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978-0-521-40553-9 - Ecological Versatility and Community Ecology

Ralph C. Mac Nally

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Even the casual observer of nature soon realizes that there are palpable differences in the breadth and diversity of resources used by species, even quite closely related ones. Species also show disparate propensities to occupy habitat types, some restricted to a very few, while others are to be found in almost any habitat within their geographic ranges. The variation in the breadth of resource use (ecological versatility) and in habitat use (ubiquity) has important implications for understanding ecological diversity. This book is the first to draw back from particular disciplinary foci, such as host-plant use in phytophagous insects, bilateral mutualisms or competitive coevolution, to develop a broader perspective of versatility and ubiquity. This is done by addressing three main questions (1) how do ecologists study versatility and ubiquity, and what do we know from these studies? (2) how well does existing theory account for observations, and what are the common threads between disciplines? and (3) what is the relationship between versatility and ubiquity? The analyses are undertaken from an ecological rather than evolutionary perspective. The outcomes of the review indicate some promise of unification and systematicization. However, there are exceedingly demanding challenges that ecologists must face in their quest for a more thorough understanding of ecological versatility.

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Ecological Versatility and Community Ecology

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*For Erica, Aleck and
especially Marty*

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Frontmatter

[More information](#)

Contents

Preface	xv
1 An introduction to ecological versatility	1
What is the significance of ecological versatility?	11
Structure of the book	13
A directory	15
Scope	16
2 Defining and measuring versatility	17
2.1 What is ecological versatility?	19
The meaning of fitness	19
2.2 What are resources?	20
Resources – the fitness basis and exclusive access	20
Critical and extraneous resources	22
Complementary and substitutable resources	23
Constraints	25
2.3 What are the problems in quantifying ecological versatility?	25
Spatial scale – ecologists and organisms	26
Resource ordering and aliasing	29
The practicalities of measuring utilization and availability	30
Overview	31
2.4 How is versatility measured?	32
2.5 Local and global pictures of species’ versatility	35
2.6 A case study	37
2.7 Summary	38
3 Studies of versatility in natural populations	40
3.1 Survey parameters	41

x · Contents

3.2	Survey domain	43
	Literature sources and selection criteria	43
	Taxonomy	45
	Habitats	46
	Climatic zones and geography	47
	Numbers of species per study	48
3.3	The survey	49
	Clear specification of resources	49
	Fitness bases	51
	Constraints	54
	Differences between individuals	55
	Population subsets	58
	Availabilities and conformances	59
	Spatial variability	62
	Temporal variability – seasonal trends	65
	Temporal variability – daily trends	68
	Measures of breadth and overlap	69
	Overview	70
3.4	The distribution of versatility in nature	71
3.5	Summary	76
4	The influence of interspecific interactions on versatility	79
	Some caveats	80
4.1	Herbivory	81
	Dietary versatility in ‘generalized’ herbivores	83
	Host-plants of small herbivores, especially phytophagous insects	88
	Herbivory – an overview	100
4.2	Parasitism	101
	Parasitoids	101
	Animal parasites	102
	Animal parasitism – an overview	108
	Plant parasites	108
4.3	Predation	109
	Predation and versatility – general ideas	110
	Optimal foraging – the contingency model	112
	Behaviour, biophysics and the versatility of predators	118
	Predation – an overview	121

	Contents	· xi
4.4 Omnivory		122
4.5 Mutualism		126
Mutualisms		128
Mutualistic associations		129
Mutualisms – an overview		132
4.6 Summary and conclusions		134
5 The influence of population structure on versatility		139
5.1 Facultative exploitation		142
Ecological polymorphism and behavioural plasticity		146
5.2 Adaptive polyphenism and phenotypic plasticity		148
5.3 Polymorphism		152
5.4 Stage-structured populations		156
5.5 An idealized set of exploitation strategies		161
Four idealized exploitation strategies		162
5.6 Summary		165
6 Ecological versatility and population dynamics		167
6.1 The principles underlying the models		169
Utilization pressure		170
Functional and numerical responses		173
The marginal utilization rate		175
The flexibility of utilization rates – hard and soft exploitation		175
The model strategies		178
The assumptions of many-resource models		179
The test environments		180
The remainder of Chapter 6		181
6.2 The flexibility of utilization rates		182
High density influxes		185
Overview		186
6.3 Differentiation within populations		187
The stability of ecological polymorphisms		190
Overview		193
6.4 Specialization		194
Overview		200

xii · Contents

6.5 Additional remarks	201
Efficiency	202
Metapopulations	203
Ecological modelling	207
6.6 Summary	209
7 Versatility and interspecific competition	213
7.1 Versatility and interspecific competition – a short review	216
Equilibria, invasibility and stability	216
Models of interspecific competition	219
Versatility and interspecific competition	220
Overview	224
7.2 Modelling	225
Parameter-space spans and the glyph representation	226
7.3 Persistence and invasibility	229
Some factors influencing persistence and coexistence	229
Invasibility	243
Overview	245
7.4 Environmental variability	245
Overview	251
7.5 Many populations	251
The impact of background populations – context-specificity	251
The N populations – N resources problem	253
Overview	258
7.6 Additional remarks	259
Absolute rates	259
Strategic and tactical options	261
On coexistence and ecological versatility	261
7.7 Summary	263
8 Ubiquity or habitat versatility	265
Distributions – range and ubiquity	267
8.1 Niche pattern	269
Ubiquity and niche position	271
Density and distribution	275

	Contents	xiii
8.2	Temporal variation in food availability	276
	Seasonal variation	276
	Between-year variation	278
8.3	Habitat selection and competition	279
	Compression and release	280
	The dominance model	281
	Habitat selection in animals	282
	Habitat selection in animals – physiognomy and floristics	286
	Habitat selection in plants	289
8.4	Other models of ubiquity	290
	Modelling the ubiquity–position relationship	290
	Contingency models of ubiquity	293
8.5	Versatility and ubiquity	301
8.6	Summary	305
9	Recapitulation and commentary	308
9.1	Overview of factors influencing ecological versatility	309
	General ideas	309
	Specific ideas	323
9.2	Questions and answers	328
9.3	Commentary	332
	Improved sampling designs	332
	Changing directions in ecological modelling?	335
	Idiosyncrasy, contingency and small numbers	336
	Prospectus	341
	Glossary of terms	343
	Appendix A	351
A.1	List of studies used in the survey	351
A.2	Breadth and overlap measures	354
	Appendix B	358
B.1	Diagnostic statistics	358
B.2	Variation in resource availability	360

xiv · Contents

B.3 Resource availability	361
‘Perceived’ and actual availabilities	361
B.4 Exploitation algorithms	363
Hard coherency algorithm	363
Soft coherency algorithm	364
Hard resource-like algorithm	365
Soft resource-like algorithm	367
Hard specialization algorithm	368
Soft specialization algorithm	369
B.5 More on assumptions and limitations	371
B.6 Implementation, hardware, etc.	375
References	376
Index	423

Cambridge University Press

978-0-521-40553-9 - Ecological Versatility and Community Ecology

Ralph C. Mac Nally

Frontmatter

[More information](#)

Preface

When Professor John Birks kindly offered me the opportunity to submit an outline for a book for the *Cambridge Studies in Ecology* series, I decided that it would be worthwhile to analyze comprehensively ecological specialization and generalization in natural communities (commonly referred to as *niche breadth*, or *niche width*). Of course, there has been no shortage of review articles on particular groups of organisms, especially insects, looking at this question (e.g., Fox and Morrow 1981, Schemske 1983, Berenbaum 1990, Jaenike 1990, Andow 1991). Nor has there been any lack of theoretical attention (e.g., MacArthur and Levins 1967, Van Valen and Grant 1970, Roughgarden 1972, Slatkin and Lande 1976, Keast 1977, Siegismund *et al.* 1990). Futuyma and Moreno (1988) provided an excellent short review of this topic from an evolutionary perspective. However, it seems that a more extensive treatment of reasons for specialized or generalized resource use and its relationship to community dynamics would be an appropriate subject for a book in this series. I did not realize at the time that this seemingly well circumscribed topic would so thoroughly ramify throughout community ecology. However, a retrospective reading of Futuyma and Moreno's (1988) article had (correctly) said as much in the very first paragraph.

An important dichotomy is developed in Chapters 1 and 2 based on specialization–generalization at the local scale, and the capacity of species to occupy few or many different types of habitats. Fox and Morrow (1981) drew attention to the difference between the degree of specialization or generalization at the scale of the local population, and the degree when integrated over the entire range of a species (i.e., all populations of a species). They noted that some species could be 'local' specialists, relying on one species of host plant, for example, in one type of habitat, yet switch hosts in different habitats. Thus, while maintaining a similar degree of specialization of local resource use, the species might still be perceived as a generalized one over the variety of habitats it occupies. Cody (1974) was another who recognized that niche width might be

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Ralph C. Mac Nally

Frontmatter

[More information](#)

xvi · Preface

partitioned into local and global components. He believed that some species of food specialists (e.g., parulid warblers) occupy many types of habitats, while species restricted in habitat use often were food generalists (e.g., emberizid finches). This distinction between local and global specialization and generalization is a crucial one, and dictates the content of this book. Almost all of this volume is concerned with specialization and generalization at the local scale. I ask questions like: how is it framed? how is it studied? what do we know? which ecological processes affect it? and how can we model it? Specialization and generalization in the use of habitats are considered more briefly, being the main focus of Chapter 8. But, generally speaking, the book addresses local specialization and generalization.

Many people have contributed in one way or another to getting this book written, but four were particularly helpful and generous with their time and conceptual and editorial criticisms. My wife, Dr Jane Doolan, deftly wielded her editorial pencil on parts of the manuscript. The project happened to coincide with the arrival of our children, Erica and Aleck, so that Jane also bore the brunt of attending to their (ongoing) constant demands and wishes during this period. For these Herculean tasks, I thank her very fondly.

The main conceptual reviewers of the manuscript (apart from the *Studies* editors) were Dr Peter Fairweather, formerly of Macquarie University but now with the CSIRO, and Dr P. S. 'Sam' Lake, of Monash University. I was indeed fortunate to be able to call upon two such fine and versatile scholars and ecologists for their advice and comments. Their marine littoral and limnological backgrounds helped, no doubt, to broaden the subject-matter from my exclusive experience in temperate, terrestrial systems.

The fourth substantial contributor was Dr Craig Blundell, formerly of BHP Research in Melbourne. Although he is a geophysicist, his broad interests in science and philosophy spurred me on continually. I like to think that I contributed modestly to his doctoral studies spanning the same period in which this book was written. His mathematical acumen and knowledge were a great boon during the development of the modelling algorithms discussed in Chapters 6 and 7 and Appendix B. We shared many tortuous paths before reaching the eventual solutions.

I am also grateful for comments on some chapters by Professor Peter Petraitis of the University of Pennsylvania (Chapters 2 and 3) and Dr Barbara Downes of Melbourne University (Chapters 1 to 4), both of whom prompted important clarifications or additions. I should add the

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Ralph C. Mac Nally

Frontmatter

[More information](#)

Preface · xvii

usual caveat that all of the opinions in the book ultimately are my responsibility and that none should necessarily reflect on the scientific credibility of any other persons named here.

I also thank Gerry Quinn, Barry Traill, Linc McIntosh, Niall Richardson, Dugal Wallace, Angela Bowles, Tim Monks, Ian Hoyle and 'both' of my families for their assistance or encouragement. The support of Professor J. W. Warren and the Department of Ecology and Evolutionary Biology at Monash University was invaluable. I also thank the Australian Research Council for some support during the latter phases of writing.

And last, but hardly least, I thank the editorial and production staff of Cambridge University Press. Professor Birks provided critical and editorial advice for which I am most grateful; I hope he is pleased with the outcome. I am especially indebted to Professor John Wiens, whose criticisms, suggestions and thoughtful comments on the manuscript were priceless. He kindly devoted time to the task when he was on sabbatical leave at the University of British Columbia, which clearly indicates a high degree of altruism on his part. I also wish to acknowledge Dr Alan Crowden for maintaining a subtle correspondence of coercion across the world.

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