

Contents

List of plates	xii
List of boxes	xiii
Preface	xiv
Acknowledgments	xvi
1 Introduction – humans, nature and human nature	1
1.1 <i>Homo not-so-sapiens?</i>	2
1.1.1 <i>Homo sapiens</i> – just another species?	3
1.1.2 Human population density and technology underlie environmental impact	3
1.2 A biodiversity crisis	4
1.2.1 The scale of the biodiversity problem	6
1.2.2 Biodiversity, ecosystem function and ecosystem services	7
1.2.3 Drivers of biodiversity loss – the extinction vortex	11
1.2.4 Habitat loss – driven from house and home	12
1.2.5 Invaders – unwanted biodiversity	13
1.2.6 Overexploitation – too much of a good thing	14
1.2.7 Habitat degradation – laying waste	17
1.2.8 Global climate change – life in the greenhouse	18
1.3 Toward a sustainable future?	20
1.3.1 Ecological applications – to conserve, restore and sustain biodiversity	22
1.3.2 From an economic perspective – putting a value on nature	28
1.3.3 The sociopolitical dimension	29
Part 1: Ecological applications at the level of individual organisms	
2 Ecological applications of niche theory	36
2.1 Introduction	37
2.2 Unwanted aliens – lessons from niche theory	41
2.2.1 Ecological niche modeling – predicting where invaders will succeed	42
2.2.2 Are we modeling fundamental or realized niches?	44
2.2.3 When humans disrupt ecosystems and make it easy for invaders	44

2.3	Conservation of endangered species – each to its own niche	46
2.3.1	Monarch’s winter palace under siege	46
2.3.2	A species off the rails – translocation of the takahe	48
2.4	Restoration of habitats impacted by human activities	49
2.4.1	Land reclamation – prospecting for species to restore mined sites	49
2.4.2	Agricultural intensification – risks to biodiversity	51
2.4.3	How much does it cost to restore a species?	52
2.4.4	River restoration – going with the flow	53
3	Life-history theory and management	59
3.1	Introduction – using life-history traits to make management decisions	60
3.2	Species traits as predictors for effective restoration	61
3.2.1	Restoring grassland plants – a pastoral duty	62
3.2.2	Restoring tropical forest – abandoned farmland reclaimed for nature	62
3.3	Species traits as predictors of invasion success	65
3.3.1	Species traits predict invasive conifers	66
3.3.2	Invasion success – the importance of flexibility	66
3.3.3	Separating invasions into sequential stages – different traits for each?	68
3.3.4	What we know and don’t know about invader traits	71
3.4	Species traits as predictors of extinction risk	71
3.4.1	Niche breadth and flexibility – freshwater and forest at risk	72
3.4.2	When big isn’t best – r/K theory, harvesting, grazing and pollution	73
3.4.3	When competitiveness matters – CSR theory, grazing and habitat fragmentation	77
4	Dispersal, migration and management	81
4.1	Introduction – why species mobility matters	82
4.2	Migration and dispersal – lessons for conservation	84
4.2.1	For whom the bell tolls – the surprising story of a South American bird	84
4.2.2	The ups and downs of panda conservation	85
4.2.3	Dispersal of a vulnerable aquatic insect – a damsel in distress	86
4.2.4	Designing marine reserves	88
4.3	Restoration and species mobility	89
4.3.1	Behavior management	89
4.3.2	Bog restoration – is assisted migration needed for peat’s sake?	89
4.3.3	Wetland forest restoration	91
4.4	Predicting the arrival and spread of invaders	92
4.4.1	The Great Lakes – a great place for invaders	92
4.4.2	Lakes as infectious agents	94

4.4.3	Invasion hubs or diffusive spread?	95
4.4.4	How to manage invasions under globalization	96
4.5	Species mobility and management of production landscapes	97
4.5.1	Squirrels – axeman spare that tree	97
4.5.2	Bats – axeman cut that track	97
4.5.3	Farming the wind – the spatial risk of pulverizing birds	100
4.5.4	Bee business – pollination services of native bees depend on dispersal distance	103

Part 2: Applications at the level of populations

5	Conservation of endangered species	108
5.1	Dealing with endangered species – a crisis discipline	109
5.2	Assessing extinction risk from correlational data	113
5.3	Simple algebraic models of population viability analysis	117
5.3.1	The case of Fender’s blue butterfly	117
5.3.2	A primate in Kenya – how good are the data?	118
5.4	Simulation modeling for population viability analysis	119
5.4.1	An Australian icon at risk	120
5.4.2	The royal catchfly – a burning issue	122
5.4.3	Ethiopian wolves – dogged by disease	123
5.4.4	How good is your population viability analysis?	126
5.5	Conservation genetics	127
5.5.1	Genetic rescue of the Florida panther	128
5.5.2	The pink pigeon – providing a solid foundation	128
5.5.3	Reintroduction of a ‘red list’ plant – the value of crossing	129
5.5.4	Outfoxing the foxes of the Californian Channel Islands	130
5.6	A broader perspective of conservation – ecology, economics and sociopolitics all matter	130
5.6.1	Genetically modified crops – larking about with farmland biodiversity	131
5.6.2	Diclofenac – good for sick cattle, bad for vultures	133
6	Pest management	139
6.1	Introduction	140
6.1.1	One person’s pest, another person’s pet	140
6.1.2	Eradication or control?	141
6.2	Chemical pesticides	146
6.2.1	Natural arms factories	146
6.2.2	Take no prisoners	147
6.2.3	From blunderbuss to surgical strike	147
6.2.4	Cut off the enemy’s reinforcements	150
6.2.5	Changing pest behavior – a propaganda war	150
6.2.6	When pesticides go wrong – target pest resurgence and secondary pests	151
6.2.7	Widespread effects of pesticides on nontarget organisms, including people	153

6.3	Biological control	154
6.3.1	Importation biological control – a question of scale	155
6.3.2	Conservation biological control – get natural enemies to do the work	156
6.3.3	Inoculation biological control – effective in glasshouses but rarely in field crops	158
6.3.4	Inundation biological control – using fungi, viruses, bacteria and nematodes	159
6.3.5	When biological control goes wrong	160
6.4	Evolution of resistance and its management	162
6.5	Integrated pest management (IPM)	164
6.5.1	IPM against potato tuber moths in New Zealand	165
6.5.2	IPM against an invasive weed in Australia	166
7	Harvest management	172
7.1	Introduction	173
7.1.1	Avoiding the tragedy of the commons	173
7.1.2	Killing just enough – not too few, not too many	174
7.2	Harvest management in practice – maximum sustainable yield (MSY) approaches	178
7.2.1	Management by fixed quota – of fish and moose	178
7.2.2	Management by fixed effort – of fish and antelopes	181
7.2.3	Management by constant escapement – in time	182
7.2.4	Management by constant escapement – in space	183
7.2.5	Evaluation of the MSY approach – the role of climate	184
7.2.6	Species that are especially vulnerable when rare	185
7.2.7	Ecologist's role in the assessment of MSY	186
7.3	Harvest models that recognize population structure	186
7.3.1	'Dynamic pool models' in fisheries management – looking after the big mothers	187
7.3.2	Forestry – axeman, spare which tree?	190
7.3.3	A forest bird of cultural importance	191
7.4	Evolution of harvested populations – of fish and bighorn rams	191
7.5	A broader view of harvest management – adding economics to ecology	193
7.6	Adding a sociopolitical dimension to ecology and economics	195
7.6.1	Factoring in human behavior	195
7.6.2	Confronting political realities	197

Part 3: Applications at the level of communities and ecosystems

8	Succession and management	202
8.1	Introduction	203
8.2	Managing succession for restoration	206
8.2.1	Restoration timetables for plants	206
8.2.2	Restoration timetable for animals	208
8.2.3	Invoking the theory of competition–colonization trade-offs	209

8.2.4	Invoking successional-niche theory	209
8.2.5	Invoking facilitation theory	210
8.2.6	Invoking enemy-interaction theory	215
8.3	Managing succession for harvesting	216
8.3.1	Benzoin ‘gardening’ in Sumatra	216
8.3.2	Aboriginal burning enhances harvests	217
8.4	Using succession to control invasions	219
8.4.1	Grassland	219
8.4.2	Forest	220
8.5	Managing succession for species conservation	221
8.5.1	When early succession matters most – a hare-restoring formula for lynx	221
8.5.2	Enforcing a successional mosaic – first aid for butterflies	222
8.5.3	When late succession matters most – range finding for tropical birds	223
8.5.4	Controlling succession in an invader-dominated community	223
8.5.5	Nursing a valued plant back to cultural health	224
9	Applications from food web and ecosystem theory	229
9.1	Introduction	230
9.2	Food web theory and human disease risk	234
9.3	Food webs and harvest management	236
9.3.1	Who gets top spot in the abalone food web – otters or humans?	236
9.3.2	Food web consequences of harvesting fish – from tuna to tiddlers	238
9.4	Food webs and conservation management	239
9.5	Ecosystem consequences of invasions	240
9.5.1	Ecosystem consequences of freshwater invaders	240
9.5.2	Ecosystem effects of invasive plants – fixing the problem	241
9.6	Ecosystem approaches to restoration – first aid by parasites and sawdust	242
9.7	Sustainable agroecosystems	245
9.7.1	Stopping caterpillars eating the broccoli – so that people can	245
9.7.2	Managing agriculture to minimize fertilizer input and nutrient loss	245
9.7.3	Constructing wetlands to manage water quality	247
9.7.4	Managing lake eutrophication	248
9.8	Ecosystem services and ecosystem health	249
9.8.1	The value of ecosystem services	249
9.8.2	Ecosystem health of forests – with all their mites	252
9.8.3	Ecosystem health in an agricultural landscape – bats have a ball	253
9.8.4	Ecosystem health of rivers – it’s what we make it	254
9.8.5	Ecosystem health of a marine environment	255

Part 4: Applications at the regional and global scales

10	Landscape management	261
10.1	Introduction	262
10.2	Conservation of metapopulations	267
10.2.1	The emu-wren – making the most of the conservation dollar	267
10.2.2	The wood thrush – going down the sink	268
10.2.3	The problem with large carnivores – connecting with grizzly bears	269
10.3	Landscape harvest management	270
10.3.1	Marine protected areas	270
10.3.2	A Peruvian forest successional mosaic – patching a living together	271
10.4	A landscape perspective on pest control	272
10.4.1	Plantation forestry in the landscape	272
10.4.2	Horticulture in the landscape	273
10.4.3	Arable farming in the landscape	274
10.5	Restoration landscapes	274
10.5.1	Reintroduction of vultures – what a carrion	275
10.5.2	Restoring farmed habitat – styled for hares	276
10.5.3	Old is good – willingness to pay for forest improvement	276
10.5.4	Cityscape ecology – biodiversity in Berlin	277
10.6	Designing reserve networks for biodiversity conservation	277
10.6.1	Complementarity – selecting reserves for fish biodiversity	279
10.6.2	Irreplaceability – selecting reserves in the Cape Floristic Region	279
10.7	Multipurpose reserve design	280
10.7.1	Marine zoning – an Italian job	280
10.7.2	A marine zoning plan for New Zealand – gifts, gains and china shops	283
10.7.3	Managing an agricultural landscape – a multidisciplinary endeavor	283
11	Dealing with global climate change	290
11.1	Introduction	291
11.2	Climate change predictions based on the ecology of individual organisms	297
11.2.1	Niche theory and conservation – what a shame mountains are conical	297
11.2.2	Niche theory and invasion risk – nuisance on the move	298
11.2.3	Life-history traits and the fate of species – for better or for worse	300

11.3	Climate change predictions based on the theory of population dynamics	303
11.3.1	Species conservation – the bear essentials	303
11.3.2	Pest control – more or less of a problem?	303
11.3.3	Harvesting fish in future – cod willing	304
11.3.4	Forestry – a boost for developing countries?	305
11.4	Climate change predictions based on community and ecosystem interactions	306
11.4.1	Succession – new trajectories and end points	306
11.4.2	Food-web interactions – Dengue downunder	307
11.4.3	Ecosystem services – you win some, you lose some	307
11.5	A landscape perspective – nature reserves under climate change	308
11.5.1	Mexican cacti – reserves in the wrong place	309
11.5.2	Fairy shrimps – a temporary setback	310
	Index	315