

Contents

<i>Preface</i>	vii-x
CHAPTER 1	
Introduction—An Outline and Justification for Autecology	1-8
CHAPTER 2	
Two Alternative Approaches in Ecology	9-20
1 Introduction	9
2 Outbreaks of Australian Psyllids	10
3 The Demographic Approach	11
3.1 Analysis and Interpretation	11
3.2 Evaluation	13
4 The Autecological Approach	15
4.1 Analysis and Interpretation	15
4.2 Evaluation	16
5 Extending Each of the Psyllid Studies	18
6 Inferences for General Ecological Interpretation	19
CHAPTER 3	
Basic Ecological Processes and the Autecological Generalization	21-88
1 Introduction	21
2 Individual Organisms and Their Ecological Interactions	25
2.1 Resource Acquisition—Foraging in Birds	29
2.2 Resource Acquisition—Feeding in Tropical Fruit Flies (Tephritidae)	35
2.3 Plant-Microbial Interactions in the Soil	37
2.4 Respiratory Mechanisms in Plants	39
2.5 Localization of Hosts and Mates	43
2.6 Adaptations for Movement	48
2.7 Conclusions—Environmental Interactions and Evolutionary Change	55

3	Examples of Specifically Structured Lifelines	56
3.1	Plants	56
3.2	Adélie Penguins—Birds of the Pack Ice	62
3.3	Large Terrestrial Mammals	66
3.4	Invertebrates With Discrete Phases to the Life Cycle	74
3.5	Conclusions—Conceptual Developments	82
4	The Galton Board Metaphor	82
5	The General Aim and Structure of Autecology	85

CHAPTER 4

Spatio-Temporal Dynamics—Climatic Variables and the Response Rates of Organisms		89–136
1	Introduction	89
2	Climate in Ecological Perspective	92
2.1	The Diversity of Climatic Influences	92
2.2	An Analysis of Climate Variability in Europe	92
2.3	Climate Variability and Its Ecological Consequences	98
3	Ecological Dynamics	101
3.1	The Quaternary Perspective—Beetles	102
3.2	Dutch Ground Beetles	105
3.3	Beech Trees in the Holarctic	114
3.4	Spatio-Temporal Perspective on Breeding Bird Densities	118
3.5	Tropical Systems	124
3.6	Rates of Change	129
4	Ecological Dynamics and Autecology	130
4.1	Nature of Autecological Theory	131
4.2	Spatio-Temporal Dynamics of Species—The Primary Pattern for Explanation	131
4.3	Understanding Species and Ecological Interpretation	132
4.4	Climatic Influences	133
4.5	Movement of Organisms—Spatial Adjustment to Environmental Change	134
5	Conclusion—General Aims for Autecological Theory	136

CHAPTER 5

Environmental Matching—Individuals, Species and Scales in Ecology		137–164
1	Introduction	137
2	The Environment in Autecology—Variables, Structure and Heterogeneity	139
3	The Requirements and Tolerances of Organisms are Species-Specific and Species-Wide	142
4	Structured Processes and Environmental Matching	150
5	Ecological Adjustment—Scales and Locality of Ecological Investigation	152
5.1	Spatial Scales of Variation	153
5.2	Temporal Scales of Variation	155

5.3	The Relevance of Species in Ecology— The Specification of Scale	157
5.4	Autecology and Scales of Variation	158
6	Autecology, Adaptation and Speciation	159
7	Overview	163
CHAPTER 6		
Environmental Response Systems of Organisms—		
	Co-Determinants of Spatio-Temporal Dynamics	165–192
1	Introduction	165
2	Autecology in Relation to Ecophysiology, Ecomorphology and Ethology	167
3	The Questions that Define Autecology	169
3.1	Relationships Between Sub-Disciplines in Biology	169
3.2	Ecology as a Sub-Discipline in Biology— Patterns and Questions	172
4	Environmental Response Systems	177
4.1	Understanding the Environmental Response System	177
4.2	Autonomic and Active Response Systems	180
4.3	Individuals and Adaptive Mechanisms	181
4.4	Species and Adaptive Change	185
4.5	Ecological Generalization and Prediction	188
5	Species-Specificity and Ecological Context	190
6	Conclusion	192
CHAPTER 7		
Quantifying Autecology—		
	Survival, Reproduction and Movement	193–224
1	Introduction	193
2	Studying Population Dynamics	195
3	The Intrinsic Rate of Population Increase, r , and Constraining Exponential Growth	197
4	The Underlying Assumptions—The Paradox of Retaining the Logistic	201
5	Structuring the Ecological Response Process	204
5.1	R_0 and Structuring the Ecological Response Process	205
5.2	Consequences for Ecological Understanding and Applied Ecology	211
5.3	Extending R_0 Through the Diffusion Parameter D	214
5.4	Ecological Insights	216
5.5	Risk Analysis	218
6	Some Methodological Remarks	219
6.1	Modeling Aims	219
6.2	Retrospective versus Prospective Explanation	220
7	Conclusion	222

CHAPTER 8

Research in Ecology—Patterns and the Scientific Exploration and Reconstruction of Ecological Processes	225–269
1 Introduction	225
2 Process Structure and Approaches to its Analysis in Ecology	229
3 Pattern Identification and Justification (Phase 1)	232
3.1 The Pattern of Discrete Species	232
3.2 Population Stability	237
3.3 Null Models in Tests of Pattern	239
3.4 Curve Fitting and Simulation Procedures	242
4 Exploration of Candidate Variables (Phase 2)	243
4.1 Statistical Analysis	244
4.2 Population Dynamics and Community Ecology are Still in Exploration Phase	247
5 Reconstruction (Modeling of Ecological Processes to Test Interpretation) (Phase 3)	249
5.1 Mechanistic Modeling	250
5.2 Types of Models for Analyzing Ecological Processes	252
5.3 Deterministic Models and Their Limitations in Ecology	253
5.4 Chaos Dynamics and Determinism	255
5.5 Stochastic Processes	258
6 A Worked Example—The Reconstruction of Biological Invasions	264
7 Conclusion	268

CHAPTER 9

Organisms Across Space and Over Time—Deterministic Structures, Stochastic Influences, Environmental Gradients and Risk Analysis	270–326
1 Introduction	270
2 Adaptive Mechanisms and the Environment—Deterministic Structure and Stochastic Influences	274
3 Individual Organisms, Ecological Dynamics and Ecological Intensity	278
3.1 Individuals and Movement—Defining the Problem	278
3.2 Environmental Dynamics—Spatial and Temporal Variation	282
3.3 Ecological Intensity (Relative to Concepts of Population)	292
3.4 Ecology and the Significance of Species	300
4 Autecological Analysis	302
4.1 Markovian Habitat Tracking, Stochastic Dynamics and Risk Analysis	302
4.2 Dealing With Spatial Variation in Terms of Risk	305
4.3 Environmental Stochasticity, Adaptations and Risk Analysis	309
4.4 Risk Distributions and Reductionist Methodology	316

5	Autecological Synthesis—Examples of Dynamic Ecological Matching	317
5.1	Bluebell Life Cycle and Seasonal Structure of the Environment	318
5.2	Variation in Growing Conditions During an Organism's Lifetime	320
5.3	Risk Analysis in Scottish Oats	322
5.4	Conclusion	325
6	The Development of Autecology— Central Questions	325
CHAPTER 10		
	Contrasting the Ecological Paradigms—Principles, Related Sub-Disciplines, General Laws and Prediction	327–366
1	Introduction	327
2	Coherence in Ecological Theory	331
3	Basic Approach and Principles of Each Paradigm	332
3.1	Demographic Ecology	334
3.2	Autecology	336
3.3	Section Summary	340
4	Communities, Ecosystems and Hierarchy —Paradigmatic Perceptions	340
4.1	Community Ecology	340
4.2	Ecosystem Ecology	342
4.3	Why Ecological Systems are Not Hierarchical	343
5	Relationships of the Two Paradigms to Other Sub-Disciplines	344
5.1	Demographic Ecology	345
5.2	Autecology	351
6	Resolving the Ambivalence in the Term Autecology	356
7	Scientific Laws, Prediction and the Two Ecological Paradigms	358
7.1	Demographic Ecology and Laws Aimed at Prediction	360
7.2	Autecology and Laws Aimed at Interpretation	362
8	Conclusions	364
	Appendix	367–370
	Glossary	371–384
	References	385–440
	Index	441–467