Contents

PART I Major Issues That Define the Discipline I

CHAPTER | What Is Conservation Biology? 3

The New Science of Conservation Biology 5

Conservation Biology Complements the Traditional Disciplines 5

BOX 1.1 CONSERVATION BIOLOGY'S INTERDISCIPLINARY APPROACH: A CASE STUDY WITH SEA TURTLES 7

Conservation Biology Is a Crisis Discipline 9

Conservation Biology's Ethical Principles 9

The Origins of Conservation Biology I

European Origins 12

American Origins

A New Science Is Born 18

Conservation Biology: A Dynamic and Growing Field I

CHAPTER 2 What Is Biological Diversity? 23

Species Diversity 24

What Is a Species? 25

BOX 2.1 NAMING AND CLASSIFYING SPECIES 26

The Origin of New Species 29

Species Diversity and Its Measurement 31

Genetic Diversity 33

What Is Genetic Diversity? 33

Ecosystem Diversity 36

What Are Communities and Ecosystems? 36

BOX 2.2 KELP FORESTS AND SEA OTTERS: SHAPING AN OCEAN ECOSYSTEM 37

Ecological Succession 39

Species Interactions within Communities 40

Principles of Community Organization 41

Keystone Species and Guilds 44

Keystone Resources 48

Ecosystem Dynamics 48

Conclusion 49

CHAPTER 3 Where Is the World's Biological Diversity Found? 53

Two of the Most Diverse Ecosystems on Earth

Tropical Rain Forests 54 Coral Reefs 55

Patterns of Diversity 57

Variation in Climate and Environment 57
Variation in Topography, Geological Age, and Habitat
Size 57

Why Are There So Many Species in the Tropics? 59

How Many Species Exist Worldwide? 61

New Species Are Being Discovered All the Time 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 66

The Need for More Taxonomists 69

PART II Valuing Biodiversity 73

CHAPTER 4 Ecological Economics and Direct Economic Values 75

Why Economic Valuation Is Needed 75
Assigning Economic Value to Biological Diversity

77

BOX 4.1 INDUSTRY, ECOLOGY, AND ECOTOURISM IN YELLOWSTONE PARK 78

Evaluating Development Projects 79

Cost-Benefit Analysis 79

Natural Resource Loss and the Wealth of Societies 81

One Approach to Assigning Economic Value 83

Direct Use Values 85

BOX 4.2 HOW MUCH IS A SPECIES WORTH? 85
Consumptive Use Value 86

Productive Use Value 88

CHAPTER 5 Indirect Economic Values 95

Nonconsumptive Use Value 95

Ecosystem Productivity and Carbon Sequestration 97
Protection of Water and Soil Resources 98
BOX 5.1 PROPHECY FULFILLED: HOW ECOSYSTEM SERVICES
BECAME FRONT PAGE NEWS 99

Waste Treatment and Nutrient Retention 101 Climate Regulation 101

Species Relationships 102
Environmental Monitors 103

Recreation and Ecotourism 103
Educational and Scientific Value 105

Other Ways of Valuing Biodiversity 105

Option Value 106

BOX 5.2 MIGHTY MULTITUDES OF MICROBES: NOT TO BE IGNORED! 107

Existence Value | | |

Is Economic Valuation Enough? 112

CHAPTER 6 Ethical Values 117

Ethical Values of Biological Diversity 117

Ethical Arguments for Preserving Biological Diversity 119
BOX 6.1 SHARKS: A FEARED ANIMAL IN DECLINE 119
BOX 6.2 RELIGION AND CONSERVATION 122

Enlightened Self-Interest: Biodiversity and Human Development 126

Deep Ecology 127

PART III Threats to Biological Diversity 133

CHAPTER 7 Extinction 135

Past Mass Extinctions 136

The Current, Human-Caused Mass Extinction 138

Background Extinction Rates 142

Extinction Rates on Islands 143

BOX 7.1 INVASIVE SPECIES AND EXTINCTION IN ISLAND ECOSYSTEMS 144

Extinction Rates in Water | 146

Estimating Extinction Rates with the Island Biogeography Model 147

Extinction Rates and Habitat Loss 149
Assumptions and Generalizations in the Island
Biogeography Model 150
Other Methods for Calculating Extinction Rates 150

Local Extinctions | | 15|

CHAPTER 8 **Vulnerability to Extinction** 155

Endemic Species and Extinction

Species Most Vulnerable to Extinction

BOX 8.1 WHY ARE FROGS AND TOADS CROAKING?

Conservation Categories Natural Heritage Data Centers 168

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

The Problem of Human Population Growth

Habitat Destruction 177

Threatened Rain Forests 180 Other Threatened Habitats 184

Desertification 187

Habitat Fragmentation 188

Edge Effects 193

Two Studies of Habitat Fragmentation

Habitat Degradation and Pollution

Pesticide Pollution 198

BOX 9.1 PESTICIDES AND RAPTORS: SENTINEL SPECIES

WARN OF DANGER 198 Water Pollution 200

Air Pollution 202

Global Climate Change 205

Changes in Temperate and Tropical Climates

Plants and Climate Change 210

Rising Sea Levels and Warmer Waters

The Overall Effect of Global Warming 211

CHAPTER 10 Overexploitation, Invasive Species, and Disease 215

Overexploitation 215

Exploitation in the Modern World 217

BOX 10.1 ENDANGERED WHALES: MAKING A COMEBACK?

219

Maximum Sustainable Yield 223

What Can Be Done To Stop Overexploitation? 224

Invasive Species 224

BOX 10.2 GMOS AND CONSERVATION BIOLOGY 227

Invasive Species on Islands 228 Invasive Species in Aquatic Habitats 229

The Ability of Species to Become Invasive 231

Disease 235

Implications of Invasive Species and

Diseases for Human Health 238

Conclusion 239

PART IV Conservation at the Population and Species Levels

CHAPTER 11 **Problems of Small Populations** 245

Essential Concepts for Small Populations 246

Minimum Viable Population (MVP)

Loss of Genetic Variability 248

Consequences of Reduced Genetic Variability 251

Factors That Determine Effective Population Size 255

BOX 11.1 RHINO SPECIES IN ASIA AND AFRICA: GENETIC

DIVERSITY AND HABITAT LOSS 260

Other Factors That Affect the Persistence of Small Populations 262

263 Demographic Variation

Environmental Variation and Catastrophes 264

Extinction Vortices 266

CHAPTER 12 Applied Population Biology 271

Methods for Studying Populations 273

Gathering Ecological Information 273

Monitoring Populations 275

BOX 12.1 THREE PRIMATOLOGISTS WHO BECAME ACTIVISTS 276

Population Viability Analysis 283

Metapopulations 285

Long-Term Monitoring of Species and

Ecosystems 288

CHAPTER 13 Establishing New Populations 293

Three Approaches to Establishing New Populations 294

BOX 13.1 WOLVES RETURN TO A COLD WELCOME 295

Considerations for Successful Programs 297

Social Behavior of Released Animals 299
Animal Reintroduction Case Studies 301

Establishing New Plant Populations 302

The Status of New Populations 305

CHAPTER 14 Ex Situ Conservation Strategies 309

Limitations of Ex Situ Conservation 312

Ex Situ Conservation Facilities 313

Zoos 314

BOX 14.1 LOVE ALONE CANNOT SAVE THE GIANT PANDA 315

Aquariums 321

Botanical Gardens and Arboretums 322

BOX 14.2 SEED SAVERS AND CROP VARIETIES 328

Conclusion 332

PART V Practical Applications 335

CHAPTER 15 Establishing Protected Areas 337

The IUCN System of Classification 338

Existing Protected Areas 339

Marine Protected Areas 340
Size and Effectiveness 341

Creating New Protected Areas 342

Identifying Priorities for Protecting Biodiversity 343

Determining Which Areas Should Be Protected 345
BOX 15.1 THE IVORY-BILLED WOODPECKER AND THE
UNEXPECTED VALUE OF PROTECTED AREAS 350

Linking New Protected Areas to Reserve Networks 353

Gap Analysis 353

CHAPTER 16 Designing Networks of Protected Areas 361

Issues of Reserve Design 362

Protected Area Size and Characteristics 363
Reserve Design and Species Preservation 367
Minimizing Edge and Fragmentation Effects 368

Conservation Networks 368

BOX 16.1 ECOLOGISTS AND REAL ESTATE EXPERTS MINGLE AT THE NATURE CONSERVANCY 369

Linking Protected Areas with Habitat Corridors 371
Habitat Corridor Case Studies 373

Landscape Ecology and Park Design 375

Conclusion 377

CHAPTER 17 Managing Protected Areas 381

Monitoring as a Management Tool 384 Identifying and Managing Threats 386

Managing Invasive Species 386

Managing Habitat 386

BOX 17.1 HABITAT MANAGEMENT: THE KEY TO SUCCESS IN THE CONSERVATION OF ENDANGERED BUTTERFLIES 388

Managing Water 389

Managing Keystone Resources 392

Managing Parks and People 392

Zoning To Partition Resource Needs 394
BOX 17.2 MANAGING LEOPARDS TOGETHER WITH
PEOPLE 394

Regulating Activities inside Protected Areas 398

BOX 17.3 IS ARCTIC WILDLIFE MANAGEMENT COMPATIBLE WITH OIL DRILLING? 399

Challenges in Park Management 400

CHAPTER 18 Outside Protected Areas 405

The Value of Unprotected Habitat 407

BOX 18.1 IN DEFENSE OF WILDLIFE... SEND IN THE MARINES 410

Conservation in Urban Areas 411

Conservation in Agricultural Areas 412

Multiple-Use Habitat 413

Ecosystem Management 415

Case Studies 418

Managed Coniferous Forests 418
African Wildlife Outside Parks 419

Community-Based Wildlife Management in Namibia 421

CHAPTER 19 Restoration Ecology 427

Damage and Restoration 428

BOX 19.1 CAN MANY SMALL PROJECTS CLEAN UP THE CHESAPEAKE BAY? 430

Ecological Restoration Techniques 431

Practical Considerations 432

Case Studies 434

Wetlands Restoration in Japan 434
The Grand Canyon–Colorado River Ecosystem 435

Restoration in Urban Areas 436

Restoration of Some Major Communities 436

Wetlands 436

BOX 19.2 EASIER SAID THAN DONE: RESTORING THE KISSIMMEE RIVER 437

Lakes 439 Prairies 439

Tropical Dry Forest in Costa Rica 441

The Future of Restoration Ecology 443

PART VI Conservation and Human Societies 447

CHAPTER 20 Conservation and Sustainable Development at the Local and National Levels 449

Conservation at the Local Level 451

Land Trusts 45 I Local Legislation 453

Conservation at the National Level 455

National Legislation 455

The U.S. Endangered Species Act 457

Traditional Societies, Conservation, and Sustainable Use 462

Conservation Beliefs 463

Conservation Efforts That Involve Traditional Societies 465

BOX 20.1 PEOPLE-FRIENDLY CONSERVATION IN THE HILLS OF SOUTHWEST INDIA 469

Evaluating Conservation Initiatives That Involve Traditional Societies 473

CHAPTER 21 An International Approach to Conservation and Sustainable Development 477

International Agreements to Protect Species 479

BOX 21.1 THE WAR FOR THE ELEPHANT: IS THE ARMISTICE OVER? 481

International Agreements to Protect Habitat 483

International Earth Summits 486

International Funding 489

The World Bank and the Global Environment Facility 491 National Environmental Funds 493 Debt-For-Nature Swaps 493 Marine Environments 494
Is the Funding Adequate and Effective? 494

International Development Banks and Ecosystem Damage 495

Development Lending Case Studies 496
BOX 21.2 HOW MUCH WILL THE THREE GORGES
DAM REALLY COST? 498

Reforming Development Lending 501
Increased Funding Is Necessary for the Future 503

CHAPTER 22 An Agenda for the Future 507

Ongoing Problems and Possible Solutions 507

BOX 22.1 CONSERVATION EDUCATION: SHAPING THE NEXT GENERATION INTO CONSERVATIONISTS 508
BOX 22.2 ENVIRONMENTAL ACTIVISM CONFRONTS THE OPPOSITION 514

The Role of Conservation Biologists 516
Challenges for Conservation Biologists 516
BOX 22.3 WHAT WILL OUR WORLD BE LIKE
IN 2050? 517

Achieving the Agenda 518

Appendix 525
Glossary 529
Bibliography 537
Index 571