Water Quality Assessments

A guide to the use of biota, sediments and water in environmental monitoring

Second edition

Edited by Deborah Chapman

Published on behalf of



UNESCO United Nations Educational, Scientific and Cultural Organization



WHO World Health Organization



UNEP United Nations Environment Programme

E & FN SPON
An Imprint of Routledge
London and New York

TABLE OF CONTENTS

Forev	word to the first edition	ix
Foreword to the second edition		xi
Sumi	Summary and scope Acknowledgements Abbreviations used in text	
Ackn		
Abbr		
Chap	ter 1 AN INTRODUCTION TO WATER QUALITY	1
1.1	Characterisation of water bodies	1
1.2	Definitions related to water quality	6
1.3	Anthropogenic impacts on water quality	9
1.4	Pollutant sources and pathways	12
1.5	Spatial and temporal variations	16
1.6	Economic development and water quality	18
1.7	References	21
Chap	ter 2 STRATEGIES FOR WATER QUALITY ASSESSMENT	23
2.1	Introduction	23
2.2	The water quality assessment process	23
2.3	Typical water quality monitoring programmes	31
2.4	Design of assessment programmes	34
2.5	Implementation of water quality assessment programmes	42
2.6	Data processing	47
2.7	Data quality control	48
2.8	Interpretation and dissemination of data	53
2.9	Recommendations	54
2.10	References	55
Chap	oter 3 SELECTION OF WATER QUALITY VARIABLES	59
3.1	Introduction	59
3.2	Hydrological variables	59
3.3	General variables	66
3.4	Nutrients	77
3.5	Organic matter	86
3.6	Major ions	89
3.7	Other inorganic variables	94
3.8	Metals	98
3.9	Organic contaminants	102

vi Table of contents

3.10	Microbiological indicators	108
3.11	Selection of variables	111
3.12	Summary and recommendations	121
3.13	References	125
Chap	ter 4 THE USE OF PARTICULATE MATERIAL	127
4.1	Introduction	127
4.2	Composition of particulate matter	128
4.3	Transport and deposition	131
4.4	Environmental control of particulate matter quality	140
4.5	Sampling of particulate matter	144
4.6	Analysis of particulate matter	146
4.7	Development of a programme for assessing particulate	
	matter quality	150
4.8	Data evaluation	155
4.9	The use of particulate material in water quality assessments:	
	case studies	160
4.10	Conclusions and future developments	171
4.11	References	172
Chap	ter 5 THE USE OF BIOLOGICAL MATERIAL	175
5.1	Introduction	175
5.2	Factors affecting biological systems in the aquatic	
	environment	176
5.3	Uses and benefits of biological methods	182
5.4	Ecological methods	186
5.5	Microbiological methods	205
5.6	Physiological and biochemical methods	207
5.7	Methods for assessing toxic pollution in controlled	
	environments	211
5.8	The use of aquatic organisms in chemical monitoring	217
5.9	Histological and morphological methods	222
5.10	Biological sampling strategies and techniques	223
5.11	Selection of biological methods: case studies	227
5.12	Conclusions and recommendations	233
5.13	References	234
Chap	ter 6 RIVERS	243
6.1	Introduction	243
6.2	Hydrological characteristics	244
6.3	Chemical characteristics	252

6.4	Biological characteristics	266
6.5	Major water quality issues in rivers	274
6.6	Strategies for water quality assessment in river systems	287
6.7	Approaches to river monitoring and assessment: case studies	305
6.8	Summary and conclusions	313
6.9	References	314
Chap	ter 7 LAKES	319
7.1	Introduction	319
7.2	Characteristics and typology	320
7.3	Water quality issues	331
7.4	The application of sediment studies in lakes	349
7.5	Assessment strategies	351
7.6	Approaches to lake assessment: case studies	355
7.7	Summary and conclusions	364
7.8	References	366
Chap	ter 8 RESERVOIRS	369
8.1	Introduction	369
8.2	Construction and uses	371
8.3	Special characteristics of reservoirs	378
8.4	Water quality issues	391
8.5	Sampling strategies	396
8.6	Approaches to reservoir assessment	403
8.7	Summary and conclusions	407
8.8	References	408
Chap	ter 9 GROUNDWATER	413
9.1	Introduction	413
9.2	Characteristics of groundwater bodies	415
9.3	Water-soil-rock interactions	436
9.4	Groundwater quality issues	442
9.5	Assessment strategies	464
9.6	Examples of groundwater assessment	493
9.7	Conclusions and recommendations	503
9.8	References	504
Chap	ter 10 DATA HANDLING AND PRESENTATION	511
10.1	Introduction	511
10.2	Handling, storage and retrieval of water quality data	512
10.3	Data characteristics	518

viii Table of contents

10.4	Basic statistics	528
10.5	Basic graphical methods	562
10.6	Data analysis and interpretation methods	575
10.7	Advanced data analysis and management techniques	589
10.8	Examples of the application of data analysis and presentation	595
10.9	References	601
Appendix 10.1 Basic design for sampling programmes		605
Index		613