

# Contents

Preface xiii

## Part I. Background

### Chapter 1. Introduction 3

- 1.1. New Bedford Harbor 3
  - 1.1.1. *The Economic Assessment* 6
  - 1.1.2. *Legal Settlement* 7
  - 1.1.3. *Cleanup and Restoration Actions* 8
  - 1.1.4. *Conclusion* 10
- 1.2. Introduction to the Book 11
- 1.3. Public Policy and Economic Assessments 12
- 1.4. Outline of the Book 13
- 1.5. Note 15
- 1.6. References 16

### Chapter 2. Primer on Welfare Economics and Environmental Economics 19

- 2.1. Background 19
- 2.2. Introduction to Welfare Economics 20
  - 2.2.1. *Prices and Distortions* 21
  - 2.2.2. *Economic Value versus Economic Effects* 22
- 2.3. Ex Ante Versus Ex Post Economic Measures and Perspectives 25
- 2.4. Introduction to Environmental Economics 28
  - 2.4.1. *Externality Theory* 28
  - 2.4.2. *Economic Efficiency* 31
- 2.5. Glossary of Economic Terminology, Measures, and Methods 32
  - 2.5.1. *Economic Terminology* 32
  - 2.5.2. *Economic Measures* 38
  - 2.5.3. *Economic Methods* 40
- 2.6. Notes 42
- 2.7. References 42

## **Chapter 3. Federal Legislation and Rulemaking: Marine Pollution and Economic Methods 45**

- 3.1. Introduction 45
- 3.2. Federal Hazardous Substances Legislation 45
  - 3.2.1. *Water Quality—Clean Water Act (CWA)* 46
  - 3.2.2. *Transportation and Ocean Dumping of Wastes (MPRSA [ODA])* 48
  - 3.2.3. *Brownfields—Contaminated Sites (CERCLA)* 49
  - 3.2.4. *Oil Spills (OPA)* 52
  - 3.2.5. *Toxic Substances (TSCA)* 53
  - 3.2.6. *Solid and Hazardous Wastes Disposal (RCRA)* 53
  - 3.2.7. *Food and Drugs* 54
- 3.3. Water Resource Development and River Basin Planning 54
  - 3.3.1. *Introduction* 54
- 3.4. Federal Rulemaking 55
  - 3.4.1. *Analysis of Federal Water Resource Projects* 55
  - 3.4.2. *Federal Economic Regulatory Analysis Procedures* 58
- 3.5. U.S. DOI Procedures for Natural Resource Damage Assessments 60
  - 3.5.1. *Introduction* 60
  - 3.5.2. *U.S. DOI NRDA Rules and Procedures* 62
- 3.6. U.S. DOC (NOAA) Procedures for Natural Resource Damage Assessments 72
  - 3.6.1. *Introduction* 72
  - 3.6.2. *NOAA NRDA Rules and Procedures* 73
- 3.7. Summary of Federal NRDA Rules and Procedures 78
  - 3.7.1. *NRDA Procedures* 78
  - 3.7.2. *Future Issues* 80
  - 3.7.3. *Progress and Cases to Date* 80
- 3.8. National Estuary Program Overview 81
  - 3.8.1. *Introduction* 81
  - 3.8.2. *Approach to Estuary Projects Under the NEP* 83
- 3.9. Notes 84
- 3.10. References 84

## **Chapter 4. Water Quality Degradations in Marine Environments: Impairments and Effects 91**

- 4.1. Introduction 91
- 4.2. Identifiable Substances 92
- 4.3. Types of Impairments 93
- 4.4. Ecosystem Health and Productivity: Impacts on Organisms 94
- 4.5. Present State of Marine Water Quality in the United States 97
  - 4.5.1. *Historical Evidence of Occurrence of Hazardous Substances: Evidence from the National Status and Trends Program* 99
  - 4.5.2. *Unsafe Seafood and Fish Consumption Advisories* 101
  - 4.5.3. *Marine Debris and Floatable Waste* 102

- 4.6. References 102
- 4.7. Further Reading 105

## Part II. Principles and Theory

- Chapter 5. Economic Damages and Losses: Principles and Methods of Assessments 113**
  - 5.1. Introduction 113
  - 5.2. Economic Measures 114
    - 5.2.1. *Aggregate Economic Activity* 115
    - 5.2.2. *Economic Impacts* 115
    - 5.2.3. *Benefits in an Economic Welfare Context* 117
    - 5.2.4. *Benefits in a Cost–Benefit Analysis Context* 119
  - 5.3. Economic Methods 122
    - 5.3.1. *Present Value Analysis* 122
    - 5.3.2. *Economic Impacts: Economic Impact Analysis (Public Policy Analysis)* 126
    - 5.3.3. *Economic Impacts: Input/Output Analysis* 127
  - 5.4. Economic Welfare Measures: Consumption Sector 129
    - 5.4.1. *Demand and the Concept of Economic Benefits* 129
    - 5.4.2. *Ordinary Consumer Surplus as a Benefit Measure* 131
    - 5.4.3. *Income and Substitution Effects of Price Changes* 133
    - 5.4.4. *Alternative Consumer Welfare Measures* 135
  - 5.5. Economic Welfare Measures: Production Sector 138
    - 5.5.1. *Profit as a Measure of Producer Welfare* 138
    - 5.5.2. *Alternative Producer Welfare Measures* 139
  - 5.6. Economic Welfare Aggregation over Individual Consumers and Producers 141
    - 5.6.1. *Private Sector/Goods Aggregation* 141
    - 5.6.2. *Public Sector/Goods Aggregation* 142
  - 5.7. Economic Losses versus Impacts: Measuring Net Losses due to Marine Pollution 143
  - 5.8. Intertemporal Economic Losses 152
  - 5.9. Scope of Analysis, Federal Criteria, and Transfers 153
    - 5.9.1. *Scope of Analysis* 153
    - 5.9.2. *Federal Criteria* 153
    - 5.9.3. *Transfers* 153
  - 5.10. Economic Value in a Total Valuation Framework 154
  - 5.11. Simplified NRDA's (Natural Resource Damage Assessments) 154
    - 5.11.1. *Introduction* 154
    - 5.11.2. *Economic Damage Assessments in Federal NRDA's* 155
  - 5.12. Technical Appendix to Chapter 5: Exact Hicksian Welfare Measures 157
  - 5.13. Technical Appendix to Chapter 5: Economic Value in a Total Valuation Framework 160

- 5.14. Technical Appendix to Chapter 5: Problem of Sequencing Losses or Gains in Economic Welfare Given Multiple (Substitute) Sites 161
- 5.15. Note 163
- 5.16. References 163

**Chapter 6. Identification of Biological Effects and Subsequent Economic Effects and Losses from Water Quality Impairments and Degradations in Marine Environments 167**

- 6.1. Introduction and Linkages 167
  - 6.1.1. *Linkages* 168
- 6.2. Impairments in Marine Environments and Subsequent Economic Effects and Economic Losses 170
  - 6.2.1. *Damage to Habitat* 170
  - 6.2.2. *Damage to Fish and Shellfish* 178
  - 6.2.3. *Damage to Birds, Mammals, Sea Turtles* 185
  - 6.2.4. *Damage to Public Health* 186
  - 6.2.5. *Damage to Beach Use* 190
  - 6.2.6. *Damage to Commercial and Pleasure Vessels* 192
  - 6.2.7. *Damage to Property Value* 192
- 6.3. References 193

**Chapter 7. Evaluation of Economic Techniques to Assess Economic Welfare Losses 197**

- 7.1. Introduction 197
- 7.2. Direct Nonmarket Valuation Methods 198
  - 7.2.1. *Contingent Valuation Approach* 198
  - 7.2.2. *Simulated Markets* 204
- 7.3. Indirect or Imputed Market Valuation Methods 205
  - 7.3.1. *Travel Cost Approach* 205
  - 7.3.2. *Household Production Framework* 206
  - 7.3.3. *Travel Cost—Varying Parameter Model* 207
  - 7.3.4. *Hedonic Travel Cost Approach* 208
  - 7.3.5. *Random Utility Models* 209
- 7.4. Property Valuation Techniques 211
  - 7.4.1. *Hedonic Price Approach* 212
  - 7.4.2. *Repeat Sales Approach* 215
- 7.5. Economic Methods to Value Morbidity and Mortality Health Effects 217
  - 7.5.1. *Human Capital or Cost-of-Illness Approach* 217
  - 7.5.2. *Willingness-to-Pay or Contingent Valuation Approach* 218
  - 7.5.3. *Adjusted Health Value Approaches* 219
- 7.6. Market Valuation of Rents in the Production Sector 220
- 7.7. Note 221
- 7.8. References 221

## Part III. Applications

### **Chapter 8. Application of Economic Techniques to Assess Economic Losses: Examples 233**

- 8.1. Introduction 233
- 8.2. Contingent Valuation Approach 234
  - 8.2.1. *Application of the Contingent Valuation Approach* 234
  - 8.2.2. *Contingent Valuation Approach—Examples* 236
- 8.3. Travel Cost Approach 240
  - 8.3.1. *Application of the Travel Cost Approach* 240
  - 8.3.2. *Travel Cost Approach—Examples* 243
- 8.4. Hedonic Price Approach 251
  - 8.4.1. *Introduction* 251
  - 8.4.2. *Structure of Approach* 252
  - 8.4.3. *Hedonic Price Approach—Examples* 257
- 8.5. Repeat Sales Approach 259
  - 8.5.1. *Introduction* 259
  - 8.5.2. *Structure of Approach* 259
  - 8.5.3. *Repeat Sales Approach—Economic Damage from PCB Contamination in New Bedford Harbor, Massachusetts* 261
- 8.6. Insights on Use of Benefits Transfer 264
  - 8.6.1. *Future of Benefits Transfer* 267
- 8.7. Applications: A Caution 268
- 8.8. Note 268
- 8.9. References 268

### **Chapter 9. Case Studies: Damage to Fish–Shellfish, Public Health, Beach Use, Property Value, and Impairments to Estuaries 273**

- 9.1. Introduction 273
- 9.2. Damage to Fish–Shellfish 274
  - 9.2.1. *Harvest Closures and Restrictions* 274
  - 9.2.2. *Mortality—Fish–Shellfish Kills* 275
- 9.3. Damage to Public Health 276
  - 9.3.1. *Unsafe Seafood—Demand Effects* 276
- 9.4. Damage to Beach Use—Closures/Restrictions 278
- 9.5. Damage to Property Value—Housing, Real Estate 280
- 9.6. Detailed Assessments of Impairments to Resources or Improvements to Water Quality in Selected Estuaries in the U.S. EPA National Estuary Program 281
  - 9.6.1. *Long Island Sound Study* 281
  - 9.6.2. *New York Bight Use Impairments* 285
  - 9.6.3. *Buzzards Bay Project—New Bedford Harbor Impairments* 301

|                                                                                                                                      |            |
|--------------------------------------------------------------------------------------------------------------------------------------|------------|
| 9.6.4. Chesapeake Bay Program                                                                                                        | 311        |
| 9.6.5. Delaware Estuary Program                                                                                                      | 314        |
| 9.6.6. Narragansett Bay Program                                                                                                      | 316        |
| 9.7. Conclusion                                                                                                                      | 317        |
| 9.8. Note                                                                                                                            | 319        |
| 9.9. References                                                                                                                      | 319        |
| <br>                                                                                                                                 |            |
| <b>Chapter 10. Restoration of Coastal Wetlands, the Role of Trustees, and Scaling Restoration Projects</b>                           | <b>325</b> |
| 10.1. Introduction                                                                                                                   | 325        |
| 10.2. Insights on Wetlands Restoration Efforts                                                                                       | 326        |
| 10.2.1. Factors and Considerations Based on NOAA–NRDA Rules                                                                          | 327        |
| 10.2.2. Parameters and Criteria in Evaluations of Wetlands Restorations                                                              | 327        |
| 10.2.3. Restoration of a Coastal Salt Marsh—Exxon Bayway Arthur Kill Oil Spill                                                       | 328        |
| 10.3. Insights on Overseers and Trustees in Restoration Efforts: Their Role, Arrangement, and Lifespan                               | 332        |
| 10.4. Insights on Scaling Restoration Projects and Determining Optimal Size                                                          | 333        |
| 10.4.1. Resource-to-Resource or Service-to-Service Scaling Approach                                                                  | 334        |
| 10.4.2. Valuation Scaling Approach                                                                                                   | 336        |
| 10.4.3. Further Insights in Scaling Projects                                                                                         | 336        |
| 10.5. References                                                                                                                     | 340        |
| <br>                                                                                                                                 |            |
| <b>Chapter 11. Policy Options and Future Directions: Effectiveness of Liability Rules and Future Directions for the NRDA Process</b> | <b>345</b> |
| 11.1. Introduction                                                                                                                   | 345        |
| 11.2. Use of Liability Rules in Controlling Random Pollution Events                                                                  | 345        |
| 11.3. The Effect of Risk and Uncertainty in Liability Rules and Outcomes                                                             | 346        |
| 11.4. Future Directions in NRDA and Assessing Losses from Marine Pollution                                                           | 347        |
| 11.5. Note                                                                                                                           | 348        |
| 11.6. References                                                                                                                     | 348        |
| <br>                                                                                                                                 |            |
| <i>Appendix A. NOAA’s Damage Assessment and Restoration Program Settlements and Restoration Status (as of May 4, 1998)</i>           | <i>351</i> |
| <i>Appendix B. Benefits Measures</i>                                                                                                 | <i>371</i> |
| <i>Index</i>                                                                                                                         | <i>381</i> |