

Contents

Contributing Authors	xi
Acknowledgments	xiii
Notational Standards	xiv
1 Introduction	1
Ulf Dieckmann, Johan A.J. Metz, Michael Doebeli, and Diethard Tautz	
1.1 A Shift in Focus	1
1.2 Adaptive Speciation	2
1.3 Adaptive Speciation in Context	6
1.4 Species Criteria	9
1.5 Routes of Adaptive Speciation	11
1.6 Pattern and Process in Adaptive Speciation	13
1.7 Structure of this Book	14
2 Speciation in Historical Perspective	17
Will Provine	
2.1 Introduction	17
2.2 Darwin on Species and Speciation	18
2.3 Mayr on Species and Speciation	20
2.4 Species Now	22
2.5 Speciation Now	24
A Theories of Speciation	31
Introduction to Part A	32
3 Genetic Theories of Sympatric Speciation	36
Tadeusz J. Kawecki	
3.1 Introduction	36
3.2 Sustained Disruptive Selection	38
3.3 Evolution of Divergent Mate Choice	42
3.4 Evolution of Divergent Habitat or Host Preference	49
3.5 Concluding Comments: Synergism Between Processes	52
4 Adaptive Dynamics of Speciation: Ecological Underpinnings	54
Stefan A.H. Geritz, Éva Kisdi, Géza Meszén, and Johan A.J. Metz	
4.1 Introduction	54
4.2 Invasion Fitness	56
4.3 Phenotypic Evolution by Trait Substitution	58
4.4 The Emergence of Diversity: Evolutionary Branching	61
4.5 Evolutionary Branching and Speciation	70
4.6 Adaptive Dynamics: Alternative Approaches	72
4.7 Concluding Comments	73

5 Adaptive Dynamics of Speciation: Sexual Populations	76
Ulf Dieckmann and Michael Doebeli	
5.1 Introduction	76
5.2 Adaptive Speciation in Sexual Populations	78
5.3 Coevolutionary Adaptive Speciation in Sexual Populations	94
5.4 Adaptive Speciation through Sexual Selection	98
5.5 Concluding Comments	107
6 Genetic Theories of Allopatric and Parapatric Speciation	112
Sergey Gavrilov	
6.1 Introduction	112
6.2 Modes of Speciation	113
6.3 Adaptive Landscapes	115
6.4 Rugged Adaptive Landscapes	118
6.5 Bateson-Dobzhansky-Muller Adaptive Landscapes	123
6.6 Holey Adaptive Landscapes	127
6.7 Concluding Comments	137
7 Adaptive Dynamics of Speciation: Spatial Structure	140
Michael Doebeli and Ulf Dieckmann	
7.1 Introduction	140
7.2 Classic Models of Parapatric Speciation	141
7.3 Evolutionary Branching in Spatially Structured Populations	143
7.4 Extension to Sexual Populations: Parapatric Speciation	155
7.5 A Note on Species-Area Relationships	161
7.6 Concluding Comments	165
B Ecological Mechanisms of Speciation	169
Introduction to Part B	170
8 Speciation and Radiation in African Haplochromine Cichlids	173
Jacques J.M. van Alphen, Ole Seehausen, and Fritson Galis	
8.1 Introduction	173
8.2 Sexual Selection and Speciation in Cichlids	175
8.3 Sexual Selection in <i>Pundamilia</i>	177
8.4 Sexual Selection in <i>Neochromis omnicaeruleus</i>	179
8.5 Pharyngeal Jaw Versatility and Feeding Diversification	186
8.6 Concluding Comments	190
9 Natural Selection and Ecological Speciation in Sticklebacks	192
Howard D. Rundle and Dolph Schluter	
9.1 Introduction	192
9.2 Natural History of the Sympatric Sticklebacks	196
9.3 Parallel Speciation of Limnetics and Benthics	199
9.4 Premating Isolation Strengthened in Sympatry	203
9.5 Concluding Comments	208
10 Adaptive Speciation in Northern Freshwater Fishes	210
Sigurður S. Snorrason and Skúli Skúlason	
10.1 Introduction	210
10.2 Ecological Factors that Promote Diversification	211
10.3 Factors that Facilitate Assortative Mating	213
10.4 Nature and Basis of Phenotypic Variation	214

10.5	Ecological Determinants of Diversity Patterns	218
10.6	Concluding Comments	222
11	Sympatric Speciation in Insects	229
	Guy L. Bush and Roger K. Butlin	
11.1	Insect Diversity, Body Size, Specialization, and Speciation	229
11.2	Cospeciation	231
11.3	Allopatric Speciation on the Same Host	232
11.4	Allopatric Speciation with a Host Shift	233
11.5	Sympatric Speciation with a Host Shift	235
11.6	Conditions Needed for Sympatric Shifts	243
11.7	Concluding Comments	247
12	Adaptive Speciation in Agricultural Pests	249
	Martijn Egas, Maurice W. Sabelis, Filipa Vala, and Iza Lesna	
12.1	Introduction	249
12.2	Crops as Ecological Niches	252
12.3	Adaptive Learning of Host Preference	253
12.4	Adaptive Mate Choice	256
12.5	Symbiont-induced Reproductive Incompatibility	259
12.6	Concluding Comments	262
13	Ecological Speciation in Flowering Plants	264
	Nickolas M. Waser and Diane R. Campbell	
13.1	Introduction	264
13.2	Ecological Speciation Driven by Animal Pollinators	265
13.3	Adaptation and Speciation in Different Environments	272
13.4	Combined Speciation Mechanisms	273
13.5	Concluding Comments	277
14	Experiments on Adaptation and Divergence in Bacterial Populations	278
	Michael Travisano	
14.1	Introduction	278
14.2	Allopatric Divergence	279
14.3	Sympatric Divergence	288
14.4	Concluding Comments	298
C	Patterns of Speciation	301
	Introduction to Part C	302
15	Phylogeography and Patterns of Incipient Speciation	305
	Diethard Tautz	
15.1	Introduction	305
15.2	Molecules, Morphology, and Time Frames	308
15.3	Assortative Mating and Patterns of Subdivision	311
15.4	Natural Populations	314
15.5	Concluding Comments	320
16	Evolutionary Diversification of Caribbean <i>Anolis</i> Lizards	322
16.1	Introduction (J.B. Losos and R.S. Thorpe)	322
16.2	Adaptation and Speciation in Lesser Antillean Anoles (R.S. Thorpe, A. Malhotra, A. Stenson, and J.T. Reardon)	324

16.3	Adaptation and Speciation in Greater Antillean Anoles (J.B. Losos)	335
16.4	Concluding Comments (R.S. Thorpe and J.B. Losos)	343
17	Adaptive Radiation of African Montane Plants	345
	Eric B. Knox	345
17.1	Introduction	349
17.2	Vegetation Zones on African Mountains	351
17.3	The Giant Senecios and Giant Lobelias	353
17.4	Phylogenetic Patterns and Biogeographic Interpretation	357
17.5	Adaptive Speciation	359
17.6	Concluding Comments	362
18	Diversity and Speciation of Semionotid Fishes in Mesozoic Rift Lakes	362
	Amy R. McCune	362
18.1	Introduction	363
18.2	Semionotid Fishes	364
18.3	Newark Lake Paleolimnology	366
18.4	<i>Semionotus</i> Radiations in the Newark Supergroup	368
18.5	Ecological Context of Evolutionary Novelty and Speciation	374
18.6	Time Required for Speciation	379
18.7	Concluding Comments	380
19	Epilogue	380
	Ulf Dieckmann, Diethard Tautz, Michael Doebeli, and Johan A.J. Metz	380
19.1	The Allopatric Dogma	381
19.2	Adaptive Speciation	383
19.3	Diversity of Speciation Processes	384
19.4	Empirical Studies of Speciation	388
19.5	Continuous Splitting and Radiations	389
19.6	Future Directions	395
	References	445
	Index	

10.5	Ecological Determinants of Diversity Patterns	218
10.6	Concluding Comments	222
11	Sympatric Speciation in Insects	229
	Guy L. Bush and Roger K. Butlin	
11.1	Insect Diversity, Body Size, Specialization, and Speciation	229
11.2	Cospeciation	231
11.3	Allopatric Speciation on the Same Host	232
11.4	Allopatric Speciation with a Host Shift	233
11.5	Sympatric Speciation with a Host Shift	235
11.6	Conditions Needed for Sympatric Shifts	243
11.7	Concluding Comments	247
12	Adaptive Speciation in Agricultural Pests	249
	Martijn Egas, Maurice W. Sabelis, Filipa Vala, and Iza Lesna	
12.1	Introduction	249
12.2	Crops as Ecological Niches	252
12.3	Adaptive Learning of Host Preference	253
12.4	Adaptive Mate Choice	256
12.5	Symbiont-induced Reproductive Incompatibility	259
12.6	Concluding Comments	262
13	Ecological Speciation in Flowering Plants	264
	Nickolas M. Waser and Diane R. Campbell	
13.1	Introduction	264
13.2	Ecological Speciation Driven by Animal Pollinators	265
13.3	Adaptation and Speciation in Different Environments	272
13.4	Combined Speciation Mechanisms	273
13.5	Concluding Comments	277
14	Experiments on Adaptation and Divergence in Bacterial Populations	278
	Michael Travisano	
14.1	Introduction	278
14.2	Allopatric Divergence	279
14.3	Sympatric Divergence	288
14.4	Concluding Comments	298
C	Patterns of Speciation	301
	Introduction to Part C	302
15	Phylogeography and Patterns of Incipient Speciation	305
	Diethard Tautz	
15.1	Introduction	305
15.2	Molecules, Morphology, and Time Frames	308
15.3	Assortative Mating and Patterns of Subdivision	311
15.4	Natural Populations	314
15.5	Concluding Comments	320
16	Evolutionary Diversification of Caribbean <i>Anolis</i> Lizards	322
16.1	Introduction (J.B. Losos and R.S. Thorpe)	322
16.2	Adaptation and Speciation in Lesser Antillean Anoles (R.S. Thorpe, A. Malhotra, A. Stenson, and J.T. Reardon)	324

16.3	Adaptation and Speciation in Greater Antillean Anoles (J.B. Losos)	335
16.4	Concluding Comments (R.S. Thorpe and J.B. Losos)	343
17	Adaptive Radiation of African Montane Plants	345
	Eric B. Knox	345
17.1	Introduction	349
17.2	Vegetation Zones on African Mountains	351
17.3	The Giant Senecios and Giant Lobelias	353
17.4	Phylogenetic Patterns and Biogeographic Interpretation	357
17.5	Adaptive Speciation	359
17.6	Concluding Comments	362
18	Diversity and Speciation of Semionotid Fishes in Mesozoic Rift Lakes	362
	Amy R. McCune	362
18.1	Introduction	363
18.2	Semionotid Fishes	364
18.3	Newark Lake Paleolimnology	366
18.4	<i>Semionotus</i> Radiations in the Newark Supergroup	368
18.5	Ecological Context of Evolutionary Novelty and Speciation	374
18.6	Time Required for Speciation	379
18.7	Concluding Comments	380
19	Epilogue	380
	Ulf Dieckmann, Diethard Tautz, Michael Doebeli, and Johan A.J. Metz	380
19.1	The Allopatric Dogma	381
19.2	Adaptive Speciation	383
19.3	Diversity of Speciation Processes	384
19.4	Empirical Studies of Speciation	388
19.5	Continuous Splitting and Radiations	389
19.6	Future Directions	395
	References	445
	Index	