

Contents

| | |
|---|----------------|
| <i>Preface</i> | <i>page xi</i> |
| PART 1 INTRODUCTION | 1 |
| 1 The importance of understanding ecosystem change | 3 |
| 2 The omnipresence of change | 9 |
| Long-term variations in climate | 10 |
| Changes in the Quaternary Period | 14 |
| Changes in the Holocene Epoch | 20 |
| Concluding comments | 31 |
| 3 Temporal scale, spatial scale and the ecosystem | 33 |
| Roots of the ecosystem concept | 33 |
| The biogeocoenosis and the ecosystem | 45 |
| Temporal scale, spatial scale and the ecosystem | 50 |
| Concluding comments | 56 |
| PART 2 BASIC CONCEPTS | 59 |
| 4 Ecological modelling | 61 |
| Finite-state automata | 63 |
| State variable representations of dynamic systems | 68 |
| Change in state space: a geometrical representation of system dynamics | 69 |
| Compartment models and material flow | 84 |
| Formulation of compartment models for ecosystem studies | 85 |
| Applications of compartment models | 92 |
| Common concepts used in ecological modelling | 93 |
| Concluding comments | 99 |

viii · Contents

| | |
|---|-----|
| 5 Niche theory | 103 |
| The Grinnellian niche | 105 |
| The Eltonian niche | 108 |
| The Eltonian niche and the competitive exclusion principle | 110 |
| Attempts to synthesise Elton's and Grinnell's niche concepts | 120 |
| Quantification of the Grinnellian niche | 122 |
| Patterns of species abundance along environmental gradients: the continuum concept | 137 |
| Concluding comments | 140 |
| 6 Vegetation–environment relations | 144 |
| Historical roots of relating large-scale vegetation pattern to the environment | 147 |
| Global classifications of vegetation–environment relations | 156 |
| Adaptation of plants to the environment | 170 |
| Concluding comments | 177 |
| 7 The mosaic theory of natural landscapes | 178 |
| The mosaic concept of vegetation dynamics | 178 |
| Roles of species on mosaic landscapes | 187 |
| Gap dynamics in the forest mosaic | 190 |
| Concluding comments | 203 |
| PART 3 ECOSYSTEM MODELS | 205 |
| 8 Individual-based models | 207 |
| Development of individual-based models in ecology | 208 |
| Individual-based models of plant and animal populations | 209 |
| Gap models | 217 |
| Tests of gap models | 232 |
| Comparisons of different gap models | 243 |
| Concluding comments | 245 |
| 9 Consequences of gap models | 248 |
| Ecological consequences at the population level | 248 |
| Consequences of gap models at the landscape level | 274 |
| Concluding comments | 291 |
| 10 Landscape models | 294 |
| Mosaic landscape models | 295 |
| Interactive mosaic models and spatial models | 310 |
| Homogeneous landscape models | 321 |
| Concluding comments | 336 |

Cambridge University Press

978-0-521-56523-3 - Terrestrial Ecosystems in Changing Environments

Herman H. Shugart

Table of Contents

[More information](#)

Contents · ix

| | | |
|-----------|---|-----|
| PART 4 | EVALUATION OF GLOBAL CHANGE | 341 |
| 11 | Mosaic landscape models | 343 |
| | The application of phytogeographical models to assess climate change effects | 344 |
| | The application of Grinnellian niche concepts to assess climate change effects | 353 |
| | The application of gap models to assess change on mosaic landscapes | 360 |
| | Simulating patterns of vegetation change under altered climates with gap models | 371 |
| | Consistency comparisons of gap models with other approaches to modelling environmental change | 376 |
| | Concluding comments | 380 |
| 12 | Spatially interactive landscape models | 382 |
| | Effects of landscape scale in interactive landscapes | 383 |
| | Ecotone dynamics under environmental change | 390 |
| | Modelling interactive landscape dynamics | 394 |
| | The global carbon budget including potential spatial dynamics | 408 |
| | Concluding comments | 410 |
| 13 | Homogeneous landscape models | 413 |
| | Initial results using material transfer models | 416 |
| | Material transfer models applied at continental scales | 420 |
| | Canopy process models at continental scales | 425 |
| | Continental-scale changes in terrestrial ecosystems: a performance comparison among homogeneous landscape models | 435 |
| | Concluding comments | 442 |
| 14 | Global change | 445 |
| | Effects of global environmental change on the Earth's terrestrial biota | 446 |
| | The terrestrial surface and its interactions with the atmosphere | 452 |
| | Human society's adaptability to global change | 463 |
| | Concluding comments | 466 |
| | <i>References</i> | 469 |
| | <i>Index</i> | 523 |