for Vegetation	103
4.8.1	The Issue	103
4.8.2	Techniques for Control of Vegetation	105
4.8.2.1	Establishing Levels of Grazing	106
4.8.2.2	Mowing	108
4.8.2.3	Pulling	108
4.8.2.4	Applying Chemicals	108
4.9	Replacing Lost or Exotic Vegetation	109
4.9.1	Stabilizing Sand Drift Areas in Dune Fields	109
4.9.2	Restoring Mined and Excavated Dunes	110
4.9.3	Controlling Exotic Species	112
4.10	Restoring Slacks	116
4.11	Allowing Time for Naturalization	118
4.12	Determining Appropriate Levels of Dynamism	119
4.13	Offsite Activities	120
4.14	Concluding Statement	121
5	Altering or Removing Shore Protection Structures	123
5.1	Rethinking Erosion	123
5.2	Breaching Dikes to Allow Inundation by Sea Water	125
5.3	Altering Hard Structures	127
5.3.1	Examples of Modifications of Protection Structures	127
5.4	The Case for Not Stabilizing Bluffs	133
5.5	Managed Realignment for Beach and Dune Environments	135
5.5.1	Feasibility	135
5.5.2	Addressing Uncertainty and Stakeholder Concern	136
5.5.3	Allowing Protection Structures to Deteriorate versus Removing Them	139
5.6	Burying Hard Structures	140
5.7	Nature-Based Shore Protection Alternatives	143
5.8	Concluding Statement	145
6	Options in Spatially Restricted Environments	146
6.1	Overview	146
6.2	Natural Gradient	148
6.3	Truncated Gradient	151
6.4	Compressed Gradient	151

6.5	Expanded Gradient	153
6.6	Fragmented and Decoupled Gradients	155
6.7	Implications	157
7	Stakeholder Interests, Conflicts, and Cooperation	159
7.1	Obtaining Public Support	159
7.2	The Need for Compromise Solutions	161
7.3	Contrasts in Stakeholder Perceptions and Values	161
7.4	Stakeholder Actions	164
7.4.1	Municipal Managers	164
7.4.2	Developers and Property Owners	166
7.4.3	Scientists	168
7.4.4	Engineers	169
7.4.5	Environmental Regulatory Departments	171
7.5	Implications	173
8	A Locally Based Program for Beach and Dune Restoration	174
8.1	The Need for Local Action	174
8.2	Gaining Acceptance for Natural Landforms and Habitats	175
8.3	Identifying Reference Conditions	178
8.4	Establishing Demonstration Sites	179
8.5	Developing Guidelines and Protocols	181
8.5.1	Litter and Wrack Management	181
8.5.2	Grading	184
8.5.3	Vehicles on the Beach	185
8.5.4	Access Paths	186
8.5.5	Structures on the Beach and Dune	186
8.5.6	Use of Vegetation for Landscaping	188
8.6	Developing and Implementing Public Education Programs	190
8.7	Maintaining and Evaluating Restored Environments	192
8.7.1	Monitoring and Adaptive Management	193
8.7.2	Creating a Stable Source of Funding	195
8.8	Developing Policies and Regulations	197
8.9	Planning for the Future	198
9	Research Needs	199
9.1	Introduction	199
9.2	Nourishing Beaches	203
9.2.1	Evaluating and Addressing Impacts	203
9.2.2	Expanding the Scope of Nourishment Projects	205
9.2.3	Overcoming Cost Constraints	206

	<i>Contents</i>	ix
9.3	Building Dunes	207
9.4	Restoring Processes, Structure, and Functions	208
9.5	Altering or Removing Shore Protection Structures	209
9.6	Options in Spatially Restricted Environments	210
9.7	Addressing Stakeholder Concerns and Needs	211
9.8	Maintaining and Evaluating Restored Environments	212
9.9	Concluding Statement	213
	<i>References</i>	215
	<i>Index</i>	271