## Contents

### Part I Introduction

1. **Noise and Marine Life: Progress From Nyborg to Cork in Science and Technology to Inform Decision Making** ................................................................. 3  
   Brandon L. Southall

2. **Listening Backward: Early Days of Marine Bioacoustics** ............................................. 11  
   William N. Tavolga

### Part II Sound Detection by Aquatic Animals

3. **Effects of Underwater Noise on Marine Mammals** ................................................................. 17  
   Christine Erbe

4. **Psychophysical Studies of Auditory Masking in Marine Mammals: Key Concepts and New Directions** .................................................................................. 23  
   Colleen Reichmuth

5. **On the Relationship Between Environmental Noise, Critical Ratios, and Comodulation Masking Release in the Bottlenose Dolphin (Tursiops truncatus)** ......................................................... 29  
   Brian K. Branstetter, Jennifer S. Trickey, and James J. Finneran

6. **Direct Measurements of Subjective Loudness in a Bottlenose Dolphin** .............................. 33  
   Carolyn E. Schlundt and James J. Finneran

7. **High Auditory Time Resolution in Bottlenose Dolphins Is Effective Protection Against Reverberation** ...................................................................................... 37  
   Gennadi Zaslavski

8. **Frequency Selectivity in the Bottlenose Dolphin Auditory System** ...................................... 41  
   Gennadi Zaslavski

9. **Auditory Brain Stem Responses Associated with Echolocation in an Atlantic Bottlenose Dolphin (Tursiops truncatus)** ......................................................... 45  
   Songhai Li, Paul E. Nachtigall, and Marlee Breese

10. **Hearing, Noise, and Echolocating Odontocetes** ................................................................. 49  
    Paul E. Nachtigall, Alexander Y. Supin, and Marlee Breese
11 Evoked Potential Audiometry in Aquatic Mammals .................................................... 53
Alexander Y. Supin

12 Prediction of a Mysticete Audiogram via Finite Element Analysis of the Middle Ear ............................................................................................................. 57
Andrew Tubelli, Aleks Zosuls, Darlene Ketten, and David C. Mountain

13 Reverse Engineering the Cetacean Ear to Extract Audiograms .............................. 61
Aleks Zosuls, Seth O. Newburg, Darlene R. Ketten, and David C. Mountain

14 Validation of a Vibroacoustic Finite Element Model Using Bottlenose Dolphin Experiments ....................................................................................................... 65
Petr Krysl, Vanessa Trijoulet, and Ted W. Cranford

15 Acoustic Function in the Peripheral Auditory System of Cuvier’s Beaked Whale (Ziphius cavirostris) ................................................................................. 69
Ted W. Cranford and Petr Krysl

16 Auditory Evoked Potential Measurement of Hearing Sensitivity in Pinnipeds ........... 73
Jason Mulsow, Colleen Reichmuth, Dorian Houser, and James J. Finneran

17 Hearing in Birds: What Changes From Air to Water ................................................ 77
Robert J. Dooling and Sara C. Therrien

18 Amphibious Hearing in Sea Turtles ........................................................................ 83
Wendy E. Dow Piniak, David A. Mann, Scott A. Eckert, and Craig A. Harms

19 Hearing Capabilities of Loggerhead Sea Turtles (Caretta caretta) Throughout Ontogeny ........................................................................................................... 89
Ashley L. Lavender, Soraya M. Bartol, and Ian K. Bartol

20 Are Sharks Even Bothered by a Noisy Environment? ............................................. 93
Brandon M. Casper, Michele B. Halvorsen, and Arthur N. Popper

Marco Lugli

22 A Critical Reevaluation of the Role of Acoustic Pressure in Source Localization by Fish ........................................................................................................... 101
Peter H. Rogers, James S. Martin, and John R. Bogle

23 Vibration of the Otoliths in a Teleost ..................................................................... 105
Carl R. Schilt, Ted W. Cranford, Petr Krysl, Robert E. Shadwick, and Anthony D. Hawkins

24 Hearing Sensitivity of the Painted Goby, Pomatoschistus pictus ................................. 109
Marta Bolgan, Silvia S. Pedroso, Raquel O. Vasconcelos, Joana M. Jordão, M. Clara P. Amorim, and Paulo J. Fonseca

25 Acoustic Communication in Pomatoschistus spp.: A Comparison Between Closely Related Species ....................................................................................... 113
Silvia S. Pedroso, Marta Bolgan, Joana M. Jordão, Paulo J. Fonseca, and M. Clara P. Amorim

26 Importance of Hearing for Survival of Danio rerio (Zebrafish) in an Experimental Predator/Prey Environment .............................................................................. 117
Rikke Agner Jørgensen, Christian Brandt, Magnus Wahlberg, and Jakob Christensen-Dalsgaard
27 Lateral Line Canal Morphology and Noise Reduction ................................................ 121
   Adrian T. Klein and Horst Bleckmann

28 Potential for Sound Sensitivity in Cephalopods ............................................................ 125
   T. Aran Mooney, Roger Hanlon, Peter T. Madsen, Jakob Christensen-Dalsgaard,
   Darlene R. Ketten, and Paul E. Nachtigall

29 Listening in Noise ............................................................................................................. 129
   Richard R. Fay

30 Discovery of Sound in the Sea: An Online Resource .................................................... 135
   Kathleen J. Vigness-Raposa, Gail Scowcroft, James H. Miller, and Darlene Ketten

Part III    Sound Production by Aquatic Animals

31 Whistles of Bottlenose Dolphins: Group Repertoires and Geographic
   Variations in Brazilian Waters....................................................................................... 141
   Lisa S. Hoffmann, Elton Ferlin, Pedro F. Fruet, Rodrigo C. Genovês,
   Fernanda P. Valdez, Juliana Di Tullio, Glaucio Caon, and Thales R. Freitas

32 Detection and Classification of Vocalizations for the Study of Marine
   Mammal Distributions in the Chukchi Sea ................................................................... 145
   David Hannay

33 Acoustic Ecology and Behavior of Minke Whales in the Hawaiian
   and Marianas Islands: Localization, Abundance Estimation,
   and Characterization of Minke Whale “Boings” ......................................................... 149
   Thomas Norris, Stephen Martin, Len Thomas, Tina Yack, Julie N. Oswald,
   Eva-Marie Nosal, and Vincent Janik

34 What You See Is Not What You Hear: The Relationship Between
   Odontocete Echolocation Click Production and Hearing ............................................ 155
   Laura N. Kloepper, Paul E. Nachtigall, and Marlee Breese

35 Sound Production and Reception in Southern Sea Otters
   (Enhydra lutris nereis) ............................................................................................... 157
   Asila Ghoul and Colleen Reichmuth

36 Nocturnal Acoustic Activity in the Shallow Waters of the WWF-Miramare
   Natural Marine Reserve (Trieste, Italy) ........................................................................ 161
   Antonio Codarin, Marta Picciulin, Linda Sebastianutto, Giuliana Calcagno,
   Maurizio Spoto, and Enrico A. Ferrero

37 Acoustic Ecology of the California Mantis Shrimp
   (Hemisquilla californiensis) ......................................................................................... 165
   Erica R. Staaterman, Christopher W. Clark, Austin J. Gallagher,
   Thomas Claverie, Maya S. deVries, and Sheila N. Patek

38 Influence of Turbidity on the Incidence of Sound Production in Atlantic
   Croaker (Micropogonias undulatus) in Pamlico Sound, North Carolina .................... 169
   Cecilia S. Krahforst, John P. Walsh, Mark W. Sprague, Devon O. Eulie,
   D. Reide Corbett, and Joseph J. Luczkovich

39 Propagation of Lusitanian Toadfish Sounds in Estuarine Shallow Waters ............... 173
   Andreia Ramos, M. Clara P. Amorim, and Paulo J. Fonseca
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Sound Production in Some Physostomous Fish Species and Effects of Biological Sounds on Fish</td>
<td>Michail Y. Kuznetsov and Yury A. Kuznetsov</td>
</tr>
<tr>
<td>41</td>
<td>Is Biological Sound Production Important in the Deep Sea?</td>
<td>Rodney A. Rountree, Francis Juanes, Clifford A. Goudey, and Kenneth E. Ekstrom</td>
</tr>
<tr>
<td>42</td>
<td>Unusual and Unexpected Biological Noisemakers in the Irish Sea and St. George’s Channel</td>
<td>Rodney Coates, Gillian A. Coates, Rachel Porter, Andrew Davies, and Dylan Evans</td>
</tr>
</tbody>
</table>

**Part IV  Physiological Effects of Sounds**

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>Noise-Induced Hearing Loss: From Animal Models to Human Trials</td>
<td>Colleen G. Le Prell</td>
</tr>
<tr>
<td>44</td>
<td>Auditory Effects of Underwater Noise in Odontocetes</td>
<td>James J. Finneran</td>
</tr>
<tr>
<td>45</td>
<td>Implementation of Acoustic Dosimeters With Recoverable Month-Long GPS/TDR Tags to Interpret Controlled-Exposure Experiments for Large Whales</td>
<td>Bruce R. Mate</td>
</tr>
<tr>
<td>46</td>
<td>Marine Mammal Auditory System Noise Impacts: Evidence and Incidence</td>
<td>Darlene R. Ketten</td>
</tr>
<tr>
<td>47</td>
<td>Effect of Broadband Sounds on the Auditory Evoked Potential Thresholds in the Beluga Whale</td>
<td>Vladimir V. Popov and Alexander Y. Supin</td>
</tr>
<tr>
<td>48</td>
<td>The ESME Workbench: Simulating the Impact of Anthropogenic Sound on Marine Mammals</td>
<td>David C. Mountain, David Anderson, Andrew Brughera, Matthew Cross, Dorian S. Houser, Nael Musleh, Michael Porter, and Martin Siderius</td>
</tr>
<tr>
<td>49</td>
<td>Using EarLab to Study Masking Due to Anthropogenic Sound</td>
<td>David C. Mountain, David Anderson, and Andrew Brughera</td>
</tr>
<tr>
<td>50</td>
<td>Portable Auditory Evoked Potential System to Assess Odontocete Hearing</td>
<td>Aude F. Pacini, Paul E. Nachtigall, and Laura N. Kloeppeper</td>
</tr>
<tr>
<td>51</td>
<td>Barotrauma in Fish and Barotrauma Metrics</td>
<td>Thomas J. Carlson</td>
</tr>
<tr>
<td>52</td>
<td>Assessment of Barotrauma Injury and Cumulative Sound Exposure Level in Salmon After Exposure to Impulsive Sound</td>
<td>Michele B. Halvorsen, Brandon M. Casper, Thomas J. Carlson, Christa M. Woodley, and Arthur N. Popper</td>
</tr>
<tr>
<td>53</td>
<td>Shipboard Assessment of Hearing Sensitivity of Tropical Fishes Immediately After Exposure to Seismic Air Gun Emissions at Scott Reef</td>
<td>Mardi C. Hastings and Jennifer Miksis-Olds</td>
</tr>
<tr>
<td>54</td>
<td>A Lack of Correlation Between Air Gun Signal Pressure Waveforms and Fish Hearing Damage</td>
<td>Robert D. McCauley and Chandra Salgado Kent</td>
</tr>
</tbody>
</table>
Contents

55 Effects of Short-and Long-Term Exposure to Boat Noise on Cortisol Levels in Juvenile Fish
Ilaria Spiga, Joe Fox, and Robert Benson ................................................................. 251

56 Potential Effects of Long-Term Exposure to Boat Noise on the Growth, Survival, and Nutrient Retention in Juvenile Fish
Ilaria Spiga, Joe Fox, and Robert Benson ................................................................. 255

57 Predicting Hearing Loss in Fishes
Michael E. Smith ...................................................................................................... 259

58 Effects of Pile-Driving Noise on Oncorhynchus mykiss (Steelhead Trout)
Richard Oestman and Christopher J. Earle ............................................................. 263

Part V Anthropogenic Sounds and Behavior

59 Controlled Exposure Study of Dolphins and Sea Lions to Midfrequency Sonarlike Signals
Dorian Houser, Laura Yeates, Daniel Crocker, Stephen W. Martin, and James J. Finneran .............................................................................................................. 269

60 A Direct Comparison of Bottlenose Dolphin and Common Dolphin Behavior During Seismic Surveys When Air Guns Are and Are Not Being Utilized
Sarah B. Barry, Anna C. Cucknell, and Nicola Clark .................................................. 273

61 Behavioral Reactions of Harbor Porpoise to Pile-Driving Noise
Jakob Tougaard, Line A. Kyhn, Mats Amundin, Daniel Wennerberg, and Carolina Bordin ............................................................................................................. 277

62 Effects of Offshore Pile Driving on Harbor Porpoises (Phocoena phocoena)
Miriam J. Brandt, Ansgar Diederichs, Klaus Betke, and Georg Nehls ....................... 281

63 Evaluating the Effects of Offshore Pile Driving on Phocoena phocoena (Harbor Porpoises) by Using Passive Acoustic Monitoring
Klaus Lucke, Michael Dähne, Sven Adler, Anja Brandecker, Kathrin Krügel, Janne K. Sundermeyer, and Ursula Siebert .................................................................................. 285

64 Effects of Underwater Explosions on Presence and Habitat Use of Harbor Porpoises in the German Baltic Sea
Janne K. Sundermeyer, Klaus Lucke, Michael Dähne, Anja Gallus, Kathrin Krügel, and Ursula Siebert ............................................................................................................. 289

65 Behavioral-Response Studies: Problems With Statistical Power
Rebecca A. Dunlop, Michael J. Noad, and Douglas H. Cato ........................................ 293

66 Detection and Tracking of Whales Using a Shipborne, 360° Thermal-Imaging System
Elke Burkhardt, Lars Kindermann, Daniel Zitterbart, and Olaf Boebel ......................... 299

67 Distribution of Bowhead Whale Calls Near an Oil Production Island With Fluctuating Underwater Sound
W. John Richardson, Trent L. McDonald, Charles R. Greene, Jr., Susanna B. Blackwell, and Bill Streever ................................................................. 303

68 Assessment of the Effect of Natural and Anthropogenic Aquatic Noise on Vaquita (Phocoena sinus) Through a Numerical Simulation
Giovanni Castellazzi, Petr Krysl, Lorenzo Rojas, and Ted W. Cranford ......................... 307
69 Impacts of Anthropogenic Sounds on *Phocoena phocoena* (Harbor Porpoise)........... 311
Ronald Kastelein and Nancy Jennings

70 Changes in Vocal Behavior of North Atlantic Right Whales in Increased Noise ................................................................. 317
Susan E. Parks, Mack P. Johnson, Douglas P. Nowacek, and Peter L. Tyack

71 Acoustic Compensation to Shipping and Air Gun Noise by Mediterranean Fin Whales (*Balaenoptera physalus*) ............................................................................ 321
Manuel Castellote, Christopher W. Clark, and Marc O. Lammers

72 Long-Term Monitoring of Anthropogenic Noise and Its Relationship to Bottlenose Dolphin (*Tursiops truncatus*) Distribution in the Cres–Lošinj Archipelago, Northern Adriatic, Croatia......................................................... 323
Nikolina Rako, Marta Picciulin, Peter Mackelworth, Draško Holcer, and Caterina Maria Fortuna

73 Does Vessel Noise Affect the Use of Sound by Foraging *Orcinus orca* (Killer Whales)? ..................................................................................................................... 327
Marla M. Holt, Dawn P. Noren, and Candice K. Emmons

74 Do Silent Ships See More Fish? Comparison of a Noise-Reduced and a Conventional Research Vessel in Alaska .................................................................................................... 331
Alex De Robertis, Christopher D. Wilson, and Neal J. Williamson

75 Behavioral Observations of Baleen Whales in Proximity of a Modern Fishing Vessel .............................................................................................................................. 335
Matteo Bernasconi, Ruben Patel, and Leif Nøttestad

Sylvia E. van der Woude

77 Acoustic Monitoring of Beluga Whales (*Delphinapterus leucas*) in Cook Inlet, Alaska .......................................................................................................................... 341
Marc O. Lammers, Robert Small, Shannon Atkinson, Manuel Castellote, Justin Jenniges, Anne Rosinski, Sue Moore, Chris Garner, and Whitlow W.L. Au

78 Soundscape of a Nearshore Coral Reef Near an Urban Center .................................. 345
Whitlow W.L. Au, Michael Richlen, and Marc O. Lammers

79 Gap Durations in Ambient Noise Impact the Communication Range of Harp Seals: A Pilot Study .................................................................................................................. 353
John M. Terhune

80 Importance of Underwater Sounds for Migration of Fish and Aquatic Mammals ................................................................................................................................. 357
Ilse van Opzeeland and Hans Slabekoorn

81 Behavioral Responses of Diamondback Terrapins (*Malaclemys terrapin terrapin*) to Recreational Boat Sounds .................................................................................. 361
Lori A. Lester, Edward A. Standora, Walter F. Bien, and Harold W. Avery

82 Assessing Disturbance From Under-Ice Noise on Fishes in Boreal Lakes ................. 363
Peter A. Cott, David A. Mann, Dennis M. Higgs, Tom A. Johnston, and John M. Gunn
83 Impacts of River-Based Air Gun Seismic Activity on Northern Fishes ................. 367
Peter A. Cott, Arthur N. Popper, David A. Mann, John K. Jorgenson, and Bruce W. Hanna

84 Effects of Underwater Noise on Larval settlement .......................................... 371
Jenni A. Stanley, Craig A. Radford, and Andrew G. Jeffs

85 Does Vessel Noise Change the Calling Rate and Intensity of Soniferous Fishes? ...... 375
Joseph J. Luczkovich, Cecilia S. Krahforst, and Mark W. Sprague

86 Behavioral Responses of Captive Herring to Sonar Signals (1-1.6 kHz) of a Naval Frigate Throughout a Yearly Cycle .............................................................. 379
Lise Doksæter, Petter H. Kvadsheim, Nils O. Handegard, Nina Nordlund, and Olav R. Godø

87 Acoustic Tagging: A Suitable Method for the Study of Natural Herring Behavior Around Spawning? ............................................................. 383
Lise Langård, Arne Johannessen, Anders Fernö, Leif Nøttestad, Georg Skaret, Aril Slotte, Jostein Røttingen, and Jan T. Øvredal

88 Effects of Pile Driving on the Behavior of Cod and Sole .................................... 387
Frank Thomsen, Christina Mueller-Blenkle, Andrew Gill, Julian Metcalfe, Peter K. McGregor, Victoria Bendall, Mathias H. Andersson, Peter Sigray, and Daniel Wood

89 A Novel Field Study Setup to Investigate the Behavior of Fish Related to Sound ................................................................. 389
Christina Mueller-Blenkle, Andrew B. Gill, Peter K. McGregor, Mathias H. Andersson, Peter Sigray, Victoria Bendall, Julian Metcalfe, and Frank Thomsen

90 Do Ocean-Based Wind Farms Alter the Migration Pattern in the Endangered European Silver Eel (Anguilla anguilla) Due to Noise Disturbance? .................... 393
Mathias H. Andersson, Ingvar Lagenfelt, and Peter Sigray

91 Effects of Vessel Engine Noise on the Acoustic Signaling Behavior of Dascyllus albisella (Hawaiian Damselfish) .............................................................. 397
Pollyanna I. Fisher-Pool, Marc O. Lammers, and Lisa M. Munger

92 Distribution and Potential Impact of Boat Noise on Fish Sound Production From an Autonomous Acoustic Array in the Eastern Gulf of Mexico ....................... 403
Carrie C. Wall, Peter Simard, and David A. Mann

93 Cichlid Courtship Acoustics: Signals and Noise Influence Reproductive Behavior ................................................................. 407
Hans Slabbekoorn, Machtedl Verzijden, and Christina May

94 Using Catch Statistics to Investigate Effects of Seismic Activity on Fish Catch Rates ................................................................. 411
Aud Vold, Sven Løkkeborg, and Maria M. Tenningen

95 Effects of Sounds From Seismic Air Guns on Fish Behavior and Catch Rates ....... 415
Svein Løkkeborg, Egil Ona, Aud Vold, and Are Salthaug
## Part VI  Population Effects

96  A Bioenergetics Approach to Developing a Population Consequences of Acoustic Disturbance Model  
Daniel P. Costa  
423

97  Energetic Cost of Behaviors Performed in Response to Vessel Disturbance: One Link in the Population Consequences of Acoustic Disturbance Model  
Dawn P. Noren, Robin C. Dunkin, Terri M. Williams, and Marla M. Holt  
427

## Part VII  Anthropogenic Sound Sources and Their Measurement

98  A Common Sense Approach to Source Metrics  
William T. Ellison and Adam S. Frankel  
433

99  Underwater Sounds From Unattenuated and Attenuated Marine Pile Driving  
James Reyff  
439

100  What is the Source Level of Pile-Driving Noise in Water?  
Michael A. Ainslie, Christ A.F. de Jong, Stephen P. Robinson, and Paul A. Lepper  
445

101  Ground Roll Waves as a Potential Influence on Fish: Measurement and Analysis Techniques  
Richard A. Hazelwood  
449

102  Assessment of Cumulative Sound Exposure Levels for Marine Piling Events  
Paul A. Lepper, Stephen P. Robinson, Michael A. Ainslie, Pete D. Theobald, and Christ A.F. de Jong  
453

103  Modeling the Propagation of Transient Sounds in Very Shallow Water Using Finite Difference Time Domain (FDTD) Calculations  
Mark W. Sprague and Joseph J. Luczkovich  
459

104  Proximate Measurements of Acoustic Emissions Associated with the Installation and Operation of an Exploration Jackup Drilling Rig in the North Sea  
Victoria L.G. Todd and Paul R. White  
463

105  Measurement of Underwater Noise Arising From Marine Aggregate Operations  
Stephen P. Robinson, Pete D. Theobald, Paul A. Lepper, Gary Hayman, Victor F. Humphrey, Lian-Sheng Wang, and Samantha Mumford  
465

106  Svein Vaage Broadband Air Gun Study  
Anders Mattsson, Gregg Parkes, and David Hedgeland  
469

107  Cetacean Hearing-Damage Zones Around a Seismic Source  
Robert Laws  
473

108  Modeling Cumulative Sound Exposure Over Large Areas, Multiple Sources, and Long Durations  
Christine Erbe  
477

109  Sound-Recording Systems for Measuring Sound Levels During Seismic Surveys  
Jan Tore Øvredal and Bjørn Totland  
481
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>First Description of the Sound Pressure and Particle Velocity Components of the Ambient Noise and Boat Noise Recorded at the WWF-Miramare Natural Marine Reserve, Trieste, Italy</td>
<td>Angelo Farina, Adriano Farina, Enrico Armelloni, Linda Sebastianutto, Carlo Franzosini, and Marta Picciulin</td>
<td>485</td>
</tr>
<tr>
<td>111</td>
<td>Underwater Particle Acceleration Induced by a Wind Turbine in the Baltic Sea</td>
<td>Peter Sigray and Mathias H. Andersson</td>
<td>489</td>
</tr>
<tr>
<td>112</td>
<td>Is the Ocean Really Getting Louder?</td>
<td>Michael Stocker and Tom Reuterdahl</td>
<td>493</td>
</tr>
</tbody>
</table>

Part VIII Science, Regulation, and Sound Exposure Criteria

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>113</td>
<td>The Complexity of Noise Impact Assessments: From Birdsong to Fish Behavior</td>
<td>Hans Slabbekoorn</td>
<td>497</td>
</tr>
<tr>
<td>114</td>
<td>Extrapolating Beyond Chinchillas: Behavioral Response Ambiguity Through the Lens of Variable Human Responses to Moderate Wind Farm Noise</td>
<td>Jim Cummings</td>
<td>501</td>
</tr>
<tr>
<td>115</td>
<td>Underwater Noise Effects From Wave Energy Devices on Marine Mammals: A Possible Approach</td>
<td>Sofia Patricio</td>
<td>505</td>
</tr>
<tr>
<td>116</td>
<td>Physical Biologists and Biological Physicists: Combining Biology and Physics in Research on the Effects of Noise on Aquatic Life</td>
<td>Douglas H. Cato</td>
<td>509</td>
</tr>
<tr>
<td>117</td>
<td>“So, Am I Correct in My Understanding That a Decibel Is the Same as a Hertz?”: The Quest for Informed, Objective Environmental Impact Analysis of Marine Anthropogenic Noise</td>
<td>John F. Polglaze</td>
<td>515</td>
</tr>
<tr>
<td>118</td>
<td>Environmental Assessment of Offshore Wind Power Generation: Effect on a Noise Budget</td>
<td>James H. Miller, Gopu R. Potty, Kathleen J. Vigness-Raposa, David Casagrande, Lisa A. Miller, Jeffrey A. Nystuen, Peter M. Scheifele, and John G. Clark</td>
<td>519</td>
</tr>
<tr>
<td>119</td>
<td>Development and Implementation of Criteria for Exposure of Western Gray Whales to Oil and Gas Industry Noise</td>
<td>Douglas P. Nowacek, Alexander Vedenev, Brandon L. Southall, and Roberto Racca</td>
<td>523</td>
</tr>
<tr>
<td>120</td>
<td>Strategic Assessment of the Risk Posed to Marine Mammals by the Use of Air Guns in the Antarctic: Concepts, Methods, Results, and Controversies</td>
<td>Olaf Boebel, Monika Breitzke, Elke Burkhardt, and Horst Bornemann</td>
<td>529</td>
</tr>
<tr>
<td>121</td>
<td>Establishing a Safety Zone for Marine Mammals Due to Underwater Blasting</td>
<td>Norm Broner and Mike Huber</td>
<td>533</td>
</tr>
<tr>
<td>122</td>
<td>The Marine Mammal Protection Act: A Regulatory Approach to Identifying and Minimizing Acoustic-Related Impacts on Marine Mammals</td>
<td>Jaclyn N. Daly and Jolie Harrison</td>
<td>537</td>
</tr>
<tr>
<td>Chapter</td>
<td>Title</td>
<td>Author(s)</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>123</td>
<td>Noise-Related Stress and Cumulative Impact Assessment</td>
<td>Andrew J. Wright</td>
<td>541</td>
</tr>
<tr>
<td>124</td>
<td>Interim Criteria for Injury to Fish From Pile-Driving Activities:</td>
<td>Richard Rodkin, Keith Pommerenck, and James Reyff</td>
<td>545</td>
</tr>
<tr>
<td></td>
<td>Recent Experiences</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental Impact Statements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>Status of the National Oceanic and Atmospheric Administration’s</td>
<td>Amy R. Scholik-Schlomer</td>
<td>557</td>
</tr>
<tr>
<td></td>
<td>Guidelines for Assessing Impacts of Anthropogenic Sound on Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mammals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>Regulatory Assessments of the Effects of Noise: Moving From Threshold</td>
<td>Craig E. Johnson</td>
<td>563</td>
</tr>
<tr>
<td></td>
<td>Shift and Injury to Behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>United States Bureau of Ocean Energy Management, Regulation and</td>
<td>Jill Lewandowski, Elizabeth Burkhard, Kimberly Skrupky, and Deborah</td>
<td>567</td>
</tr>
<tr>
<td></td>
<td>Enforcement: Filling Data Gaps to Better Understand the Effects</td>
<td>Epperson</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of Anthropogenic Noise on Marine Life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>129</td>
<td>Regulation of Sound in the Ocean: Recent and Future Possible Changes</td>
<td>Mark L. Tasker</td>
<td>571</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kuznetsov</td>
<td></td>
</tr>
<tr>
<td>131</td>
<td>Update From the OEER Association on Research Findings Associated</td>
<td>Jennifer M. Matthews</td>
<td>579</td>
</tr>
<tr>
<td></td>
<td>With the Assessment of the Impacts of Seismic Exploration on</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marine Invertebrates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>Managing Underwater Noise in European Waters: Implementing the</td>
<td>Mark Tasker, Mats Amundin, Michel Andre, Anthony D. Hawkins, William</td>
<td>583</td>
</tr>
<tr>
<td></td>
<td>Marine Strategy Framework Directive</td>
<td>Lang, Thomas Merck, Amy Scholik-Schlomer, Jonas Teilmann, Frank Thomsen,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stefanie Werner, and Manell Zakharia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part IX</td>
<td>Monitoring, Management, and Mitigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>Acoustic-Based Cetacean Detection in Irish Waters</td>
<td>Eugene McKeown</td>
<td>589</td>
</tr>
<tr>
<td>134</td>
<td>Real-Time Monitoring of Noise in Cetacean Acoustic Niches</td>
<td>Michel André, Mike van der Schaar, Serge Zaugg, Ludwig Houégnigan, Antonio</td>
<td>593</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sánchez, Alex Mas, and Joan V. Castell</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>What Does Ecosystem Acoustics Reveal About Marine Mammals in the</td>
<td>Jennifer L. Miksis-Olds, Jeffrey A. Nystuen, and Susan E. Parks</td>
<td>597</td>
</tr>
<tr>
<td></td>
<td>Bering Sea?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>Ship Traffic Noise Distribution in the Strait of Gibraltar: An</td>
<td>Thomas Folegot</td>
<td>601</td>
</tr>
<tr>
<td></td>
<td>Exemplary Case for Monitoring Global Ocean Noise Using Real-Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology Now Available for Understanding the Effects of Noise on</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marine Life</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Contents**

123 Noise-Related Stress and Cumulative Impact Assessment ........................................ 541
Andrew J. Wright

124 Interim Criteria for Injury to Fish From Pile-Driving Activities:
Recent Experiences ........................................................................................................ 545
Richard Rodkin, Keith Pommerenck, and James Reyff

125 Marine Mammal Acoustics Exposure Analysis Models Used in US Navy Environmental Impact Statements ........................................................... 551
Douglas Wartzok, Christine Erbe, Wayne M. Getz, and Jeanette Thomas

126 Status of the National Oceanic and Atmospheric Administration’s Guidelines for Assessing Impacts of Anthropogenic Sound on Marine Mammals ........................................ 557
Amy R. Scholik-Schlomer

127 Regulatory Assessments of the Effects of Noise: Moving From Threshold Shift and Injury to Behavior ......................................................... 563
Craig E. Johnson

Jill Lewandowski, Elizabeth Burkhard, Kimberly Skrupky, and Deborah Epperson

129 Regulation of Sound in the Ocean: Recent and Future Possible Changes ............... 571
Mark L. Tasker

130 Marine Bioacoustics and the Regulation of Fisheries ........................................ 575
Yury A. Kuznetsov, Lev N. Bocharov, Valeriy N. Akulin, and Michail Y. Kuznetsov

131 Update From the OEER Association on Research Findings Associated With the Assessment of the Impacts of Seismic Exploration on Marine Invertebrates ........................................ 579
Jennifer M. Matthews

Mark Tasker, Mats Amundin, Michel Andre, Anthony D. Hawkins, William Lang, Thomas Merck, Amy Scholik-Schlomer, Jonas Teilmann, Frank Thomsen, Stefanie Werner, and Manell Zakharia

Part IX Monitoring, Management, and Mitigation

133 Acoustic-Based Cetacean Detection in Irish Waters ........................................ 589
Eugene McKeown

134 Real-Time Monitoring of Noise in Cetacean Acoustic Niches ................................ 593
Michel André, Mike van der Schaar, Serge Zaugg, Ludwig Houégnigan, Antonio Sánchez, Alex Mas, and Joan V. Castell

135 What Does Ecosystem Acoustics Reveal About Marine Mammals in the Bering Sea? ............................................................... 597
Jennifer L. Miksis-Olds, Jeffrey A. Nystuen, and Susan E. Parks

Thomas Folegot
137  Are There Technological Alternatives to Air Guns for Oil and Gas Exploration to Reduce Potential Noise Impacts on Cetaceans? ........................................ 605
Linda Weilgart

138  Modeling Cumulative Sound Exposure Along a Seismic Line to Assess the Risk of Seismic Research Surveys on Marine Mammals in the Antarctic Treaty Area ........................................................................... 609
Monika Breitzke and Thomas Bohlen

139  North Atlantic Treaty Organization Marine Mammal Risk Mitigation Principles and Guidelines ........................................................................................................... 613
Kendra L. Ryan and Stephane Jespers

140  Mitigating Impacts of Underwater Noise From Dredging on Beluga Whales in Cook Inlet, Alaska .......................................................................................... 617
Christopher A. Hoffman

141  Exploration and Production Sound and Marine Life Joint Industry Programme: Research Progress and Applications .................................................................................. 621
Jennifer L. Michael, John Campbell, David Hedgeland, Michael Jenkerson, H. Rodger Melton, Lori Notor, Russell D. Tait, Sarah L. Tsoulias, and Gary Wolinsky

142  Managing Anthropogenic Underwater Noise in the Northwest Territories, Canada ......................................................................................................................... 625
Bruce W. Hanna, Peter A. Cott, Amanda A. Joynt, and Lois Harwood

143  SIRENA ’10: Beyond the Mediterranean .......................................................................................................................... 629
Jeffery Haun, Kendra Ryan, and Arnold B-Nagy

144  Planning Is Critical to Ensure Effective Mitigation of Naval Activities .......................................................................................... 633
Sarah J. Dolman

145  Standardizing Protected Species Observer Requirements in the United States .......................................................................................... 637
Kyle Baker, Deborah Epperson, Howard Goldstein, Kimberly Skrupky, Brad Smith, Gregg Gitschlag, Jill Lewandowski, and Teresa Turk

146  Using Passive Acoustics to Monitor the Presence of Marine Mammals During Naval Exercises .......................................................................................... 641
Anurag Kumar, Jene Nissen, Joel Bell, and Mandy Shoemaker

147  Development of a National Database and Standards for Protected Species Observer Data in the United States .................................................................................. 645
Howard Goldstein, Deborah Epperson, Kyle Baker, Kimberly Skrupky, Brad Smith, Gregg Gitschlag, Jill Lewandowski, and Teresa Turk

148  Coordinated Management of Anthropogenic Noise From Offshore Construction Off Sakhalin Island for Protection of the Western Gray Whale .................................................................. 649
Roberto Racca

Part X  Workshops and Concluding Remarks

149  Workshop One: Risk Analysis .................................................................................................................................................. 657
Thomas J. Carlson, Christ de Jong, and Rene P.A. Dekeling

150  Workshop Two: Long-Term and Cumulative Effects of Acoustic Exposure Along With Other Stressors ............................................................................. 661
Robert Gisiner and George Frisk
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>151</td>
<td><strong>Workshop Three: Approaches to Behavioral Analysis of Responses</strong></td>
<td>665</td>
</tr>
<tr>
<td></td>
<td>to High-Energy Acoustic Sources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Svein Løkkeborg and Frank Thomsen</td>
<td></td>
</tr>
<tr>
<td>152</td>
<td><strong>Workshop Four: International Regulatory Issues</strong></td>
<td>669</td>
</tr>
<tr>
<td></td>
<td>Amy R. Scholik-Schlomer and Camille Mageau</td>
<td></td>
</tr>
<tr>
<td>153</td>
<td><strong>Summing Up</strong></td>
<td>673</td>
</tr>
<tr>
<td></td>
<td>Roger L. Gentry</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Index</strong></td>
<td>681</td>
</tr>
</tbody>
</table>
The Effects of Noise on Aquatic Life
Popper, A.N.; Hawkins, A. (Eds.)
2012, XXVIII, 695 p., Hardcover
ISBN: 978-1-4419-7310-8