

The Ecology of Phytoplankton

C. S. Reynolds



CAMBRIDGE
UNIVERSITY PRESS

Contents

<i>Preface</i>	<i>page</i> ix
<i>Acknowledgements</i>	xii

Chapter 1. Phytoplankton	1
1.1 Definitions and terminology	1
1.2 Historical context of phytoplankton studies	3
1.3 The diversification of phytoplankton	4
1.4 General features of phytoplankton	15
1.5 The construction and composition of freshwater phytoplankton	24
1.6 Marine phytoplankton	34
1.7 Summary	36

Chapter 2. Entrainment and distribution in the pelagic	38
2.1 Introduction	38
2.2 Motion in aquatic environments	39
2.3 Turbulence	42
2.4 Phytoplankton sinking and floating	49
2.5 Adaptive and evolutionary mechanisms for regulating w_s	53
2.6 Sinking and entrainment in natural turbulence	67
2.7 The spatial distribution of phytoplankton	77
2.8 Summary	90

Chapter 3. Photosynthesis and carbon acquisition in phytoplankton	93
3.1 Introduction	93
3.2 Essential biochemistry of photosynthesis	94
3.3 Light-dependent environmental sensitivity of photosynthesis	101
3.4 Sensitivity of aquatic photosynthesis to carbon sources	124
3.5 Capacity, achievement and fate of primary production at the ecosystem scale	131
3.6 Summary	143

Chapter 4. Nutrient uptake and assimilation in phytoplankton	145
4.1 Introduction	145
4.2 Cell uptake and intracellular transport of nutrients	146
4.3 Phosphorus: requirements, uptake, deployment in phytoplankton	151

4.4 Nitrogen: requirements, sources, uptake and metabolism in phytoplankton	161
4.5 The role of micronutrients	166
4.6 Major ions	171
4.7 Silicon: requirements, uptake, deployment in phytoplankton	173
4.8 Summary	175
Chapter 5. Growth and replication of phytoplankton	178
5.1 Introduction: characterising growth	178
5.2 The mechanics and control of growth	179
5.3 The dynamics of phytoplankton growth and replication in controlled conditions	183
5.4 Replication rates under sub-ideal conditions	189
5.5 Growth of phytoplankton in natural environments	217
5.6 Summary	236
Chapter 6. Mortality and loss processes in phytoplankton	239
6.1 Introduction	239
6.2 Wash-out and dilution	240
6.3 Sedimentation	243
6.4 Consumption by herbivores	250
6.5 Susceptibility to pathogens and parasites	292
6.6 Death and decomposition	296
6.7 Aggregated impacts of loss processes on phytoplankton composition	297
6.8 Summary	300
Chapter 7. Community assembly in the plankton: pattern, process and dynamics	302
7.1 Introduction	302
7.2 Patterns of species composition and temporal change in phytoplankton assemblages	302
7.3 Assembly processes in the phytoplankton	350
7.4 Summary	385
Chapter 8. Phytoplankton ecology and aquatic ecosystems: mechanisms and management	387
8.1 Introduction	387
8.2 Material transfers and energy flow in pelagic systems	387
8.3 Anthropogenic change in pelagic environments	395
8.4 Summary	432
8.5 A last word	435
<i>Glossary</i>	437
<i>Units, symbols and abbreviations</i>	440

<i>References</i>	447
<i>Index to lakes, rivers and seas</i>	508
<i>Index to genera and species of</i> <i>phytoplankton</i>	511
<i>Index to genera and species of other</i> <i>organisms</i>	520
<i>General index</i>	524