



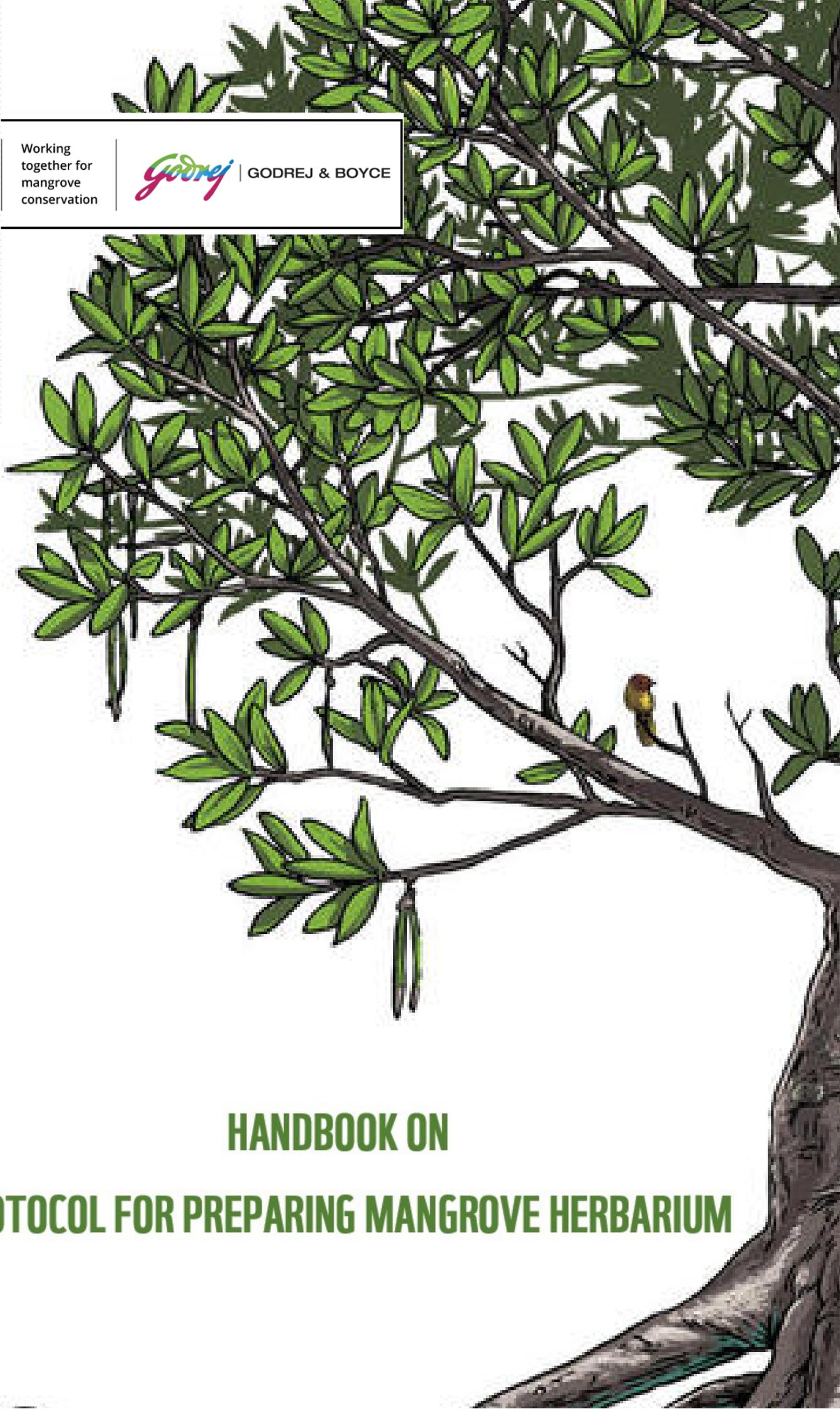
Working
together for
mangrove
conservation



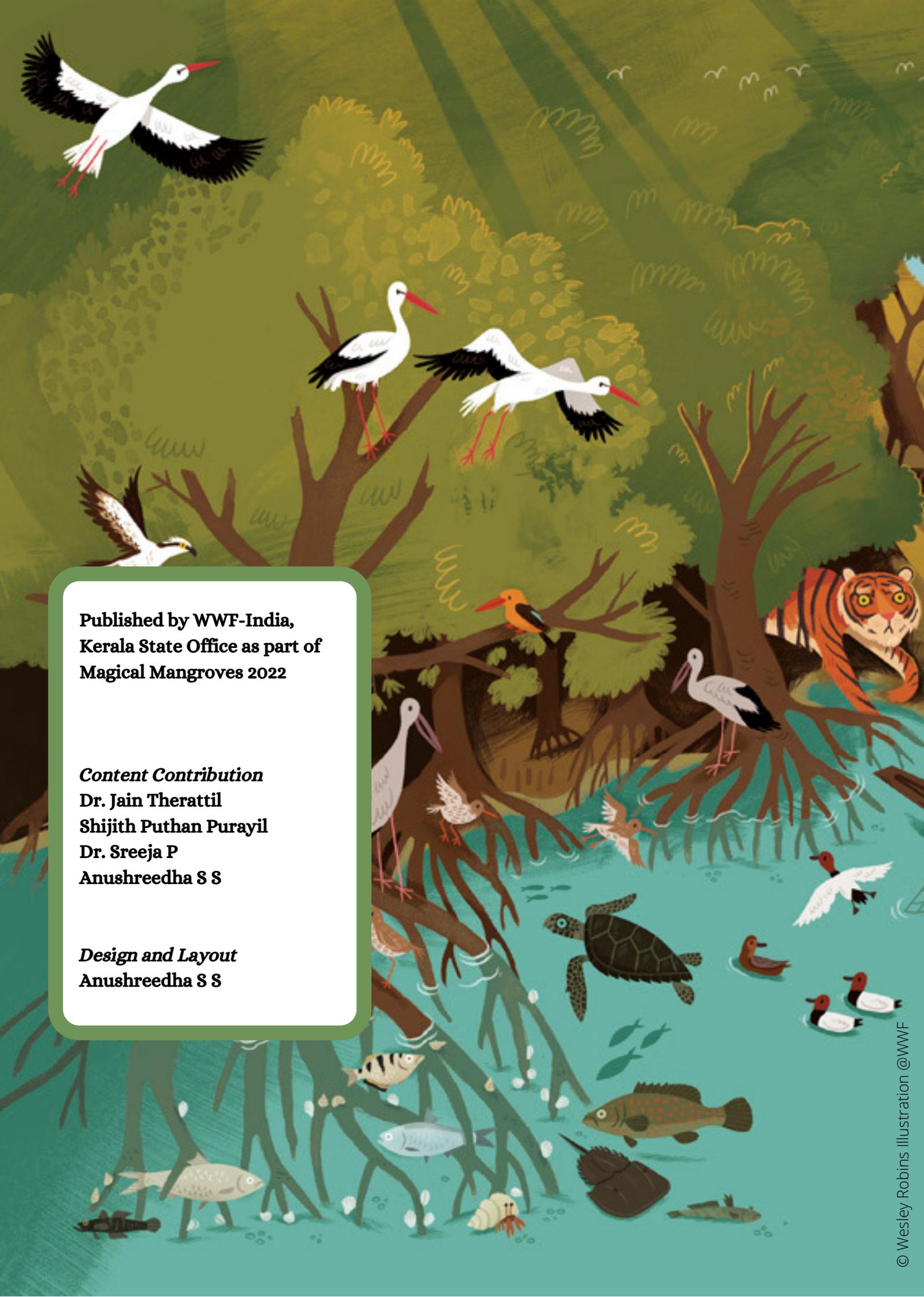
HANDBOOK

IND

2021



HANDBOOK ON PROTOCOL FOR PREPARING MANGROVE HERBARIUM



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1.0 Introduction

The term mangrove originates from the Senegalese word ‘mangue’, which means ‘into the sea’. Mangrove ecosystem is considered to be the most productive ecosystem across the world and are characterized by excess salt in its environment (air, soil, water). Physically, they play an important role in regulating the environment. They serve as a buffer between marine and terrestrial communities and protect shorelines from damaging winds, waves, and floods. They improve water quality by filtering pollutants and trapping sediments from the land, and they reduce coastal erosion. Ecologically, they provide habitat for a diverse array of terrestrial organisms, and many species of coastal and offshore species rely exclusively on mangroves as their breeding, spawning, and hatching grounds.



1.1 Challenges and Threats to Mangrove Habitats

A growing threat to the global mangrove ecosystem is climate change with its associated increasing temperatures, flooding, changing hydrologic regimes, rising sea level, increasing magnitude and frequency of tropical storms and natural calamities like tsunamis. Their location at the interface between land and sea make mangroves one of the first ecosystems to be affected. It is also rapidly losing its biodiversity owing to anthropogenic activities like, water pollution from domestic and industrial sewage, agriculture and aquaculture, cutting of mangroves for firewood, dredging of sand, poaching of wildlife, land reclamation, infrastructure development associated with tourism etc.

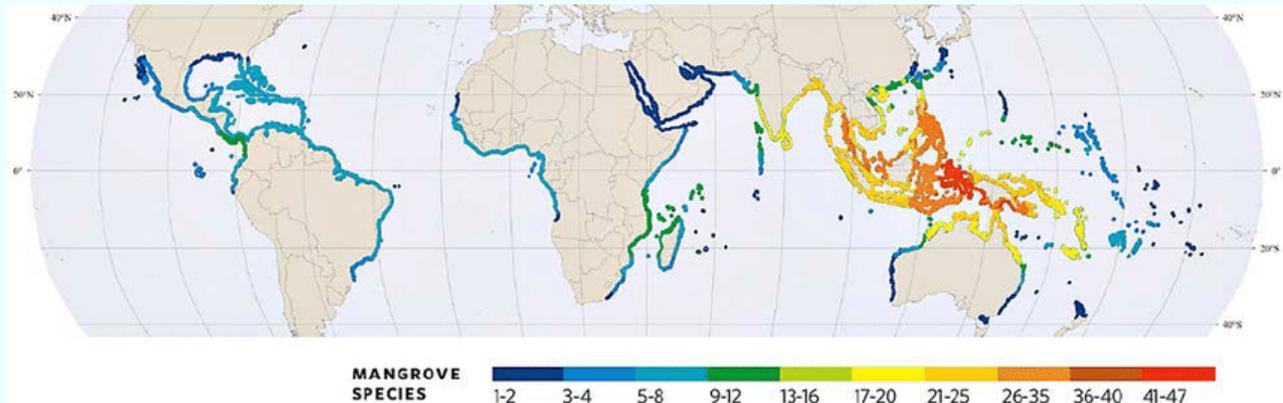


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1.2 Mangrove Distribution

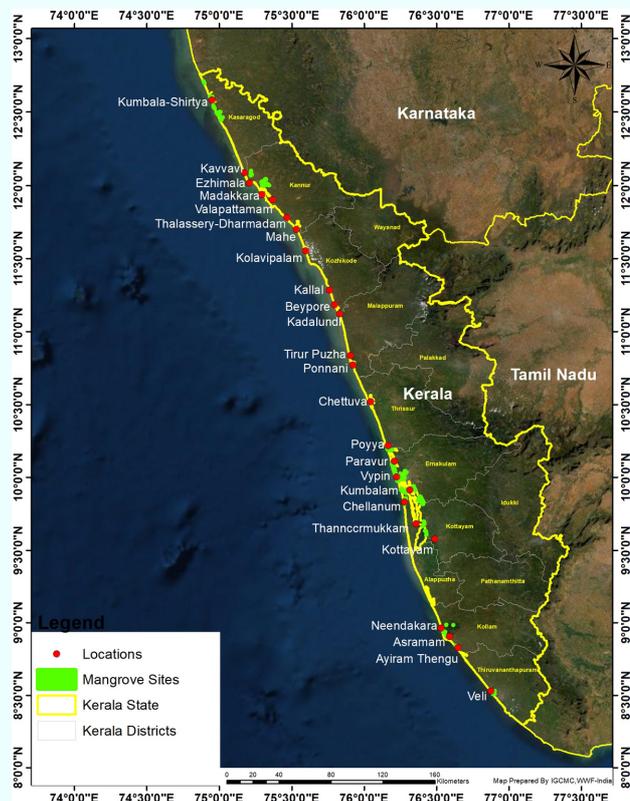
Mangroves are mostly distributed over 123 countries and territories in the tropical and subtropical regions. Asia has the largest extent of the world's mangroves. About 40% of the world's mangrove cover is found in South East Asia followed by South America, North Central America and West and Central Africa. Amongst the remaining 6 regions, (South Asia, Australia/New Zealand, East and South Africa, Pacific Ocean, East Asia and Middle East), South Asia has the highest percentage (6.8%) comprising 10,344 sq km mangrove cover. The largest mangrove forest of in the world is Sundarbans, spread across parts of India and Bangladesh.



//www.researchgate.net/figure/World-map-of-the-mangrove-distribution-zones-and-the-number-of-mangrove-species-along_fig1_271193539

Mangroves in India account for about 3% of the world's mangrove vegetation and are spread over an area of about 4,975 sq km along the coastal States and Union Territories of the country.*

Kerala has 590 kilometers of long narrow coastal line. Mangrove vegetation occurs along the banks of estuarine water bodies and adjacent to the back water channels, in the form of a narrow continuous belt or patches. The regular tidal flooding and fresh water supply from the 41 perennial rivers create a suitable ecological environment leading to the establishment of the mangroves. Kannur and Kasaragod districts have maximum area of mangroves. The other districts include Trivandrum, Kollam, Alappuzha, Kottayam, Ernakulam, Thrissur, Kozhikode, and Malappuram, along with the three identified Ramsar sites, namely Ashtamudi, Sasthamkotta, and Vembanad.



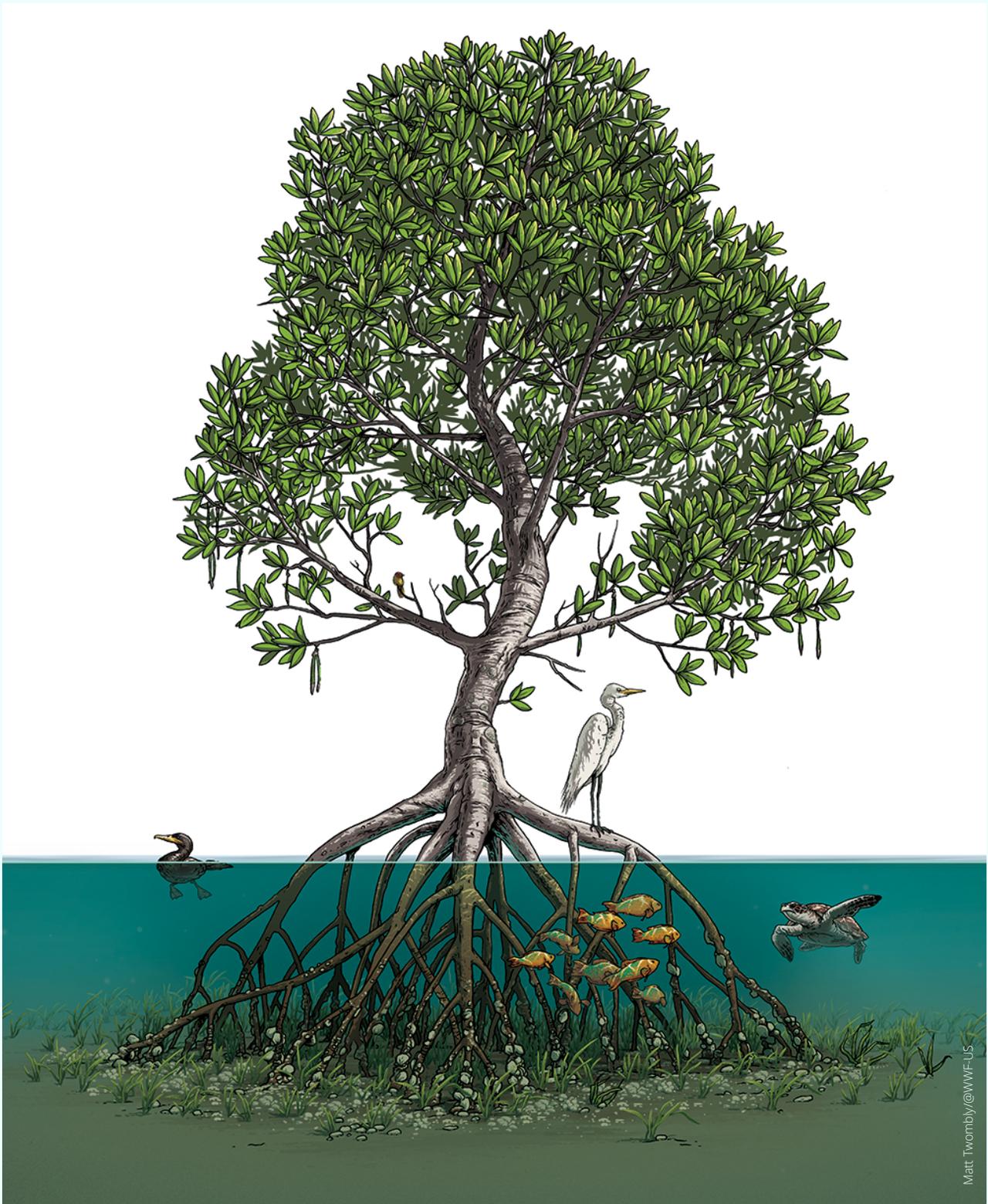
*India State of Forest Report 2019

Map: IGCNC / WWF India



1.3 About Magical Mangroves Programme

On the occasion of International Day for the Conservation of the Mangrove Ecosystems, Godrej & Boyce Mfg. Co. Ltd., in collaboration with WWF India (World Wide Fund for Nature, India) launched 'Magical Mangroves', in 2019 a nationwide campaign which highlights the significance of mangroves conservation in present times. It promoted awareness on the importance of the mangrove ecosystems through citizen volunteers.



Matt Twombly/@WWF-US



1.4 Classification of Mangroves

The vegetation of mangrove forests is loosely classified as "true mangroves" or "mangrove associates".

1.4.1 True Mangroves

True mangroves are woody plants, facultative (their optimum growth usually occurs in salt-free or low-salinity environment) or obligate halophytes (salt is necessary for their growth). "True mangroves" are defined as plant species that

- 1) occur only in mangrove forests and are not found in terrestrial communities;
- 2) play a major role in the structure of the mangrove community,
- 3) have morphological specializations to the mangrove environment;
- 4) have some mechanism for salt exclusion.

1.4.2 Mangrove Associates

Mangrove associates are flora representing non-arborescent, herbaceous, sub-woody and climber species that are found to grow mostly in regions adjoining the tidal periphery of mangrove habitats.

Other specializations of mangrove plants include:

- 1) aerial roots to counteract the anaerobic sediments,
- 2) support structures such as buttresses and above-ground roots,
- 3) low water potentials and high intracellular salt concentrations,
- 4) salt-excretion through leaves and
- 5) buoyant, viviparous propagules

(Duke et al. 1998).



Viviparous Propagules



Salt excretion



Buttress roots



2.0 Herbarium

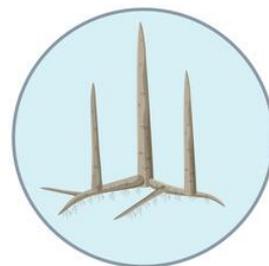
Herbarium is an age-old method for preserving collected samples of plants, required for future references during identification of plant specimens and to clarify doubts regarding the morphology and reproductive characters of a species. The method was invented by Luca Ghini of Italy, who founded the first botanical garden in 1544. The herbarium also provides information such as place of occurrence of the plant, date, altitude, longitude, latitude, morphological characters and habitat. The principle of herbarium preparation is drying the specimen so as to disallow suitable habitat for microbes, which destroy and degrade the specimen, as presence of water acts as a stimulant for microbial organisms such as bacteria and fungi.



3.0 Methodology

3.1 Field Specimen Collection

Now, let's understand the methodology of preparing a herbarium of mangrove plants. To begin with, we need a healthy twig of any mangrove plant, which can be collected during a field visit. It is ideal to cut a twig having at least four or five leaves and one or more flowers. A twig with a fruit is also collected if all flowers have become fruits. Keep the fact in mind that any plant to be identified will need to be compared with a herbarium specimen, especially for the characters of the flower. You are supposed to carry a Field Book during the collection of specimen, to note the important morphological characters of the plant and any other relevant information. The field book usually has printed numbers at its bottom called as Herbarium Tags. These tags can be easily cut from the book and tied using a twine to the specimen collected, so that the description in the field book corresponds to a particular number in the herbarium tag and can be used for reference.





3.2 Lab Preservation Work

The collected twig can be dipped in a fixative (made using ethanol – 500 ml, water – 300 ml formaldehyde – 100 ml and acetic acid – 50 ml.) which is helpful in preventing the withering of leaves and protects the specimen from fungal attack. The fixed specimens can be dried using blotting paper or ordinary newspaper as paper absorbs water. The paper has to be changed daily till the specimen becomes completely dry. Cover it with a few more layers of paper and keep it in a Herbarium Press. The press can be wooden or metallic. It has to be kept horizontally after tightening the screws for pressing the specimens.

3.3 Making of herbarium

Herbarium sheets are available which are thicker than regular print quality papers. The standard size of a herbarium sheet is 41 cm x 29 cm or 11.5 inch x 16.5 inch. The dried specimen is taken out from the press and mounted on the herbarium sheet using adhesive such as Fevicol. A Herbarium Label is used to write details about the specimen, such as scientific name of the plant, family, date of collection, place of collection, habitat, morphology of plant, altitude, name of specimen collector etc. Standard herbaria of the world usually add the name of herbarium at the top of the label, eg. Royal Botanic Garden, Kew. Advanced herbaria also provide measurement scale in the herbarium sheet.

3.4 Storage

The mounted herbaria are stored in wooden or metallic shelves designed specifically for herbarium. The racks in the shelf are usually arranged based on the family of plants in an alphabetical order for easy reference. For the purpose of preserving viviparous seeds of mangroves, 4% formalin solution can be used for bottle preservation. Finally, effort has to be taken not to waste any plant specimen as many plants are rare or endangered; hence plant collection has to be done in a minimalistic way.



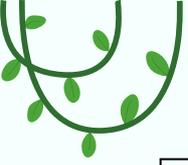


4.0 Mangrove database

A world-wide online Mangrove Reference Database and Herbarium (MRDH) has been created by a group of scientists in Belgium. It was a project started in 2001 and completed by 2010 with the collaboration of different countries such as India, USA and Canada. The objectives of MRDH include providing a rational database of all extant true mangrove plant species based on the Angiosperm Phylogeny Group classification system, provide facts about each mangrove plant species, make a Global Information System based distribution map of mangrove plant species and to deposit herbarium reference specimens of all mangrove plant species at Herbarium of National Botanic Garden of Belgium. The MRDH database on mangroves can be accessed at the following URL: <http://www.vliz.be/vmdcdata/mangroves/>

4.1 True Mangroves in Kerala

Sl. No	Common Name	Scientific Name	Family	Malayalam Name
1	Sea Holy	<i>Acanthus ilicifolius</i>	Acanthaceae	ചുള്ളിക്കണ്ടൽ
2	Variegated Sea Holly	<i>Acanthus ebracteatus</i>	Acanthaceae	
3	River Mangrove	<i>Aegiceras corniculatum</i>	Primulaceae	പൂക്കണ്ടൽ
4	Gray Mangrove	<i>Avicennia marina</i>	Acanthaceae	ചെറു ഉപ്പട്ടി
5	White Mangrove	<i>Avicennia officinalis</i>	Acanthaceae	ഉപ്പട്ടി
6	golden leather fern	<i>Acrostichum aureum</i>	Pteridaceae	മച്ചിൻതോൽ
7	Small leaved Mangrove	<i>Bruguiera cylindrica</i>	Rhizophoraceae	ചെറു കണ്ടൽ
8	Large leaved Mangrove	<i>Bruguiera gymnorhiza</i>	Rhizophoraceae	പേന കണ്ടൽ
9	Lenggadai	<i>Bruguera parviflora</i>	Rhizophoraceae	
10	Golden orange Mangrove	<i>Bruguiera sexangula</i>	Rhizophoraceae	സ്വർണ്ണകണ്ടൽ
11	Yellow Mangrove	<i>Ceriops tagal</i>	Rhizophoraceae	ആനകണ്ടൽ
12	Blinding Tree	<i>Excoecaria agallocha</i>	Euphorbiaceae	കണ്ണാം പൊട്ടി
13	Kandelia	<i>Kandelia candel</i>	Rhizophoraceae	വള്ളിക്കണ്ടൽ



Sl. No	Common Name	Scientific Name	Family	Malayalam Name
14	Black Mangrove	<i>Lumnitzera racemosa</i>	Combretaceae	കടക്കണ്ടൽ
15	Nypa palm	<i>Nypa fruticans</i>	Nypoideae	ഞെട്ടിപ്പന
16	Tall stilt Mangrove	<i>Rhizophora apiculata</i>	Rhizophoraceae	പിക്കണ്ടൽ
17	Swamp Willow	<i>Shirakiopsis indica</i>	Euphorbiaceae	കരിമട്ടി
18	Looking-glass Mangrove	<i>Heritiera littoralis</i>	Malvaceae	മുകുരം
19	Asiatic Mangrove	<i>Rhizophora mucronata</i>	Rhizophoraceae	ഭ്രാന്തൻ കണ്ടൽ
20	Mangrove Apple	<i>Sonneratia apetala</i>	Lythraceae	
21	Sweet scented apple Mangrove	<i>Sonneratia alba</i>	Lythraceae	നക്ഷത്ര കണ്ടൽ
22	Apple Mangrove	<i>Sonneratia caseolaris</i>	Lythraceae	ചക്കരക്കണ്ടൽ
23	Indian wild date	<i>Phoenix sylvestris</i>	Arecaceae	കാടിനൊത്ത
24	Phoenix humilis	<i>Phoenix humilis</i>	Arecaceae	





4. 2 Mangrove Associates in Kerala

Sl. No	Common Name	Scientific Name	Family	
1	Golden leather fern	<i>Acrostichum aureum</i>	Pteridaceae	മച്ചിൻതോൽ
2	Pond apple	<i>Annona glabra</i>	Annonaceae	ചക്കക്കണ്ടൽ
3	Indian coralberry	<i>Ardisia littoralis</i>	Myrsinaceae	കടൽ ചെറി
4	Powderpuff Mangrove	<i>Barringtonia racemosa</i>	Lecythidaceae	സമുദ്രക്കായ
5	Fever nut	<i>Caesalpinia crista</i>	Fabaceae	കാളാഞ്ചി
6	Alexandrian laurel	<i>Calophyllum inophyllum</i>	Calophyllaceae	പുന്ന
7	Bay Bean	<i>Canavalia maritima</i>	Fabaceae	മണൽ അമര
8	Bush Grape	<i>Cayratia trifolia</i>	Vitaceae	കാട്ടുപെരണ്ട
9	Suicide Tree	<i>Cerbera odollam</i>	Apocynaceae	ഒരുളങ്ങ
10	Sea Jasmine	<i>Clerodendrum inerme</i>	Verbenaceae	പുഴമുല്ല.
11	River Lilly	<i>Crinum viviparum</i>	Amaryllidaceae	വെളുത്തപൊളത്താളി
12	Shichito matgrass	<i>Cyperus malaccensis</i>	Cyperaceae	കുനികോരപ്പുല്ലി
13	Mangrove dalbergia	<i>Dalbergia candenatensis</i>	Fabaceae	
14	Jewel vine	<i>Derris scandens</i>	Leguminosae	പൊന്നാംവള്ളി
15	Sea derris	<i>Derris trifoliata</i>	Fabaceae	കമ്മട്ടിവള്ളി
16	Beetle grass	<i>Diplachne fusca</i>	Poaceae	ചാമപ്പുല്ലി
17	Mangrove trumpet tree	<i>Dolichandrone spathacea</i>	Bignoniaceae	നീർപൊങ്ങിളിയം
18	Water caltrop	<i>Eleocharis dulcis</i>	Cyperaceae	നീർചെല്ലി
19	Button sedge	<i>Fimbristylis cymosa</i>	Cyperaceae	വയൽപോറ്റ
20	Common finger rush	<i>Fimbristylis ferruginea</i>	Cyperaceae	പുഴപോറ്റ
21	Marsh sedge	<i>Fimbristylis polytrichoides</i>	Cyperaceae	പടപ്പൻപോറ്റ
22	Whip vine	<i>Flagellaria indica</i>	Flagellariaceae	പനമ്പുവള്ളി



23	Quail plant	<i>Heliotropium curassavicum</i>	Boraginaceae	കണ്ടൽ തേൾക്കട
24	Spider Lilly	<i>Hymenocallis latifolia</i>	Amaryllidaceae	Kadal thali
25	Bay hops	<i>Ipomoea pes-caprae</i>	Convolvulaceae	അടമ്പ്
26	Beach moonflower	<i>Ipomoea violacea</i>	Convolvulaceae	മോണിംഗ് ഗ്ലോറി
27	Swamp pimperl	<i>Lindernia tenuifolia</i>	Scrophulariaceae	ചെളിച്ചുള്ളി
28	Noni	<i>Morinda citrifolia</i>	Rubiaceae	നോനി
29	Screw pine	<i>Pandanus odorifer</i>	Pandanaceae	കൈത
30	Swamp silkweed	<i>Parsonsia inodora</i>	Apocyanaceae	പെനാളിവള്ളി
31	Knot grass	<i>Paspalum distichum</i>	Poaceae	കുളവരഗു
32	Water reed	<i>Phragmites karka</i>	Poaceae	ചോരപ്പുല്ല്
33	Indian Beech tree	<i>Pongamia pinnata</i>	Fabaceae	പൊങ്ങം
34	Hedace tree	<i>Premna serratifolia</i>	Lamiaceae	മുഞ്ഞ
35	Berryshaped sauropus	<i>Synostemon bacciformis</i>	Euphorbiaceae	നിലംതേങ്ങ
36	Beach plum	<i>Scaevola sericea</i>	Goodeniaceae	വെള്ളമോദകം
37	Silky sesban	<i>Sesbania sericea</i>	Fabaceae	ഷെമ്പ
38	Sea purslane	<i>Sesuvium portulacastrum</i>	Aizoaceae	കൊഴുപ്പ
39	Chicken spike	<i>Sphenoclea zeylanica</i>	Sphenocleaceae	പൊങ്ങാടി
40	Sea hibiscus	<i>Talipariti tiliaceum</i>	Malvaceae	തൈപ്പരുത്തി
41	Indian tulip tree	<i>Thespesia populnea</i>	Malvaceae	ചിലാന്തി
42	Wild Pea	<i>Vigna adenantha</i>	Fabaceae	കണ്ടൽപായര്
43	Chinese wedelia	<i>Wedelia chinensis</i>	Asteraceae	മണ്ണക്കണ്ണുണ്ണി
44	Manila grass	<i>Zoysia matrella</i>	Poaceae	ചെറുപുല്ല്





5.0 Photographs

True Mangroves

1. Sea Holly / *Acanthus ilicifolius*



2. River Mangrove / *Aegiceras corniculatum*



3. Gray Mangrove / *Avicennia marina*





4. White Mangrove or Indian Mangrove/ *Avicennia officinalis*



5. Small leaved Mangrove / *Bruguiera cylindrica*



6. Large leaved Mangrove / *Bruguiera gymnorhiza*





7. Golden orange Mangrove / *Bruguiera sexangula*



8. Yellow Mangrove / *Ceriops tagal*



9. Blinding Tree / *Excoecaria agallocha*





10. Kandelia / *Kandelia candel*



11. Black Mangrove / *Lumnitzera racemosa*



12. Indian Wild Date / *Phoenix sylvestris*





13. Tall stilt Mangrove / *Rhizophora apiculata*



14. Asiatic Mangrove / *Rhizophora mucronata*



15. Mangrove Apple / *Sonneratia apetala*





16. Sweet scented apple Mangrove / *Sonneratia alba*



17. Apple Mangrove / *Sonneratia caseolaris*



18. Looking-glass Mangrove / *Heritiera littoralis*



Photographs Courtesy (from India Biodiversity Portal): Dharanidharan Arumugam, Juliana Prospero, Dinesh Valke, Rujuta Vinod, Pierre Gard, Monica.M, Dr. Mu.Akshaya, N B Killedar, Ajit Ampalakkad, Gladwin Chakravarthy Joseph, Sankar Thampuran M V, Dr. N Sasidharan, C.B. Robinson, Sachin Medigeshi Harish, Milan Jose, Arijith,



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