

Contents

List of Contributors vii

Acknowledgements ix

1. Introduction: An Overview

S.E. JØRGENSEN

- 1.1 Application of Ecological Modeling 1
- 1.2 Model Classification and Model Types 4
- 1.3 Application of the 14 Model Types 7
- 1.4 The Ecosystem as an Object for Modeling 9
- References 11

2. Biogeochemical Models

S.E. JØRGENSEN

- 2.1 Advantages and Properties of Biogeochemical Models 13
- 2.2 Modeling Elements 16
- 2.3 The Modeling Procedure 19
- 2.4 Ecological and Environmental Biogeochemical Models 33
- References 38

3. Dynamic Population Models

T. LEGOVIĆ

- 3.1 A Definition of a Population Model 39
- 3.2 The First Law (Model) of Population Dynamics: Malthus Law 40
- 3.3 The Second Law of Population Dynamics: Verhulst Law 43
- 3.4 A Logistic Population in Periodic Environment 44
- 3.5 A Logistic Population in a Random Environment 46
- 3.6 Prey-Predator Models 48
- 3.7 Models of Competition 52

- 3.8 Models of Cooperation 55
- 3.9 Food Chains 56
- 3.10 Cycling of Matter 58
- 3.11 Conclusions 61
- 3.12 A Brief History of Population Modeling 62
- References 63

4. Steady State Models

X.-Z. KONG, F.-L. XU, W. HE, W.-X. LIU, B. YANG

- 4.1 Steady State Model: Ecopath as an Example 66
- 4.2 Ecopath Model for a Large Chinese Lake: A Case Study 68
- 4.3 Conclusions 86
- References 86

5. Earth's Surface Modeling

T.X. YUE, N. ZHAO, Z.P. DU

- 5.1 Introduction 91
- 5.2 Equivalent Indexes 92
- 5.3 High Accuracy Surface Modeling 93
- 5.4 The Fundamental Theorem of Earth's Surface Modeling and Its Corollaries 97
- 5.5 Conclusions 98
- References 99

6. Application of Structurally Dynamic Models (SDMs)

S.E. JØRGENSEN

- 6.1 Introduction 103
- 6.2 Ecosystem Properties 104
- 6.3 Development of Structurally Dynamic Models 108
- 6.4 Overview of Structurally Dynamic Models Using Work Energy as Goal Function 112

- 6.5 Development of Structurally Dynamic Model for Darwin's Finches 115
- 6.6 Application of Structurally Dynamic Model for the Assessment of Ecological Changes Due to Climate Changes 117
- 6.7 Conclusions 121
- References 121

7. Artificial Neural Networks: Multilayer Perceptron for Ecological Modeling

Y.-S. PARK, S. LEK

- 7.1 Introduction 124
- 7.2 Multilayer Perceptron 125
- 7.3 MLPs in Ecological Modeling 132
- 7.4 Advantages and Disadvantages of MLPs 133
- 7.5 Example of MLP Usage in Ecological Modeling 134
- References 138

8. Ecotoxicological Models

S.E. JØRGENSEN

- 8.1 Application of Ecotoxicological Models 141
- 8.2 Characteristics of Ecotoxicological Models 144
- 8.3 An Overview: The Application of Models in Ecotoxicology 154
- 8.4 Estimation of Ecotoxicological Parameters 154
- 8.5 Ecotoxicological Case Study I: Contamination of Agricultural Products by Cadmium and Lead 166
- 8.6 Illustrations of Ecotoxicological Models Used as Experimental Tools 172
- References 176

9. Fugacity Models

X.-Z. KONG, F.-L. XU, W. HE, W.-X. LIU, B. YANG

- 9.1 Fugacity Models: Development and Applications 182
- 9.2 Fugacity Model for PAHs in Lake Small Baiyangdian, Northern China: A Case Study 185

- 9.3 Conclusions 205
- Acknowledgments 206
- References 206

10. Fuzzy Adaptive Management of Coupled Natural and Human Systems

T. PRATO

- 10.1 Introduction 212
- 10.2 Methods 213
- 10.3 Discussion 222
- 10.4 Conclusions 224
- References 224

11. Coastal Ecosystem Modeling in the Context of Climate Change: An Overview With Case Studies

D. JUSTIC, S.M. DUKE-SYLVESTER, J.M. VISSER, Z. XUE, J. LIANG

- 11.1 Models as Tools for Assessing the Effects of Climate Change on Coastal Ecosystems 228
- 11.2 Case Studies 230
- 11.3 Challenges in Predicting the Effects of Climate Change on Coastal Ecosystems 254
- 11.4 Conclusions 255
- Acknowledgments 255
- References 255

Index 261