Contents

*

Prefa Abou	ce It the companion website	xi xiii
1	 Introduction: goals and decisions 1.1 How to use this book 1.2 What is wildlife conservation and management? 1.3 Goals of management 1.4 Hierarchies of decision 1.5 Policy goals 1.6 Feasible options 1.7 Summary 	1 1 2 3 6 7 7 8
Part	1 Wildlife ecology	9
2	 Food and nutrition 2.1 Introduction 2.2 Constituents of food 2.3 Variation in food supply 2.4 Measurement of food supply 2.5 Basal metabolic rate and food requirement 2.6 Morphology of herbivore digestion 2.7 Food passage rate and food requirement 2.8 Body size and diet selection 2.9 Indices of body condition 2.10 Summary 	11 11 14 17 20 23 26 27 28 33
3	 Home range and habitat use 3.1 Introduction 3.2 Estimating home range size and utilization frequency 3.3 Estimating habitat availability and use 3.4 Selective habitat use 3.5 Using resource selection functions to predict population response 3.6 Sources of variation in habitat use 3.7 Movement within the home range 3.8 Movement among home ranges 3.9 Summary 	35 35 36 38 40 42 42 45 45 48 51

4	Dispe	ersal, dispersion, and distribution	53
	4.1	Introduction	53
	4.2	Dispersal	53
	4.3	Dispersion	55
	4.4	Distribution	56
	4.5	Distribution, abundance, and range collapse	61
	4.6	Species reintroductions or invasions	62
	4.7	Summary	67
5	Popu	lation growth and regulation	69
	5.1	Introduction	69
	5.2	Rate of increase	69
	5.3	Geometric or exponential population growth	73
	5.4	Stability of populations	73
	5.5	The theory of population limitation and regulation	76
	5.6	Evidence for regulation	81
	5.7	Applications of regulation	85
	5.8	Logistic model of population regulation	86
	5.9	Stability, cycles, and chaos	88
	5.10	Intraspecific competition	90
	5.11	Interactions of food, predators, and disease	93
	5.12	Summary	93
6	Com	petition and facilitation between species	95
	6.1	Introduction	95
	6.2	Theoretical aspects of interspecific competition	96
	6.3	Experimental demonstrations of competition	98
	6.4	The concept of the niche	103
	6.5	The competitive exclusion principle	106
	6.6	Resource partitioning and habitat selection	106
	6.7	Competition in variable environments	113
	6.8	Apparent competition	113
	6.9	Facilitation	114
	6.10	Applied aspects of competition	119
	6.11	Summary	122
7	Preda	tion	123
	7.1	Introduction	- 123
	7.2	Predation and management	123
	7.3	Definitions	123
	7.4	The effect of predators on prey density	124
	7.5	The behavior of predators	125
	7.6	Numerical response of predators to prey density	129
	7.7	The total response	. 130
	7.8	Behavior of the prey	136
	7.9	Summary	138

8	Parasi	tes and pathogens	139
	8.1	Introduction and definitions	139
	8.2	Effects of parasites	139
	8.3	The basic parameters of epidemiology	140
	8.4	Determinants of spread	143
	8.5	Endemic pathogens	144
	8.6	Endemic pathogens: synergistic interactions with food and	
		predators	144
	8.7	Epizootic diseases	146
	8.8	Emerging infectious diseases of wildlife	147
	8.9	Parasites and the regulation of host populations	150
	8.10	Parasites and host communities	151
	8.11	Parasites and conservation	152
	8.12	Parasites and control of pests	155
	8.13	Summary	156
9	Consi	imer_resource dynamics	157
,	91	Introduction	157
	97	Quality and quantity of a resource	157
	93	Kinds of resource	157
	9.4	Consumer-resource dynamics: general theory	158
	95	Kangaroos and their food plants in semi-arid Australian sayannas	161
	96	Wolf-moose-woody plant dynamics in the horeal forest	167
	97	Other population cycles	172
	9.8	Summary	175
10	71	14.3 Technical judgments can be templicate at Assemi-stores as A	1
10	The e	cology of behavior	177
	10.1	Introduction	177
	10.2	Diet selection	177
	10.3	Optimal patch or habitat use	183
	10.4	Risk-sensitive habitat use	186
	10.5	Social behavior and foraging	187
	10.6	Summary	190
11	Clima	te change and wildlife	191
	11.1	Introduction	191
	11.2	Evidence for climate change	191
	11.3	Wildlife responses to climate change	192
	11.4	Mechanisms of response to climate change	196
	11.5	Complex ecosystem responses to climate change	199
	11.6	Summary	201
Part	2 W	ildlife conservation and management	203
12	Coun	ting animals	205
	12.1	Introduction	205

	12.2	Total counts	205
	12.3	Sampled counts: the logic	207
	12.4	Sampled counts: methods and arithmetic	212
	12.5	Indirect estimates of population size	220
	12.6	Indices	227
	12.7	Harvest-based population estimates	228
	12.8	Summary	231
13	Age an	nd stage structure	233
	13.1	Introduction	233
	13.2	Demographic rates	233
	13.3	Direct estimation of life table parameters	235
	13.4	Indirect estimation of life table parameters	236
	13.5	Relationships among parameters	238
	13.6	Age-specific population models	239
	13.7	Elasticity of matrix models	242
	13.8	Stage-specific models	243
	13.9	Elasticity of the loggerhead turtle model	245
	13.10	Short-term changes in structured populations	246
	13.11	Environmental stochasticity and age-structured populations	246
	13.12	Summary	249
14	Exper	imental management	251
	14.1	Introduction	251
	14.2	Differentiating success from failure	251
	14.3	Technical judgments can be tested	252
	14.4	The nature of the evidence	255
	14.5	Experimental and survey design	257
	14.6	Some standard analyses	262
	14.7	Summary	271
15	Mode	l evaluation and adaptive management	273
	15.1	Introduction	273
	15.2	Fitting models to data and estimation of parameters	274
	15.3	Measuring the likelihood of the observed data	276
	15.4	Evaluating the likelihood of alternate models using AIC	278
	15.5	Adaptive management	281
	15.6	Summary	284
16	Popul	ation viability analysis	285
	16.1	Introduction	285
	16.2	Environmental stochasticity	285
	16.3	PVA based on the exponential growth model	286
	16.4	PVA based on the diffusion model	287
	16.5	PVA based on logistic growth	290
	16.6	Demographic stochasticity	291
	16.7	Estimating both environmental and demographic stochasticity	294

	16.8	PVA based on demographic and environmental stochasticity	296
	16.9	Strengths and weaknesses of PVA	296
	16.10	Extinction caused by environmental change	298
	16.11	Extinction threat due to introduction of exotic predators or	
		competitors	298
	16.12	Extinction threat due to unsustainable harvesting	300
	16.13	Extinction threat due to habitat loss	302
	16.14	Summary	302
17	Conse	ervation in practice	305
	17.1	Introduction	305
	17.2	How populations go extinct	305
	17.3	How to prevent extinction	315
	17.4	Rescue and recovery of near-extinctions	316
	17.5	Conservation in National Parks and reserves	317
	17.6	Community conservation outside National Parks and reserves	322
	17.7	International conservation	323
	17.8	Summary	324
18	Wildl	ife harvesting	325
	18.1	Introduction	325
	18.2	Fixed-quota harvesting strategy	325
	18.3	Fixed-proportion harvesting strategy	329
	18.4	Harvesting in practice: dynamic variation in quotas or effort	332
	18.5	No-harvest reserves	334
	18.6	Age- or sex-biased harvesting	335
	18.7	Commercial harvesting	340
	18.8	Bioeconomics	340
	18.9	Game cropping and the discount rate	344
	18.10	Summary	346
19	Wildl	ife control	347
	19.1	Introduction	347
	19.2	Definitions	347
	19.3	Effects of control	348
	19.4	Objectives of control	348
	19.5	Determining whether control is appropriate	349
	19.6	Methods of control	350
	19.7	Summary	356
20	Evolu	tion and conservation genetics	357
0	20.1	Introduction	357
	20.2	Maintenance of genetic variation	358
	20.3	Natural selection	359
	20.4	Natural selection and life history tradeoffs	361
	20.5	Natural selection due to hunting	363
	20.6	Natural selection due to fishing	365

	20.7	Selection due to environmental change	367
	20.8	Ecological dynamics due to evolutionary changes	372
	20.9	Heterozygosity	374
	20.10	Genetic drift and mutation	375
	20.11	Inbreeding depression	376
	20.12	How much genetic variation is needed?	377
	20.13	Effective population size	378
	20.14	Effect of sex ratio	379
	20.15	How small is too small?	380
	20.16	Summary	380
21	Habita	t loss and metapopulation dynamics	381
	21.1	Introduction	381
	21.2	Habitat loss and fragmentation	381
	21.3	Ecological effects of habitat loss	384
	21.4	Metapopulation dynamics	386
	21.5	Territorial metapopulations	389
	21.6	Mainland-island metapopulations	390
	21.7	Source-sink metapopulations	391
	21.8	Metacommunity dynamics of competitors	392
	21.9	Metacommunity dynamics of predators and prey	393
	21.10	Corridors	394
	21.11	Summary	398
22	Ecosys	stem management and conservation	399
	22.1	Introduction	399
	22.2	Definitions	400
	22.3	Gradients of communities	400
	22.4	Niches	400
	22.5	Food webs and intertrophic interactions	400
	22.6	Community features and management consequences	402
	22.7	Multiple states	404
	22.8	Regulation of top-down and bottom-up processes	405
	22.9	Ecosystem consequences of bottom-up processes	407
	22.10	Ecosystem disturbance and heterogeneity	408
	22.11	Ecosystem management at multiple scales	410
	22.12	Biodiversity	411
	22.13	Island biogeography and dynamic processes of diversity	413
	22.14	Ecosystem function	415
	22.15	Summary	417
App	endices		419
Glos	ssary		423
Refe	rences		435
Inde	X		489