Prospectus for

The Biology of Freshwater Wetlands

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Rationale

The Biology of Freshwater Wetlands is intended to be an introduction to freshwater wetlands. It will stress those abiotic features of wetlands that make them unique as a habitat and will examine in detail the adaptations, distributions, and interactions of various organisms (microbes, invertebrates, plants, and vertebrates) that collectively form wetland ecosystems. All kinds of freshwater wetlands will be covered including lacustrine, palustrine, riverine and tidal wetlands. The management, conservation and restoration of wetlands will also be considered. It is intended for students, naturalists, and professionals without any previous knowledge of wetlands. Currently, there is no comprehensive introduction to wetlands. Existing texts are ether too specialized or too detailed.

As with other books in the Biology of Habitats series, the emphasis in this book will be on the organisms that dominate wetland habitats. It will stress those features of wetlands and wetland organisms that distinguish them from both their terrestrial and aquatic equivalents. Figures and tables will be used throughout to illustrate and elucidate topics covered in the text. Suggestions for simple field studies and experiments that can be done with wetland organisms or in wetlands will be presented in an appendix.

Competing Titles

There is only one textbook available for college or university courses in wetland ecology:

Mitsch, W. J. and J. G. Gosselink. 2000. Wetlands. 3rd ed. John Wiley & Sons, New York, NY. 920pp.

The third edition of Mitsch and Gosselink is over 900 pages long. This book a cross between an introductory wetland ecology textbook and a monograph describing selected coastal and freshwater wetlands, primarily in North America. It has an ecosystem perspective and is especially strong on topics like wetland primary production and biogeochemistry as well as some applied aspects of wetland ecology such as the use of wetlands to improve water quality. It almost completely ignores animals, most notably waterfowl. Consequently, as with other wetland textbooks (see below), this book provides incomplete coverage of the field.

Other recent books:

Cronk, J. K. and M. S. Fennessy. 2001. *Wetland Plants: Biology and Ecology*. Lewis Publishers, Boca Raton, Florida, USA. 462pp.

This book is essentially an update of two classic books, C. D. Sculthorpe's *Aquatic Plants* and G. E. Hutchinson's *Treatise on Limnology Volume III. Aquatic Macrophytes and Attached Algae*. Its coverage of all aspects of plants in wetlands is excellent. Its focus on plants limits its utility as an introduction to wetland ecology.

Keddy, P. A. 2000. *Wetland Ecology: Principles and Conservation*. Cambridge University Press, Cambridge, United Kingdom. 614pp.
This is Paul Keddy's treatise on wetland plant communities. Most of the chapters are expansions of papers that Keddy and co-authors have published on the development, composition, and distribution of wetland plant communities. Its scope is too limited for it to be useful as an introduction to wetland ecology.

Middleton, Beth 1999. *Wetland Restoration: Flood Pulsing and Disturbance Dynamics*. John Wiley & Sons, New York, NY. 388pp.
This book is a solid introduction to wetland restoration from a theoretical perspective. It was never intended to be an introduction to wetland ecology.

Table of Contents

Title: *The Biology of Freshwater Wetlands*

Chapter 1. ***Introduction. What are wetlands?*** **(20 pages)**

This chapter will stress that wetlands habitats have four important characteristics: they are areas that are shallowly flooded (hydrology) with a unique flora (hydrophytes) and fauna (waterfowl, aquatic mammals) and unique soils (hydric soils). This flooding results in the development of anaerobic conditions in their soils that allows only specially adapted plants, invertebrates, and microorganisms to dominant wetland habitats. How wetlands are classified and the different types of wetlands that are recognized will be described. Common freshwater wetlands will be illustrated from boreal peatlands to tropical floodplain wetlands. Historic changes in wetland abundance will also be covered. The need to classify and inventory wetlands globally in order to better document their fate will be discussed as will current efforts to conduct a global inventory of wetlands.

Chapter 2. ***The Wetland Environment: Water and Soils*** **(40 pages)**

Wetland hydrology (palustrine, lacustrine, riverine, tidal, rainfed) and wetland(hydric) soils and their consequences are the main theme of this chapter. Among and within wetlands, there are a variety of water regimes that are delimited by the timing, duration and depth of flooding. The range of water regimes found in freshwater wetlands and seasonal and inter-annual variations in these water regimes will be described. The dynamic nature of many wetlands that results from year-to-year changes in their water regimes (wet-dry cycles) will be emphasized. How water regime and other environmental factors results in the development of different types of wetland (hydric) soils will be covered in the second half of this chapter. This will include a discussion of redox reactions and how redox is measured. The characteristics and classification of hydric soils will be described. It will be stressed that anaerobic soils are the defining characteristic of wetlands. Other environmental factors such as light, temperature, water chemistry, pH, and gas

concentrations and diffusion (oxygen, carbon dioxide) will be covered where relevant throughout this chapter.

Chapter 3. *Wetland Plants and Animals* (30 pages)

Characteristic types of animals and plants found in freshwater wetlands will be described. Vascular plants (submersed, emergent, floating-leaved, free-floating species), non-vascular plants (mosses, liverworts, and ferns), various algal groups (phytoplankton, epiphyton, epipelon, and metaphyton/periphyton), major invertebrates (crustacea, gastropods, diptera, coleoptera, and hemiptera) and vertebrates (amphibians, reptiles, fish, aquatic mammals, waterfowl, other birds) will be covered. The emphasis will be on anatomical, morphological, physiological and behavioral adaptations of these organisms that enable them to live in wetlands. Examples of parallel evolution, especially evident in vascular plants, will be pointed out.

Chapter 4. *Organization of Wetlands* (20 pages)

Wetlands are characterized by easily observed vegetation zones. Representative zonation patterns will be described and illustrated. Theories about the nature and origin of these vegetation zones will be presented. How zonation patterns influence the distribution and abundance of both invertebrate and vertebrates, especially waterfowl and other birds and how zonation patterns affect physical and chemical conditions in wetlands will be discussed. The effects of seed dispersal, plant establishment requirements, interspecific competition and herbivory on the development of wetland zonation patterns along a water depth gradient will be major themes in this chapter. Inter-annual changes in hydrology, especially droughts, and their affects on plant and animal communities will be discussed. Fire and its role in wetlands will also be considered.

Chapter 5. *Wetland Production and Mineral Cycling* (20 pages)

This chapter will examine wetlands from an ecosystem perspective. Primary production (algal and vascular plant) and litter decomposition (i.e. carbon cycling) will be emphasized as will their implications for food chains and nutrient cycling in wetlands. Environmental factors that control primary production and litter decomposition will be described, including nutrients, water depths, water currents, and temperatures. Representative food chains will be described and illustrated. The relative importance of algae and vascular plants in overall wetland primary production and of herbivory and detritivory in wetland food chains will be examined. Nitrogen and phosphorus cycles in wetlands and their significance will be described.

Chapter 6. *The Landscape, Continental, and Global Significance of Wetlands* (20 pages)

The importance of wetlands for human societies is the focus of this chapter. It will include a consideration of wetlands as part of local surface and groundwater systems and as sinks for pollutants. The continental importance of different kinds of wetlands as habitats for migrating birds as they move between their breeding grounds and over-wintering grounds will be illustrated. The significance of wetlands for the global carbon cycle and global climate will also be described, including wetlands as global carbon sinks (carbon sequestration) and as sources of the greenhouse gas methane.

Chapter 7: *The Future of Wetlands* (20 pages)

Threats to wetlands, wetland management, wetland preservation/conservation, and wetland restoration/creation are the main topics in this chapter. Major threats to wetlands include drainage or reduction of water inputs, direct human encroachment, increasing inputs of nutrients and sediments, and

invasion by exotic species of plants and animals. Techniques for managing wetlands will be described, including water level manipulations, controlling exotic species, controlled grazing, and controlled burning. The wetland preservation/conservation section will examine changes in societal attitudes toward wetlands and how this has affected the conservation/preservation of wetlands. Major international efforts to save existing wetlands will be described, e.g., the Ramsar Convention. The wetland restoration section will examine the reasons that wetlands are being restored/created, how wetlands are restored/created, and how successful these efforts have been. Some major projects to restore wetlands will be highlighted, such as the Kissimmee River restoration in Florida.

Appendix: *Practical Field and Laboratory Studies* (30 pages)

(a) Redox Measurement
(b) Composition of Gasses released by Wetland Sediments
(c) Seasonal Water Level Changes
(d) Identification of Wetland Soils
(e) Adaptations of Submersed and Emergent Wetland Plants
(f) Wetland Seed Banks
(g) Distribution of Plant Species along a Water Depth Gradient
(h) Standing Crop of Wetland Vegetation
(i) Common Wetland Invertebrates
(j) Estimating the Abundance of Aquatic Mammals
(j) Nutrient Concentration in Inflows and Outflows
(k) Wetland Delineation
(l) Synoptic Mapping of Oxygen Concentrations in Wetlands
(m) Litter Decomposition and Invertebrates
(n) Algal Production in Emergent Stands and Open Water

Glossary (5 pages)
References (*10 pages)*