

Preface

FIRST EDITION

The study of freshwater algae in North America has a long and rich history, with some of the early monographic works dating back to the late 1800s. In recent years, there has been an enormous and remarkable level of research on this very diverse and heterogeneous collection of organisms, making any definitive taxonomic or ecological treatise always out of date. Nonetheless, it is our goal with this book to synthesize and update much of this vast knowledge and to provide a practical and comprehensive guide to all of the genera of freshwater algae known from throughout the continent, in one volume. Chapters also provide guides to other publications and specialized works for the identification and ecological information at the species level. Our intent is to combine the necessary ecological and taxonomic information in a practical book that can be used by all scientists working in aquatic environments, whether their specialty is in environmental monitoring, ecology, evolution, systematics, biodiversity, or molecular biology. This is the first book of its sort covering the entire continent. We also hope that this book will serve to encourage new generations of aquatic biologists to explore freshwater algae carefully, rather than regarding phytoplankton or benthic algae as simply quantities of chlorophyll or carbon. The enormous variety of algae in lakes, rivers, and other aquatic habitats is part of the ecological content of aquatic communities, and their ecosystem functions vary with the species that occur there.

Many of the previous monographs dealing with a broad geographic region are still useful, such as Smith's (1950) *Freshwater Algae of the United States*, but most are decades old and do not contain recent taxonomic changes. Our approach is to include chapters authored by experts who have specialized in the study of specific groups of freshwater algae. Given the great quantity of research that has been produced on all of the major algal taxa, it is no longer possible for one or two authors to produce an authoritative book of this kind and one that will span the entire range of taxonomic and ecological detail that is now known about all the organisms termed algae. This volume is modeled closely after the book by Thorp and Covich on freshwater invertebrates (*Ecology and Classification of North American Freshwater Invertebrates*), also published by Academic Press.

The organization of this book includes an introduction to the freshwater algae (with a guide to the taxonomic chapters that follow), an overview of freshwater habitats, 20 taxonomic chapters, and finally chapters on the use of algae in environmental assessments and control of nuisance algae. More than 770 genera are described and illustrated in this book, and each taxonomic chapter includes an introduction to the key terms and characteristics of the group, ecological distribution, and a guide to the taxonomic literature to distinguish species within each genus. While we have undoubtedly omitted some less common or yet unrecorded freshwater genera, this compilation represents an increase in the taxonomic scope and geographic coverage of the freshwater algae of North America. This compares with roughly 490 genera recorded from the United States by Smith (1950), about 335 in Prescott's (1962) coverage of the Western Great Lakes region, and nearly 380 genera from the southeastern United States reported by Whitford and Schumacher (1984). Because not all algal groups are equally well studied, coverage in the present volume varies among taxa and chapters. We hope that students, scientists working in water management agencies, and experienced phycologists will use this book thoroughly and provide us with feedback, such as missing taxa or incomplete geographic information. We will endeavor to incorporate this information into a future edition.

SECOND EDITION

The second edition of *Freshwater Algae of North America* occurs at a time of rapid and exciting change in the fields of phycology and aquatic ecology. The development and widespread use of molecular tools in the intervening years have provided remarkable insights into the evolution, classification, and ecology of algae. Genetic data have been used to clarify phylogenetic relationships among algal groups, to discern how marine species may have evolved to colonize freshwater environments, to understand gene function as cells respond to their environment, and to uncover far greater diversity than was imagined. The challenge for algal taxonomists is this: How do we reconcile new genetic data with traditional species concepts based on morphology and reproduction? Fortunately, some stud-

ies have found agreements between gene-based and older species concepts. Notably, this includes names dating back to Linnaeus (Hayden et al., 2003). In other cases, the discovery of cryptic and, in some cases, endemic species not previously recognized using microscopy has both expanded our knowledge of the freshwater algal flora and created challenges for morpho-taxonomic work (Boo et al., 2010; Guiry, 2012; Komárek and Mares, 2012; Mann and Vanormelingen, 2013). We should also note that through these studies a few genera reported in the first edition are no longer valid and have either been renamed or merged with other taxa. However, many, perhaps most, genera have yet to be studied in any detail by molecular methods.

It has been estimated that more than half of the cyanobacteria species on earth remain to be described by any method (Nabou et al., 2013) and that only 10% of all diatoms species have yet been named (Guiry, 2012). Discoveries of new species and genera will continue. There are some that have been reported from just a few lakes or a single pool, or their true identity has not yet been confirmed. Other taxa are regarded as "uncertain" or "doubtful" and await further study and molecular analysis. We contend that these are healthy developments for our science. This volume, while still based largely on morpho-species, has nonetheless expanded from the first edition in part due to the inclusion of taxa that have been recognized through these new methods. Also, several authors have described genera (and species) that have been observed on other continents, but expected to occur in North America, leaving the door open for further additions to our flora. Many of new genera are described in this volume, some the result of reclassifications, others from discoveries of taxa not previously observed or known. We predict that this growth will continue and that further links between traditional and molecular approaches will be created. The present volume now describes 922 genera, an increase of more than 150 from the first edition.

On the whole, readers of our first edition have been very complimentary and generous in their feedback and advice. A student carrying a well-worn book is always a welcome sign. One frequent suggestion was to include color images. This is an understandable request we are pleased to provide, given that pigments are important in characterizing different algal groups and that these colors highlight the beauty and diversity that encompass the algae. The organization of this book is similar to that of the first edition, but has been reorganized in recognition of some of the new classification schemes that have emerged in recent years. The result is 17 taxonomic chapters, preceded by Chapter 1, a general

introduction to these chapters, and Chapter 2, an overview of freshwater algal habitats. We still employ common names for the chapters, but also provide current phylogenetic information. The final two chapters focus on two important applied topics in algal research; bioassessment methods and harmful algal blooms in fresh waters. Feedback from all users of this edition is warmly encouraged.

We are again exceedingly indebted to the contributors to this volume. Their care and expertise are evident in these pages. We also offer our sincere thanks to all of the external reviewers who have provided invaluable comments for our authors: Robert A. Andersen, António J. Calado, Peter F. M. Coesel, Gertrud Cronberg, Walter K. Dodds, Karolina Fučíková, Thomas Friedl, Jennifer L. Graham, Theodore D. Harris, David M. John, Ric W. Jordan, J. Patrick Kociolek, Lothar Krienitz, Jørgen Kristiansen, Brian S. Leander, Robert E. Lee, Louise A. Lewis, Eric W. Linton, Rex L. Lowe, Richard M. McCourt, Kirsten M. Müller, Orlando Necchi, Jr., Phil M. Novis, Karin Rengefors, Samuel R. Rushforth, Robert G. Sheath, Alison R. Sherwood, and Alan D. Steinman.

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