
Contents

Preface	ix
Glossary	xv
Abbreviations	xxi
Chapter 1. Marine Monitoring: Historical Background, Regulatory Framework and Science–Policy Interactions	1
1.1. Introduction	1
1.2. International institutions	3
1.2.1. International Council for the Exploration of the Sea	5
1.2.2. United Nations Environment Programme	6
1.2.3. Intergovernmental Oceanographic Commission of UNESCO	10
1.2.4. European Union	11
1.3. International conventions/programs	12
1.3.1. UN Convention on the Law of the Sea	12
1.3.2. London Dumping Convention	13
1.3.3. OSPAR Conventions	13
1.3.4. Helsinki Convention	16
1.3.5. MARPOL	17
1.3.6. Mediterranean Sea: Barcelona Convention	18
1.3.7. Bonn Agreement	19

1.3.8. Arctic Ocean: Arctic Monitoring and Assessment Programme	19
1.3.9. North East Pacific Ocean	20
1.3.10. North West Atlantic Ocean	21
1.3.11. North Sea conferences	22
1.3.12. Other conventions	22
1.4. The EU marine strategy.	22
1.4.1. The notion of “good environmental status”.	24
1.4.2. Marine strategies of the Member States	25
1.4.3. Monitoring in the MSFD policy context	26
1.5. Science–policy interactions	29
1.5.1. Scientific foundation of environmental policies: where do we stand?	29
1.5.2. EU scientific framework in support of water and marine policies	31
1.5.3. Identification of research needs in the water policy sectors	33
1.5.4. Interactions with the scientific community	34
1.5.5. Science-based development of an integrated environmental policy	37
1.6. Conclusions	39
Chapter 2. Monitoring and Quality Assurance	41
2.1. Monitoring of what?	41
2.1.1. Selection of compartments	41
2.1.2. Selection of compounds	42
2.2. Quality of data	44
2.2.1. Introduction	44
2.2.2. Interlaboratory comparisons.	45
2.2.3. Guidelines	47
2.2.4. (Certified) reference materials	48
2.2.5. Laboratory performance studies	49
2.2.6. Example: monitoring of trace metals in seawater	51
2.3. Certified reference materials	53
2.3.1. Introduction	53
2.3.2. Production and use of reference materials	53
2.3.3. CRMs for trace elements in nutrients	62
2.3.4. CRMs for organic non-halogenated compounds	66
2.3.5. CRMs for organic halogenated compounds	68
2.3.6. Future needs of CRMs	71

Chapter 3. Types of Monitoring	73
3.1. Classical chemical marine monitoring	73
3.1.1. Introduction	73
3.1.2. The basis and purpose of marine monitoring	74
3.1.3. Some considerations around classical monitoring	77
3.1.4. Designing a sampling program	80
3.1.5. Sample collection and immediate handling	82
3.1.6. Sample storage (short- and long-term)	83
3.1.7. Laboratory analyses	86
3.1.8. The final assessment.	93
3.1.9. Conclusions.	94
3.2. <i>In situ</i> methods	94
3.2.1. Introduction	94
3.2.2. <i>In situ</i> automatic analyzers	96
3.2.3. Passive sampling technologies.	99
3.2.4. Spectroscopic methods	106
3.2.5. Electrochemical techniques	110
3.2.6. Sensors.	113
3.2.7. Biological early warning systems	116
3.2.8. Future	119
3.3. Biomonitoring	121
3.3.1. Introduction	121
3.3.2. Analytical trends in chemical monitoring of marine biota	123
3.3.3. Main features of biota monitoring programs	128
3.3.4. Analytical methods	131
3.3.5. Integration of chemical and biological effect monitoring	136
3.4. Use of sediment in coastal monitoring	139
3.4.1. Introduction	139
3.4.2. Sediment monitoring in the WFD context	142
3.4.3. Chemical monitoring in estuaries for coastal management	142
Chapter 4. Analytical Methods	147
4.1. Trace elements	147
4.1.1. Introduction	147
4.1.2. Digestion methods	148
4.1.3. Preconcentration methods for seawater analysis	150

4.1.4. Atomic absorption and emission techniques	151
4.1.5. (Instrumental) neutron activation analysis	157
4.1.6. X-ray techniques	158
4.1.7. Electrochemical techniques	159
4.1.8. Conclusions	160
4.2. Chemical species	161
4.2.1. Introduction	161
4.2.2. Labile/complexed fractionation of metal species	163
4.2.3. Inorganic chromium species	168
4.2.4. Inorganic and organic arsenic species	171
4.2.5. Inorganic and methylated mercury species	176
4.2.6. Butyltin and other organotin species	181
4.3. Organic micropollutants	185
4.3.1. Introduction	185
4.3.2. Polychlorinated biphenyls	186
4.3.3. Polybrominated diphenyls ethers	189
4.3.4. Emerging contaminants	191
4.3.5. Organohalogens in water	193
4.3.6. Polycyclic aromatic hydrocarbons	196
4.4. Nutrients	197
4.4.1. Introduction	197
4.4.2. Nutrient monitoring	198
4.4.3. Analytical methods	199
Chapter 5. Conclusions: Achieving Traceability in Marine Monitoring Measurements?	205
5.1. Metrology in marine chemistry: traceability principles of chemical measurements	205
5.1.1. Meaning of traceability for chemical measurements	206
5.1.2. Stated references	209
5.1.3. Case studies illustrating metrology in marine chemistry	220
5.1.4. Conclusions	229
5.2. Policy perspectives	231
Bibliography	235
Index	283