

Blue Carbon in Shallow Coastal Ecosystems

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Editors

Blue Carbon in Shallow Coastal Ecosystems

Carbon Dynamics, Policy,
and Implementation



Springer

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Foreword

Tomohiro Kuwae and Masakazu Hori's *Blue Carbon in Shallow Coastal Ecosystems: Carbon Dynamics, Policy, and Implementation* is a major contribution to blue carbon science, providing a solid reference source to those starting to consider this important aspect of environmental sciences. Most importantly, this book provides a unique effort to broaden the scope of blue carbon by also addressing nonconventional blue carbon ecosystems, such as macroalgal stands and corals, with a rich suite of examples from a range of coastal ecosystems in Japan. As a unique contribution, the contributing authors integrate the fluxes of CO₂ that these coastal habitats support at the global scale for the first time, a prerequisite to evaluate the efficiency of various policy actions to strengthen the role of blue carbon ecosystems in climate change mitigation. I strongly recommend this book to students and scholars interested in climate change and the role that conservation and restoration of coastal ecosystems may play in mitigating climate change.

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Preface

The term “blue carbon” was coined by the United Nations Environment Programme in 2009 and is still rather new. However, this concept and the role of blue carbon stored in shallow coastal ecosystems (SCEs) as a climate mitigation measure have attracted the interest of many people worldwide. Some such typical ecosystems (e.g., mangroves, tidal marshes, and seagrass meadows) are now being called “blue carbon ecosystems.” The number of publications dealing with blue carbon has been increasing exponentially since the genesis of the term, and the science of blue carbon and its role within the context of the mitigation of global warming seem to be rapidly maturing. However, there are very few comprehensive books about blue carbon and the role of carbon storage and CO₂ uptake in SCEs.

The suppression of CO₂ emissions to the atmosphere by blue carbon storage is a process that reduces atmospheric CO₂ concentrations and mitigates climate change indirectly. The net uptake of atmospheric CO₂ through the exchange of CO₂ at the air–ecosystem interface accomplishes the same goal directly. The role of both blue carbon storage and CO₂ gas uptake should therefore be considered when SCEs are targeted for climate change mitigation. However, we feel that there is a disciplinary division between these two blue carbon-related sciences: ecologists seem to focus on biological processes, biogeochemists consider carbon cycling, and meteorologists study greenhouse gas fluxes and physicochemical processes.

In addition to the classical blue carbon SCEs, other SCEs, including macroalgal beds, tidal flats, coral reefs, and embayments, are drawing attention as sites that could potentially contribute to climate change mitigation. However, there is very little published scientific information on these new potential climate change mitigation areas.

From the standpoint of policy and implementation, about 20% of the countries that approved the Paris Agreement have pledged in their Nationally Determined Contributions (NDCs) to use SCEs as a climate change mitigation option and are moving toward measuring blue carbon inventories. About 40% of those same countries have pledged to use SCEs to adapt to climate change. Australia has begun including blue carbon as a national carbon offset scheme, and as discussed in this book, Yokohama City, Japan, has also started using SCEs for carbon credit trading.

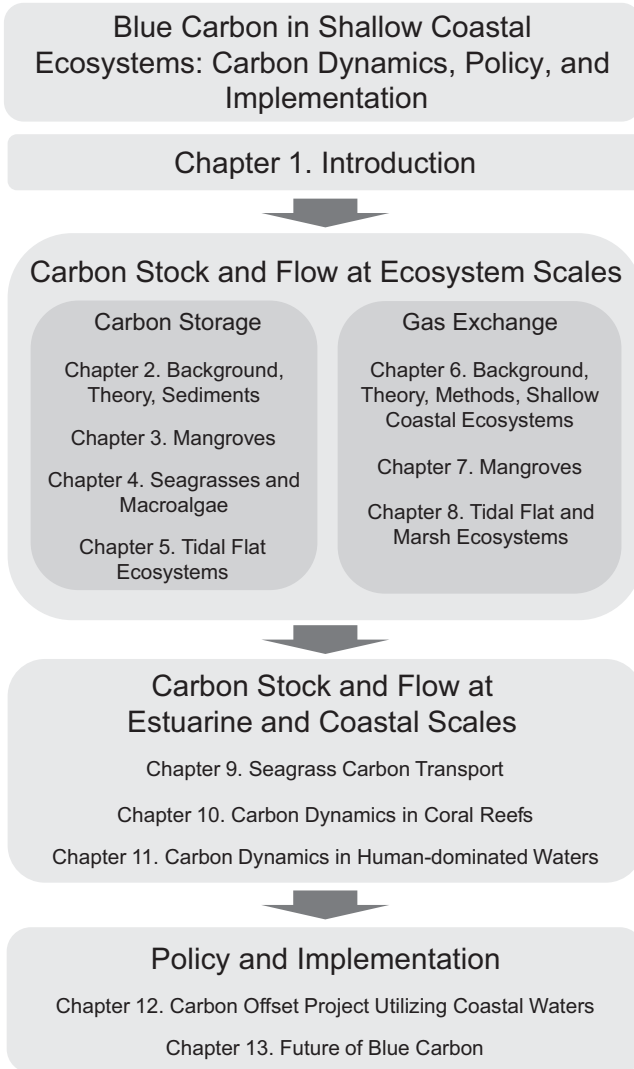


Fig. 1 Overview of this book

An overview and the highlights of this book are shown in Fig. 1 and Table 1, respectively. In consideration of the background described above, we chose the subject, purpose, and features of this book as follows:

1. Compilation of very recent studies and quantitative assessment of relevant processes and mechanism to demonstrate how much SCEs can take up CO₂ and store carbon and how they can contribute to climate change mitigation

Table 1 Chapter highlights

Chapter 1	Introduction of blue carbon and carbon cycling (carbon storage and CO ₂ gas flux) in shallow coastal ecosystems
Chapter 2	Distribution pattern and chemical and genetic characteristics of sedimentary organic carbon on a timescale of several thousand years and factors controlling rates of burial in marine and seagrass sediments
Chapter 3	Global distribution of mangrove biomass, carbon stocks, and carbon burial rates in mangroves
Chapter 4	Japan nationwide estimate of carbon sequestration potential (annual plant tissue production) in seagrass and macroalgal beds
Chapter 5	Carbon stocks and flows in tidal flat ecosystems, especially for rates of microalgal production and bivalve-related organic and inorganic carbon, with special emphasis on Japanese sites
Chapter 6	Theory, methods (bulk formula, chamber, eddy-covariance), and empirical studies of air-water CO ₂ fluxes in shallow coastal waters, which are sinks for atmospheric CO ₂ .
Chapter 7	Three types of CO ₂ fluxes (atmosphere-ecosystem, air-soil, air-water) in mangrove ecosystems, with special emphasis on the Sundarban, the world’s largest mangrove forest
Chapter 8	Three types of CO ₂ fluxes (atmosphere-ecosystem, air-sediment, air-water) in tidal flat and marsh ecosystems, with special emphasis on Japanese sites
Chapter 9	Numerical model to estimate transport of the sequestered carbon from eelgrass beds through shallow coastal waters to the deep sea, and the process of carbon storage both within eelgrass beds and off sites
Chapter 10	Carbon cycle (CO ₂ sink/source, carbon storage, and export) in coral reefs and interrelationships between coral reefs and other ecosystems such as seagrass meadows and mangroves
Chapter 11	Blue carbon ecosystems, estuaries, and embayments as sinks for atmospheric CO ₂ under some biogeochemical and socio-economic conditions, e.g., appropriate management of wastewater treatment
Chapter 12	A social experiment conducted by Yokohama City, Japan, that served to counter climate change and included a novel carbon offset campaign utilizing coastal waters
Chapter 13	Summary of carbon flows and stocks in various shallow coastal ecosystems reported in previous chapters, current status of blue carbon discussions at the international level, and future needs for policy making and social implementation

2. Inclusion of not only classical blue carbon ecosystems (i.e., mangroves, seagrass meadows, and salt marshes) but also macroalgal beds, tidal flats, coral reefs, and shallow waters near urban areas to show the potential of these ecosystems to serve as new carbon sinks
3. A thorough review of the literature, including many Japanese case studies, on blue carbon studies of not only topics that are currently research foci (i.e., sedimentary carbon stocks and accumulation rates [indirect processes for reducing atmospheric CO₂]) but also exchanges of CO₂ gas between the atmosphere and SCEs (direct processes for reducing atmospheric CO₂), carbon storage in the water column as refractory organic carbon, and off-site carbon storage (e.g., the deep sea)

4. Compilation of international policies and frameworks related to blue carbon and a case study of the application and implementation thereof (carbon offset credit) in Japan

We hope that this book will provide readers with a comprehensive and up-to-date understanding of the state-of-the-art science, technology, and policies related to blue carbon. We believe that publication of this book is timely because the Paris Agreement calls for initiation of climate change measures in 2020 and many countries have pledged in their NDCs to utilize SCEs as described above.

We anticipate that the audience of this book will be broad and will include professionals (e.g., managers and policymakers in local and national governments, conservationists, engineers involved with dredging companies, coastal environmental consultancies, NPOs, and NGOs), academics (coastal ecologists, biogeochemists, fisheries scientists, civil engineers, and climate scientists), and all levels of students and educators from undergraduates to university faculty.

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