
Table of Contents

Chapter 1	Introduction	1
1.1	About the Book	13
Chapter 2	Environmentally Driven Plasticity	15
2.1	The Physical Environment	15
2.1.1	Growing and Flowing.....	17
2.2	The Case Studies	30
2.2.1	Case Studies of Environmentally Driven Plasticity: Seaweeds ..	30
2.2.2	Morphological Plasticity in Sponges	34
2.2.3	Morphological Plasticity in Colonial Cnidarians	43
2.2.4	Biologically Inherent Regulation of Morphogenesis	56
Chapter 3	Measuring Growth and Form	67
3.1	Metrics for Branching Networks	67
3.1.1	Branch Ordering	68
3.1.2	Horton Statistics	69
3.1.3	Tokunaga Statistics	70
3.2	Morphological Analysis of a Branching Sponge	72
3.2.1	Image Processing	72
3.2.2	Horton Analysis	73
3.2.3	Fractal Analysis	75
3.3	Two-dimensional Morphological Analysis of Ranges of Growth Forms	75
3.3.1	Sampling Growth Forms Along a Gradient of Increasing Water Movement	77
3.3.2	Morphological Measurements in a Range of Growth Forms	78
3.3.3	A Comparison of the Morphological Measurements in a Range of Growth Forms of the Three Species	84
3.4	Three-Dimensional Morphological Analysis of Growth Forms of <i>Madracis Mirabilis</i> (Preliminary Results) ..	87

Chapter 4	Simulating Growth and Form	91
4.1	L-systems	91
4.1.1	Introduction to Modeling Using L-systems	91
4.1.2	Examples of L-systems for Modeling Seaweed	94
4.2	Example of a Simple Model of Plasticity in Algal Morphology	97
4.3	Modeling Fluid Flow Using Lattice Gases and the Lattice Boltzmann Model	99
4.3.1	Cellular Automata as Models for Fluid Flow	100
4.3.2	Transport, Erosion, Deposition, and Hydrodynamic Forces	105
4.3.3	Transport and Sedimentation	108
4.4	A Laplacian Model of Branching Growth	109
4.4.1	Laplacian Growth	109
4.4.2	The Numerical Model	110
4.4.3	Model Results	112
4.5	Growth by Aggregation	114
4.5.1	Morphological Plasticity and the Influence of Hydrodynamics	114
4.5.2	Modeling the Nutrient Distribution	115
4.5.3	Growth by Aggregation in a Monodirectional Flow	116
4.5.4	Growth by Aggregation in a Bidirectional (Alternating) Flow	119
4.5.5	Comparison Between the Range of Aggregates and the Growth Forms	123
4.6	Accretive Growth	125
4.6.1	Surface Normal Deposition in Marine Sessile Organisms	125
4.6.2	A Model of Surface Normal Accretive Growth	127
4.6.3	Accretive Growth Using an Approximation of Actual Deposition Velocities and the Amount of Contact with the Environment	128
4.6.4	A Model of Accretive Growth Driven by the Local Amount of Available Nutrient and the Influence of Hydrodynamics	130
4.6.5	A Model of Accretive Growth Driven by Local Light Intensities	137
4.6.6	A Model of Accretive Growth Driven by Local Nutrient Availability and Regulated by a Growth-Suppressing Isomone	139
4.6.7	A Comparison Between the Accretive Model and the Growth Forms	139
4.7	Gastrovascular Dynamics of Hydractiniid Hydrozoans	144

Chapter 5	Verifying Models	147
5.1	Transplantation Experiments with Stony Corals	147
5.2	Transplantation and Other Perturbation Experiments with the Sponge <i>Haliclona oculata</i> and a Comparison to the Simulation Models	151
5.3	Colonial Hydrozoans: Perturbation Experiments of Gastrovascular Physiology and Effects on Colony Development	155
Chapter 6	Applications	159
6.1	Antarctic Sponges	160
6.2	Coral Records	163
Chapter 7	Epilogue	169
7.1	Conclusion	172
References	173
Subject Index	191