Ecology of Tidal Freshwater Forested Wetlands of the Southeastern United States
Ecology of Tidal Freshwater Forested Wetlands of the Southeastern United States

Edited by

William H. Conner
Clemson University
Georgetown, SC
USA

Thomas W. Doyle
US Geological Survey
Lafayette, LA
USA

and

Ken W. Krauss
US Geological Survey
Lafayette, LA
USA

Springer
A C.I.P. Catalogue record for this book is available from the Library of Congress.

ISBN 978-1-4020-5094-7 (HB)

Published by Springer,
P.O. Box 17, 3300 AA Dordrecht, The Netherlands.

www.springer.com

Printed on acid-free paper

Cover Pictures from upper left clockwise:
Barnacles growing on base of baldcypress tree in Louisiana.
Hermit crab on base of baldcypress tree in South Carolina.
Tidal freshwater baldcypress stand on Turkey Creek, South Carolina.
(photos by William Conner).

All Rights Reserved
© 2007 Springer
No part of this work may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission from the Publisher, with the exception of any material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work.
Contributors

## Contents

Preface xi

**Chapter 1 - Tidal Freshwater Swamps of the Southeastern United States: Effects of Land Use, Hurricanes, Sea-level Rise, and Climate Change**
Thomas W. Doyle, Calvin P. O’Neil, Marcus P.V. Melder, Andrew S. From, and Monica M. Palta 1

**Chapter 2 - Hydrology of Tidal Freshwater Forested Wetlands of the Southeastern United States**
Richard H. Day, Thomas M. Williams, and Christopher M. Swarzenski 29

**Chapter 3 - Soils and Biogeochemistry of Tidal Freshwater Forested Wetlands**
Christopher J. Anderson and B. Graeme Lockaby 65

**Chapter 4 - Plant Community Composition of a Tidally Influenced, Remnant Atlantic White Cedar Stand in Mississippi**
Bobby D. Keeland and John W. McCoy 89

**Chapter 5 - Sediment, Nutrient, and Vegetation Trends Along the Tidal, Forested Pocomoke River, Maryland**
Daniel E. Kroes, Cliff R. Hupp, and Gregory B. Noe 113

**Chapter 6 - Vegetation and Seed Bank Studies of Salt-Pulsed Swamps of the Nanticoke River, Chesapeake Bay**
Andrew H. Baldwin 139

**Chapter 7 - Tidal Freshwater Swamps of a Lower Chesapeake Bay Subestuary**
Richard D. Rheinhardt 161
Chapter 8 - Biological, Chemical, and Physical Characteristics of Tidal Freshwater Swamp Forests of the Lower Cape Fear River/Estuary, North Carolina
Courtney T. Hackney, G. Brooks Avery, Lynn A. Leonard, Martin Posey, and Troy Alphin

Chapter 9 - Ecology of Tidal Freshwater Forests in Coastal Deltaic Louisiana and Northeastern South Carolina
William H. Conner, Ken W. Krauss, and Thomas W. Doyle

Chapter 10 - Ecology of the Coastal Edge of Hydric Hammocks on the Gulf Coast of Florida
Kimberlyn Williams, Michelina MacDonald, Kelly McPherson, and Thomas H. Mirti

Chapter 11 - Ecological Characteristics of Tidal Freshwater Forests Along the Lower Suwannee River, Florida
Helen M. Light, Melanie R. Darst, and Robert A. Mattson

Chapter 12 - Community Composition of Select Areas of Tidal Freshwater Forest Along the Savannah River
Jamie Duberstein and Wiley Kitchens

Chapter 13 - Ecology of the Maurepas Swamp: Effects of Salinity, Nutrients, and Insect Defoliation
Rebecca S. Effler, Gary P. Shaffer, Susanne S. Hoeppner, and Richard A. Goyer

Chapter 14 - Selection for Salt Tolerance in Tidal Freshwater Swamp Species: Advances Using Baldcypress as a Model for Restoration
Ken W. Krauss, Jim L. Chambers, and David Creech

Chapter 15 - Assessing the Impact of Tidal Flooding and Salinity on Long-term Growth of Baldcypress Under Changing Climate and Riverflow
Thomas W. Doyle, William H. Conner, Marceau Ratard, and L. Wayne Inabinette
## Contents

### Chapter 16 - Conservation and Use of Coastal Wetland Forests in Louisiana

Page 447

### Chapter 17 - Tidal Freshwater Forested Wetlands: Future Research Needs and an Overview of Restoration

Page 461

### Appendix 1

Page 489

### Index

Page 497
Tidal freshwater forested wetlands represent an intriguing and under-studied type of ecosystem in the southeastern United States. The physiographic position of tidal freshwater forested wetlands in occupying low-lying, coastal areas makes them susceptible to upland runoff, tidal flooding, saltwater intrusion, and other global climate change phenomena. While information on them is rather sparse in the scientific literature, these ecosystems are among the most sensitive to sea-level rise and increased drought or flood frequency. Tidal freshwater forested wetlands are readily impacted by acute and chronic exposure to even low levels of salinity. The combined stress of flooding and salinity may compound the threat in these systems such that the margin for survival and compensation to changing climate is much less than for other coastal habitats. In this book, we bring together principal investigators whose research focus has targeted the hydrology, biogeochemistry, community ecology, forestry, stress physiology, and restoration of tidal freshwater forested wetlands in the southeastern United States. It is our foremost intent to develop an up-to-date treatise that includes not only peer-reviewed journal articles but also the dispersive grey literature on the topic in order to spark future research interest in tidal freshwater forested wetlands and to provide land managers with a concise overview of research findings. We have thus formalized all scientific and common names into the standard of ITIS (Integrated Taxonomic Information System, http://www.itis.gov, January 2007; for a complete listing of scientific and common names of all plants used in book, see Appendix 1).

This book resulted from several research projects that we were conducting under the auspices of the U.S. Geological Survey’s Global Change Research Program. In particular, as we began to investigate carbon cycling in tidal freshwater forested wetlands impacted by salinity in South Carolina, we noticed that there were few applicable studies in the scientific literature. However, distribution of these forests along the tremendously altered coastlines is often in the form of remnant patches in need of major atten-
tion by restorationists. Without concise documentation of the many services provided by these ecosystems and of how those services shift with climate change, restoration is likely to be stalled considerably in light of the many natural and human impacts to tidal freshwater forested wetlands in the Southeast.

Tidal forests are certainly not new to the literature, but most attention has been devoted to mangrove wetlands in which tidal flooding, salinity, and nutrient gradients interact in complex ways. This literature has so dominated tidal forested wetland research that the terms “tidal” and “salinity” have become tightly linked, and some have even suggested that any mention of “tidal” and “freshwater” together is contradictory. We submit that this is not the case either etymologically or in natural systems. These wetlands – which make up at least 200,000 ha in the southeastern United States (Field et al. 1991) – can be periodically exposed to salinity either by large tides, droughts, or storm events, but their general function and species assemblage are those of a freshwater ecosystem.

In the first part of this book (Chapters 1–3), we describe land-use history in the southeastern United States that has led to the restricted distribution of tidal freshwater forested wetlands. We then describe what is known about the function of these systems by dedicated chapters on hydrology, soils, and biogeochemistry. The second part of this book (Chapters 4–13) describes specific tidal freshwater forested wetlands as case studies that detail specific hydrologic cycles, salinity regimes, floristics, disturbances, and discoveries made in particular tidal forests. Tidal freshwater forested wetlands can occur just about anywhere a river meets the sea, but they are more likely to occur where larger tidal ranges persist (Figure P.1). This section omits many tidal freshwater forested wetlands for which little information exists, but generalities can be made from focal systems. Specifically, we present information from a broad range of sites in the southeastern United States, including the Nanticoke River (Delaware/Maryland), Pocomoke River (Maryland), Lower Chesapeake Bay subestuary (Virginia), Cape Fear River (North Carolina), Waccamaw River (South Carolina), Savannah River (South Carolina/Georgia), Waccasassa Bay (Florida), Suwannee River (Florida), Escatawpa River (Mississippi), Lower Mississippi River Deltaic Plain (Louisiana), and Maurepas Swamp (Louisiana). In the final part of this book (Chapters 14–17), we present some of the research that has been conducted on restoration, and in assessing past
Fig. P.1. Map of the southeastern United States showing the location of tidal freshwater wetlands discussed in this book. 1=Nanticoke River (Delaware/Maryland), 2=Pocomoke River (Maryland), 3=Lower Chesapeake Bay sub-estuary (Virginia), 4=Cape Fear River (North Carolina), 5=Waccamaw River (South Carolina), 6=Savannah River (South Carolina/Georgia), 7=Waccasassa Bay (Florida), 8=Suwannee River (Florida), 9=Escatawpa River (Mississippi), 10=Lower Mississippi River (Louisiana), and 11=Maurepas Swamp (Louisiana).

effects of climate change on tidal freshwater forested wetlands. We end with our thoughts on what some of the future research topics should include, and we highlight the importance of collaborative research and interactions with land managers in this endeavor.

We are very appreciative of the many peer and editorial reviewers who contributed to ensuring that these chapters were scientifically accurate and informative to a broad range of professionals. These reviewers include James A. Allen (Northern Arizona University), Christopher J. Anderson (Auburn University), Andrew H. Baldwin (University of Maryland), Mark M. Brinson (East Carolina University), Jim L. Chambers (Louisiana State University), Jarita Davis (IAP World Services, Inc.), John W. Day, Jr. (Louisiana State University), Richard H. Day (U.S. Geological Survey),
Diane DeSteven (USDA Forest Service), Jamie Duberstein (Clemson University), Rebecca S. Effler (University of Georgia), Katherine C. Ewel (USDA Forest Service, retired), Emile S. Gardiner (USDA Forest Service), Graeme B. Lockaby (Auburn University), Courtney Hackney (University of North Carolina at Wilmington), Bobby D. Keeland (U.S. Geological Survey), Richard Keim (Louisiana State University), Cheryl Kelley (University of Missouri-Columbia), James O. Luken (Coastal Carolina University), Thomas McGinnis II (IAP World Services, Inc.), Beth A. Middleton (U.S. Geological Survey), William J. Mitsch (Ohio State University), Leonard G. Pearlstine (University of Florida), Brian C. Perez (U.S. Geological Survey), Jack Putz (University of Florida), Gary P. Shaffer (Southeastern Louisiana University), Rebecca R. Sharitz (University of Georgia), Erik Shilling (National Council for Air and Stream Improvement, Inc.), Thomas J. Smith III (U.S. Geological Survey), David W. Stahle (University of Arkansas), Michael Stine (Louisiana State University), Robert R. Twilley (Louisiana State University), Beth A. Vairin (U.S. Geological Survey), Jos T.A. Verhoeven (Utrecht University), Michael G. Waldon (U.S. Fish and Wildlife Service), and Dennis F. Whigham (Smithsonian Environmental Research Center).

William H. Conner, Thomas W. Doyle, and Ken W. Krauss

Reference