

Brief Contents

PART I Major Issues That Define the Discipline 1

- 1 What Is Conservation Biology? 3
- 2 What Is Biodiversity? 23
- 3 Where Is the World's Biodiversity Found? 53

PART II Valuing Biodiversity 73

- 4 Ecological Economics 75
- 5 Indirect Use Value 95
- 6 Ethical Values 117

PART III Threats to Biodiversity 133

- 7 Extinction 135
- 8 Vulnerability to Extinction 157
- 9 Habitat Destruction, Fragmentation, Degradation, and Global Climate Change 175
- 10 Overexploitation, Invasive Species, and Disease 217

PART IV Conservation at the Population and Species Levels 247

- 11 Problems of Small Populations 249
- 12 Applied Population Biology 275
- 13 Establishing New Populations 297
- 14 Ex Situ Conservation Strategies 315

PART V Practical Applications 341

- 15 Establishing Protected Areas 343
- 16 Designing Networks of Protected Areas 369
- 17 Managing Protected Areas 391
- 18 Conservation Outside Protected Areas 419
- 19 Restoration Ecology 441

PART VI Conservation and Human Societies 463

- 20 Conservation and Sustainable Development at the Local and National Levels 465
- 21 An International Approach to Conservation and Sustainable Development 495
- 22 An Agenda for the Future 523

Contents

Part I | Major Issues That Define the Discipline 1

CHAPTER 1 What Is Conservation Biology? 3

The New Science of Conservation Biology 5

Conservation biology complements the traditional disciplines 6

Conservation biology's ethical principles 7

BOX 1.1 Collaborative Conservation: The Recovery of Kemp's Ridley Sea Turtles 9

The Origins of Conservation Biology 10

European origins 12

American origins 15

A New Science Is Born 18

Conservation biology: A dynamic and growing field 18

CHAPTER 2 What Is Biodiversity? 23

Species Diversity 24

What is a species? 25

BOX 2.1 Naming and Classifying Species 27

The origin of new species 29

Measuring species diversity 32

Genetic Diversity 34

Ecosystem Diversity 36

What are communities and ecosystems? 37

Ecological succession 38

BOX 2.2 Kelp Forests and Sea Otters: Shaping an Ocean Ecosystem 39

Species interactions within ecosystems 40

Principles of community organization 42

Keystone species and guilds 45

Keystone resources 48

Ecosystem dynamics 49

Conclusion 49

CHAPTER 3 Where Is the World's Biodiversity Found? 53

Diverse Ecosystems 53

Tropical forests 53

Coral reefs 54

Oceanic diversity 56

Mediterranean-type communities 56

Patterns of Diversity 56

Variation in climate and environment 56

Variation in topography, geological age, and habitat size 57

Why Are There So Many Species in the Tropics? 58

How Many Species Exist Worldwide? 60

New species are being discovered all the time 60

Discovery of new species 62

Recently Discovered Communities 63

BOX 3.1 Conserving a World Unknown: Hydrothermal Vents and Oil Plumes 64

Diversity surveys: Collecting and counting species 65

Estimating the number of species 65

BOX 3.2 Humans as Habitat: The Incredible Diversity of the Human Microbiome 66

The Need for More Taxonomists and Collections 69

Part II Valuing Biodiversity 73

CHAPTER 4 Ecological Economics 75

Ecological and Environmental Economics 76

Evaluating Development Projects 78

Cost-benefit analysis 78

Natural Resource Loss and the Wealth of Societies 80

BOX 4.1 Conservation as an Economic Driver:
National Parks in the United States 83

CHAPTER 5 Indirect Use Value 95

The Value of Ecosystem Services 95

*Ecosystem productivity and carbon
sequestration* 96

Water and soil protection 98

Waste treatment and nutrient retention 99

BOX 5.1 Prophecy Fulfilled: How Ecosystem Services
Became Front-Page News 100

Climate regulation 102

Species relationships 102

Assigning Economic Value to Biodiversity 85

Direct Use Values 85

Consumptive use value 85

Productive use value 89

*Multiple uses of a single resource:
A case study* 92

BOX 5.2 How Much Are Bats Worth? A Case Study
of Texas Bats 103

BOX 5.3 Pollination: A Vital Ecosystem Service 104

Environmental monitors 105

Amenity value 106

Educational and scientific value 108

The Long-Term View: Option Value 109

Existence Value 112

Is Economic Valuation Enough? 114

BOX 6.2 Religion and Conservation 123

*Enlightened self-interest: Biodiversity and human
development* 126

Evolving Perspectives and Deep Ecology 128

CHAPTER 6 Ethical Values 117

Ethical Values of Biodiversity 118

*Ethical arguments for preserving
biodiversity* 119

BOX 6.1 Sharks: Conservation Benefits of a Public
Perception Makeover? 120

Part III Threats to Biodiversity 133

CHAPTER 7 Extinction 135

Past Mass Extinctions 136

The Current, Human-Caused Mass Extinction 138

Background Extinction Rates 143

Extinction Rates on Islands 143

BOX 7.1 Extinctions of Island Birds 144

Extinction Rates in Aquatic Environments 146

Estimating Extinction Rates with the Island
Biogeography Model 147

Extinction rates and habitat loss 149

*Assumptions and generalizations in the island
biogeography model* 151

Time to extinction 151

Local Extinctions 152

Estimating population extinction rates 153

CHAPTER 8 Vulnerability to Extinction 157

Endemic Species and Extinction 158

Vulnerability to Extinction 160

BOX 8.1 Why Are Frogs and Toads Croaking? 165

IUCN Conservation Categories 166

The U.S. Endangered Species Act 171

Natural Heritage Data Centers 172

CHAPTER 9 Habitat Destruction, Fragmentation, Degradation, and Global Climate Change 175

Human Population Growth and Its Impact 176

Habitat Destruction 179

Threatened tropical rain forests 181*Other threatened habitats* 185*Marine coastal areas* 186*Desertification* 187

Habitat Fragmentation 189

Population effects 192*Edge effects* 194*Two studies of habitat fragmentation* 196

Habitat Degradation and Pollution 197

Pesticide pollution 198*Water pollution* 198BOX 9.1 Pesticides and Raptors: Sentinel Species
Warn of Danger 199*Air pollution* 203

Global Climate Change 205

Changes in temperate and tropical climates 209*Plants and climate change* 210*Rising sea levels and warmer waters* 210*The overall effect of global warming* 212**CHAPTER 10 Overexploitation, Invasive Species, and Disease 217**

Overexploitation 217

Exploitation in the modern world 218*International wildlife trade* 220BOX 10.1 Endangered Whales: Making a
Comeback? 222*Commercial harvesting* 224*What can be done to stop overexploitation?* 226

Invasive Species 227

Invasive species on islands 230

BOX 10.2 GMOs and Conservation Biology 231

Invasive species in aquatic habitats 232*The ability of species to become invasive* 235*Control of invasive species* 236

Disease 238

Implications of Invasive Species and Diseases for
Human Health 241

A Concluding Remark 243

Part IV Conservation at the Population and Species Levels 247**CHAPTER 11 Problems of Small Populations 249**

Essential Concepts for Small Populations 250

Minimum viable population (MVP) 250*Loss of genetic variability* 253*Consequences of reduced genetic variability* 256*Factors that determine effective population
size* 259BOX 11.1 Rhino Species in Asia and Africa: Genetic
Diversity and Habitat Loss 264Other Factors That Affect the Persistence of Small
Populations 266*Demographic variation* 266*Environmental variation and catastrophes* 268

Extinction Vortices 270

CHAPTER 12 Applied Population Biology 275

Methods for Studying Populations 276

Gathering ecological information 277

Monitoring populations 279

BOX 12.1 Finding a Needle in a Haystack:
Monitoring Rare Species with
Environmental DNA (eDNA) 283

Population Viability Analysis 285

BOX 12.2 Three Primatologists Who Became
Activists 286

Metapopulations 290

Long-Term Monitoring of Species and Ecosystems 292

CHAPTER 13 Establishing New Populations 297

Three Approaches to Establishing New Populations 298

BOX 13.1 Wolves Return and Change an
Ecosystem 299

New Animal Populations 301

Learned behavior of released animals 304

New Plant Populations 307

The Status of New Populations 310

CHAPTER 14 Ex Situ Conservation Strategies 315

Ex Situ Conservation Facilities 318

Zoos 318

BOX 14.1 Love Alone Cannot Save the Giant
Panda 319

BOX 14.2 Can Technology Bring Back Extinct
Species? 325

Aquariums 329

Botanical gardens and arboreta 331

Seed banks 333

BOX 14.3 Seed Savers and Crop Varieties 336

Conclusion 339

Part V Practical Applications 341

CHAPTER 15 Establishing Protected Areas 343

Types and Classification of Protected Areas 344

Existing Protected Areas 344

Marine protected areas 346

BOX 15.1 The Rise of Giant Marine Protected
Areas 348

The effectiveness of protected areas 349

Creating New Protected Areas 350

Establishing conservation priorities 352

Identifying areas to protect 354

Selecting New Protected Areas: Filling Gaps and Creating Networks 362

Gap analysis 362

CHAPTER 16 Designing Networks of Protected Areas 369

Issues of Reserve Design 370

Protected area size and characteristics 371

Reserve design and species preservation 375

Minimizing edge and fragmentation effects 376

Networks of Protected Areas 377

Habitat corridors 378

BOX 16.1 Ecologists and Real Estate Experts Mingle
at The Nature Conservancy 379

Habitat corridor case studies 382

Landscape Ecology and Park Design 383

Conclusion 387

CHAPTER 17 Managing Protected Areas 391**Monitoring as a Management Tool 394**

BOX 17.1 Drones: No Longer Just for the
Military 396

Identifying and Managing Threats 397

Managing invasive species 398

Managing Habitat 399

BOX 17.2 Habitat Management: The Key
to Success in the Conservation of
Endangered Butterflies 402

Managing Water 403**Managing Keystone Resources 404****Management and Local Communities 405**

Zoning to separate conflicting demands 406

Regulating Activities inside Protected Areas 410

BOX 17.3 Is Arctic Wildlife Management Compatible
with Oil Drilling? 411

Challenges in Park Management 413

Lack of resources 413

*Management in a rapidly changing
environment* 415

CHAPTER 18 Conservation Outside Protected Areas 419**The Value of Unprotected Habitat 420**

BOX 18.1 In Defense of Wildlife ... Send in the
Soldiers 424

Conservation in Urban Areas 425**Conservation in Agricultural Areas 426****Multiple Use Habitat 428****Ecosystem Management 430****Case Studies 434**

Managed coniferous forests 434

*Community-based wildlife management in
Namibia and Kenya* 435

CHAPTER 19 Restoration Ecology 441**Where to Start? 443**

BOX 19.1 Restoring an Extinct Ecosystem on the
Edge of Amsterdam 444

Damage and Restoration 445**Ecological Restoration Techniques 446**

Practical considerations 447

Restoration in Urban Areas 448**Restoration of Some Major Communities 450**

Wetlands 450

BOX 19.2 Restoring the Everglades: An Ambitious
Project to Restore One of the World's
Largest Wetlands 451

Rivers 452

Lakes 453

Prairies and farmlands 454

BOX 19.3 Can Many Small Projects Clean Up the
Chesapeake Bay? 456

Tropical dry forest in Costa Rica 457

The Future of Restoration Ecology 459

Part VI Conservation and Human Societies 463

CHAPTER 20 Conservation and Sustainable Development at the Local and National Levels 465

Conservation at the Local Level 467

Local legislation 467

BOX 20.1 How Clean Is "Green" Energy? 468

Land trusts and financial incentives 470

Conservation at the National Level 472

The U.S. Endangered Species Act in practice 475

Traditional Societies, Conservation, and Sustainable Use 479

Conservation beliefs 481

Conservation efforts that involve traditional societies 482

Evaluating conservation initiatives that involve traditional societies 489

BOX 20.2 Conservation and Poverty Reduction: Can It Be as Simple as Paying to Protect Bird Nests? 490

CHAPTER 21 An International Approach to Conservation and Sustainable Development 495

International Agreements to Protect Species 497

BOX 21.1 The War for the Elephant: Is the Armistice Over? 499

International Agreements to Protect Habitat 501

International Earth Summits 504

Funding for Conservation 507

What gets funded? 509

Large Development Projects 511

Reforming development lending 512

BOX 21.2 The Three Gorges Dam at Twelve Years Old 514

National environmental funds 516

Debt-for-nature swaps 517

How Effective Is Conservation Funding? 518

Increased funding is necessary for the future 518

CHAPTER 22 An Agenda for the Future 523

Ongoing Problems and Possible Solutions 523

BOX 22.1 Getting Your Hands Dirty: Citizen Science and Shaping the Next Generation of Conservationists 525

The Role of Conservation Biologists 530

BOX 22.2 Environmental Activism Confronts the Opposition in the Field and in the Boardroom 531

Challenges for conservation biologists 532

Achieving the agenda 533

Appendix 539

Illustration Credits 543

Glossary 547

Bibliography 555

Index 589