Preface

The study of wetland plants has been of interest to botanists for many years, but the need to identify and understand these plants has expanded dramatically since the 1970s. At that time, ecologists began to make known the vital role that wetlands play in our landscapes. The image of wetlands has shifted from that of mosquito-ridden wastelands to natural areas of critical importance. Because the field of wetland ecology has expanded, so has the study of the plants that thrive there, and their role in ecosystem dynamics. Today, many professionals are expert in the identification of wetland plants and identification courses are regularly taught throughout the U.S. and elsewhere. Whether readers are working with wetlands in their professions, or novices to the field, we hope to convey an understanding of the habitat, life histories, and adaptations of these plants.

Wetland plants are interesting not only because they help us identify the boundaries of a wetland, but also because of their unique evolutionary strategies for coping with life in a saturated environment. Of approximately 250,000 described angiosperm species, only a small proportion has adapted to life in the water or saturated soils. The ways in which this evolution from land to water occurred are numerous and the group of plants we discuss here is far from uniform in this regard.

More than half of the wetlands of the U.S. have disappeared since the time of European settlement and many of the remaining areas are threatened by human alterations to the landscape. In Europe, virtually no wetlands are in their natural state. This rapid habitat loss has placed many wetland species on threatened and endangered species lists. And, as in other ecosystem types, invasive plants have displaced many native or more desirable species. In some ecosystems, invasives present almost as great a threat to wetland plants as outright destruction of the ecosystem. Gaining an understanding of wetland plants and their habitats is a critical first step in helping to combat these losses.

We refer to the plants covered here as *wetland plants, wetland macrophytes,* and *hydrophytes*. Our discussion includes vascular plants that grow in or on water or in saturated soils. These include submerged, emergent, floating, and floating-leaved species. The vast majority of vascular plants that grow in these conditions are angiosperms, and our discussion centers almost exclusively on them. We also discuss a few exceptions, such as *Taxodium distichum* (bald cypress) and *Larix laricina* (tamarack), both gymnosperms that inhabit wetlands. Some pteridophytes, or ferns and fern allies, are also adapted to wetland conditions and they are mentioned, though not extensively discussed. We include species of both freshwater and saline wetlands. Most of our discussion involves wetlands of the temperate zone; however, we have included mangrove forests, a subtropical and tropical wetland type. Species of algae are not discussed, but they are covered as a component of wetland primary productivity, and methods to measure phytoplankton and periphyton primary productivity are discussed. Bryophytes, or mosses, are discussed as the basis of peatland systems and as one of the driving forces in their substrate chemistry. However, species of bryophytes and their specific adaptations and reproduction are not covered. The plants adapted to flowing water environments and to marine habitats are not specifically discussed.

Plant names follow the U.S. Fish and Wildlife Service's National List of Plant Species that Occur in Wetlands (Reed 1997), and where plants outside the U.S. are named, we refer to the literature reference in which the plant is named. Family names follow Cook's 1996 book, *Aquatic Plant Book*. Cook sometimes provides equivalent or older names for families and we give these in parentheses following the family name. The names of orders are according to a recent re-classification of angiosperm families by the Angiosperm Phylogeny Group (1998). The names of species formerly all classified in the genus *Scirpus* (bulrush) have been undergoing a number of name changes. In a classification scheme proposed by Smith and Yatskievych (1996), the genus was divided into five genera (*Scirpus, Schoenoplectus, Bolboschoenus, Isolepsis,* and *Trichorphorum*). The recent literature is mixed regarding the adoption of the new names. For the species found in the U.S., we use the names as they appear in Reed 1997. For species found outside of the U.S., we use the name used by the authors of the papers we cite in each instance. In each chapter, the first time a species, genus, or family is mentioned, we give the scientific name first and follow it with the common name in parentheses. Subsequent mentions of the plant use only the scientific name, often with the genus abbreviated to the first letter (i.e., *Phragmites australis* becomes *P. australis* after the first time it is mentioned in any given paragraph or section). Some plants have no common name, or at least none that we were able to find in English, so for these, none is mentioned.

Wetland Plants: Biology and Ecology is a synthesis of current research on wetland plants and their communities. In our introductory section (Chapters 1 through 3), we present general information about the growth forms, evolution, distribution, and diminishing habitat of wetland plants. We also discuss wetland classifications and definitions and broad types of wetland ecosystems such as salt marshes, mangrove forests, riparian wetlands, and peatlands. To understand wetland plant evolution and life history strategies it is vital to understand the abiotic conditions that set the boundaries for their growth. A brief explanation of some important hydrological principles is provided in the first section of Chapter 3, with an emphasis on how wetland hydrology shapes the plant community. The second half of Chapter 3 covers other important factors for plant growth such as substrate type, salinity, and nutrient availability.

Part 2 is devoted to a discussion of the adaptations and reproduction of wetland macrophytes. In Chapter 4 we discuss the adaptations of wetland plants to anoxia, salinity, and other stressful conditions for growth. Chapter 5 covers wetland angiosperm reproduction, both sexual and asexual, as well as adaptations of pollen and pollination mechanisms, and methods of seed dispersal.

In Part 3, the function, dynamics, and potential disturbances of wetland plant communities are discussed. Chapter 6 provides background on the concept of primary productivity and the history and methods of its measurement. Primary productivity is of particular interest in wetland studies because some types of wetlands are among the most productive ecosystems in the world. We focus on methods in this chapter because the results depend so heavily on the method chosen. In Chapter 7 we discuss community dynamics. Specifically, we cover ecological succession, with a look at the classical idea that wetlands are a sere, or successional stage, between lake and terrestrial ecosystems; we look as well at material that refutes that idea. We also include competition in Chapter 7. Competition influences the diversity and composition of plant communities and many plant strategies have evolved to compete for both space and resources. In Chapter 8 we give examples of invasive plants and describe techniques used, with varying degrees of success, to control them. The ecological implications of invasive species are also discussed.

Applications of wetland plant study are discussed in the last two chapters (Part 4). We present research on the development of plant communities in newly restored or created wetlands, including the role of plants in wetlands constructed to improve water quality (Chapter 9). The interest in restoring degraded aquatic ecosystems is growing exponentially, and an understanding of wetland plant community dynamics is critical in planning successful restoration efforts. Indeed, it is often vegetation establishment that is used as a benchmark of success in restoration projects. Planting and seeding techniques, the use of seed banks, including the use of salvaged soils, and the design aspects of restoration planning are covered. The uses of wetland plants as indicators of ecological integrity and of wetland boundaries (delineation) are covered in Chapter 10. The use of wetland plants as biological indices of ecosystem integrity is currently under study and we present methods for choosing and testing plant indicators. We also discuss the history of wetland delineation, the ecological principles behind it, and its current status.

Wetland Plants: Biology and Ecology is intended for wetland professionals, academicians, and students. Professionals whose plant identification skills may be well honed from delineation experience will be interested in a comprehensive reference on the ecology of aquatic plants. The book may also serve as a text for courses on wetland plants, aquatic botany, or wetland ecology. This book will be best for upper-level undergraduates or graduate students. A textbook for wetland plant courses has not been available in the past. We have found that without a textbook, students are at a disadvantage to understand and integrate course material. For this reason, we have tried to gather the information necessary for such a course under one title. To use this book, a basic knowledge of botany and ecology is helpful, but not essential, as we try to provide enough background for those who are learning on the job or who are catching up on background material as they learn new subject matter.

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Julie K. Cronk, who is currently a private consultant in wetland ecology and restoration, earned a Ph.D. in environmental biology from The Ohio State University in 1992. Her dissertation research was on water quality and algal primary productivity in four constructed riparian emergent marshes at the Des Plaines River Wetlands Demonstration Project outside Chicago, Illinois. She worked as an assistant professor in the Department of Biological Resources Engineering at the University of Maryland from 1993 to 1995. Her primary research interests have been wetland plant primary productivity, the development of plant communities in new wetlands, and the improvement of water quality in constructed wetlands to treat domestic and animal wastewater. She is author or co-author of several peer-reviewed journal articles on wetland-related topics and she has given presentations at conferences for the Society of Wetland Scientists, INTECOL, and the American Society of Agricultural Engineers. Dr. Cronk has taught wetland ecology, aquatic plants, plant biology, and water quality courses, as well as seminars on constructed wetlands at the University of Maryland, Grand Valley State University in Allendale, Michigan, and at The Ohio State University. She is a member of the Society of Wetland Scientists.

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