Contents

List of Tables page xiii
Foreword xv
Acknowledgements xvii
Author Note xix
Table of Cases xx
List of Abbreviations xxx

I THE THREE-FOLD CHALLENGE OF ENGAGING WITH SCIENCE IN INTERNATIONAL ENVIRONMENTAL ADJUDICATION 1

1 Introduction to a Comparative Study on Judicial Engagement with Science 3
  I Science Enters International Environmental Adjudication 3
  II The Three-Fold Challenge of Using Science in Adjudication: The Context 9
  III Judicial Engagement with Science: The Framework 10
  IV Science and the Legitimacy of Judicial Reasoning: The Focus 13
  V International Environmental Adjudication: The Scope of This Study 15
  VI Structure of the Book 17

2 The Rules of Judicial Engagement with Science: A Three-Fold Challenge 19
  I The Three-Fold Challenge of Using Science in an Adjudicatory Setting 20
    1 Epistemic Challenge: Clash of Cognitive Authorities 21
    2 Doctrinal Challenges: Structural Differences between Law and Natural Sciences 27
3 Legitimacy Challenges of Relying on Science by Legal Adjudicators 38
4 Implications for Judicial Engagement with Science 41

II Adjudicatory Techniques for Scientific Engagement: The Framework of This Study 43
1 Framing of Disputes: Adjusting the Level of Science Entering the Judicial Inquiry 45
2 Scientific Fact-Finding: The Use of Experts and Expert Opinions 47
3 Causal Inquiry 52
4 Standard and Extent of Judicial Review 56

III The Impact of Science on Judicial Reasoning 59
1 Low Level of Science Allowed to Enter Adjudicatory Deliberations in Environmental Disputes 60
2 Science and the Legitimacy of Adjudicatory Reasoning 61

II TECHNIQUES FOR JUDICIAL ENGAGEMENT WITH SCIENCE IN THE PRACTICE OF INTERNATIONAL COURTS AND TRIBUNALS 67

3 Judicial Engagement with Science in the Environmental Case Law of the International Court of Justice 69
I Environmental Disputes Appear on the Court’s Docket 70
1 Science Becomes Legally Relevant before the Court 72
II Framing Science-Intensive Disputes: Carving Out Science from Legally Relevant Aspects of Disputes 73
1 The Parties’ Approach Towards Science: Settling Science-Heavy Claims Out of Court 74
2 Judicial Framing Techniques Downplaying Science 76
III Scientific Fact-Finding Techniques of the ICJ 81
1 The Beginnings: Declining to Consider Scientific Evidence 82
2 Using Expertise: From Counsels to Witnesses and Beyond 84
3 Expert Evidence: Mathematical Models, Ecological Damage Valuation, and the Use of New Technologies 88
4 The Standard and Burden of Proof 92
5 Proposals for Future Developments in Scientific Fact-Finding 93
IV Causal Inquiry 95
1 Relevance of Causal Links in Environmental Responsibility 96
2 The Court’s Approach to Assessing Uncertain Causal Links: Reluctance to Deal with Science 98
V Standard and Extent of Judicial Review
1 The Extent of Review: Justiciability of the Term Scientific Research 101
2 Standard of Review: The Reasonableness Test 106
3 Doctrinal Implications of the Reasonableness Test for the Judicial Purview 116

4 Science in the Practice of Inter-State Arbitral Tribunals 118
  I Science Enters Environmental Adjudication 119
  II Framing of Disputes: Carving Out Science or Harnessing Its Authority 119
    1 Marginalizing Science by Adjudicators 120
    2 Marginalizing Science by the Plaintiff 124
    3 Including Science in the Legally Relevant Aspects of Disputes 126
  III Scientific Fact-Finding in International Arbitration 129
    1 Setting a High Bar: Surprisingly Thorough Fact-Finding 130
    2 Appointing Expert Arbitrators 132
    3 Appointing Ex Tribunal Experts 135
  IV Causal Inquiry 137

5 Science in the Environmental Jurisprudence of Regional Human Rights Courts 139
  I Science before Human Rights Courts in Environmental Complaints 140
    1 Environmental Claims in the European System 140
    2 Environmental Claims in the Inter-American System 141
    3 Environmental Claims in the African System 145
  II Framing the Judicial Inquiry 145
  III Causal Inquiries to Handle Science in Human Rights Claims 146
    1 Sources of Causal Uncertainty Inherent in Cases of Toxic Exposure 147
    2 Role of Science-Based Causality in the European System 150
    3 Causal Inquiry in the European System: A Proxy-Based Assessment 153
    4 Science-Intensive Causal Links in the Inter-American System 164
    5 Causal Links in the African System 168
  IV Scientific Fact-Finding Techniques 169
    1 The Fact-Finding Powers of the Strasbourg Court 169
    2 Fact-Finding of the Inter-American Court in Cases Involving Environmental Damage and Pollution 172
    3 Fact-Finding Powers of African Human Rights Courts 175
V Standard of Review in Human Rights Adjudication 175
1 The Strasbourg System: The Margin of Appreciation Doctrine 176
2 The Inter-American and African Systems: Measure of Deference 177

6 Scientific Claims before the WTO 178
I Science in the Context of WTO Law 179
II Scientific Fact-Finding in the WTO: Practices of Using Scientific Expertise 185
1 Party-Appointed Experts 186
2 Independent Experts: Panel-Appointed Experts and In-House Expertise 187
3 Novel Ways of Expert Consultation 189
4 Standards Issued by International Organizations 189
1 Policy Dilemmas in Setting the Standard of Review 191
2 Bordering De Novo Review in Early SPS Cases: From Hormones to the Panel Report in Continued Suspension of Obligations 192
3 Turning Towards a More Deferential and Nuanced Approach: A Two-Stage Standard of Review 197
4 Appraisal of the Changing Standards of Review 202
5 Reasoning Techniques: With or Without Scientific Rationality 204

7 Science in the Practice of Investment Arbitral Tribunals 212
I Science in Investor-State Environmental Arbitration 213
1 Environmental Disputes Brought before Investment Arbitral Tribunals 213
2 Entry Points for Science in Environmental Investment Disputes 215
II Framing of Disputes: Strategically Managing the Science-Intensity of the Legal Inquiry 219
1 Framing Techniques of Litigants 219
2 Adjudicatory Framing Techniques 223
III Scientific Fact-Finding Techniques in Investment Arbitration 226
1 Party-Appointed Experts 226
2 Tribunal-Appointed Experts 228
3 Engagement with Expertise: Appraisal from a Legitimacy Point of View 229
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Causal Inquiry</td>
<td>231</td>
</tr>
<tr>
<td>V Standard and Extent of Adjudicatory Review of Scientific Claims</td>
<td>232</td>
</tr>
<tr>
<td>1 Affording Deference to Host States' Scientific Claims</td>
<td>232</td>
</tr>
<tr>
<td>2 Standards of Review: Indicia of Credible Scientific Positions</td>
<td>234</td>
</tr>
<tr>
<td>8 Science Appears before the International Tribunal for the Law of the Sea</td>
<td>241</td>
</tr>
<tr>
<td>I Science Enters Environmental Disputes Brought before ITLOS</td>
<td>242</td>
</tr>
<tr>
<td>1 Remarks on the Institutional Set-Up</td>
<td>242</td>
</tr>
<tr>
<td>2 Entry Points for Science in Legal Disputes</td>
<td>244</td>
</tr>
<tr>
<td>II Framing Environmental Disputes</td>
<td>247</td>
</tr>
<tr>
<td>1 Science-Intensive Disputes Are Deemed Justiciable</td>
<td>248</td>
</tr>
<tr>
<td>2 Response to Uncertain Risks: Issuing Precautionary Measures</td>
<td>248</td>
</tr>
<tr>
<td>3 Science as Both a 'Progressive Ceiling' and a 'Hard Floor' for State Obligations</td>
<td>250</td>
</tr>
<tr>
<td>4 Referring Disputes to Expert-Led Consultation of the Parties</td>
<td>251</td>
</tr>
<tr>
<td>III Scientific Fact-Finding Techniques</td>
<td>254</td>
</tr>
<tr>
<td>1 Ex Parte Scientific Experts</td>
<td>254</td>
</tr>
<tr>
<td>2 Enhancing the Tribunal’s Internal Expertise</td>
<td>255</td>
</tr>
<tr>
<td>3 Standard of Proof</td>
<td>257</td>
</tr>
<tr>
<td>IV Causal Inquiry</td>
<td>258</td>
</tr>
<tr>
<td>III ENGAGING WITH SCIENTIFIC KNOWLEDGE IN THE JUDICIAL REASONING</td>
<td>261</td>
</tr>
<tr>
<td>9 Trends in Judicial Engagement with Science: A Comparative Assessment</td>
<td>263</td>
</tr>
<tr>
<td>I Judicial Techniques Adjusting the Level Of Science In Adjudicatory Inquiry</td>
<td>264</td>
</tr>
<tr>
<td>1 Downplaying Science: And a Corresponding Need for Non-Scientific Justifications in the Reasoning</td>
<td>265</td>
</tr>
<tr>
<td>2 Integrating Science in the Judicial Inquiry: And Harnessing Its Cognitive Authority</td>
<td>266</td>
</tr>
<tr>
<td>II Framing Legal Disputes: Choosing Relevant Questions to Decide</td>
<td>267</td>
</tr>
<tr>
<td>1 Adjudicatory Techniques Serving to Carve Out Science from the Judicial Inquiry</td>
<td>267</td>
</tr>
</tbody>
</table>
Contents

2 Incorporating Science in the Judicial Inquiry: Framing Disputes to Harness Science’s Cognitive Authority 275

III Comparative Analysis of International Scientific Fact-Finding Techniques 279
  1 Adjudicators Distancing Themselves from Scientific Expertise 279
  2 Avenues of Engaging with Scientific Expertise 284

IV Causal Inquiry: The Role of Science in the Causal Assessments 289
  1 Causal Inquiry that Downplays the Role of Science 290
  3 Assessment: The Status of Science in the Causal Policy of International Courts 312

V Trends in Setting the Standard of Judicial Review 317
  1 Balancing between Deferential and Intrusive Review 317
  2 Scrutinizing Scientific Claims: With or Without Reference to Scientific Rationality 319

VI Concluding Remarks: Where Do International Courts Stand with Science? 329

10 Science and the Legitimacy of Judicial Reasoning 332
  I Science in the Judicial Reasoning: Implications for Legitimacy 333
    1 Appealing to Scientific Rationality 336
    2 Relying on Purely Legal Rationality in Judicial Reasoning 340
    3 Reasoning with Intuitive Rationality 347
    4 Hybrid Concepts in Adjudicatory Reasoning 351
  III Guidance for Selecting the Appropriate Reasoning Style: Some Recommendations 357
    1 On the Interdisciplinary Nature of the Judicial Function 357
    2 General Recommendations for Selecting the Appropriate Reasoning Style 359

11 Conclusion 367

Bibliography 371

Index 391