

Contents

Contributors to Volume 37	v
Preface	vii
Foreword: Message in a Bottle	xi

Understanding Ecological Concepts: The Role of Laboratory Systems

MICHAEL B. BONSALE AND MICHAEL P. HASSELL

I. Introduction	1
II. Rationale	2
A. Model Choice	3
B. Simplicity	8
C. Risk and Reward	8
III. Concepts in Population Ecology	9
A. Density Dependence	10
B. Nicholson's Concepts	10
C. Chaos	11
D. Competition	12
E. Predation	15
F. Stability and Complexity in Ecosystems	22
IV. Future Perspectives	25
A. Population Dynamics	25
B. Role of Productivity in Ecosystems	26
C. Role of Weak Links in Ecosystems	26
D. Role of Noise in Ecological Interactions	27
E. Role of Space in Ecological Interactions	28
V. Conclusions	29
Acknowledgments	29
References	29

**Complexity, Evolution, and Persistence in Host-Parasitoid Experimental
Systems With *Callosobruchus* Beetles as the Host**

MIDORI TUDA AND MASAKAZU SHIMADA

I. Summary	37
II. General Introduction	38
III. Persistence of a Simple Host-Parasitoid System.	39
A. Bottom-Up Control Factors	39
B. Top-Down Control Factors	45
IV. Persistence of Complex Host-Parasitoid Assemblies.	46
V. Population Dynamics in a Three-Species System: At the Interface Between Simplicity and Complexity	47
A. Experiment	47
B. Detection of Chaos by a Non-Mechanistic Model.	50
C. Parameter Estimation and Reconstruction of Population Dynamics by a Semi-Mechanistic Model	50
D. Results and Discussion	56
VI. Host-Parasitoid Interaction and Beyond.	65
Acknowledgments.	67
Appendices	67
Appendix 1. Basic Ecology of the Experimental Organisms	67
Appendix 2. Selection Model.	68
Appendix 3. Assumption of Noise and Parameter Estimation	69
References	70

**Population Dynamics, Life History, and Demography:
Lessons From *Drosophila***

LAURENCE D. MUELLER, CASANDRA L. RAUSER AND
MICHAEL R. ROSE

I. Introduction.	77
II. Populations Without Age Structure	79
A. Evolution of Density-Dependent Rates of Population Growth	79
B. Evolution of Population Stability	82
III. Populations with Age Structure	85
A. Age-Specific Mortality Rates.	85
B. Mortality-Rate Plateaus	88
C. Fecundity Plateaus	92
IV. Discussion	93
Acknowledgments.	95
References	95

**Nonlinear Stochastic Population Dynamics: The Flour Beetle *Tribolium*
as an Effective Tool of Discovery**

ROBERT F. COSTANTINO, ROBERT A. DESHARNAIS,
JIM M. CUSHING, BRIAN DENNIS,
SHANDELLE M. HENSON AND AARON A. KING

I. Introduction	101
II. Animal Model	103
III. Deterministic Skeleton	104
IV. Stochastic Models	104
V. Parameter Estimation and Model Validation	105
VI. Experimental Confirmation of Nonlinear Dynamic Phenomena	110
VII. Bifurcations in the Dynamic Behavior of Populations	110
VIII. A Second Bifurcation Experiment: The Hunt for Chaos	112
IX. Chaos and Population Outbreaks	116
X. Back in the Saddle (Node) Again	120
XI. Phase Switching in Population Cycles	123
XII. Lattice Effects	127
XIII. Anatomy of Chaos	130
XIV. Mechanistic Models of the Stochasticity	135
XV. Beyond Beetles	137
Acknowledgments	138
References	139

**Population Dynamics in a Noisy World: Lessons From a Mite
Experimental System**

TIM G. BENTON AND ANDREW P. BECKERMAN

I. Summary	143
II. Introduction	144
A. The Mite Model System	147
B. The Effect of Noise on Population Dynamics	148
C. Investigating the Mechanism: "Top-Down" Time Series Analysis	158
D. Investigating the Mechanism: "Bottom-Up" Experiments on Mite Biology	167
III. Discussion	173
Acknowledgments	176
References	176

Global Persistence Despite Local Extinction in Acarine Predator-Prey Systems: Lessons From Experimental and Mathematical Exercises

MAURICE W. SABELIS, ARNE JANSSEN, ODO DIEKMANN,
VINCENT A.A. JANSEN, ERIK VAN GOOL AND
MINUS VAN BAALEN

- I. Summary 183
- II. Introduction 185
- III. Zooming in on Local Predator-Prey Dynamics 187
- IV. A Caricature of Local Predator-Prey Dynamics 189
- V. Zooming out to the Metapopulation Level: The “Baseline” Model 192
- VI. Deriving a Hierarchy of Models from the “Baseline” Model . . . 194
- VII. Confronting the “Baseline” Model with Experimental Tests. . 199
- VIII. Testing the Robustness of the “Baseline” Model by Extended Simulations 203
- IX. Is the “Baseline” Model Evolutionarily Robust? 207
- X. Lessons from Mathematical and Experimental Exercises 212
- Appendix: Differential Prey Patch Vulnerability Stabilizes Predator-Prey Interaction 214
- References 217

Ecological and Evolutionary Dynamics of Experimental Plankton Communities

GREGOR F. FUSSMANN, STEPHEN P. ELLNER,
NELSON G. HAIRSTON, JR., LAURA E. JONES,
KYLE W. SHERTZER AND TAKEHITO YOSHIDA

- I. Summary 221
- II. Introduction 222
- III. Predator and Prey in the Chemostat—A Simple Story? 224
- IV. Testing Hypotheses of Mechanism 228
- V. Rapid Evolution: A Clonal Approach 231
- VI. Rapidly Evolving Rotifers 238
- VII. Conclusions 240
- Acknowledgments 241
- References 241

The Contribution of Laboratory Experiments on Protists to Understanding Population and Metapopulation Dynamics

MARCEL HOLYOAK AND SHARON P. LAWLER

I. Summary	245
II. Introduction	246
III. Protists as Model Systems	248
IV. Early Experiments with Protozoa and the Birth of Population Ecology	249
V. Population Control and Environmental Variation	251
VI. Stabilizing Predator-Prey Interactions in Populations and Metapopulations	254
VII. Source and Sink Dynamics	260
VIII. Omnivory and Stability	261
IX. The Interaction Between Productivity and IGP	264
X. Conclusions	265
Acknowledgments	266
References	266

Microbial Experimental Systems in Ecology

CHRISTINE M. JESSUP, SAMANTHA E. FORDE AND
BRENDAN J.M. BOHANNAN

I. Summary	273
II. Introduction	274
III. The History of Microbial Experimental Systems in Ecology	275
A. G.F. Gause and His Predecessors	275
B. Studies Since Gause	276
IV. Strengths and Limitations of Microbial Experimental Systems	277
A. Strengths of Microbial Experimental Systems	277
B. Limitations of Microbial Experimental Systems	281
V. The Role of Microbial Experimental Systems in Ecology: Consensus and Controversy	283
A. The Role of Microbial Experimental Systems	283
B. Controversies Surrounding Experimental Systems and Microbial Experimental Systems	285
VI. Recent Studies of Microbial Experimental Systems	289
A. The Ecological Causes of Diversity	290
B. The Ecological Consequences of Diversity	296

C. The Response of Diversity to Environmental Change . . .	298
D. Directions for Future Research	299
VII. Conclusions	300
Acknowledgments.	300
References	300

Parasitism Between Co-Infecting Bacteriophages

PAUL E. TURNER

I. Summary	309
II. Introduction.	310
III. Phage Biology and Intracellular Conflicts	312
IV. Parasitism in Co-Infecting RNA Phages	314
V. Frequency-Dependent Selection and Virus Parasitism	318
VI. How Many Viruses Should Enter a Cell?	321
VII. Parasitism in Plant and Animal Viruses	326
VIII. Concluding Remarks	328
Acknowledgments.	329
References	329

Constructing Nature: Laboratory Models as Necessary Tools for Investigating Complex Ecological Communities

MARC W. CADOTTE, JAMES A. DRAKE AND
TADASHI FUKAMI

I. Time, Scale, and Observation in Ecological Systems	335
II. Contingent Structure and Reciprocal Interactions	342
A. Historical Contingency and Ecological Processes	342
B. The Interaction of Ecological Processes Operating at Different Spatial Scales	344
C. What These Examples Tell Us.	345
III. Problematic Field Studies	345
IV. The Role of Microcosms in Community Ecology	346
V. Endnote.	349
References	349
Index	355
Cumulative List of Titles	369