

Contents

1	Introduction	1
1.1	What Is META-X?	1
	Metapopulation	1
	PVA	2
	Ecological Models	3
1.2	What Is so Special About META-X?	3
1.3	In What Areas Can META-X Be Used?	4
	In Teaching	4
	In Empirical Research	4
	In Biological Conservation and Planning	5
1.4	What Do You Need to Use META-X?	5
1.5	What Cannot Be Done with META-X?	6
1.6	News on META-X	6
2	Contents	9
3	Installation	13
4	Basic Concepts	15
4.1	The Model	15
4.2	Landscape Structure	15
	Position of Patches	16
	Initial Occupancy	16
	Net of Connections	16
4.3	Patch Characteristics	16
	Local Extinction Rate	16
	Number of Emigrants	17
	Number of Immigrants Needed	17
4.4	Spatial Processes	17
	Dispersal	17
	Correlated Extinctions	18
4.5	Simulation	18
	Control Parameters	19
	Interactive Simulations	19
	Automatic Simulations	19
4.6	Evaluation	20

VIII Contents

4.7	Organizing Projects	20
	Scenarios	20
	Experiments	21
	Projects	21
4.8	The META-X Steps	22
5	Guided Tour	25
5.1	Your First META-X Experiment	25
	Defining a New Project	25
	Creating a New Project by Saving	26
	Enter Project Documentation	27
	Creating and Documenting Your First Experiment	28
	Naming the Species and Delineating the Landscape	29
	Defining Control Parameters	30
	Scenario: Documentation and Defining the Landscape	30
	Patch Characteristics	31
	Connection Between Patches	33
	Correlation Length	33
	Dispersal Range	34
	Main Model Parameters	35
	Saving the Project to Your Hard Disk	38
5.2	Interactive Simulation	39
	Choosing a Scenario	39
	Interactive Simulation	41
	Check Parameters	41
	Pattern of Occupancy	42
	Modifying the Scenario	43
	Mean Time to Extinction	44
	Adding a Second Scenario	46
5.3	Automatic Simulation	47
5.4	Evaluation	48
5.5	Generating a Report	51
5.6	Where Next?	51
6	The Project Tree	53
6.1	The Elements of the Project Tree	53
	The Root of the Project Tree	53
	The Experiments Branch	54
	The Scenarios Branch	55
6.2	Working with the Project Tree	56
	Working with Experiments	56
	Working with Scenarios	58
7	Scenarios and Experiments	61
7.1	The Experiment Wizard	61
	Compile Documentation	62
	Specify the Species and the Study Area	63
	Specify Control Parameters	63

Specify New Scenario (Based on ...)	63
Modify Existing Scenario	63
Complete Definition	64
7.2 The Scenario Wizard	64
Documentation of the Scenario	64
Number of Patches for a Scenario	65
Position of Patches	65
Patch Characteristics	66
Connection of Patches	66
Correlation Length	66
Correlation Length (Direct)	67
Correlation Length (Indirect)	67
Mean Dispersal Range	68
Mean Dispersal Range (Direct) :	68
Mean Dispersal Range (Indirect) :	68
Rates of Colonization	69
Main Model Parameters	70
Control Parameters for the Whole Experiment	70
End of the Scenario Specification	70
7.3 Homogeneous Parameters	71
7.4 User-Defined Scenarios and the Parameter Hierarchy of META-X	72
Submodels	72
The Standard Submodels of META-X	73
User-Defined	73
Parameter Hierarchy	73
Update Matrix: Warning Message	74
8 Simulation and Evaluation	75
8.1 Interactive Simulation	75
Metapopulation Dynamics	76
Recorded Data	77
Diagrams	77
Control Unit	77
Further Analysis – FD	78
Further Analysis – TM	78
Change Scenario	80
8.2 Simulation and Evaluation of Scenarios	80
Automatic Simulation	80
Evaluation	80
8.3 Simulation and Evaluation of Experiments	81
Select Experiments and Scenarios	81
Check Control Parameters	82
Batch Simulation	82
What to Evaluate?	82
Evaluation	83
9 The Landscape Editor	85
9.1 Elements of the Landscape Editor	85
9.2 Visualization	87

X	Contents	
9.3	Modifying Existing Scenarios	89
9.4	Saving Your Work with the Apply Button	91
9.5	Creating New Scenarios	92
10	Parameter Variation	95
10.1	Variation Experiments	95
	Creating Variation Experiments (1)	95
	Creating Variation Experiments (2)	97
	Modify Variation Experiments	98
	Resetting Variation Experiments	98
10.2	Simulation, Evaluation and Reports	99
11	Import, Export and Report	101
11.1	Import of Model Parameters	101
	Format of Import Files	102
11.2	Export of Simulation Results	103
11.3	Reports	104
	Report of Scenarios	104
	Report of Experiments	105
	Report of Projects	106
11.4	Exporting Graphs to the Clipboard	106
12	Reference	107
12.1	The META-X Menu	107
	The File Menu	108
	The Edit Menu	109
	The View Menu	110
	The Experiment Menu	110
	The Scenario Menu	110
	The Parameter Variation Menu	111
	The Editor Menu	111
	The Tools Menu	112
	The Window Menu	113
	The Help Menu	114
12.3	Context Menus	114
	Project Tree	114
	Landscape Editor	115
	Evaluation	116
12.4	Warning Messages	116
	Scenario Wizard Warning Messages	117
	Landscape Editor Warning Messages	117
	Interactive Simulation Warning Messages	118
13	Goals, Methods, and Concepts of PVA	119
13.1	Introduction	119
13.2	Goals of PVA	119
13.3	Ecological Models for PVA	121

13.4	A Stochastic Example Model	122
	1 st Element: Demographic Noise	123
	2 nd Element: Environmental Noise	123
	3 rd Density Dependence	124
	Implementing the Example Model	124
	Results of the Example Model	125
13.5	Quantifying Persistence and Viability	126
	Established Phase and Intrinsic Mean Time to Extinction	126
	Persistence and Viability	127
	The $\ln(1-P_0)$ plot	128
13.6	Dealing with Uncertainty	130
	Relative Risk Assessment	130
	Sensitivity Analysis	131
13.7	Overview of PVA Models	131
13.8	Potentials and Limitations of PVA	132
13.9	Metapopulation Viability Analysis	133
13.10	Alternatives to Tailored PVA Models	135
13.11	The Conception of META-X	136
13.12	Suggested Reading	138
	Appendix: Technical Aspects of the $\ln(1-P_0)$ Plot	138
14	The META-X Model in Detail	141
14.1	Introduction	141
14.2	The Main Model	142
	Local Extinction	142
	Correlated Extinction	143
	Recolonization	143
14.3	The Submodels Provided by META-X	144
	A Submodel for the Degree of Correlation of Local Extinction	144
	A Submodel for the Rate of Colonization	145
	A Submodel for Reachability	146
14.4	Summary and Discussion	146
	Appendix: the Simulation Algorithm	148
15	Parameterizing META-X	151
15.1	Introduction	151
15.2	General Concepts of Parameterization	151
	Direct Parameterization of Main Model Parameters	151
	Indirect Parameterization	152
	Mechanistic Submodels	152
	‘Soft’ Data, Empirical Knowledge and Hypotheses	153
15.3	Dealing with Uncertainty	154
	Upper and Lower Boundaries	154
	Scenarios	154
	Parameter Variation	155
15.4	Some Specific Guidelines	155
	Parameterizing the Landscape	155

XII	Contents	
	Local Patch Characteristics	156
	Correlated Extinctions	156
	Colonization	157
15.5	Summary and Discussion	158
	Appendix	159
16	Example Applications	161
16.1	Introduction	161
16.2	Examples of Theoretical Problems	161
	Demonstrating and Analysing the Minimal Dispersal Range	162
	Increasing the Number of Emigrants from a Certain Patch	166
16.3	Examples of PVA for Specific Metapopulations	167
	Ecological Uncertainty and the Ranking of Management Options: the Butterfly <i>Melitaea diamina</i>	168
	Metapopulation Scenarios of Capercaillie <i>Tetrao urogallus</i> in the Bavarian Alps	172
16.4	Example of Decision Support for Landscape Management	175
16.5	Summary	177
	Glossary	179
	References	187
	Index	193

META-X®-Software for Metapopulation Viability Analysis

Frank, K.; Lorek, H.; Köster, F.; Sonnenschein, M.;

Wissel, C.; Grimm, V. - UFZ-Centre for Environmental

Research Leipzig-Halle (Ed.)

2003, XII, 195 p. 94 illus. With CD-ROM., Hardcover

ISBN: 978-3-540-44182-3