Contents

Chapter 1

Defining Conservation Biology 2



The New Science of Conservation Biology 5

The roots of conservation biology 6

A new science is born 12

The interdisciplinary approach: A case study with sea turtles 13

The Ethical Principles of Conservation
Biology 15
Looking to the Future 17
Summary 18

Chapter 2

What Is Biodiversity? 22



Species Diversity 25
What is a species? 25
Measuring species diversity 28

Genetic Diversity 31

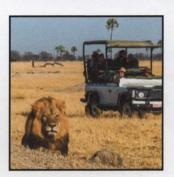
Ecosystem Diversity 33

What are communities and ecosystems? 33
Species interactions within ecosystems 35
Food chains and food webs 37
Keystone species and resources 38
Ecosystem dynamics 41

Biodiversity Worldwide 41 How many species exist worldwide? Where is the world's biodiversity found? The distribution of species 47 Summary 48

Chapter 3

The Value of Biodiversity



Ecological and Environmental Economics 55 Cost-benefit analysis 57 Financing conservation 59 What are species worth? Ecosystem services 60 Economic Use Values 61 Direct use values 61 Consumptive use value 61 Productive use value 63 Indirect use values 68 Ecosystem productivity 68 Water and soil protection 70 Climate regulation 72 Species relationships and environmental monitors 73 Amenity value 74 Educational and scientific value 77 Multiple uses of a single resource: A case study 77 The Long-Term View: Option Value 78

Existence Value 80 Environmental Ethics 83 Ethical values of biodiversity 83 Deep ecology 86 Summary 87

Chapter 4

Threats to Biodiversity 90



Human Population Growth and Its Impact 92
Habitat Destruction 96
Tropical rain forests 99
Other threatened habitats 102
Desertification 105

Habitat Fragmentation 106

Threats posed by habitat fragmentation 107

Edge effects 110

Environmental Degradation and Pollution 112

Pesticide pollution 113

Water pollution 114

Air pollution 117

Global Climate Change 118

Ocean acidification, warming, and rising sea
level 122

The overall effect of global warming 124

Overexploitation 126
International wildlife trade 128
Commercial harvesting 130

Invasive Species 132

Threats posed by invasive species 134

Invasive species on oceanic islands 135

Invasive species in aquatic habitats 136

The ability of species to become invasive 137

Control of invasive species 140

GMOs and conservation biology 141

Disease 142 A Concluding Remark 146 Summary 146

Chapter 5

Extinction Is Forever 150



The Meaning of "Extinct" 154

The current, human-caused mass
extinction 155

Local extinctions 158

Extinction rates in aquatic environments 159

Measuring Extinction 160

Background extinction rates 161

Extinction rate predictions and the island biogeography model 161

Extinction rates and habitat loss 164

Vulnerability to Extinction 166
Problems of Small Populations 172

Loss of genetic diversity 172

Consequences of reduced genetic diversity 176

Factors that determine effective population size 179

Other factors that affect the persistence of small populations 184

Demographic stochasticity 184

Environmental stochasticity and catastrophes 187

The extinction vortex 188

Summary 189

Chapter 6

Conserving Populations and Species 192



Applied Population Biology 194

Methods for studying populations 195

Population viability analysis (PVA) 203

Metapopulations 208

Long-term monitoring 210

Conservation Catagories 212

Conservation Categories 212

Prioritization: What Should Be Protected? 21

Legal Protection of Species 222 National laws 222 International agreements to protect species 228 Summary 232

Chapter 7

Bringing Species Back from the Brink



Establishing and Reinforcing Populations 236 Considerations for animal programs 238 Behavioral ecology of released animals 242 Establishing plant populations 243 The status of new populations Ex Situ Conservation Strategies 246 Zoos 249 Aquariums 255 Botanical gardens 256 Seed banks 258

Can Technology Bring Back Extinct Species? 261 Summary 262

Chapter 8

Protected Areas 264



Establishment and Classification of Protected Areas 266

Marine protected areas (MPAs) 271 The effectiveness of protected areas 272 Measuring effectiveness: Gap analysis 274

Designing Protected Areas 277 Protected area size and characteristics 280

Networks of Protected Areas 283 Habitat corridors 284

Landscape Ecology and Park Design 286 Managing Protected Areas 288 Managing sites 290 Monitoring sites 292 Management and people 294 Zoning as a solution to conflicting demands 294 Biosphere reserves 296 Challenges to Park Management 298 Poaching 298 Trophy hunting 298 Human-animal conflict 299 Degradation 299 Climate change 299 Funding and personnel 300 Summary 301

Chapter 9

Conservation Outside Protected Areas 304



The Value of Unprotected Habitat 307

Military land 308

Unprotected forests 310

Unprotected grasslands 310

Unprotected waters 311

Land that is undesirable to humans 312

Private land 312

Conservation in Urban and Other
Human-Dominated Areas 313
Other human-dominated landscapes 315
Ecosystem Management 318
Working with Local People 321
Biosphere reserves 324
In situ agricultural conservation 325
Extractive reserves 325
Community-based initiatives 327

Payments for ecosystem services 328
Evaluating conservation initiatives that involve traditional societies 330

Case Studies: Namibia and Kenya 330

Summary 334

Chapter 10

Restoration Ecology 336



Where to Start? 339
Restoration in Urban Areas 344
Restoration Using Organisms 346
Moving Targets of Restoration 350
Restoration of Some Major Communities 351
Wetlands 351
Aquatic systems 353
Prairies and farmlands 355
Tropical dry forest in Costa Rica 357
The Future of Restoration Ecology 359
Summary 360

Chapter 11

The Challenges of Sustainable Development 362



Level 365

Local and regional conservation
regulations 365

Land trusts and related strategies 367
Enforcement and public benefits 371

Conservation at the National Level 372

International Approaches to Sustainable
Development 374
International Earth summits 374
International agreements that protect
habitat 379

Sustainable Development at the Local

Funding for Conservation 383

The World Bank and international nongovernmental organizations (NGOs) 383

Environmental trust funds 386

Debt-for-nature swaps 387

How effective is conservation funding? 387

Summary 389

Chapter 12

An Agenda for the Future 392



Ongoing Problems and Possible Solutions 394
The Role of Conservation Biologists 402
Challenges for conservation biologists 402
Achieving the agenda 403
Summary 408

Appendix: Selected Environmental
Organizations and Sources of
Information 411
Glossary 415
Chapter Opening Photograph
Credits 424
Bibliography 425
Index 463
About the Author 477