Biodiversity & Conservative Research

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About the Book

The responsibility of society in all sectors is to realize the conservation of biodiversity due to variation in climatic changes and life extinctions. Fragmented research and meager books are available currently in emphasizing consolidated views on conservation of different biological diversity. Comprehensive information of species diversity is required by many scientist and graduates to understand and inculcate its importance for their futuristic attempts. This book in nutshell focuses on various diversity research and views in indicating the existence of micro and macro biomes in different niches. This book will shed lights on mangrove and its associated diversity, soil ecosystem diversity and research techniques pertaining to most of the biodiversity concept. Many Universities across the country as well globally have implemented the concept of biodiversity conservation in their syllabus. Hence this book will provide a thorough insight on biological diversity for young researchers and academicians.

This book has valuable information on threats and conservation strategies of mangrove diversity, bacterial diversity, fungal diversity, algal diversity and floristic diversity. Indeed this book will enlighten the students in biological diversity concept and provide appropriate references and key points to researchers.

Preface

Increasing Urbanization, pollution, emerging disease faces a crisis in the vast array of life on earth. To stem such crisis insights on areas that are rich in species diversity is very much important which is, need of the hour. Without species, there would not be air available to breathe, no food to eat and no water to drink. Recently biodiversity conference COP15 framed a new set of goals across the world to guide global action through 2030 to halt and reverse the nature loss.

The great challenge is that most of the people around the world still unaware about the critical importance of biological diversity. Microscopic biodiversity in the soil creates the chemical conditions necessary for healthy, abundant and sustainable crops. In heath sector, novel medicines are been identified in nature including cancer fighting fungi and pain killing tree resins. This book is intended to change such notions and spark new hope for the future. The chapters in this book would educate the reader's curiosity to know about the surroundings and provoke them in conservation of such areas. The research techniques and information discussed in this chapter will showcase a new dimension for the young researchers where they can acquire a compiled version from a vast fragmented data.

This book entitled "Biodiversity Conservative Research" is beneficial to students, faculties and scientists in understanding various ecosystems diversity and conservation strategies.

Basic research information and reviewed literature data are presented in table, figure formats. Geographic locations indicating the existence of rich species are represented in map and photographs related to the content of the chapter are precisely given. This book will no doubt shed a spotlight on numerous unexplored biota and niches that will have a clear understanding on conservative research for any type of readers.

Acknowledgment

This book flavors the concept of Biodiversity of living organisms habituate to terrestrial, marine and aquatic ecosystem. We hope the reader can know still better the importance of diversity conservation since the context in every chapter in this book are framed and written in such a way for easy understanding. The book is equipped with didactic elements such as recent reviews, case study and related self-contained concepts so that readers will likely dip in and out of the book rather than reading it linearly

D. P. Ponmurugan owes his special thanks to Science academy for funding a two week refresher course on Modern Biotechnology tools and techniques in Biodiversity conservation. He also thank Prof. Dr. P. Kaliraj, Vice-Chancellor, and Prof. Dr. K. Murugavel, Registrar i/c and Dr. T. Parimelazhagan, Professor and Head, Department of Botany, Bharathiar University, Coimbatore, Tamil Nadu, India, Dr. V. Kalaiselvi, Principal, and Dr. P. Ranjithselvi, Head, PG and Research Department of Botany, Government Arts College (A), Coimbatore for their whole hearted support and encouragement in bringing out this book in an useful manner. We profusely thank Drs. A. Rajendran, N. Geetha, T. Muthukumar, K. Vasanth, P. Gurusaravanan and K. Chitra for their valuable comments which in turn useful to improve the quality of the book. We must thank Mrs. S. Rajalakshmi, S. Jeya Preethi, S. Kavimalar, B. Raveena and N. Koushik Srinivas for their valuable support in writing this book in a beautiful manner.

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We take an opportunity to wish the publishers for their attempt in publishing the book to every nook and corner in India and abroad.

P. Ponmurugan

D. Arunkumar

Contents

Chapter - 3

Conservation of Mangroves

Amutha Swaminathan, T. Ramanathan and S. Sarah

Abstract

Mangrove species play a substantial role in the coastal ecosystem to protect from the natural calamities such as Tsunami, Hurricane and Cyclones. Mangrove plants occur mostly in coastal areas, river banks, marshy areas and sea shores. Mangroves are rich in both floral and faunal diversity. Mangrove vegetation consists of a variety of functional forms, such as trees, bushes, a palm and a ground fern, all of which grow above mean sea level in the intertidal zone of coastal marine habitats or estuary edges. Hence, these plants are called as “natural barriers”. Mangroves are found mainly in the coastal areas of tropical and subtropical regions around the world. These plants have rich medicinal properties. In general, each ecosystem provides incalculable benefits to habitat diversity and genetic diversity and sustainable service to human well-being. Especially mangrove ecosystem is one among the vital system protects from the natural hazardous such as mitigating the effects of tsunami, cyclones, floods. The exploitation of mangrove ecosystem leads to a threat in condition. Most of the species are noted as endangered and vulnerable. To overcome this exploitation, to conserve the Mangrove through conservation tools, for instance, Plant Tissue Culture method is the significant tools for *in vitro* conservation

Introduction

Mangrove species play a significant role in the coastal ecosystem to protect from the natural calamities such as Tsunami, Hurricane and other factors. Mangroves play a vital role in safeguarding human population and aquatic livelihood from the cyclones and storm surges. Mangrove plants occur mostly in coastal areas, river banks, marshy areas and sea shores. Hence, these plants are called “natural barriers”. Mangroves are found mainly in the coastal areas of tropical and subtropical regions around the world.

Fig 1: Mangrove Trees, *Source*: Online

Mangroves are halophytic in nature and they can withstand salinities of up to 100 parts per thousand, ranging from freshwater to hypersaline. They can also survive at considerably lower salinities, although competition with other species better adapted to the terrestrial environment limits their distribution in terrestrial groups. More than 100 nations have mangrove forests, which provide a diverse variety of ecosystem services that maintain the livelihoods and well-being of millions around the world. Despite its value, global mangrove loss has been so significant that researchers predicted "a future without mangroves" twelve years ago. Mangroves are a tropics-adapted species, and its poleward growth is limited by frost frequency and severity and the lowest temperature requirements.

Mangrove biodiversity has become progressively more important, because of the Convention on Biological Diversity and Mangrove Ecosystems are among the most vulnerable to global climate change, particularly sea-level rise. They are most prevalent in Asia (39%), followed by Africa (21%), North and Central America (15%), South America (12.6%), and Oceania (Australia, Papua New Guinea, New Zealand, and the South Pacific Islands) (12.4%). Mangrove plants are rich in medicinal properties. The exploitation of these plants leads to a threat in conditions.

Fig 2: Mangrove ecosystem, *Source*: Online

Most of the species are noted as endangered and vulnerable. To overcome this exploitation, to conserve the Mangrove through conservation tools, for instance, Plant Tissue Culture method is the significant tool for *in vitro* conservation.

Current status of mangrove under threat

Several numbers of the plants and animals that rely on mangrove ecosystems are endangered, and their place has been documented in the red data list (Table. 1). One of the main causes of decline is habitat loss due to human intrusion. As human populations spread further into the mangroves, these effects are likely to continue and exacerbate. Efficient utilization of the whole mangrove habitat is required to protect mangrove-dependent wildlife. This could be difficult and necessitate a species-by-species analysis of habitat requirements Saenger *et al.,* (1983).

S. No.	Species	Place
1	*Ardea cinerea*	Endangered-Malaysia
2	*Bruguiera gymnorrhiza*	Extinct-Taiwan
3	*Bruguiera hainseii*	Critically Endangered in India (Sundarbans)
4	*Crocodylus porosus*	Vulnerable; protected within reserves India and Malaysia; collecting prohibited-Australia, India & Sri Lanka
5	*Egretta alba*	Endangered-Malaysia & Puerto Rico
6	*Grammatophyllum speciosum*	Endangered- Thailand
7	*Leptoptilos javanicus*	Vulnerable-S and SE Asia
8	*Macaca fascicularis*	Near threatened-S and SE Asia, Protected within reserves-Malaysia
9	*Nasalis larvatus*	Endangered-Found only in Borneo; protected within reserves
10	*Panthera tigris tigris*	Endangered-protected within reserves in India, Bangladesh, Bhutan, Burma and Nepal
11	*Pitta megarhyncha*	Near threatened-Bangladesh, Indonesia, Malaysia, Myanmar, Singapore, Thailand
12	*Phoenix paludosa*	Near Threatened in India

13	*Sciurus niger avicennia*	Conservation dependent-Found only in southern Florida where two breeding populations remain; protected under Florida legislation
14	*Sonneratia griffithii*	Critically Endangered in India (Sundarbans)
15	*Tabebuia palustris*	Vulnerable in India
16	*Trichechus inunguis*	Vulnerable-Amazon river
17	*Trichechus senegalensis*	Vulnerable-Africa

Saenger *et al.,* (1983); Hilton-Taylor (2000); Source: http://www.redlist.org, Polidoro *et al.,* (2010)

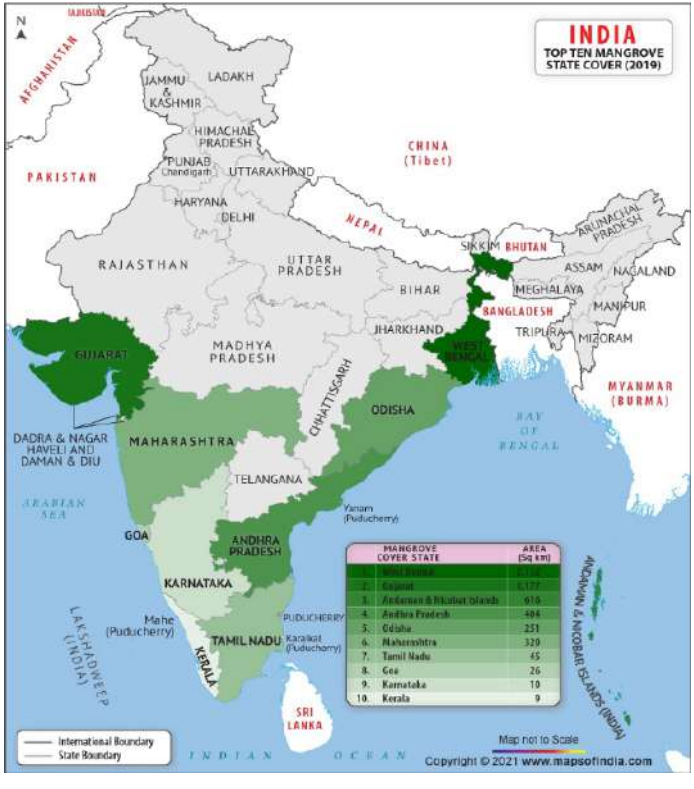
Mostly mangroves present all over the world except Antarctica. For instance, Asia has the largest area enrich with 42% of mangroves, when compared to other parts of the world (Giri *et al.,* 2011).

Map showing the global distribution of mangroves (in black colour).

Source: United Nations Environment World Conservation Monitoring Centre (UNEP-WCMC); Giri *et al.,* (2011); version 1.3, http://data.unep-wcmc.org/datasets/4.

In Asia, India, Indonesia, Malaysia and China have the largest mangrove areas. China is the largest country in Asia, it has a total area of mangrove forest that is 25,000 ha recorded currently. There are 20 families, 25 genera and 37 species including 26 true mangrove species and 11 semi-mangrove species were recorded (Li and Lee, 1997; Wang, 2007). China covers only a fair amount (0.14%) of world's mangrove forest cover, however it possesses one third of the world's mangrove species (Wang, 2007). In the past decades mangrove forest has converted into agricultural areas, aquaculture and urbanization through development of ports and duck farming (Zuang *et al.,* 2011). Malaysia has the largest mangrove forest area about 575,000 ha but it

has reduced from 17% of 695,000 ha due to the involvement of land conversion, urbanization, agriculture and aquaculture and natural calamities played a major role for mangrove threats. In India, during seventeenth and eighteenth centuries, the mangrove considered as wasteland and approximately 280,000 ha of mangrove forest of Bengal has been cleared for the purpose of rice cultivation by the British administrators.



Source: https://www.drishtiias.com/printpdf/mangroves-in-india

Later on, mangroves were considered as a good source for firewood by the Imperial Royal Forest Department of British India. The mangrove trees were used as fire woods for railways, steamers and consumption in the mangrove forest areas and this practice was stopped in1980 after the Indian Forest Conservation Act was passed by the Indian government.

The largest area 190,000 ha of mangroves in Florida, U.S were recorded. Other parts of US, Texas have 3790 ha (Armitage *et al*., 2015), chill-tolerant black mangrove (*Avicennia germinans*) has been disseminated and recolonized in the past three decades in Louisiana (Michot *et al.,* 2010; Osland *et al.,* 2013, 2015). There are no mangroves native to Hawaii, however some species have been introduced. Pollution caused by human beings to destruction of the mangrove ecosystem includes animal waste, application of pesticides, domestic duck farming and aquaculture.

Conservation of mangroves

Conservation strategies are of two types: *In-situ and Ex- situ. In- situ* conservation is protected under the natural condition in order to conserve the whole ecosystem and its biodiversity. *In- situ* conservation is again divided into two types are 1. Hotspots 2. Protected areas.

***In-situ* Conservation**

Maintaining biodiversity in natural habitat is called *in-situ* conservation. During the late 20th century, awareness has been created among human beings about the necessity of conservation of mangrove forests for its emergency need of conservation. After realization of extinction of many plant and animal species are highly susceptible to random change in environment factors. Hence, to conserve the mangrove forest ecosystem many National Parks, Sanctuaries and some protected areas have been established (Alongi, 1996).

Source: Online. Figure 3. In Situ Conservation of Mangrove ecosystem

In India Sundarban mangrove forest has 31 mammal species that existed in the past decades, all the species became extinct in the nineteenth century (Chowdhuri and Chowdhury, 1994; Sanyal, 1999). The Royal Bengal Tiger (Panthera Tigris Tigris) is flagship species and also it is a very good indicator of forest wealth. Tigers have been hunted for its valuable parts, now it is globally considered as an endangered species (IUCN, 2006). Adverse conditions lead to biology ecosystem imbalance, so considering the importance of the mangrove ecosystem, *in situ* conservation of Royal Bengal Tiger is established as Sundarban Tiger Reserve Forest as a protected area to conserve Biosphere.

***Ex-situ* conservation**

Conservation of Mangroves is very critical because it is an incredible ecosystem that serves as virtuous habitats for aquatic animals such as fish, manatees, crabs and some other species. Mangrove plants can store a greater percentage of carbon than other species therefore serve as an important source for preventing climatic change. Coastal habitats across the world are under heavy population and development pressures. Exploitation of the Mangroves has been increased because of its wood and food for aquatic ecosystems. Early 21st century, Mangrove plants have approximately reduced the rate from 2% to 0.4% per year around the world (Friess, 2019). Mangroves have valuable wood property and good resources for fisheries

and other industrial practices. The measure of human influence on the mangroves is increasing drastically over the past decades. Henceforth, many countries put forward their interest to protect the mangrove forest cover. On the one hand approximately 370 ha mangrove forest has been destroyed by the way of construction of Tieshan port of Beihai, Guangxi province. On the other hand, more than the total amount of mangroves were planted artificially.

Nowadays, the rate of global damage of mangrove forests is alarmingly lesser than the previous decades and the magnitude between the late 20th and early 21st century shows the improved monitoring data access and extended mangrove forest management and protection. Thus, the results of strong indications of conservation provide rehabilitation of mangrove species. Conservation initiatives have been taken by a number of countries through the International Blue Carbon Initiative and the Global Mangrove Alliance and discussed the climate change and conservation of mangroves worldwide. Awareness for conservation has increased as the public and government sectors lead to investment on conservation and management of mangroves (Daniel, 2020).

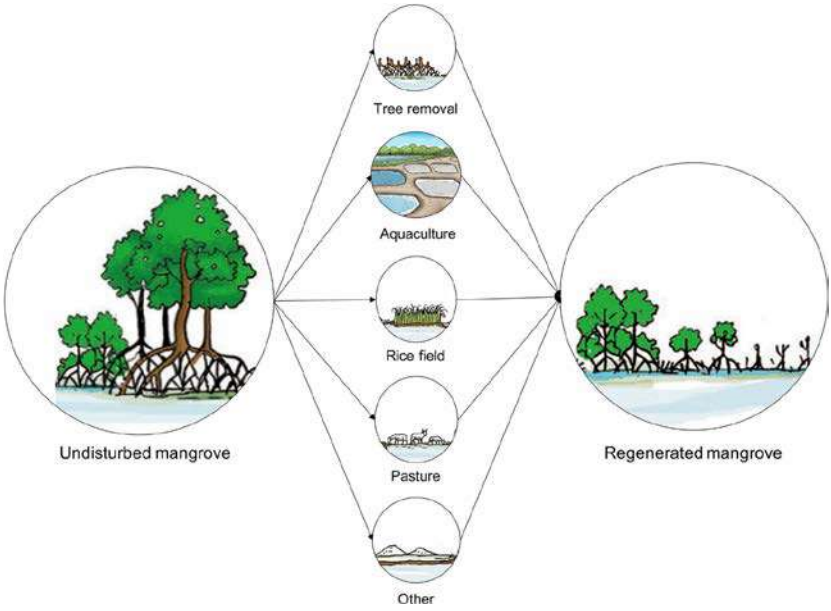
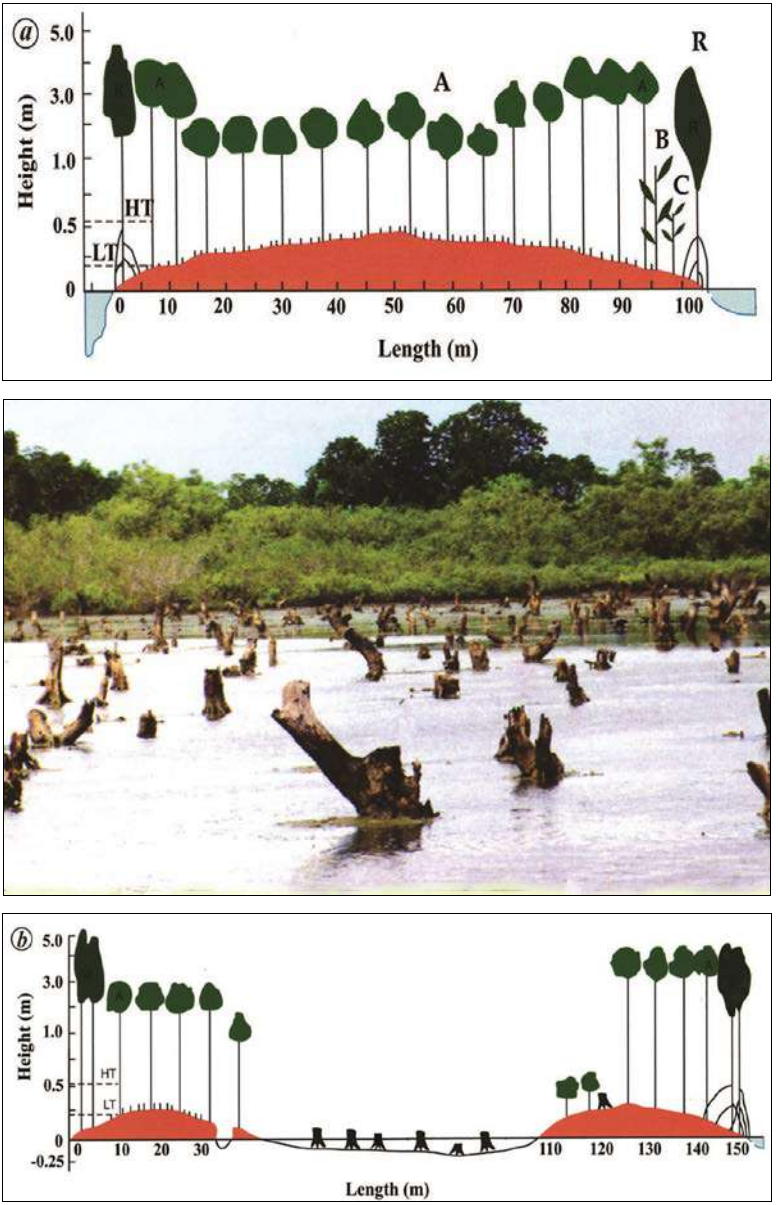


Fig 4: Blue Carbon Initiative for conservation

In India restoration of mangrove forest was initiated first time in Pichavaram mangrove in Tamil Nadu. This initiation involves a scientific

method with lower price consumption to develop the entire establishment of 50 ha of Mangrove Genetic Resources Centre in the Pichavaram Mangrove in Cuddalore district by Tamilnadu Forest Department (TNFD) Government of Tamil Nadu and M.S. Swaminathan Research Foundation (MSSRF).



Clear-felled mangrove area with stools and stagnant tidal water.

Source: Online: Afforestation of mangroves in marshy land of Pichavaram

Mangroves restoration in Pichavaram

Mangrove and carbon storage protection

The carbon storage of this mangrove forest has been increased by below and above the ground plant biomass carbon, sedimented organic carbon and total ecosystem carbon storage. The conservation ecosystem is a co-benefit for the ecosystem as well as climate change and humankind worldwide.

Mangrove forests play a vital role in rendering carbon sequestration through the reduction of carbon di-oxide. Human induced carbon di-oxide concentration in the atmosphere leads to climatic change and impacts the biodiversity of blue carbon storage of coastal ecosystems. Rehabilitation and afforestation of mangrove will be implemented through the post 2020

biodiversity agenda (Mace, 2009; Rahman, 2021). Biotic and abiotic factors influence the carbon in the mangrove biomass and sediment organic matter over the period of time (Alongi, 2020; Lovelock and Reef, 2020). Climatic factors such as temperature precipitation plays a major role in carbon storage which influence the plant growth and ecosystem productivity (Gilman *et al.*, 2008). According Deepika (2021) reviewed the past and present changes due to human activities through industrialization and urbanization. The heavy metal content also influenced both quality and quantity of mangrove forests.

References

1. Alongi, D. M. 2000. Global Significance of Mangrove Blue Carbon in Climate Change Mitigation. *Sci.*, 2: 67.
2. Alongi, D.M. 1996. The dynamics of benthic nutrient pools and fluxes in tropical mangrove forests. *J. Mar Res.*, 54: 123-148.
3. Chowdhuri, A.B. and Chowdhury, A. 1994. Mangroves of the Sundarbans. Vol. - I: India. World Conservation, Gland., 247
4. Daniel A. Friess, Erik S. Yando, Guilherme M.O. Abuchahla, Janine B. Adams, Stefano Cannicci, Steven W.J. Canty, Kyle C. Cavanaugh, Rod M. Connolly, Nicole Cormier, Farid Dahdouh-Guebas, Karen Diele, Ilka C. Feller, Sara Fratini, Tim C. Jennerjahn, Shing Yip Lee, Danielle E. Ogurcak, Xiaoguang Ouyang, Kerrylee Rogers, Jennifer K. Rowntree, Sahadev Sharma, Taylor M. Sloey and Alison K.S. Wee. 2020. Mangroves give cause for conservation optimism, for now. *Curr. Biol.*, 30: R135–R158.
5. Sharma, D., Rao, K., Ramanathan, A. 2022. A Systematic Review on the Impact of Urbanization and Industrialization on Indian Coastal Mangrove Ecosystem. In: Madhav, S., Nazneen, S., Singh, P. (eds) Coastal Ecosystems. *Coastal Research Library*, 38. Springer, Cham. https://doi.org/10.1007/978-3-030-84255-0_8.
6. Friess, D.A., Rogers, K., Lovelock, C.E., Krauss, K.W., Hamilton, S.E., Lee, S.Y., Lucas, R., Primavera, J., Rajkaran, A., and Shi, S. 2019. The state of the world's mangrove forests: past, present, and future. *Annu. Rev. Environ. Res.*, 4: 16.1–16.27.
7. Gilman, E. L., Ellison, J., Duke, N. C. and Field, C. 2008. Threats to mangroves from climate change and adaptation options: a review. *Aquat. Bot.* 89: 237–250.
8. Giri, C., Ochieng, E., Tieszin, L.L., Zhu, Z., Singh, A., Loveland, T.,