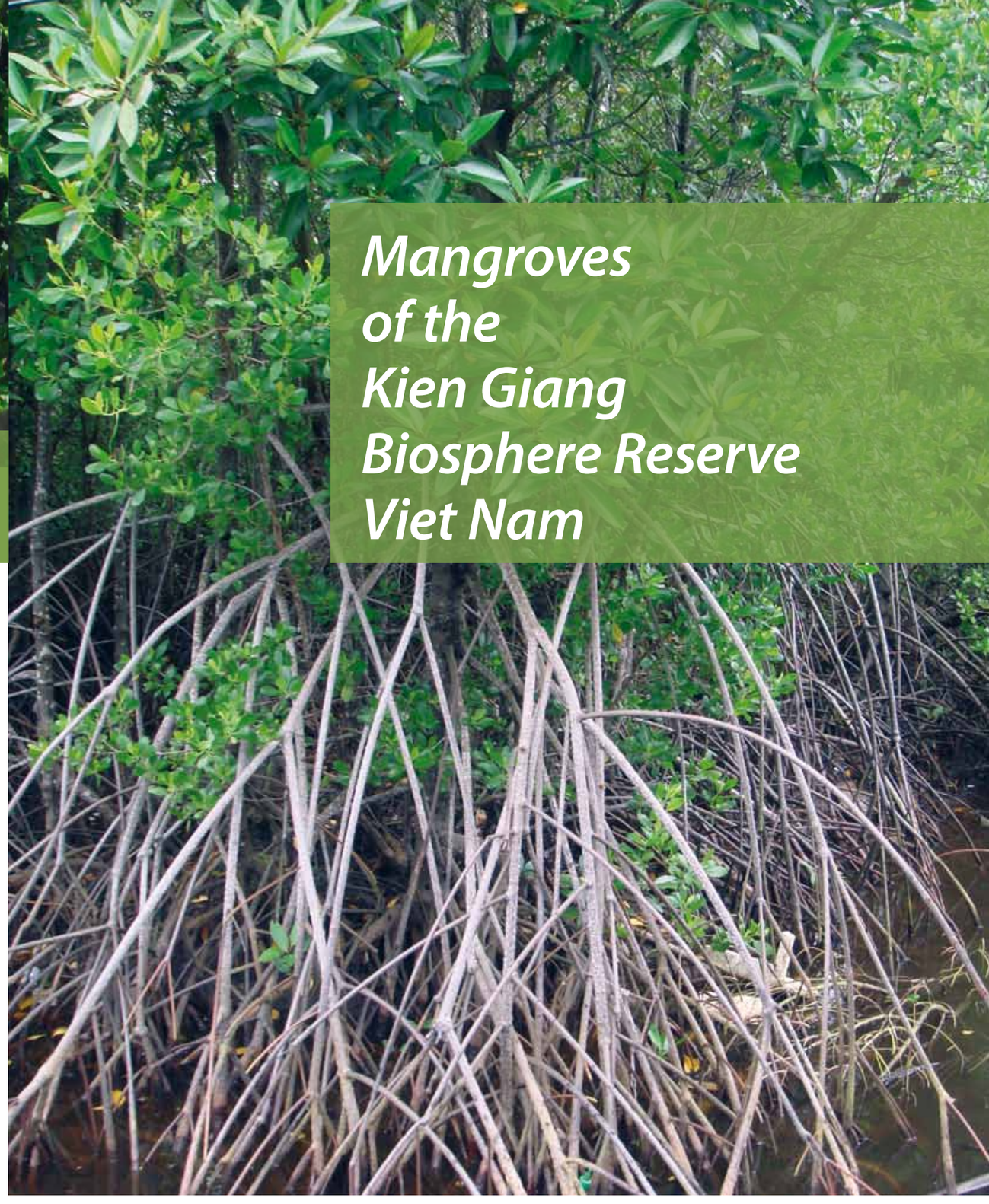
Mangroves of the Kien Giang Biosphere Reserve Vietnam



Mangroves of the Kien Giang Biosphere Reserve Viet Nam

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About GIZ in Viet Nam

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We have been working with our partners in Viet Nam since 1993 and are currently active in three main fields of cooperation:

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3) **Health**.

Furthermore, we implement development partnerships with the private sector, provide advisory services to the Vietnamese Office of the Government within the framework of the German-Vietnamese dialogue on the rule of law, promote civil society, non-formal vocational training and work with people with disabilities. In addition, we are involved in the volunteer programme weltwärts.

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Kien Giang Biosphere Reserve

The Kien Giang Biosphere Reserve (KGBR) was recognized by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) on October 27, 2006. The KGBR is one of the largest biosphere reserves in South East Asia, with a total area of 1,146,079 hectares. It includes sea, land and islands with the core zone encompassing U Minh Thuong National Park, Phu Quoc National Park and protected coastal forests of Hon Dat – Kien Luong and An Bien – An Minh.

The Reserve contains significant biodiversity with 6 main ecosystems and 22 different habitat types. These support about 2340 species, with many species being endemic and of high conservation significance. There are 30 plant species, 20 mammal species, 19 bird species, 1 amphibian species and 26 reptile species that are listed in the Vietnamese and World Red Books. This is a significant source of rare and valuable natural resources that needs to be protected and sustainabely managed for today and future generations.

Foreword

This field guide showcases the beauty and diversity of mangrove species throughout the Kien Giang Province. Its development has been a joint initiative between the Kien Giang Biosphere Reserve and Dr Norm Duke from the University of Queensland, Australia, who is an internationally recognised expert of mangrove taxonomy and ecology.

The mangrove forests of Kien Giang form an important vegetative barrier that protect our communities, their households and valuable farming land from the impacts of a changing climate. It is anticipated that this field guide will be used for identification that will promote greater protection, increased propagation, as well as better appreciation of these species and the forests in which they occur. This publication will be an important resource for community, land managers, provincial staff and visitors alike.

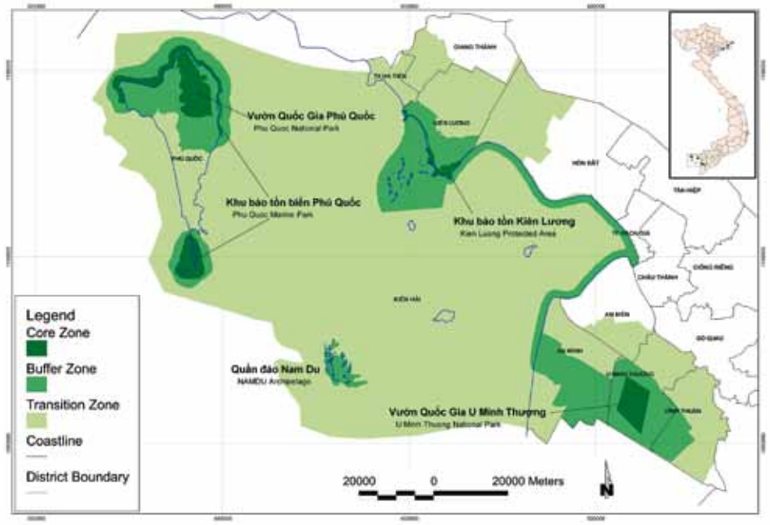
Mr Luong Thanh Hai
Vice Director
Kien Giang Biosphere Reserve Management Board

Preface

The goal of this publication has been to identify and describe mangrove plant species present in the province of Kien Giang, located in south-west Vietnam. In achieving this, the biodiversity of mangrove plants and habitat found in the province is described. Descriptions and image material for each species is provided, which allows easy identification of individual species. This information is needed for coastal management planning and policy development, especially in relation to shoreline rehabilitation and expansion of appropriate shoreline livelihood projects in the face of climate change and sea level rise. During field investigations, each species of mangrove and associated plants were identified and sampled. Data and specimens have been compiled as a reference collection for the Province. These investigations extended on observations compiled for prior reports and studies dating up until October-November 2009.

Sharon Brown

Contents

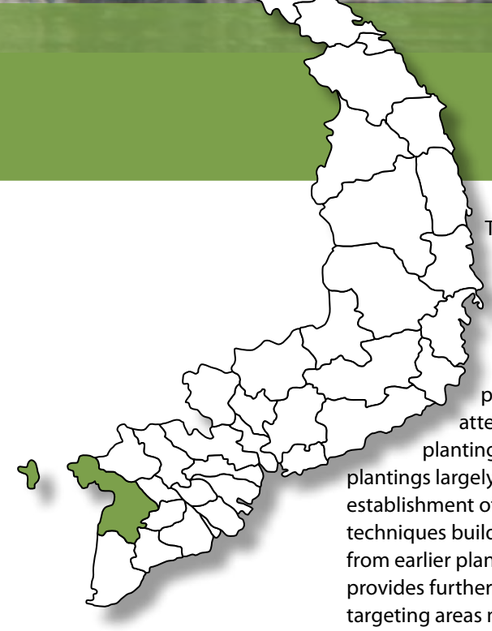


Map of the Kien Giang Biosphere Reserve - highlighted in green.

PART 1

Introduction

Kien Giang is a coastal province in tropical southern Vietnam where mangrove forests provide a pivotal role in climate change mitigation and adaptation by reducing immediate threats from increased typhoon activity and sea level rise. Mangrove forests also support economic development of tourism, coastal protection and aquaculture throughout the province. It is generally acknowledged that well managed healthy mangrove ecosystems have a greater potential and capacity to adapt to climate change; resist and recover more easily from extreme weather events; and provide a wide range of benefits on which many people depend. However, local communities living along the shoreline mangrove belt of Kien Giang have limited knowledge and techniques for the sustainable management of these valued forests and many have been converted to incompatible landuse types, such as small-scale aquaculture. As a result, the mangrove belt of Kien Giang is either completely lost, or at best, very narrow and degraded with significantly reduced habitat resilience and little capacity for mitigation of the imminent impacts of climate change. To attend to this issue, specific instances of inappropriate coastal landuse are being addressed and appropriate mitigation and rehabilitation strategies applied with necessary urgency to offset immediate threats.



The predominant human impacts on mangrove forests in Kien Giang province include harvesting of wood for firewood and building materials, combined with the conversion of mangrove habitat into aquaculture ponds. In some instances, where mangrove forests have been severely reduced or lost, strong sea currents now erode dykes that were constructed to protect local people and their farmland from inundation during storms. Past attempts to protect the coastline from erosion include mangrove plantings by both Province and District authorities. Because these plantings largely failed, there is a growing need to develop new techniques for the establishment of mangrove forests as coastal stabilisors in Kien Giang. The new techniques build on a sound knowledge of current coastal stability and lessons from earlier planting efforts. Data gathered from recent shoreline assessments provides further confidence for future planting efforts by applying methods and targeting areas more likely to succeed.

In addition to their role in coastal stabilization, mangroves have other important ecosystem services, including their sequestration of large amounts of atmospheric carbon (Duke et al 2007). Deforestation, however, contributes about 20% of total anthropogenic carbon dioxide emissions into the atmosphere, enhancing global warming and environmental changes that potentially will have devastating effects on Vietnamese communities. To address this threat, and to help change community behaviour, the United Nations Framework Convention on Climate Change has established a program for reducing emissions from deforestation in developing counties (REDD). The REDD program is designed to provide financial incentives to encourage developing countries to voluntarily reduce deforestation and associated carbon emissions. Under a REDD program, developed countries would pay countries such as Vietnam for the carbon that is “saved” (as carbon credits) when they show they have reduced local deforestation. Implementation of the REDD carbon scheme is also likely to improve mangrove protection by increasing the monetary value of mangrove forest resources. The feasibility of this program is considered potentially beneficial in Kien Giang Province where mangrove forests might stabilize vulnerable coastal areas.

Definition of mangroves

"A mangrove is a tree, shrub, palm or ground fern, generally exceeding one half metre in height, that normally grows above mean sea level in the intertidal zone of marine coastal environments and estuarine margins. A mangrove is also the tidal habitat comprising such trees and shrubs."

The word '*mangrove*' refers to the habitat in the same way as 'rainforest' is regarded with its mixture of plant types. Sometimes the habitat is called a 'tidal forest' or a 'mangrove forest' to distinguish it from the trees that are also called mangroves (Duke 2006).

Mangrove plants are not a single genetic entity because the plant types represented in the tidal zone are not all closely related. While they sometimes look the same, and have similar function, this is due to the environment they live in, rather than their family relationships. The plants growing in the tidal zone also require serious adaptations for their continued survival in this habitat. However, this does not preclude other plants from occasionally being found within the tidal zone. Some are grouped as 'associates' where they only occasionally occur in intertidal sediments and most of the time they are found elsewhere. Others also regularly share the tidal niche, like saltmarsh plants, but these are smaller in size. A number of others, the epiphytes and plant parasites, perch in the branches and stems of mangroves. All these plants shape and define mangrove habitat.

Mangrove diversity

The mangroves of Kien Giang Province are very diverse in species, with 27 of the 39 species likely found elsewhere in Vietnam. The table lists the observed species in each district of Kien Giang. The resilence of mangroves - and thus the capacity of the mangroves to provide their important ecosystem services - is enhanced by the species diversity of the forest itself. High mangrove diversity in Kien Giang Province will therefore be an asset to natural resource managers in the area.

Mangrove Plant Species in Kien Giang Province and Vietnam

Local Name	Latin Name	Kien Giang Province									
		Districts, Cities									
		Phu Quoc	Ha Tien	Kien Luong	Hon Dat	Rach Gia	Chau Thanh	An Bien	An Minh	**Kien Giang**	**Vietnam**
Ô rô trắng	*Acanthus ebracteatus*				1					**1**	1
Ô rô tím	*Acanthus ilicifolius*	1	1	1				1	1	**1**	1
Ráng	*Acrostichum aureum*	1	1	1	1		1	1	1	**1**	1
Ráng	*Acrostichum speciosum*	1	1		1	1	1	1	1	**1**	1
Sú	*Aegiceras corniculatum*	1	1	1	1					**1**	1
Sú đỏ	*Aegiceras floridum*										1
Mắm trắng	*Avicennia alba*	1	1	1	1	1	1	1	1	**1**	1
Mắm biển	*Avicennia marina*	1	1	1	1	1		1	1	**1**	1
Mắm lưỡi đòng (Mắm đen)	*Avicennia officinalis*		1					1	1	**1**	1
Mắm quăn	*Avicennia rumphiana*										1
Tim lang	*Barringtonia racemosa*										1
Vẹt trụ	*Bruguiera cylindrica*		1		1	1		1	1	**1**	1
Vẹt dù	*Bruguiera gymnorhiza*	1		1	1	1				**1**	1
	Bruguiera hainesii										1
Vẹt tách	*Bruguiera parviflora*										1
Vẹt khang (Vẹt đen)	*Bruguiera sexangula*	1	1	1	1		1	1	1	**1**	1
Dà quánh	*Ceriops zippeliana (C. decandra)*	1	1	1				1	1	**1**	1
Dà vôi	*Ceriops tagal*	1		1				1	1	**1**	1
Quao nước	*Dolichandrone spathacea*		1					1	1	**1**	1
Giá	*Excoecaria agallocha*	1	1	1	1	1	1	1	1	**1**	1
Cui biển	*Heritiera littoralis*	1	1	1	1		1	1		**1**	1
Trang	*Kandelia candel*										1
Trang	*Kandelia obovata*										1
Cóc đỏ	*Lumnitzera littorea*	1	1		1					**1**	1
Cóc vàng	*Lumnitzera racemosa*	1	1	1	1			1	1	**1**	1
Cóc hồng (cây lai)	*Lumnitzera X rosea*										1
Dừa nước	*Nypa fruticans*	1	1	1	1	1	1	1	1	**1**	1
	Pemphis acidula										1
Đước (Đước đôi)	*Rhizophora apiculata*				1	1	1	1	1	**1**	1
	Rhizophora X lamarckii	1	1	1							1
Đưng (Đước bộp)	*Rhizophora mucronata*	1						1	1	**1**	1
Đâng (Đước vòi)	*Rhizophora stylosa*										1
Côi	*Scyphiphora hydrophylacea*	1	1	1						**1**	1
Bần trắng	*Sonneratia alba*	1	1	1	1			1	1	**1**	1
	Sonneratia apetala										1*
Bần chua	*Sonneratia lanceolata (= S. caseolaris)*	1	1		1	1	1	1	1	**1**	1
Bần ổi	*Sonneratia ovata*	1	1	1	1	1		1	1	**1**	1
Xu ổi	*Xylocarpus granatum*	1		1				1	1	**1**	1
Xu mekong	*Xylocarpus moluccensis* *(ex X. mekongensis)*		1						1	**1**	1
	TOTAL SPECIES	**22**	**22**	**18**	**18**	**10**	**9**	**21**	**21**	**27**	**39**

Mangrove plant species in Kien Giang Province, including sites in Phu Quoc, Ha Tien, Kien Luong, Hon Dat, An Bien and An Minh districts, compared with all Viet Nam (Hong 2004; Nam 2008; Duke pers. Observations).
*Introduced.




General features of mangrove vegetation in Kien Giang

Kien Giang's mangrove vegetation has some interesting features, but is otherwise similar in general pattern to other areas of Vietnam and South East Asia. The sea fringe is dominated in most places by *Avicennia alba* (Vietnamese name: Mắm trắng). This is also typical of much of Ca Mau (Hong & San 1993), an adjacent province to the south-east. Stands of *A. alba* are also typical in the natural re-colonisation of abandoned aquaculture ponds. *Sonneratia alba* (Bần trắng), which is typical of the sea front in other places has only been recorded sporadically with *A. alba* at the front of the mangrove in northern parts of the province (Ha Tien).

Sonneratia caseolaris (Bần chua) with *A. alba* is dominant in the sea fringe that makes up most of the mangrove in the central area from about Rach Gia north to around Vam Rang. In places, blocks of both *A. alba* and *S. caseolaris* have been planted at the front of the mangrove, extending seaward. These are mostly clear but sometimes difficult to distinguish from natural stands. It is possible that nearly all of established *S. caseolaris* stands were planted.

Stands in back, away from the sea, form 'mixed' mangrove assemblages at mid to high tide levels. A number of additional species are associated with these inner stands. This is the richest zone for species biodiversity and these stands can develop dense, stable vegetation, with some of the tallest trees. *Avicennia* is a major component. Hong & San (1993) refer to this vegetation zone as an *Avicennia alba-Rhizophora apiculata* community, but other taxa such as *Bruguiera* spp. (Vet), *Xylocarpus* spp. (Xu) and *Sonneratia alba* (Bần trắng) are also well represented.

In the north of the Province, a greater breadth of the mangrove allows a drier mixed forest to develop in places, with species such as *Heritiera littoralis* (Cui biển) and *Ceriops tagal* (Dà vôi) along with *Phoenix paludosa* (Chà là). Mixed forests with an elevated proportion of *Excoecaria agallocha* (Giá) are present in places subject to past or present cutting of the forest. *E. agallocha* is favoured by heavy cutting, with some stands heavily dominated this, and others species.

In the northern areas of Kien Luong and Ha Tien Districts, stands of an upper intertidal 'scrub' of about 2-3 metres height and good diversity are present. Plants such as *Scyphiphora hydrophylacea* (Côi), *Lumnitzera littorea* (Cóc đỏ) and *L. racemosa* (Cóc vang) that are rare or absent elsewhere in Kien Giang are present, along with the more common species like *E. agallocha*. South of Kien Luong, the mangrove forests are typically too narrow to support this vegetation.

Significant areas of *Rhizophora apiculata* (Đước) have been planted in blocks. This species is native to this coast, but few natural stands have been observed. Fringing stands on small streams on Phu Quoc Island, however, have been recorded. Older planted stands were about 18 years old and approaching 13 metres in height have been recorded at some sites, such as those within Hon Dat district.

The island of Phu Quoc has extensive and intact mangrove stands, but these are seriously threatened by recent expansion of tourist resorts and associated construction developments. The northern part of the island has perhaps the last remaining stands of mangrove forests with *Lumnitzera littorea* individual trees reaching 30 metres in height. There are also significant numbers of the relatively rare species, like *Scyphiphora hydrophylacea*, *Xylocarpus granatum* and *Rhizophora mucronata*. The latter two are of particular interest as possible species useful for growing with community livelihood projects for wood products and shoreline stabilization.

Stands of the palm *Nypa fruticans* (Dừa nước) were often recorded as present at the rear of the coastal fringes, or fronting canals or river margins. Some stands are natural occurrences, although many are planted. *Nypa* is grown for its leaves and, to a lesser extent, its palm fruit. There are some relatively large planted areas along rivers (like Ha Tien) and there is widespread planting at the rear of the mangrove, involving replacement of other mangrove trees.

Fringing strips of mangrove 'associate' species are typically present at the rear of the tidal influence, with characteristic species such as *Hibiscus tiliaceous* (Tra nhớt) and *Thespesia populnea* (Tra bồ đề) and numerous others. Low thickets of plants such as the daisy *Pluchea indica* (Lức cây), the shrubs of *Acanthus* spp. (Ô rô), the mangrove ferns *Acrostichum* spp. (Ráng) and the scrambling *Clerodendrum inerme* (Dây chùm gong) grow on degraded former mangrove land. Trees may be absent as tidal exchange is compromised or alternatively because the thicket is suppressing tree regrowth.

Mangrove highlights

- The *S. caseolaris* to the north of Rach Gia, particularly in the Vinh Quang area are perhaps the tallest in Vietnam and are very tall for the species generally (Giesen et al. 2006). These 21 metres tall trees may be planted and are amongst the highest biomass forests to be found in Kien Giang.

- *Sonneratia caseolaris* prefers brackish conditions, but is well developed along the ocean front of Kien Giang. Here, the tidal water is very low in salinity (often freshwater) during the wet season. Because of the salinity marginal conditions, many brackish water prefering species, including vines, herbs and trees have been observed amongst mangrove trees.

- There are three *Avicennia* species present, with *A. alba* easily the most common. However, the numbers of another species *A. marina* (Mắm biển) are quite high and the species grows on mud, which is somewhat unusual in Vietnam (V.N. Nam, pers. comm.).

- There is more mangrove diversity in the north of the Province, including species such as *S. hydrophyllacea*, *Lumnitzera littorea*, *Aegiceras corniculatum* (Sú) and the palm *Phoenix paludosa*, not observed elsewhere.

- *Lumnitzera littorea* with its red flowers was previously poorly known in Vietnam, but is widely present in the high intertidal scrub mangrove in the north of the Province, and on Phu Quoc island. It can occur alongside the white flowered *L. racemosa*; Giesen et al. (2006) state that the two species have not been collected from the same site previously.

- Natural mangrove regeneration is generally very good within the forest area and is not a problem overall in Kien Giang, although some species may be restricted more than others.

- A significant number of species are associated with the mangrove in Kien Giang, but are not generally considered core mangrove species, including many climbers. Most are typical and are detailed in Hung & Tan (1993). A few interesting tree species found within or at the tidal edge of the mangrove, including *Barringtonia acutangula* (Chiếc) and *Cerbera odollam* (local name: Mát sát) in or on the edge of the brackish *S. caseolaris* mangrove fringe and *Phoenix paludosa* and *Instia bijuga* (Gô nủỏc) in the north. Vascular epiphytes are not uncommon on tropical mangrove trees and Hung & Tan (1993) record some from Ca Mau, but none were seen on the trees of Kien Giang.

- Large seeding trees of *Xylocarpus granatum* identified in Phu Quoc could prove useful propagule ‘source trees’ for planting trials. An isolated planted area of *Rhizophora mucronata* located in Kien Luong district may also be a valuable source of seed stock for this uncommon *Rhizophora* species in Kien Giang province.

Mangrove condition overall

Approximately 60% of the coastline is eroding and the mangroves are being lost.

Melaleuca protection fences are saving the coastlines from erosion and allowing the natural regeneration of mangroves.

Mangrove forest areas in northern Phu Quoc have been the rare exception of being in relatively natural conditions. In other areas, while sometimes diversity levels are relatively high, the condition of stands can be seriously depleted. This becomes a serious issue for the capacity of local mangrove forests to fulfil their ecosystem service functions. Areas to the south of Rach Gia – districts of An Mien and Ah Bien are the most degraded, with the mangrove fringe reduced to a thin narrow strip pressured from landward and seaward sites, as well as from direct cutting. **If these ecosystems are to provide ecosystem services, particularly in shoreline protection – they must be rehabilitated as a matter of urgency.** The resilience of these services is enhanced by the diversity of species observed in the province, albeit at relatively low numbers of trees for many species. For the latter point, this is why it is important to locate particular individuals and stands as seed sources for future rehabilitation works. These stands and trees require high levels of protection.

Factors Influencing Mangrove Distribution

Mangroves have evolved and flourished in their often dynamic setting. While mangroves collectively have specialised morphologies and physiologies, these attributes have limits that differ with individual species. The distributional range of each mangrove species reflects its response to the dominant influencing factors at global, regional and local scales (Duke et al. 1998).

Where mangroves inhabit tropical and subtropical regions of the world, their presence in higher latitudes is generally constrained by the 20° C winter isotherm in respective hemispheres. Exceptions to this pattern mostly correspond to the paths of oceanic circulation currents where mangrove distributions are broader on eastern continental margins and more constrained on the west. Present day distribution patterns depend on specialized, water-buoyant propagules of mangroves.

Regional distribution patterns of mangroves are influenced further by habitat availability and local environmental factors such as, rainfall, estuary size and tides. Two major environmental factors, temperature and rainfall, largely explain regional distributions where low temperatures limit the latitudinal extent of species - affecting the pool of available species. The relative number of species is also highest in areas of higher rainfall. Species richness declines generally with increasing latitude on north-south coastlines and groupings of islands.

At the local scale, individual mangrove species usually occupy only part of an estuary from sea mouth to tidal limit upstream. Species generally display a preferred estuarine range based on the overall salinity tolerance. For instance, species like *Avicennia marina*, *Rhizophora stylosa*, *Sonneratia alba* commonly occur in downstream locations. By comparison, *Rhizophora mucronata*, *Sonneratia lanceolata* and *Bruguiera sexangula* are found upstream in larger, freshwater-dominated estuaries. Furthermore, at this local scale, respective species occupy distinct parts of the tidal profile above mean sea level. Characteristic zonation bands of different mangrove assemblages, indicate the pronounced influences of inundation frequency and tidal elevation. For example, species like *Avicennia integra* and *Sonneratia alba* commonly occupy low intertidal positions. By comparison, *Heritiera littoralis*, *Xylocarpus granatum* and *Lumnitzera racemosa* are found in high intertidal positions. Some species, like *Avicennia marina*, *Acanthus ilicifolius* and *Aegiceras corniculatum* are observed at high and low intertidal positions.

Descriptions of mangrove species in Kien Giang Province

Twenty seven (27) species of mangrove plants have been identified and sampled in Kien Giang Province, Vietnam. All are described and illustrated in this field guide. General information relating to each of the genera that occur within the province is included and precedes the species information. Information relating to genera that have only one species is contained on that species page.

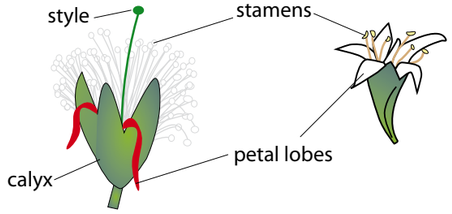
In addition to the text elements compiled, all species pages have the following standard elements:
Photographs of features, including: tree, leaves, flowers, fruits, bark, stem base and above ground roots;
Maps showing the distributions in Vietnam and in the Indo West Pacific region; and
Notes on each species, including their benefits.

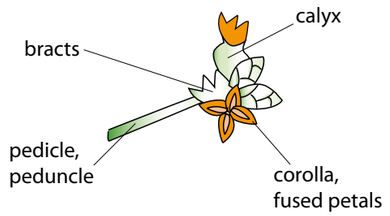
The drawn images used in this book where kindly provided by Diana Kleine.
Distribution maps where provided by Norm Duke and Dr Vien Ngoc Nam, Nong Lam University, HCM City.
Photographs where provided by Norm Duke and Sharon Brown GIZ Kien Giang.

Margin icons and descriptive charts

Many plant parts have botanical terms that are commonly used throughout the book. Where possible, these are accompanied with a description in brackets. Some of the more commonly used terms are illustrated below.

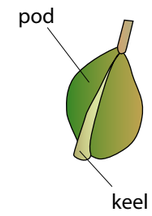
FLOWERS



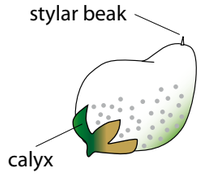


PROPAGULES

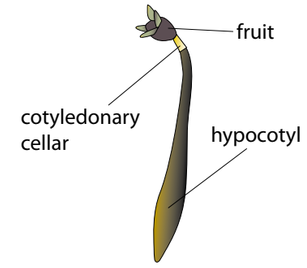
SEED CAPSULE



CRYPTO-VIVIPAROUS

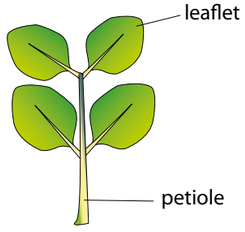


VIVIPAROUS

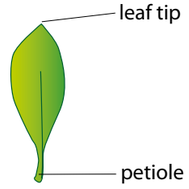


LEAVES

COMPOUND



SINGLE



Example

Sonneratia lanceolata

Nine icons show the key attributes that characterise each species.
These illustrate the features of the species and appear in the botanical description for each.

GROWTH FORM

Plant Structure

Distinctive plant, stem, roots

FOLIAGE

Leaf Position

OPPOSITE

OR

ALTERNATE

Leaf Structure

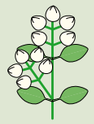
SIMPLE

OR

COMPOUND

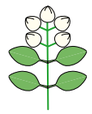
Leaf Shape

Distinctive leaf, margin, tip

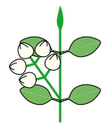


REPRODUCTIVE PARTS

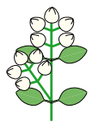
Inflorescence



TERMINAL



AXILLARY



BOTH

Flower

Distinctive flower, petals, stamens

Fruit

Distinctive fruit, propagule

LOCAL DISTRIBUTION

Tidal Position

HIGH

MID

LOW

Position Upriver

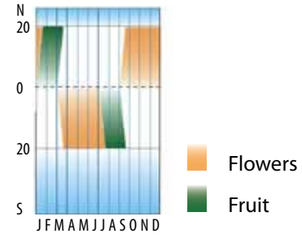
DOWNSTREAM

INTERMEDIATE

UPSTREAM

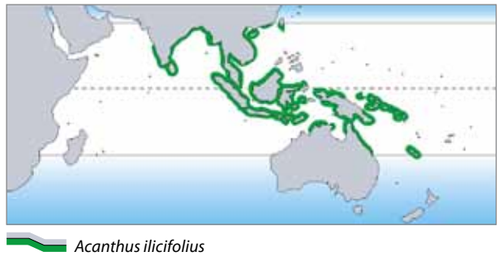
PHENOLOGY CHART

The chart shows months of flowering and fruiting at different latitudes. There is a shift to later months with higher latitude and cooler climate. Flowering and fruiting in the southern hemisphere differs by 6 months.



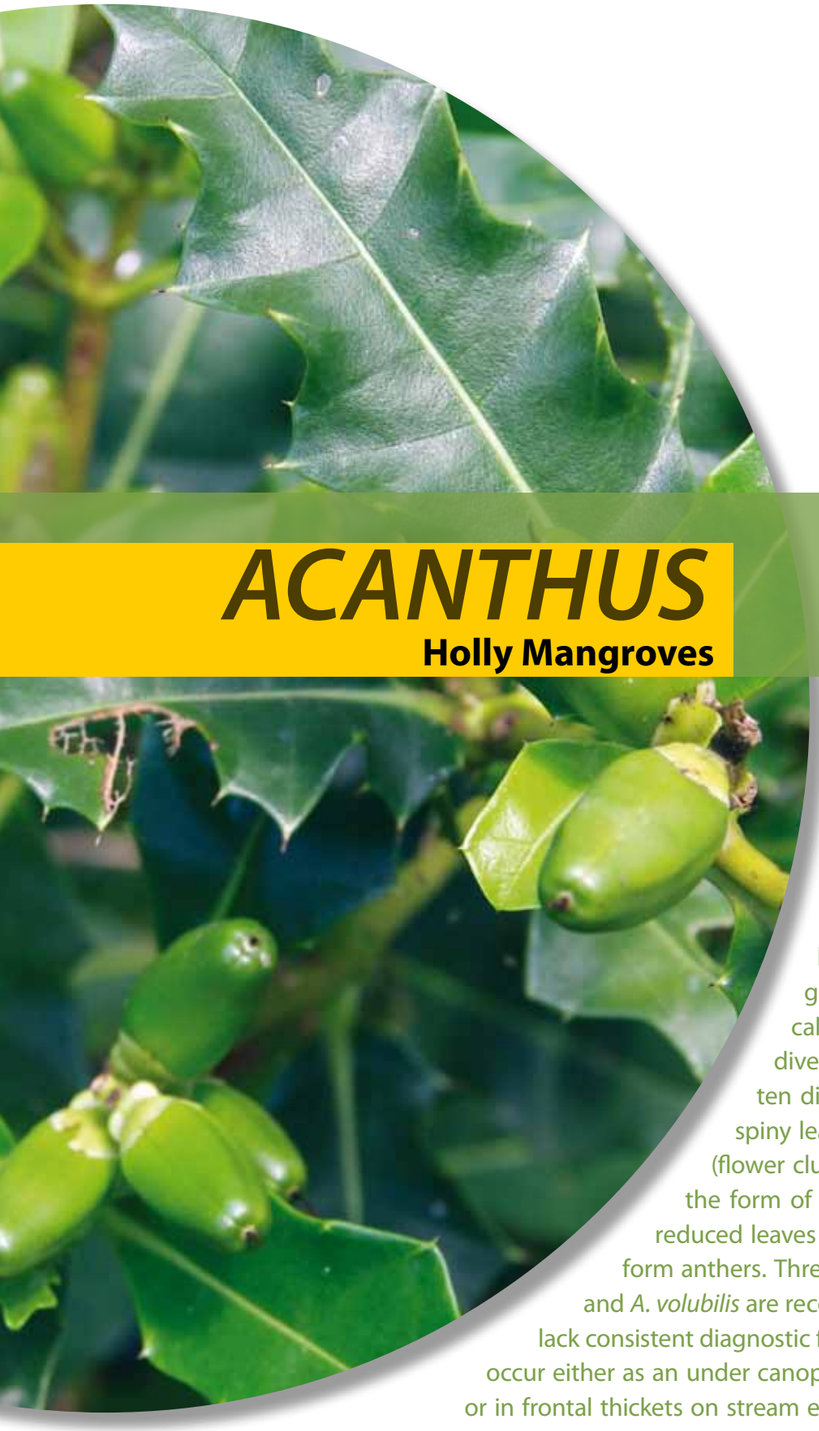
DISTRIBUTION MAP

Map shows Australian and Indo-West Pacific distributions for each species.



Acanthus ilicifolius

Map shows Vietnam distributions for each species.



ACANTHUS

Holly Mangroves

Acanthus is the only genus with mangrove inhabitants in the family Acanthaceae which is chiefly tropical herbs, shrubs and small trees with conspicuous zygomorphic (bilaterally symmetrical) flowers and capsular fruits with hardened shells. *Acanthus* is a large genus of some 300 species in tropical Asia and Africa with a centre of diversity in the Mediterranean. It is often distinguished from related genera by spiny leaves, spicate terminal inflorescences (flower clusters situated at end of the stem in the form of a spike), two bracteoles (secondary reduced leaves close to the flower cluster) and uniform anthers. Three species, *A. ebracteatus*, *A. ilicifolius* and *A. volubilis* are recorded in mangrove habitat, but they lack consistent diagnostic features. Mangrove *Acanthus* species occur either as an under canopy of various mangrove associations, or in frontal thickets on stream edges of recently accreting estuarine banks. Although mangrove *Acanthus* do occur in lower estuarine locations, they grow most commonly in middle to upper estuarine areas, in both dense frontal thickets and as undercanopy patches to the high water margin.

Derivation of Genus Name

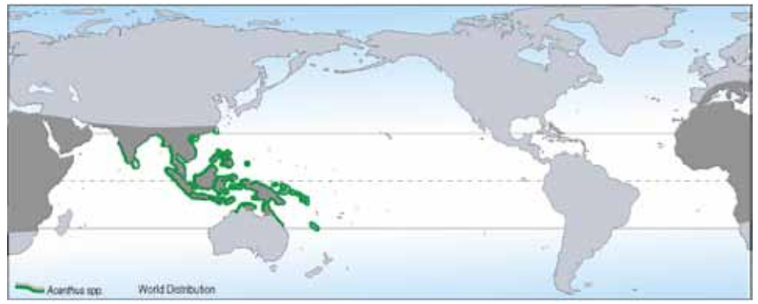
'Acantha' means thorn or thistle (in Greek) and refers to the spiny leaves of some species.

Genus Feature

Holly leaves and axillary (lateral) stem spines are present on unshaded plants and often absent on plants that are shaded.

Distribution

Acanthus species growing in mangroves are distributed across the Indo-West Pacific from India and China, through Asia and Indonesia to the Philippines, western Pacific, New Caledonia and tropical Australia. Two species are recorded in mangrove habitats of Vietnam.



2 species in Kien Giang Province, Vietnam

Acanthus ebracteatus
Acanthus ilicifolius

Key of *Acanthus* species found in Kien Giang Province

Inflorescence (flower cluster) open, flowers white or deep purple	**Inflorescence** (flower cluster) dense, flowers mauve streaked with white
	
Bract (reduced leaf close to the flower cluster) single, **bracteoles** (secondary reduced leaves) absent	**Bract** (reduced leaf close to the flower cluster) single, **bracteoles** (secondary reduced leaves) x 2
	
Stem without axilliary (lateral) spines	**Stem** with axilliary (lateral) spines
	
Acanthus ebracteatus	***Acanthus ilicifolius***

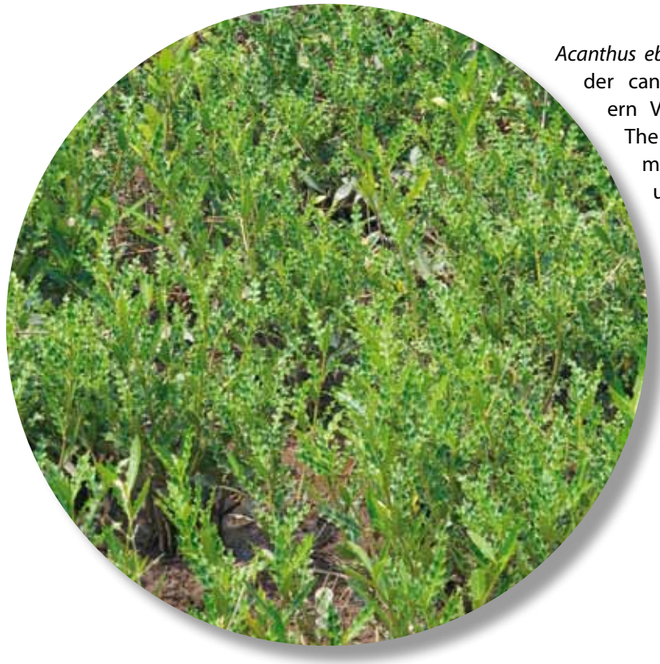
Species of *Acanthus* are distinguished by flower colour, inflorescence shape and the presence/absence of bracts and bracteoles at the base of flower buds and fruits. At times some species can have spiny leaves, but not always.

Acanthus ebracteatus

= Acanthus ebracteatus subsp. ebracteatus

White-flowered Holly Mangrove

Ô rô trắng



Acanthus ebracteatus is typically a low viny herb that grows under canopy patches. The species is uncommon in northern Vietnam, but more abundant in southern provinces. The species is often confused with *A. ilicifolius*. They share most vegetative growth form characters including: viny undercanopy thickets, their scrambling habit over adjacent vegetation, adventitious (i.e. not arising from the primary root or its branches) aerial roots, leaf form, stem spines and spiny leaves. Reproductive characters, like pollination and seed release are similar also to *A. ilicifolius*. *Acanthus ebracteatus* is distinguished from *A. ilicifolius* by its flowers being white, slightly smaller (2-2.5 cm L), with absent or minute bracteoles (secondary reduced leaves close to the flower cluster) and smaller fruits (<2 cm L).

Species Feature

Absent or minute bracteoles on flowers and fruits.

Derivation of Species Name

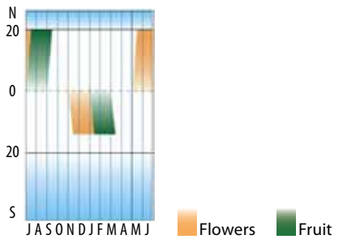
'E-bracteatus' means without bracts (reduced leaf close to the flower cluster) (in Latin) and refers to the lack of bracteoles in this species.

Flowers

Fruits

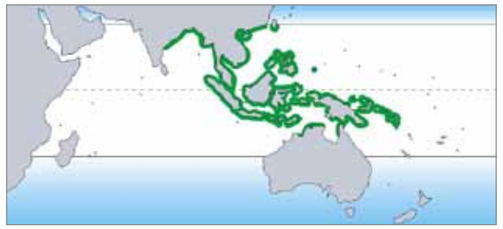
PHENOLOGY

In Vietnam, peak flowering occurs from May to July and peak fruiting occurs around July and September.



DISTRIBUTION

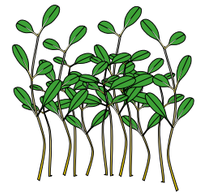
Acanthus ebracteatus occurs in estuaries throughout the Asian tropics to northern Australia. In Vietnam, it occurs in estuaries and embayments from north to south.

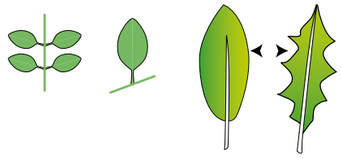


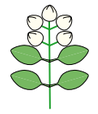
Acanthus ebracteatus

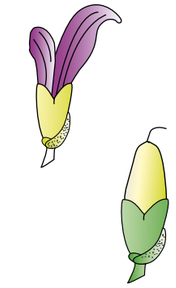
BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	1-3 m, non-woody, somewhat viny with sparsely branched stems
Bark	smooth, green
Stem	slender, 10 mm W, cylindrical, shiny-green with speckles, with or without axillary spines
Roots	occasional aerial along lower parts of reclining stems
FOLIAGE	
Leaves	opposite, simple, narrowly ovate to oblong tending lanceolate, shiny green, 7.5-20 cm L, 2.5-5.5 cm W, glabrous, apex acute, base cuneate, margins either entire or spiny and dentate, presence of spines with greater sunlight and exposure
Petiole	1-1.9 cm L
REPRODUCTIVE PARTS	
Inflorescence	terminal, forming open bracteate erect spikes to 10 cm L, spikes extend with age
Flowers	in 4 ranks, to 20 pairs; flowers perfect, zygomorphic; bract 5 mm shorter than calyx, often caducous; lateral bracteoles absent; calyx 4-lobed, upper lobe conspicuous, enclosing flower bud, lower lobe smaller, lateral lobes narrow, wholly enclosed by upper and lower sepal; corolla white or deep purple, to 2 cm L, short tube closed by basal hairs; abaxial lip 3-lobed to entire, adaxial lobes absent; stamens 4, subequal with thick hairy connectives; anthers medifixed each with 2 cells aggregated around style; ovary bilocular with 2 superposed ovules in each loculus; style enclosed by stamens, capitate to pointed stigma exposed
Fruit	4-seeded capsule, ovoid, green, shiny, smooth, 2 cm L, 1 cm W
DISPERSAL PROPAGULE	
Seeds	orbicular, about 1 cm L, germination hypogeal testa delicate, wrinkled whitish green
Cotyledons	flattened, green
LOCAL DISTRIBUTION	
	High-mid intertidal, **intermediate** estuarine position.









Acanthus ilicifolius

Spiny Holly Mangrove

Ô rô tím

Acanthus ilicifolius is typically a low viny herb that often grows in sand on accreting banks, to mud under canopy patches. The species often forms large patches where plants scramble over adjacent vegetation for support. Development of adventitious (i.e. not arising from the primary root or its branches) aerial roots complement and support the sprawling habit. There is considerable variation in leaf form and presence of spines. Spiny leaves are the result of increased sun exposure, with spines more numerous on plants growing in exposed frontal stands of accreting estuarine banks and open canopy back areas. Flowers of this species are visited by small nectar-feeding birds and butterflies, but large bees are suspected of being the chief pollinator. The large size of the flower indicates that a relatively large and specific animal is needed for effective pollen transfer. The occasional great abundance of maturing fruits shows that pollination is usually successful. Seed release is explosive with capsules splitting violently in the dorsiventral (i.e. extending from upper to lower) plane. Seeds are propelled away with a spinning action like a discus up to 2m distance. *Acanthus ilicifolius* is distinguished from *A. ebracteatus* by its flowers being pale mauve, larger (3.5 - 4 cm L), with persistent large bracteoles (secondary reduced leaves close to the flower cluster) (to 1 cm L), and larger fruits (2.5 - 3 cm L).

Species Feature

Flower with pale mauve and white petals.

Derivation of Species Name

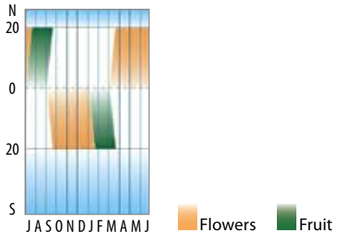
'Ilici-folius' means ilex leaves (in Latin) and refers to the holly-like leaves of this species.

Flowers

Fruits

PHENOLOGY

In Vietnam, peak flowering occurs from March to July and peak fruiting occurs during July and September.



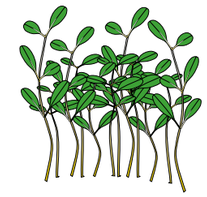
DISTRIBUTION

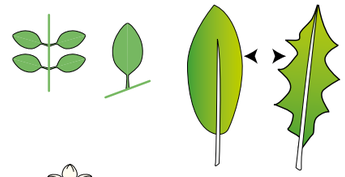
Acanthus ilicifolius is common in estuaries throughout the Asian tropics from India to Polynesia and northern Australia. In Vietnam, it occurs in estuaries and embayments from north to south.

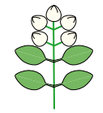
Acanthus ilicifolius

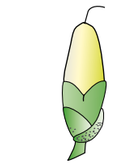
BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or **shrub**	1 - 2 m, non-woody, somewhat viny with sparsely branched stems
Bark	smooth, green
Stem	slender, 10 mm W, cylindrical, shiny-green with speckles, often with a pair of spines at leaf axils
Roots	sometimes aerial or prop roots on lower parts of reclining stems
FOLIAGE	
Leaves	opposite, simple, oblong, shiny green, glabrous, to 20 cm L, margins either entire or spiny and dentate, presence of spines with greater sunlight and exposure
Petiole	short, 1 - 1.5 cm L
REPRODUCTIVE PARTS	
Inflorescence	terminal, forming bracteate spikes 10 - 20 cm L, spikes extend with age; flowers clustered in 4 ranks, to 20 pairs
Flowers	perfect, zygomorphic; bract 5 mm shorter than calyx, often caducous; lateral bracteoles 2, conspicuous, persistent; calyx 4-lobed, upper lobe conspicuous, enclosing flower bud, lower lobe smaller, lateral lobes narrow, wholly enclosed by upper and lower sepal; corolla usually mauve to pale blue in colour with white stripes, rarely all white, to 3 cm L, short tube closed by basal hairs; abaxial lip broadly 3-lobed to entire, adaxial lobes absent; stamens 4, subequal with thick hairy connectives; anthers medifixed each with 2 cells aggregated around style; ovary bilocular with 2 superposed ovules in each loculus; style enclosed by stamens, capitate to pointed stigma exposed
Fruit	4-seeded capsule, ovoid, green, shiny, smooth, 2 - 3 cm L, 1 cm W
DISPERSAL PROPAGULE	
Seeds	rugose angular, about 1 cm L, germination hypogeal; testa delicate, wrinkled whitish green
Cotyledons	flattened, green
LOCAL DISTRIBUTION	
	High to low intertidal, **intermediate-upstream** estuarine position.









ACROSTICHUM

Mangrove Ferns

Derivation of Genus Name

'Acros-stichos' means upper row (in Latin) and refers to the apical, spore-covered, fertile pinna (leaflets) of this genus.

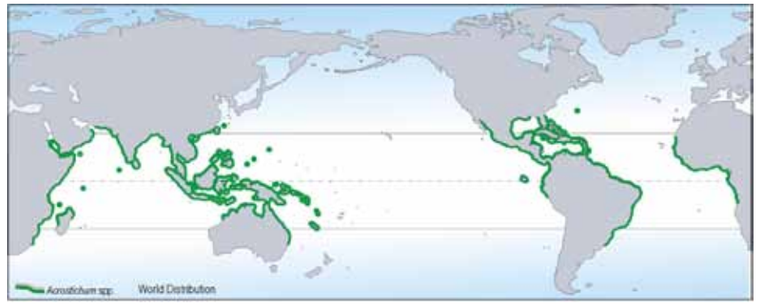
Genus Feature

A single lanceolate leaf frond with alternate pinna. Sporangia (spore cases) covering the whole undersurface of the fertile pinna and not aggregated into sori (clusters of spore cases) as found with other ferns.

Acrostichum is the only genus with mangrove inhabitants in the family Pteridaceae, a family of true ferns consisting of 35 genera and over 1000 species. The 'mangrove fern' genus is distinguished by its sporangia covering the whole undersurface of the fertile pinna and not aggregated into sori as found with other ferns. Spores of this genus represent a discrete type within the pteroid ferns, and their morphology varies within and between species. Species are sexually established from gametophytes (in ferns this is usually a small but discrete plant very different from what is normally considered the fern plant) via widely dispersed spores. Gametophytes are unusually salt tolerant. In general, *Acrostichum* is a pantropic genus of rhizomatous (with horizontal stems that lay at or under the soil surface), ground-living ferns, common and often dominant in the understory of mid to higher intertidal mangrove habitat. They comprise three species with just two in the Indo-West Pacific region.

Distribution

Acrostichum occur throughout most tropical regions of the world. Two species are recorded in mangrove habitats of Vietnam.



2 species in Kien Giang Province, Vietnam

Acrostichum aureum
Acrostichum speciosum

Key of *Acrostichum* species found in Kien Giang Province

Growth form large, indistinct stem, fronds 1 - 3 m long	**Growth form** small, no stem, fronds to 1 m long
	
Pinnae rounded or truncate (i.e. squared off), abruptly acuminate (i.e. narrowing to a point), 20 - 40 cm long	**Sterile pinnae** (leaflets) tapering to a narrow point (i.e. acuminate), 10 - 20 cm long
	
Acrostichum aureum	***Acrostichum speciosum***

Species of *Acrostichum* are distinguished by growth form, size, stem, leaf pinnae shape and upstream occurrence.

Acrostichum aureum

Golden Mangrove Fern

Ráng đai

Acrostichum aureum is distinguished from *A. speciosum* by its larger growth form in all its parts; juvenile leaves with oblong blunt blade, relatively sterile pinnae (leaflets) are acuminate whereby they taper to a long point. The species is further distinguished by its apparent restriction to upstream tidal estuarine environments.

Species Feature

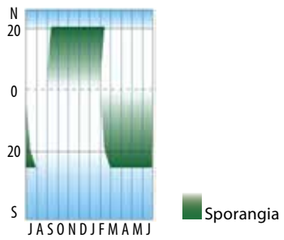
Leaves 1-3 m long, apex of sterile pinnae rounded or truncate (i.e squared off), abruptly acuminate.

Derivation of Species Name

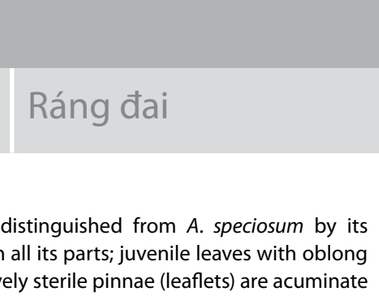
'Aureum' means *golden* (in Latin) and named for its golden yellow sporangia (spore cases) covering the undersides of large leaflets.

PHENOLOGY

In Vietnam, newly fertile fronds may be observed during September to January.



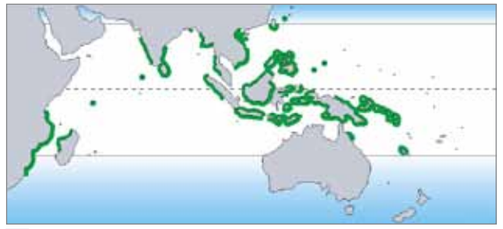
Stem



Fruit (Sporangia)

DISTRIBUTION

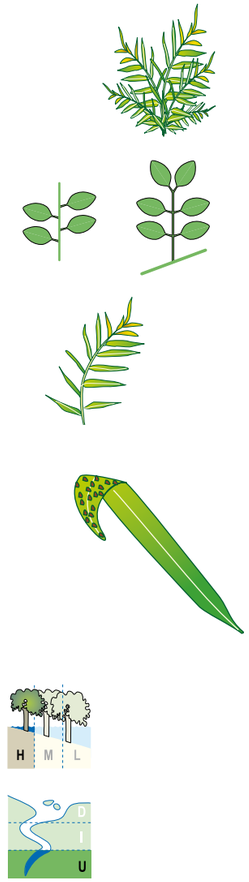
Acrostichum aureum has the distinction of being the only pan tropical mangrove species. The species can survive without regular tidal inundation. Its distribution across the Indo West Pacific is not well described, however, because of continuing confusion with like species, *A. speciosum*. In Vietnam, *A. aureum* is located from north to south.



Acrostichum aureum

BOTANICAL DESCRIPTION

GROWTH FORM	
Fern	perennial, ground living with spreading foliage, to 4 m
Stem	base of spreading cluster of leaf petioles, barely distinct trunk
Roots	thick, rhizome scales lanceolate, border hyaline, 8 mm W, below ground
FOLIAGE	
Leaves	once-pinnate, oblong blunt blade with a terminal leaflet, fronds erect to horizontal, 1-3 m L, only upper pinnae fertile; early simple leaf blades oblong, long, distinctly crimson in colour
Leaflets (pinnae)	coriaceous, dark green, up to 30, each around 20-40 cm L, 5-8 cm W, margins entire, apex rounded or truncate at most abruptly acuminate when sterile, stalked; venation reticulate without free vein endings; scales on petiole base not leaving a prominent scar, no scales up leaf axis
REPRODUCTIVE PARTS	
Fertile fronds	with only upper 5 pinnae pairs with undersurface uniformly covered with rusty brown sporangia when fertile, mixed with capitate paraphyses; sporangia large includes spore
DISPERSAL PROPAGULE	
Spores (paraphyses)	large, tetrahedral, clear to translucent, 1-1.5 mm W, buoyant
LOCAL DISTRIBUTION	
	High intertidal, **upstream** estuarine position.



Acrostichum speciosum

Showy Mangrove Fern

Ráng đai thanh

Acrostichum speciosum is distinguished from *A. aureum* by its smaller growth form in all its parts, plus early simple leaves (i.e. not divided into leaflets) being lanceolate, relatively short blade with sterile pinnae (leaflets) that are acuminate whereby they gradually narrow to a point. The species is further distinguished by its apparent restriction to tidal estuarine and saline environments. In some locations, however, *A. speciosum* may inhabit freshwater see pages beyond the upper mangrove fringe.

Species Feature

Leaves up to 1 m long, apex of sterile pinnae narrowly acuminate, lanceolate.

Derivation of Species Name

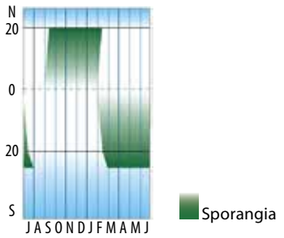
'Speciosum' means *showy* or *good looking* (in Latin) and refers to the showy presence of this species in the undergrowth of many mangrove stands.

Diagnostic feature

Fruit (Sporangia)

PHENOLOGY

In Vietnam, newly fertile fronds may be observed during September to January.



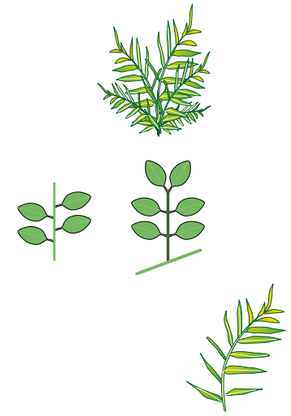
DISTRIBUTION

Acrostichum speciosum is restricted to the tropical Indo-West Pacific, extending from Asia to Australia and the western Pacific. Regional distributions however are not well described because of continuing confusion with like species, *A. aureum*. In Vietnam, *A. speciosum* is located in the south only.

Acrostichum speciosum

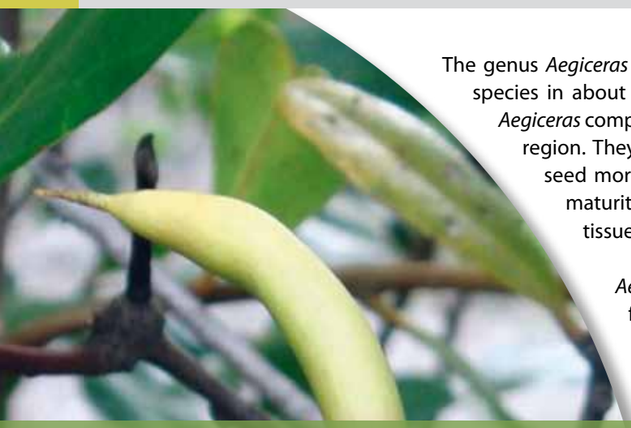
BOTANICAL DESCRIPTION

GROWTH FORM	
Fern	perennial, ground living with clumped foliage, to 1.5 m
Stem	base of spreading cluster of leaf petioles
Roots	thick, rhizome scales lanceolate, border hyaline, 8 mm W, below ground
FOLIAGE	
Leaves	once-pinnate, lanceolate pointed blade with a terminal leaflet, fronds erect to horizontal, to 1 m L; early simple leaf blades lanceolate, short, distinctly dark green in colour
Leaflets (pinnae)	coriaceous, dark green, narrowly oblong or lanceolate, each around 10-20 cm L, 2-3 cm W, margins entire, apex narrowly acuminate-acute, stalked; venation reticulate without free vein endings; petiolar scales broad, restricted to base of frond; stipules tufted, cartilaginous
REPRODUCTIVE PARTS	
Fertile fronds	with most or only a few distal pinnae with undersurface uniformly covered with rusty brown sporangia when fertile, mixed with capitate paraphyses; sporangia large includes spore
DISPERSAL PROPAGULE	
Spores (paraphyses)	large, tetrahedral, clear to translucent, 1-1.5 mm W, buoyant
LOCAL DISTRIBUTION	
	High intertidal, **upstream** estuarine position.



Aegiceras corniculatum

River Mangrove | Sú



The genus *Aegiceras* belongs to the Myrsinaceae family which has more than 1000 species in about 30 genera distributed throughout the tropics and subtropics. *Aegiceras* comprises of two mangrove species restricted to the Indo-West Pacific region. They are readily distinguished from other Myrsinaceae by fruit and seed morphology being elongate capsular, dehiscent (i.e. splits open at maturity) fruit and elongate seeds without endosperm (the food reserve tissue in a seed).

Aegiceras corniculatum named for its distinctly curved, horn-like fruits when mature, distinguishing it from *A. floridum* that has largely straight fruits. These species also differ in a number of other characters respectively including: inflorescence umbel or racemose (flower cluster has no terminal flower

AEGICERAS

River Mangrove

1 species in Kien Giang Province, Vietnam

and appears either with floral stalks equal in length and arising from a common point like an umbrella or with flowers having short stalks situated along the main stem), flowers sweet scented or sour-smelling, peduncle (stalk of the flower cluster) short (to 5 mm) or long (to 20 mm), pedicels (individual flower stalks) long (8-12 mm) or short (4-6 mm), and leaves large (11 X 6 cm) or small (6 X 3 cm). *Aegiceras corniculatum* occurs often as dense sub-canopy, frontal hedges bordering estuarine margins. The upriver position influences the presence of co-inhabitant species where these vary from marine locations with *Avicennia marina*, *Sonneratia alba* and *Rhizophora stylosa*, to more freshwater influenced locations with *Acanthus ilicifolius*, *Sonneratia lanceolata* (=*S.caseolaris*) and *Rhizophora apiculata*.

Derivation of Species Name

'Corniculatum' means *like a curved horn* (in Latin) and refers to the characteristically curved fruits of this species.

Species Feature

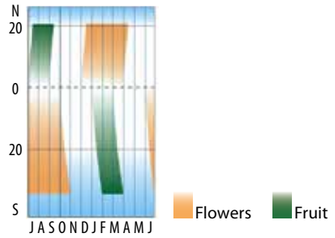
Cluster of horn-shaped fruits.

Flowers

Fruit

PHENOLOGY

In Vietnam, flowering occurs in winter from December to April, while fruits mature in July and September. Phenoevents tend to occur later in higher latitude locations.



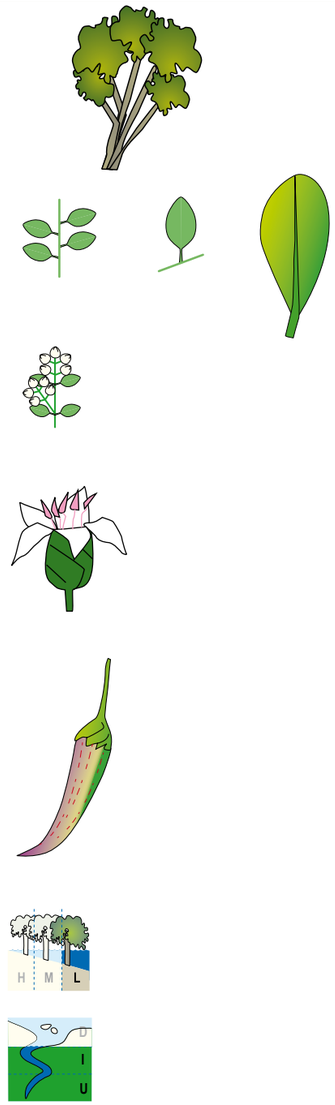
DISTRIBUTION

Aegiceras corniculatum is widely distributed across the Indo-West Pacific from India and Sri Lanka through Asia to Polynesia and Australia. In Vietnam, the species occurs in most estuaries and embayments from north to south.

Aegiceras corniculatum

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 5 m, low multi-stemmed, evergreen
Bark	smooth, dark grey-brown, lenticels small
Roots	not often above ground
FOLIAGE	
Leaves	alternate, simple, rarely sub-opposite, spirally arranged, elliptic to obovate, coriaceous, glabrous, 4-8 cm L, 3-4 cm W, margin entire, apex rounded to slightly emarginate, cuneate at base
Petiole	short, 0.5-1.0 cm L, terete but slightly 2-keeled laterally
REPRODUCTIVE PARTS	
Inflorescence	either terminating long shoots or on short leafy or leafless lateral shoots in axils of foliage, simple umbels; bracts minute, 1-3 mm L, ephemeral; bracteoles absent
Flowers	perfect, pentamerous, fragrant, pointed bud with slender pedicel, 1-2 cm L; calyx lobes 5, free imbricate contorted blunt, asymmetric, remain erect; petals 5, white, pointed, twisted to the left, fused basally to form short tube, 5-6 mm L, reflexed at maturity, dense hairs in corolla tube mouth, shorter capitate hairs at base; stamens 5, opposite corolla lobes; filaments ~3 mm L, united below into a short tube; anthers medifixed; ovary 8 mm L, conical, single loculus, extended to long simple style beyond corolla tube, nectariferous at base
Fruit	capsule enclosing 1 propagule, horn-shaped, pointed apically, curved, 5-8 cm L, crypto-viviparous, persistent calyx
DISPERSAL PROPAGULE	
Hypocotyl	pedicellate, dehisces early piercing the seed coat to expose the green radicle curving away from the capsule wall, germination immediately on release epigeal; on the ground the radicle penetrates the substrate and elongates to lift the plumule
LOCAL DISTRIBUTION	
	Low intertidal, **intermediate-upstream** estuarine position.



AVICENNIA

Grey Mangroves

Derivation of Genus Name

Named in honour of the famous Arabian physician and scientist, abu-Ali al-Husayn ibn-Sina, known as Avicenna (980-1037) - his *Qanun* remained the standard medical textbook on plants for 500 years after his death.

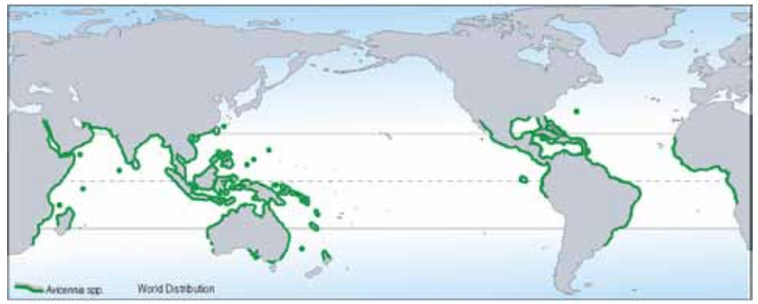
Genus Feature

Leaves are pale grey-green on undersurface.

Avicennia is the sole genus in the exclusively pantropic mangrove family Avicenniaceae, once grouped within the family Verbenaceae. This small but widespread and distinct mangrove family is characterised by anomalous secondary thickening, leaf anatomy, characteristic pollen, incipient vivipary (whereby seeds germinate before they detach from the parent plant) and seedling morphology. *Avicennia* consists of eight species worldwide including: five in the Indo-West Pacific - *A. alba*, *A. integra*, *A. marina*, *A. officinalis* and *A. rumphiana*; and three others in the Atlantic East Pacific. *Avicennia* are generally considered pioneers of mangrove forests. They occupy a diversity of habitats within the tidal range and across salinity extremes of tropical and subtropical sheltered areas. In tropical regions, this often includes a select group of co-inhabitors, like *Rhizophora*. In subtropical and temperate tidal habitats, *Avicennia* often dominate as trees or shrubs. An unusually cold-tolerant variety grows at latitudes as high as 38° 45′ S in southern Australia and New Zealand, making this the most widely distributed of any mangrove genus.

Distribution

Avicennia occur throughout most tropical-subtropical regions of the world. Of the three species recorded in Vietnam, *A. alba* is ubiquitous and widespread while *A. officinalis* is uncommon or rare.



3 species in Kien Giang Province, Vietnam

Avicennia alba
Avicennia marina
Avicennia officinalis

Key of *Avicennia* species found in Kien Giang Province

Flower small 3-8 mm long
Inflorescence (flower cluster) usually spicate (i.e. in the form of a spike)

Propagule very elongate with pointed (distal) end

Leaf apex usually pointed (bluntly)

Avicennia alba

Flower small 3-8 mm long
Inflorescence (flower cluster) **capitate** (i.e. forms a dense head)

Propagule ovoid with rounded distal end

Leaf apex pointed

Avicennia marina

Flower large, > 7 mm long, **calyx inflorescence** (flower cluster) capitate

Propagule elongate with pointed end

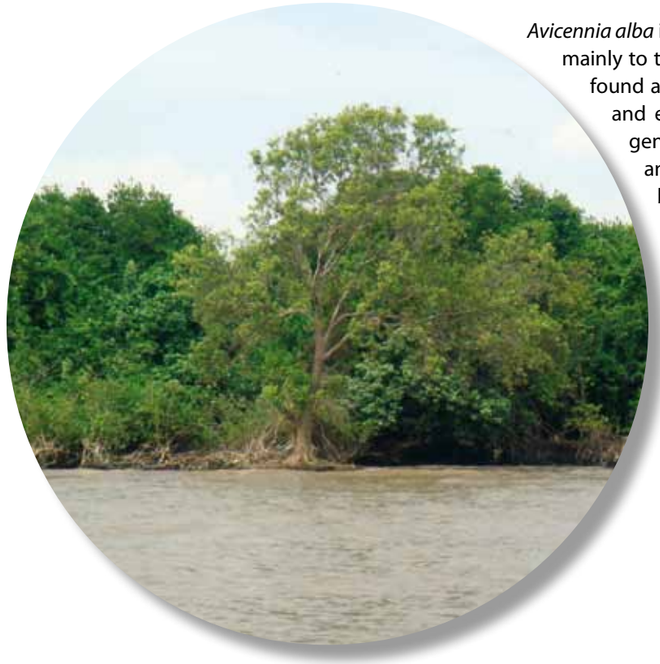
Leaf apex usually rounded

Avicennia officinalis

Species of *Avicennia* are distinguished by flower size, margins of calyx lobes, style shape, fruit shape, leaf apex shape and bark colour.

Avicennia alba

White Grey Mangrove | Mắm trắng



Avicennia alba is a significant pioneer of mangrove species, restricted mainly to the Asian area of the Indo-West Pacific. The species is found along tidal river banks, about entrances of tidal inlets, and extending along shoreline mudflats. In these sites it generally occupies the lower tidal position of mangroves and it is commonly observed on newly formed mud banks. *Avicennia alba* is readily distinguished by relatively spicate inflorescences (i.e. flower clusters in the form of a spike), small flowers and very elongate propagules.

Species Feature

Small spicate flowers and pointed fruits.

Derivation of Species Name

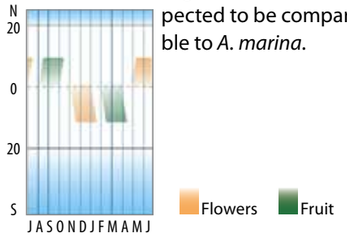
'Alba' means *white* (in Latin) and refers to the pale undersurface of the leaves contrasting with the blackish bark of this species.

Flowers

Fruits

PHENOLOGY

Flowering and fruit maturation varies considerably with latitude. Phenological events are initiated by daylength and governed by temperature. Flowering (May-July) and fruiting (August-October) occurs progressively later in higher latitude sites. Timing of events is expected to be comparable to *A. marina*.



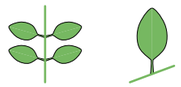
DISTRIBUTION

Avicennia alba occurs from western India, through Indo-Malesia, southeastern Asia, southern Philippines, Palau and Yap Islands of the western Pacific to northern Australasia. In Vietnam, it occurs in estuaries and embayments in the south only.

Avicennia alba

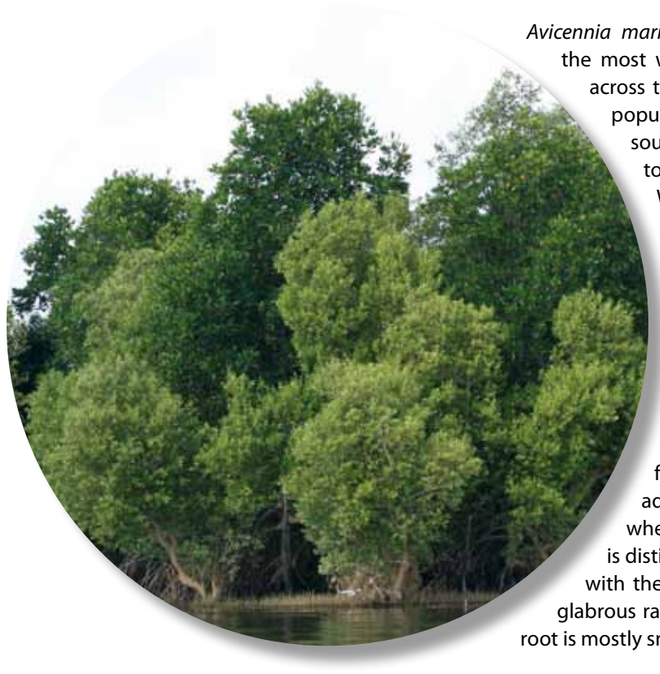
BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 25 m, spreading, widely variable
Bark	dark brown to black, or warty or smooth, often with many short longitudinal fissures or reticulate lines forming very small scales
Stem	base simple, occasional low-placed aerial and prop roots
Roots	pencil-like pneumatophores, around 20 cm L, 5-10 mm W
FOLIAGE	
Leaves	opposite, simple, ovate-elliptic, 73-111 mm L, 20-46 mm W, apex bluntly acute, upper surface dark satiny green, under-surface dull pale finely pubescent
Petiole	4-21 mm L, glabrous above, often pubescent below
REPRODUCTIVE PARTS	
Inflorescence	terminal or subterminal axillary, mostly spicate, 3-7 bud pairs, 20-30 mm L
Flower	actinomorphic, sweetly scented, 3-5 mm L; bract triangular curved, edge ciliate, sometimes foliaceous; bracteoles 2, ovate, edges ciliate; calyx lobes 5, ovate, 3-4 mm L, edge ciliate, outer surface mostly pubescent; corolla orange, 4-6 mm W, lobes mostly 4, slightly revolute, reflexed, slightly unequal, 2-3 mm L, apices rounded, outer surface mostly pubescent, inner surface dull glabrous; stamens 4 mostly, alternate with corolla lobes, ~0.5 mm L, anthers ~0.5 mm L; style minute, glabrous, stigma below anthers; ovary depressed conical, upper portion glabrous
Fruit	pod enclosing one propagule, rarely two, compressed elongate ellipsoid, 19-27 mm L, 10-15 mm W, cryptoviviparous, distal tip sharply acute with persistent stylar beak ~0.5 mm L; pericarp fleshy, outer surface puberulent pale grey-green; calyx persistent, 2-3 mm L
DISPERSAL PROPAGULE	
Propagule	with 4 cotyledons, green, compressed elongate ellipsoid, fleshy; radicle ~9 mm L, mostly glabrous with densely hairy collar ~2 mm W, distal tip hooked, glabrous; buoyant with pericarp, neutral to negative without
LOCAL DISTRIBUTION	
	Medium to low intertidal, **downstream-intermediate** estuarine position.



Avicennia marina

Northern Grey Mangrove | Mắm biển



Avicennia marina, the pioneer of mangrove species, is possibly the most widely distributed of all mangroves, ranging widely across the Indo-West Pacific. There are unique cold tolerant populations recognised as genetic variants restricted to southern Australia and New Zealand. There are also known to be a number of varietal forms in several locations. Where varieties overlap, they express no inhibition to genetic mixing. In addition to the extraordinary wide tolerance of temperature conditions, this species further shows remarkable adaptation to: 1) a wide range of tidal inundation levels varying from 1-10 m; 2) a wide moisture tolerance from the wettest to driest regions; 3) a wide tolerance of salinity varying from freshwater to hypersaline; and 4) various substrate types from reef flats, to sandy or rocky embayments, and to fine clay mudflats. These features provide this species with significant dispersal advantages since it can become established in sites where no other mangrove can survive. *Avicennia marina* is distinguished by its capitate inflorescences (flower cluster with the flowers unstalked and aggregated densely), mostly glabrous radicle (the part of the seedling that develops into the root is mostly smooth and free from hair) and rounded fruit.

Species Feature

Small flowers and pointed leaves.

Derivation of Species Name

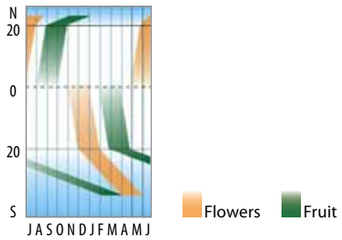
'Marina' means of *the sea* (in Latin) and refers to the coastal habit of this species.

Flowers

Fruits

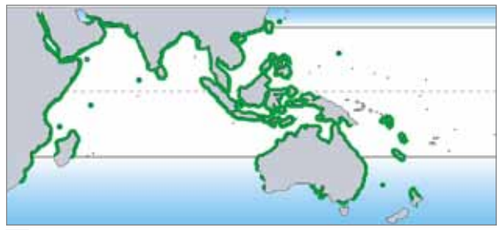
PHENOLOGY

Flowering and fruit maturation varies considerably with latitude. Phenological events are initiated by daylength and governed by temperature. Flowering (May-July) and fruiting (August-October) occurs progressively later in higher latitude sites.



DISTRIBUTION

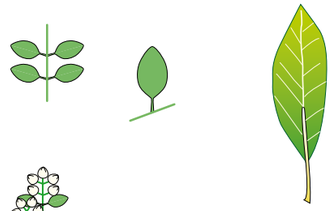
Avicennia marina is distributed from East Africa and the Arabian Gulf, throughout Asia to China and Japan, to the south western Pacific, New Zealand and Australia. In Vietnam, it occurs in estuaries and embayments from north to south.



Avicennia marina

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 25 m, spreading, widely variable
Bark	white smooth flaky, or brown fissured pustular with longitudinal fissures stem base simple, occasional low-placed aerial and prop roots
roots	pencil-like pneumatophores, 20-30 cm L, 5-10 mm W
FOLIAGE	
Leaves	opposite, simple, ovate-elliptic to narrowly lanceolate, 43-164 mm L, 12-49 mm W, apex variably pointed, upper surface shiny green, under-surface dull pale finely pubescent
Petiole	3-23 mm L, glabrous above, often pubescent below
REPRODUCTIVE PARTS	
Inflorescence	terminal or subterminal axillary, tightly capitate, 2-5 bud pairs, 10-30 mm L
Flower	actinomorphic, sweetly scented, 4-8 mm L; bract triangular or ovate, edge ciliate, sometimes foliaceous; bracteoles 2, ovate, edges ciliate; calyx lobes 5, ovate, 3-6 mm L, edge ciliate, outer surface fully or partly pubescent; corolla orange, 3-7 mm W, lobes mostly 4, revolute, reflexed, mostly equal, 1-3 mm L, apices rounded, outer surface mostly pubescent, inner surface dull glabrous; stamens 4 mostly, alternate with corolla lobes, ~0.5 mm L, anthers ~1 mm L; style short, glabrous, stigma below anthers or barely exserted; ovary conical, upper portion densely tomentose
Fruit	pod enclosing 1 propagule, rarely two, compressed ovoid, 14-31 mm L, 11-27 mm W, cryptoviviparous, persistent stylar beak ~1 mm L; pericarp fleshy, outer surface, puberulent, pale grey green; calyx persistent, 3-7 mm L
DISPERSAL PROPAGULE	
Propagule	with 4 cotyledons, green, rounded, fleshy; radicle ~10 mm L, mostly glabrous with short densely hairy collar ~2 mm W, distal tip blunt, glabrous; buoyant with pericarp, neutral to negative without
LOCAL DISTRIBUTION	
	High to low intertidal, **downstream-intermediate** estuarine position.



Avicennia officinalis

Round-leafed Grey Mangrove

Mắm lưỡi đòng (Mắm đen)

Avicennia officinalis is easily distinguished from *A. alba* and *A. marina* by its larger flowers and rounded glossy leaves. The species occurs from India and Asia to Indonesia and southern New Guinea but not Australia. There it is seemingly replaced by *A. integra*, a sibling species distinguished principally by calyx (collective of sepals forming an outer whorl) lobe edges which are entire in *A. integra*, and ciliate (i.e. with a margin of hairs) or hairy in all other *Avicennia* species, including *A. officinalis*. *Avicennia officinalis* commonly occurs on soft mud banks at low-intertidal positions along river-dominated estuaries. In such locations it is considered a coloniser in association with *Sonneratia alba* and *Acanthus ebracteatus*. The upriver distribution of *A. officinalis* is restricted to the middle portion of the upstream range of *A. alba* and *A. marina*. These distributional restrictions imply that *A. officinalis* has relatively restricted physiological tolerances for salinity and tidal inundation, making it more vulnerable to fluctuating estuarine conditions with climate change and human influences.

Species Feature

Large, glossy rounded leaves.

Derivation of Species Name

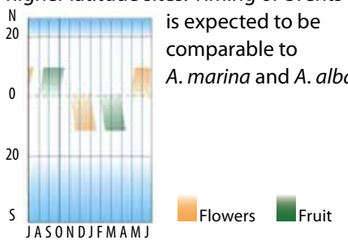
'Officinalis' means *of or belonging to an officina* (in Latin) - the officina being a storeroom for medicines. The epithet denotes the plant has a medial use.

Flowers

Fruits

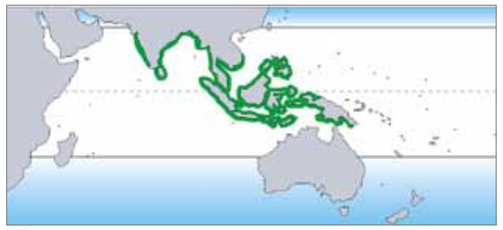
PHENOLOGY

Flowering and fruit maturation varies considerably with latitude. Phenological events are initiated by daylength and governed by temperature. Flowering (May-July) and fruiting (August-October) occurs progressively later in higher latitude sites. Timing of events is expected to be comparable to *A. marina* and *A. alba*.



DISTRIBUTION

Avicennia officinalis is distributed from western India through Indo-Malesia, south-eastern Asia and the Philippines to Australasia. The species is unknown in Australia. In Vietnam, *Avicennia officinalis* is found in the south only.



Avicennia officinalis

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 25 m, spreading
Bark	reddish brown to grey-greenish, pustular in larger trees stem base simple
Roots	pencil-like pneumatophores, 20-30 cm high
FOLIAGE	
Leaves	opposite, simple, ovate-elliptic, slightly revolute margins, 52-118mm L, 27-46 mm W, apex mostly rounded, upper surface bright satiny green, under-surface pale finely pubescent
Petiole	8-17 mm L, glabrous above, pubescent below
REPRODUCTIVE PARTS	
Inflorescence	terminal or subterminal axillary, capitate, 1-3 bud pairs, 20-30 mm L
Flower	zygomorphic, lightly scented, 11-13 mm L; bract, triangular, entire, sometimes foliaceous or absent; bracteoles 2, oblong, entire; calyx lobes 5, ovate, 8-10 mm L, edge hairy, pubescent at base; corolla yellow-orange, 7-12 mm W, lobes 4 mostly, tending revolute, reflexed, unequal, 3-5 mm L, apices rounded, outer surface mostly pubescent, inner surface dull glabrous; stamens 4 mostly, alternate with corolla lobes, 2 pairs 1.5 and 2.5 mm L, anthers 1.5 mm L; style elongate, glabrous, stigma not exceeding anthers; ovary ampulla-shaped, densely tomentose
Fruit	pod enclosing one propagule, elongate compressed ellipsoid, 14-38 mm L, 8-27 mm W, crypto-viviparous, persistent stylar beak to 5-10 mm L; pericarp fleshy, velvety pubescent, pale grey-green; calyx persistent, 5-8 mm L
DISPERSAL PROPAGULE	
Propagule	with 4 cotyledons, green, elongate ellipsoid, fleshy; radicle around 13 mm long, densely hairy along full length, distal tip blunt, glabrous; buoyant with pericarp, neutral to negative without
LOCAL DISTRIBUTION	
	Medium to high intertidal, **intermediate** estuarine position.

BRUGUIERA

Orange Mangroves

Bruguiera is an Indo-West Pacific genus within the small pantropic family Rhizophoraceae that consists of 16 genera and around 120 species of trees and shrubs. Four genera are found exclusively in mangroves, and all are notably viviparous (whereby seeds germinate before they detach from the parent plant), including *Rhizophora*, *Ceriops*, *Kandelia* and *Bruguiera*. Bruguiera are distinguished by calyces with 8-16, lanceolate, pointed lobes, 16-32 stamens, explosive pollen release, and distinctly viviparous propagule. The genus consists of two imperfect groupings of species, including: 4 species with large, mostly solitary flowers, namely *B. exaristata*, *B. gymnorhiza*, *B. X rhynchopetala* and *B. sexangula*; and, 3 species with 2-5 small flowers in each inflorescence (flower cluster), namely *B. cylindrica*, *B. hainesii* and *B. parviflora*. The hybrid is here described as *B. X rhynchopetala* (= *B. gymnorhiza* X *B. sexangula*) from stands in China and North-eastern Australia. All taxa except *B. exaristata* are likely to occur in Vietnam.

Derivation of Genus Name

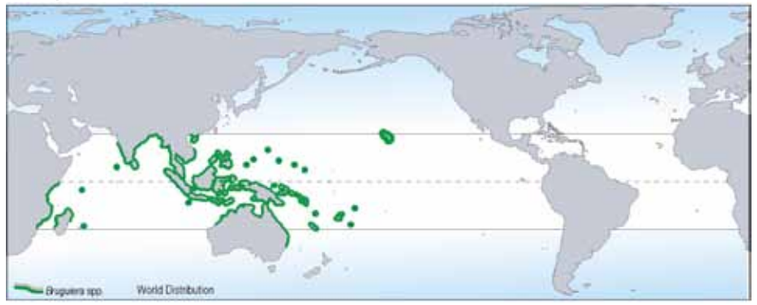
Named in honour of the French biologist and explorer, Jean-Guillaume Bruguiére (1750-1798), famous for his naming of molluscs, marine life and plants.

Genus Feature

Flowers characterised by having 8-16, pointed calyx (collective of sepals forming an outer whorl) lobes and orange petals.

Distribution

Bruguiera are an Indo-West Pacific genus present in most mangrove stands from the East Coast of Africa through Asia and Indonesia, the Philippines, to the western Pacific Islands and northern Australia. *Bruguiera gymnorhiza* is considered one of the most broadly distributed by longitude of any mangrove species. *Bruguiera sexangula* was introduced to the Hawaiian Islands around 1927.



3 species in Kien Giang Province, Vietnam

Bruguiera cylindrica
Bruguiera gymnorhiza
Bruguiera sexangula

Key of *Bruguiera* species found in Kien Giang Province

Flowers small, less than 3 mm wide petal spine exceeds lobes

Fruit **calyx** (collective sepals forming an outer whorl) are smooth and reflexed

Bruguiera cylindrica

Flowers large, greater than 3 mm wide
Petal spine shorter than lobes or absent
Flowers solitary (1 bud per **inflorescence**)

Petal bristles absent or minute

Bruguiera sexangula

Petal bristles 3, greater than 2 mm

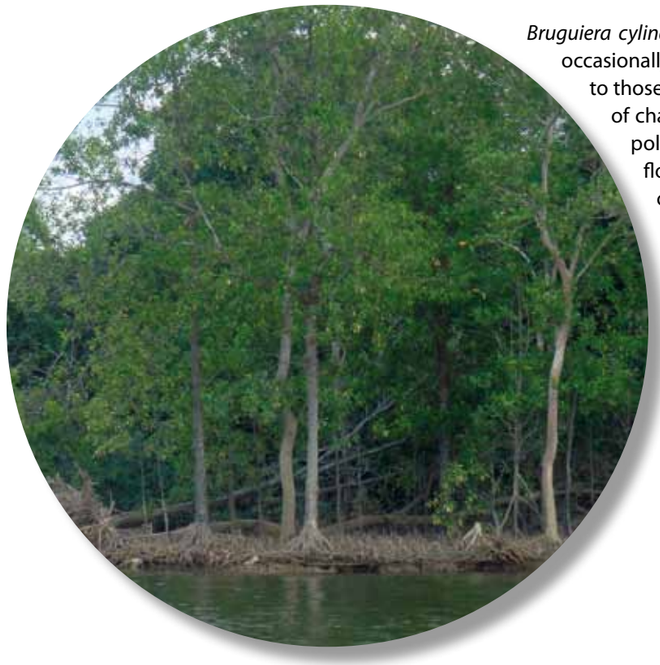
Bruguiera gymnorhiza

Species of *Bruguiera* are distinguished by the number of buds in inflorescences, bud size, ribbing on calyces, numbers of calyces, shape of petal lobes, and presence of spines and bristles on petals.

Bruguiera cylindrica

Reflexed Orange Mangrove

Vẹt trụ (Vẹt thăng)



Bruguiera cylindrica grows as a small tree in inner mangroves and occasionally forms pure stands that appear similar in appearance to those of *B. parviflora*. These species further share a number of characteristics as well as habit, including their explosive pollen release triggered by small insects visiting the flowers. *Bruguiera cylindrica* is distinguished from its close relatives by some key characteristics. It differs from large single-flowered *Bruguiera* species, like *B. gymnorhiza*, by its small flowers and multi-flowered inflorescences (flower clusters). In addition, it differs from small-flowered species, such as *B. parviflora* and *B. hainesii*, by its 7-8-lobed calyx (collective of sepals forming an outer whorl) with fully reflexed (i.e. bent sharply backwards) lobes.

Species Feature

Calyx lobes on flowers and mature fruits are notably reflexed and spreading.

Derivation of Species Name

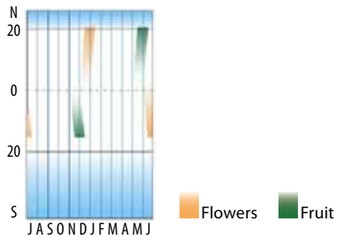
'Cylindrica' means *cylindrical* (in Latin) and refers to the shape of the hypocotyl (the stem of the embryo or young seedling) of this species.

Flowers

Fruits

PHENOLOGY

In Vietnam, flowering occurs mostly during December-January, and propagule maturation in May-June.



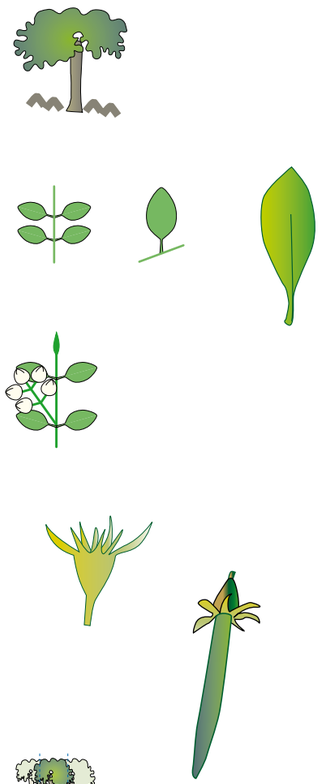
DISTRIBUTION

Bruguiera cylindrica is distributed from India and Sri Lanka through the Malay Archipelago to New Guinea and northern Australia. In Vietnam, it is restricted to estuaries of the south only.

Bruguiera cylindrica

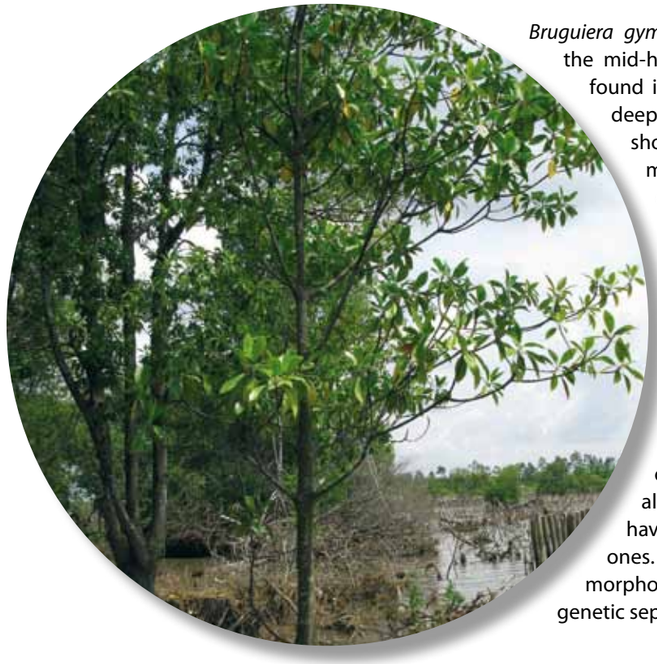
BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 10 m, evergreen, columnar
Bark	greyish, finely fissured
Stem	with short buttresses
Roots	small, knee-like looping pneumatophores
FOLIAGE	
Leaves	opposite, simple, elliptic, thinly glossy green, 7-17 cm L, 2-8 cm W, margin entire, blunt pointed apex, cuneate base
Petiole	often reddish, to 4 cm L
Stipules	paired, lanceolate, enclosing terminal bud, to 3 cm L
REPRODUCTIVE PARTS	
Inflorescence	axillary, often 3-flowered, peduncle to 1 cm L
Flower	pale-greenish, erect at anthesis, 10-12 mm L; calyx tube turbinate, smooth, 4-6 mm L, 2 mm W, lobes 8 stout-pointed as long as tube; petals 8, creamy white, 3-4 mm L, shortly bilobed, apices with 2-3 bristles, sinus between with spine exceeding lobes; stamens 16, 2 enclosed in each petal, dehiscing precociously; style slender, stigma minutely 3-lobed
Fruit	within calyx tube, enlarged, turbinate, smooth, lobes completely reflexed, germination viviparous, hypocotyl emergent from calyx during maturation
DISPERSAL PROPAGULE	
Hypocotyl	pencil-like, terete, slender, green, to 15 cm L, 0.4-0.8 cm W, slightly grooved, buoyant
LOCAL DISTRIBUTION	
	Mid intertidal, **downstream-intermediate** estuarine position.



Bruguiera gymnorhiza

Large-leafed Orange Mangrove | Vẹt dù (Vẹt dù bông đỏ)



Bruguiera gymnorhiza is a distinctive and common member of the mid-high intertidal mangrove community. The species is found in a wide variety of habitat conditions ranging from deep estuarine muds, to sandy beaches, to coral and rock shorelines. This is also one of the most wide-ranging of mangrove species, based on its broad longitudinal distribution. *Bruguiera gymnorhiza* is distinguished from other *Bruguiera* by a number of characteristics: - large solitary-flowered inflorescences (flower cluster) with petals having a spine slightly shorter than the paired-lobes, as distinct from *B. parviflora*, *B. cylindrica* and *B. hainesii*; and, its acutely-pointed petal lobes with 3-4 bristles, being distinct from the more rounded petal lobes with lesser bristle numbers of *B. sexangula* and *B. X rhynchopetala*. The calyces (collective of sepals forming an outer whorl) of *B. gymnorhiza* are often also distinctly bright red, almost scarlet in colour, but not always. Some trees have pale yellowish-green coloured calyces, and no red ones. These colour differences do not correspond to any morphological characters, implying a lack of any significant genetic separation.

Species Feature

Open flower showing petals with 3 longish bristles at lobe tips.

Derivation of Species Name

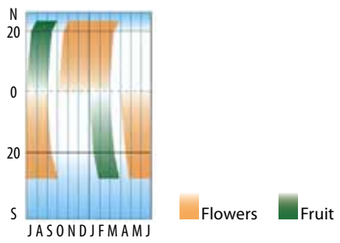
'Gymno-rhiza' means *naked root* (in Greek) and refers to the conspicuous exposed knee roots of this species. Spelling of the Linnaeus species name is preserved.

Flowers

Fruits

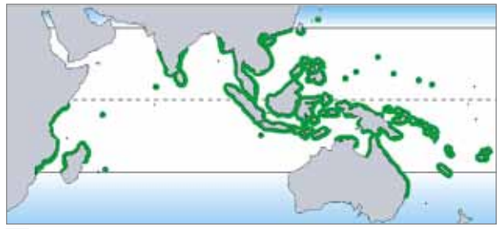
PHENOLOGY

In Vietnam, flowering peaks through October to March, and propagule maturation occurs in July and September.



DISTRIBUTION

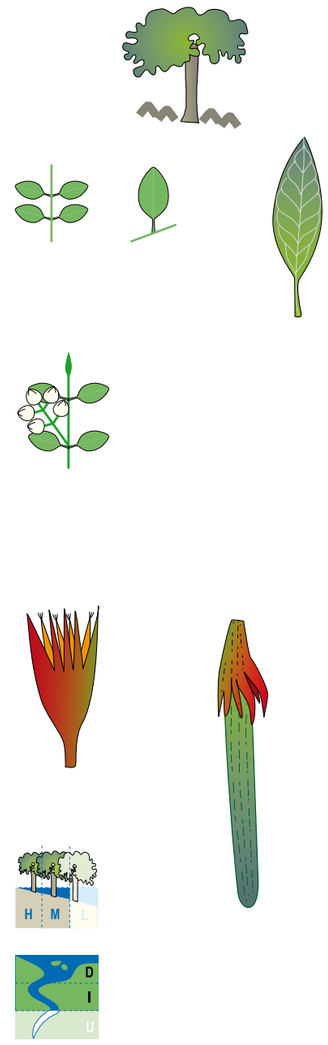
Bruguiera gymnorhiza is distributed from East Africa through India and the Malay Peninsula to the Ryukyu Islands, Polynesia to Samoa and northern Australia. In Vietnam, it is found in most estuaries along the northern coast from north to south.



Bruguiera gymnorhiza

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 25 m, evergreen, columnar or multi-stemmed
Bark	dark grey to black, rough, friable, checkered fissuring
Stem	with short buttresses
Roots	thick knee-like pneumatophores
FOLIAGE	
Leaves	opposite, simple, elliptic-oblong, glossy green, coriaceous, 9-24 cm L, 3-9 cm W, margin entire, apex bluntly pointed, base cuneate
Petiole	green, to 2-6 cm L, often glaucous with white wax
Stipules	paired, lanceolate, enclosing terminal bud, to 8 cm L, often reddish
REPRODUCTIVE PARTS	
Inflorescence	axillary, 1-flowered, peduncle 1-3 cm L
Flower	bright red occasionally yellowish-green, recurved, to 3-5 cm L; calyx tube turbinate, grooved, lobes 9-14 narrow pointed longer than tube, 15-25 mm L; petals 9-14, creamy orange, 13-19 mm L, bilobed, 4-8 mm L, apices acute with 3-4 bristles 2-4 mm L, sinus between lobes with long spine; stamens 18-28, with 2 enclosed in each petal, dehiscing precociously; style slender, 15-24 mm L, stigma minutely 3-4-lobed
Fruit	within calyx tube, enlarged, turbinate, grooved, lobes only slightly reflexed, if at all; germination viviparous, hypocotyl emergent from calyx during maturation
DISPERSAL PROPAGULE	
Hypocotyl	cigar-shaped, terete, elongate, green, longitudinal ribbing, to 25 cm L, 1-2 cm W, distal tip blunt, buoyant
LOCAL DISTRIBUTION	
	High-mid intertidal, **downstream-intermediate** estuarine position



Bruguiera sexangula

Upriver Orange Mangrove

Vẹt khang (Vẹt đen, Vẹt dù)

Bruguiera sexangula is usually found in upstream reaches of river-dominated estuaries in high rainfall areas. Other *Bruguiera*, especially *B. gymnorhiza*, dominate the lower and intermediate sections of these estuaries. *Bruguiera sexangula* closely resembles *B. gymnorhiza* and together they further share an intermediate-hybrid form, *B. X rhynchopetala*. This combination of closely related taxa has resulted in considerable confusion and mis-identification for each entity. *Bruguiera sexangula* is distinguished from other *Bruguiera* by: large solitary-flowered inflorescence (flower cluster) with petals having a spine slightly shorter than the paired-lobes, as distinct from from *B. parviflora*, *B. cylindrica* and *B. hainesii*; and, blunt petal lobes with single minute or absent bristles, and relatively short hypocotyls (the stem of the embryo or young seedling), as distinct from *B. gymnorhiza* and *B. X rhynchopetala*.

Species Feature

Open flower showing petals with no hairs at lobe tips.

Derivation of Species Name

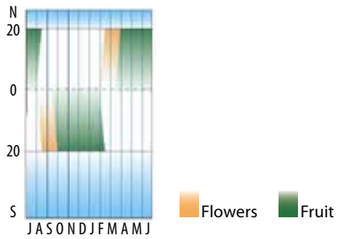
'Sex-angula' means *six-angled* (in Latin) and refers to the angular sides of the hypocotyl of this species.

Flowers

Fruits

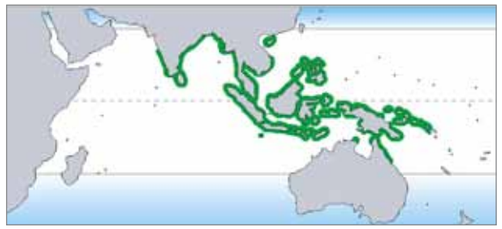
PHENOLOGY

In Vietnam, flowering peaks in February and March, and maturation of propagules occurs in March to August.



DISTRIBUTION

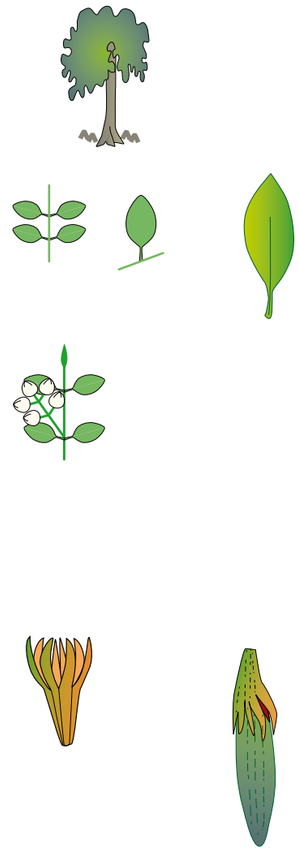
Bruguiera sexangula is distributed from India to Asia, through the Indonesian Archipelago to New Caledonia and the northern coast of Australia. In Vietnam, the species occurs in estuaries along the coastline in the south only.

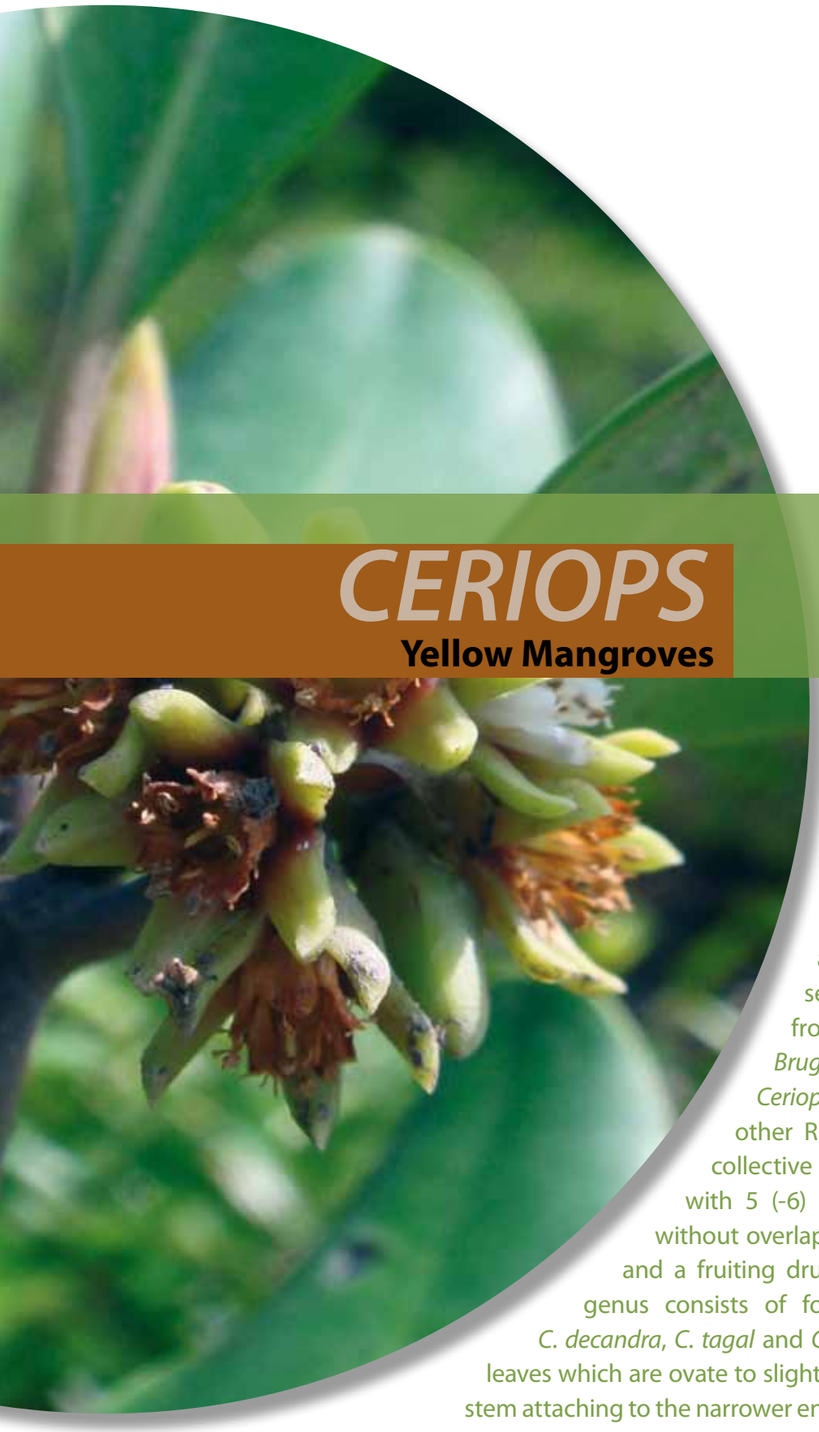


Bruguiera sexangula

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 15 m, evergreen, columnar or multi-stemmed
Bark	grey, fine longitudinal fissuring
Stem	with fin-like buttresses, occasional prop aerial roots low-placed
Roots	knee-like pneumatophores
FOLIAGE	
Leaves	opposite, simple, elliptic-oblong, glossy green, smooth, 10-20 cm L, 4-7 cm W, margin entire, apex pointed, base cuneate
Petiole	to 4 cm L, green
Stipules	paired, lanceolate, occasional pinkish tinge, enclosing terminal bud, to 8 cm L
REPRODUCTIVE PARTS	
Inflorescence	axillary, 1-flowered, peduncle 0.5-1.1 cm L
Flower	pink-orange to pale yellowish-green, recurved, 3-3.5 cm L; calyx tube turbinate, ribbed, with 12-14 narrow pointed lobes longer than tube, 1.6-1.9 cm L; petals 10-12, creamy orange, 9-15 mm L, bilobed, apices blunt with bristles absent or minute to 0.5 mm L, sinus between with spine not exceeding lobes 4-6 mm L; stamens 20-24, enclosed 2 in each petal, dehiscing precociously; style slender, 12-21 mm L, minutely 3(-4)-lobed stigma
Fruit	within calyx tube, enlarged, turbinate, ribbed, lobes slightly reflexed; germination viviparous, hypocotyl emergent from calyx during maturation
DISPERSAL PROPAGULE	
Hypocotyl	cigar-shaped, terete, stout, green, slight longitudinal ribbing, 5-12 cm L, 1-1.5 cm W, distal tip blunt, buoyant
LOCAL DISTRIBUTION	
	Mid intertidal **upstream** estuarine position





CERIOPS

Yellow Mangroves

Derivation of Genus Name

'Ceras-opsis' means *horn-like appearance* (in Greek) and refers to the small hypocotyl (the stem of the embryo or young seedling) emergent from fruits of this genus.

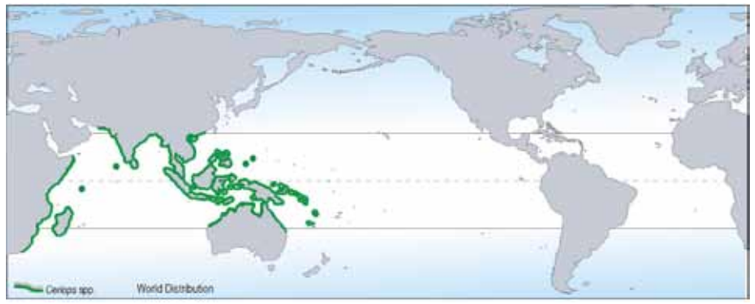
Genus Feature

Bark is smooth, pale yellow-pink, flaking with lenticels (pores in the bark). Foliage is yellow-green in appearance.

Ceriops is an Indo-West Pacific genus and a member of the small pantropic family Rhizophoraceae consisting of 16 genera and around 120 species of trees and shrubs. Four genera are found exclusively in the mangroves and all are notably viviparous (whereby seeds germinate before they detach from the parent plant) including, *Bruguiera*, *Kandelia*, *Rhizophora* and *Ceriops*. *Ceriops* are distinguished from other Rhizophoracaeae by calyces (i.e. the collective of sepals that form an outer whorl) with 5 (-6) valvate (i.e. meeting at the edges without overlapping), blunt lobes, 10 (-12) stamens, and a fruiting drupe with viviparous propagule. The genus consists of four species, including: *C. australis*, *C. decandra*, *C. tagal* and *C. zippeliana*. All species have similar leaves which are ovate to slightly obovate (i.e. egg-shaped with the stem attaching to the narrower end) or elliptic-oblong, apices rounded or slightly emarginate (i.e. notched at the tip), never apiculate (i.e. having a short, sharply pointed tip), and yellow-green in colour.

Distribution

Ceriops are an Indo-West Pacific genus present in most mangrove stands from East Africa through Asia, the Malay Peninsula, the Philippines, to the south-western Pacific Islands and northern Australia.



2 species in Kien Giang Province, Vietnam

Ceriops tagal
Ceriops zippeliana (ex C. decandra)

Key of *Ceriops* species found in Kien Giang Province

Inflorescence (flower cluster) 2-12 flowers; **peduncle** (stalk of inflorescence) length greater than width	**Inflorescence** (flower cluster) 3-5 flowers, **peduncle** (stalk of inflorescence) length equal to width
	
Hypocotyl (stem of germinating seedling) is angular with ridges 35 cm long	**Hypocotyl** (stem of germinating seedling) is angular with ridges 27 cm long
	
Ceriops tagal	***Ceriops zippeliana (ex C. decandra)***

Species of *Ceriops* are distinguished by shape of petal lobes, relative length and width of the peduncle, shape of the calyx tube, and ribbing on the hypocotyl.

Ceriops tagal

Rib-fruited Yellow Mangrove | Dà vôi

Ceriops tagal is a common and familiar constituent of mangrove forests throughout much of the Indo-Malaysian region. It often grows as broad monotypic stands across gently sloping tidal areas surrounding the wide estuarine deltas of sheltered coastlines. *Ceriops tagal* is distinguished from other *Ceriops* by its long, slender peduncles (stalks of the flower clusters) holding the inflorescences (flower clusters), the distinctly sunken calyx (collective of sepals forming an outer whorl) tube after fruit development, and ribbed slender hypocotyls (the stem of the embryo or young seedling). Further diagnostic characters include: petals enclosing paired stamens at anthesis (the time of flowering during which a flower is fully open and functional) and opening explosively, petal apices with three clavate (i.e club shaped) appendages, stamens with long-slender filaments greater than the anthers. The flower buds of *C. tagal* appear to open mostly in the evening, emitting a faint fragrant odor. At anthesis, the petals are closed, enveloping the stamens in pairs exactly as in *Bruguiera*. Pollination may be by night-flying insects. Pollen release is explosive, triggered by a delicate touch of the petals. The tension that sets this mechanism is generated by the enclosed stamen pair held back by the pouched petal.

Species Feature

Maturing hypocotyl showing ribbing.

Derivation of Species Name

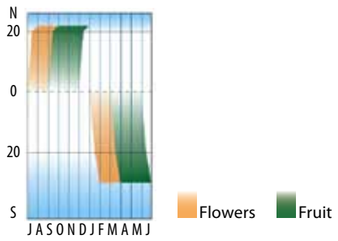
Species named apparently for the Tagal cultural group of the Philippines.

Flowers

Fruits

PHENOLOGY

In Vietnam, flowering peaks from August to September, and propagule maturation occurs from September to January.



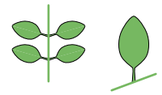
DISTRIBUTION

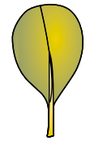
Ceriops tagal is widely distributed from East Africa and Madagascar through India and Asia to New Guinea, Solomon Islands and northern Australia. In Vietnam, the species is found in estuaries along the coast in the south only.

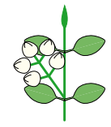
Ceriops tagal

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 25 m, evergreen, dense, columnar or multi-stemmed
Bark	grey-white to orange-brown, smooth with scattered pustular lenticels
Stem	base with stout flanged buttresses
Roots	pneumatophores sometimes developed as looped surface roots, radiating anchor roots are often exposed
FOLIAGE	
Leaves	opposite, simple, glossy yellowish-green, ovate to ovate-elliptic, glabrous, 3.5-11.5 cm L, 1.5-7.5 cm W, margin entire, apex rounded, base cuneate
Petiole	yellowish-green, terete, to 2 cm L
Stipules	paired, flattened, yellowish-green, to 1-3 cm L, apex rounded, enclosing terminal bud
REPRODUCTIVE PARTS	
Inflorescence	axillary, 2-12-flowered, bifurcating, dense; peduncle 1-3 cm L, 0.3 cm W
Flowers	erect, yellowish-green to orangy-red, to 5 mm L; calyx tube shortly turbinate, smooth, with 5(-6) oblong erect lobes longer than tube, 4-5 mm L; petals 5(-6), creamy white becoming brown with age, oblong, 3 mm L, apex emarginate with 3 clavate bristles; stamens 10(-12), 2 enclosed by each petal, 2-5 mm L; style slender, 1-3 mm L
Fruit	inverted pear-shaped drupe, brown, finely coriaceous, 1-3 cm L, 0.5-1 cm W, seated in sunken calyx tube, lobes reflexed; germination viviparous, hypocotyl emergent from distal end of fruit during maturation; maturation indicated by distinct cotyledonary collar prior to abscission
DISPERSAL PROPAGULE	
Hypocotyl	Hypocotyl pencil-like but tapered, slender, yellowish-green, ribbed, to 35 cm L, 0.5 cm W, distil tip bluntly pointed, distal half widest, buoyant
LOCAL DISTRIBUTION	
	High-mid intertidal **downstream-intermediate** estuarine position

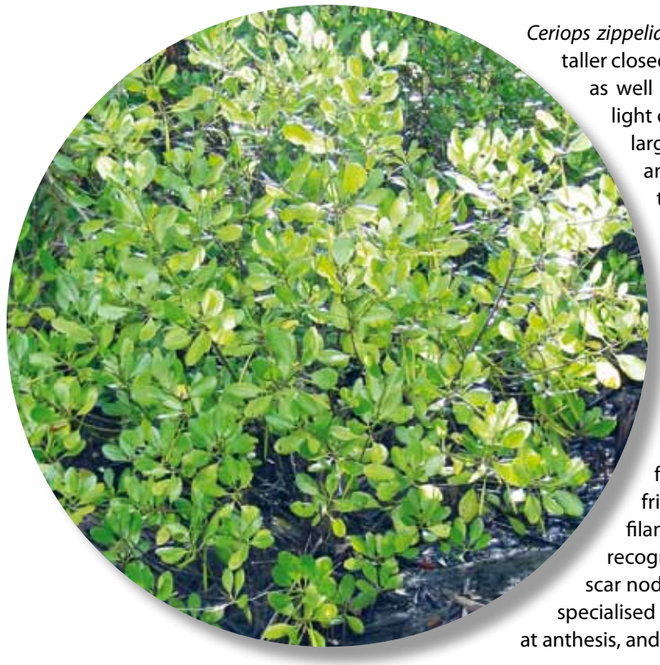






Ceriops zippeliana

Clumped Yellow Mangrove | Dà quánh



Ceriops zippeliana grows in Vietnam as a shrubby small tree under taller closed canopies of *Sonneratia lanceolata* and *Avicennia alba,* as well as other species. This species appears to prefer low light conditions where its foliage is often darker green with larger flat leaves. It is not restricted to this habit however, and the species can also on occasion form canopy trees. Generally, *C. zippeliana* does not form extensive monotypic stands, but prefers mixed forests. This species is readily distinguished from other *Ceriops* by its short, stout peduncles (stalk of the flower cluster) that hold the inflorescences (flower cluster), as well as distinctly swollen calyx (collective of sepals forming an outer whorl) tube after fruit development. Further diagnostic characters include: petals not enclosing stamens at anthesis (the time of flowering during which a flower is fully open and functional); stamens in a single series; petal apices with fringing filamentous appendages; stamens with short filaments less than or equal to the anthers. Stems are also recognised often by their knobbly twigs due to swollen leaf scar nodes. The floral mechanism of *C. zippeliana* appears less specialised than other *Ceriops* since the stamens are not enclosed at anthesis, and there is no explosive release of pollen.

Species Feature
Fruit with swollen calyx and stout pedicles (individual flower stalks).

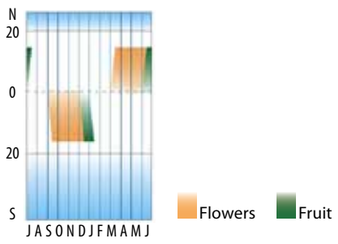
Derivation of Species Name
Named in honour of Zippel.

Flowers

Fruits

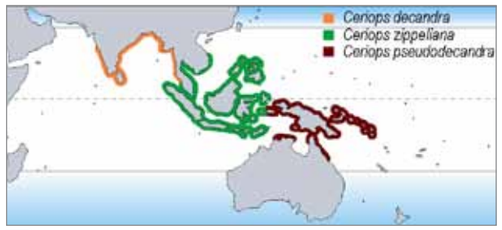
PHENOLOGY

In Vietnam, flowering peaks from March to May, and propagule maturation occurs in June-July.



DISTRIBUTION

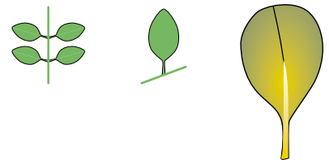
Ceriops zippeliana is distributed within central Asia from Malaysia, Indonesia and the Philippines. A similar species, *C. decandra* is found to the west while another similar species, *C. pseudodecandra*, is found to the south east. In Vietnam, the species is found in coastal areas along the shoreline in the south only.

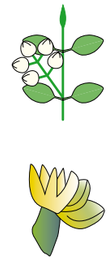


Ceriops zippeliana

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 15 m, multi-stemmed or columnar, often undercanopy, evergreen
Bark	grey-white to orange-brown, smooth with scattered pustular lenticels
Stem	base with stout flanged buttresses
Roots	roots sometimes developed as looped surface roots
FOLIAGE	
Leaves	opposite, simple, flatish, ovate to elliptic-oblong, glossy green, finely coriaceous, 4.5-10 cm L, 2.5-6 cm W, margin entire, apex obtuse-rounded, base cuneate
Petiole	terete, green, to 2 cm L
Stipules	paired, flattened, pale green, to 1-3 cm L, apex rounded, enclosing terminal bud
REPRODUCTIVE PARTS	
Inflorescence	axillary, 3-5-flowered, bifurcating, dense peduncle 0.5-1 cm L, 0.6 cm W
Flowers	erect, yellowish-green to orangy-red, to 5 mm L; calyx tube shortly turbinate, smooth, with 5 oblong erect lobes longer than tube, 3-5 mm L; petals 5, creamy white becoming brown with age, oblong, 3 mm L, fringe-like, divided at apex; stamens 10, uniformly spaced, 1-4 mm L; style slender, 1-2 mm L
Fruit	inverted pear-shaped drupe, brown, finely coriaceous, 1-2 cm L, 0.8 cm W, seated in swollen calyx tube, lobes erect or ascending; germination viviparous, hypocotyl emergent from distal end of fruit during maturation; maturation indicated by distinct cotyledonary collar prior to abscission
DISPERSAL PROPAGULE	
Hypocotyl	pencil-like but tapered, slender, green, ribbed, to 27 cm L, 0.8 cm W, distil tip bluntly pointed, distal half widest, buoyant
LOCAL DISTRIBUTION	
	High-mid intertidal **intermediate** estuarine position





Dolichandrone spathacea

Trumpet Mangrove | Quao nước

Dolichandrone spathacea belongs to the tropical family, Bignoniaceae of trees and lianes. The family usually has opposite, pinnately-compound leaves (where there is a row of leaflets on either side of the extended leaf stem) and characteristically large, conspicuous flowers with a tubular, trumpet-shaped corolla (whorl of petals located above the sepals). Pollination occurs presumably by long-tongued nocturnal animals like hawk moths seeking nectar within the corolla. Extra-floral nectaries are present on the outer surface of corolla lobes before expanding.

DOLICHANDRONE

Trumpet Mangrove

1 species in Kien Giang Province, Vietnam

A number of genera have species that inhabit mangroves including: *Dolichandrone*, an Indo-West Pacific genus of trees; and four other genera from the Atlantic East Pacific the vines *Anemopaegma* and *Phryganocydia*, and the tree/shrubs, *Amphitecna* and *Tabebuia*. *Dolichandrone* consists of around 9 species distributed from tropical East Africa to New Caledonia, but only one, *D. spathacea*, is a mangrove. This species has the widest geographical range of any in the genus. It is a frequent constituent of the high intertidal mangrove, but only in low latitude estuaries influenced by wetter climates. The species often grows in swamp or beach communities such as dune or river bank margins. *Dolichandrone spathacea* has similar long-tubed flowers as *D. serrulata* of India and Sri Lanka, but is distinguished by its entire, not serrate, leaflets.

Derivation of Species Name

'Dolich-androne' means *long male parts* (in Greek) and refers to the relatively long anthers in flowers of this genus. 'Spathacea' means *like a broad, double-edged sword* (in Latin) and refers to the long bean-like fruits of this species.

Species Feature

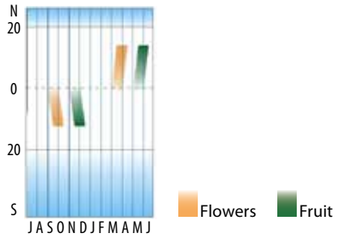
White flower shaped like a trumpet.

Flowers

Fruit

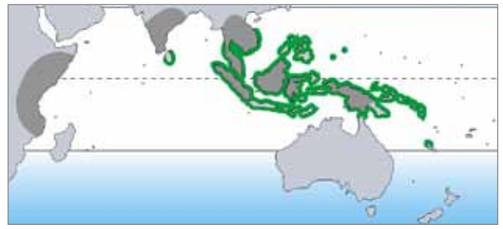
PHENOLOGY

In Vietnam, peak flowering occurs mostly during March-April and fruit maturation during May-June.



DISTRIBUTION

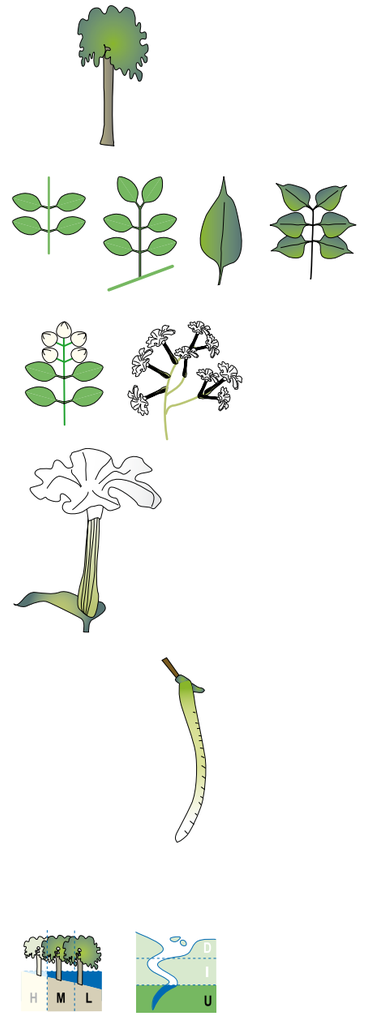
Dolichandrone spathacea is distributed from Sri Lanka and southern India throughout Indonesia, to Micronesia, New Guinea, the Solomon Islands, New Caledonia and northern Australia. In Vietnam, the species is found from north to south.



Dolichandrone spathacea

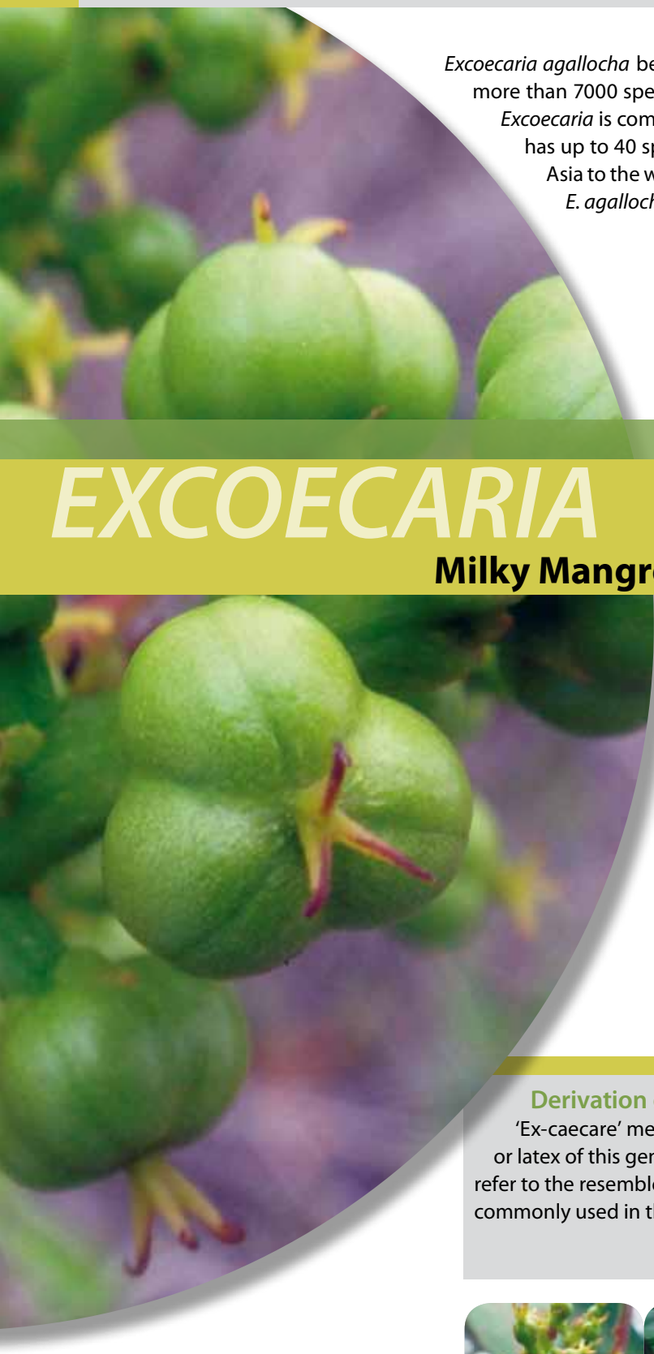
BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	evergreen, to 25 m, architecture not regular, short trunk
Bark	grey to dark brown, fissured in older trees;
Stem	simple
Roots	not often above ground
FOLIAGE	
Leaves	opposite, compound, 20-30 cm L, shiny darker green above than below, younger leaves often reddish, petiole to 6 cm L
Leaflets	2-4 pairs, ovate to lanceolate, 5-17 cm L, 3-7 cm W, narrow gradually to pointed apex, base abruptly, short petiole, margin entire, often glabrous or minutely hairy
REPRODUCTIVE PARTS	
Inflorescence	terminal racemes, 2-6 buds, pervasive scent, nectar at base of corolla tube; pedicel thick, ~2 cm L
Flowers	flowers large, conspicuous, trumpet-shaped, tubular, zygomorphic, corolla maturing white, 15-20 cm L, tube 10 cm L, 7-8 mm W; bracteole inserted at about the midpoint; calyx green, inflated tubular, split adaxially, spathe-like, recurved at anthesis, 6-8 cm L, apex with a blunt mucro, purple glandular patch on the abaxial side; petals abruptly enlarged to 5-fringed lobes, 12 cm W at maturity; stamens 4, with a fifth adaxial stamen as a filiform vestige, fertile stamens inverted in the tube throat, enclosed by corolla lobes; ovary slender, cylindrical, style tapered into filiform, stigma bilobed, peltate, extending beyond stamens
Fruit	bean-like capsule, flattened, pendulous, linear, green to brown, to 70 cm L, dries whitish, 2 valves twist and split to release numerous seeds
DISPERSAL PROPAGULE	
Seeds	oblong-rectangular, flattened, 0.6-1.0 cm L, 1-2 cm W, corky winged, cotyledons bilobed, buoyant
LOCAL DISTRIBUTION	
	Mid-low intertidal **upstream** estuarine position



Excoecaria agallocha

Milky Mangrove | Giá



Excoecaria agallocha belongs to a very large family, the *Euphorbiaceae* consisting of more than 7000 species found commonly in the tropics of the world. One genus, *Excoecaria* is commonly recognised with mangrove representatives. The genus has up to 40 species in the Indo West Pacific region from tropical Africa and Asia to the western Pacific. Two occur in mangroves including, *E. indica* and *E. agallocha*.

EXCOECARIA

Milky Mangrove

1 species in Kien Giang Province, Vietnam

Excoecaria indica is distinguished readily by its thorny trunk, crenulate-lanceolate (i.e. leaf margins are minutely scalloped) leaves, and black, globose-smooth (i.e. almost spherical) capsular fruit to 3 cm in diameter. *Excoecaria agallocha* is conspicuously dioecious having separate male or female trees. Trees are also notable during the dry season when they sometimes shed and replace their leaves turning bright red and orange before they fall. An upland species is found in south-eastern Australia, notably *E. dallachyana*.

Derivation of Species Name

'Ex-caecare' means to *make blind* (in Latin) and refers to the toxic white sap or latex of this genus. 'Agallocha' means *soft resinous wood* (in Greek) and may refer to the resemblence of this species to *Aquilaria malaccensis* (=*A. agallocha*) commonly used in the production of incense in Asia.

Species Feature

Leaves with exuding white sap.

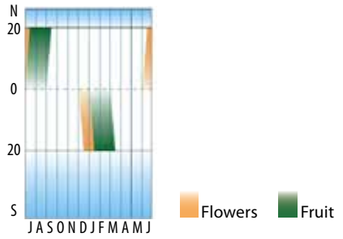
Flowers female

Flowers male

Fruits

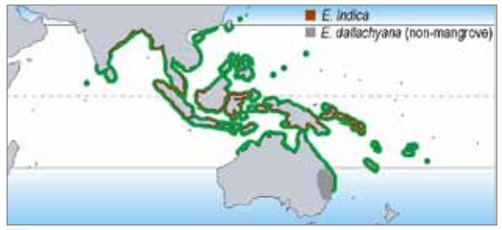
PHENOLOGY

In Vietnam, flowering peaks in June-July, and propagule maturation occurs during July and September.



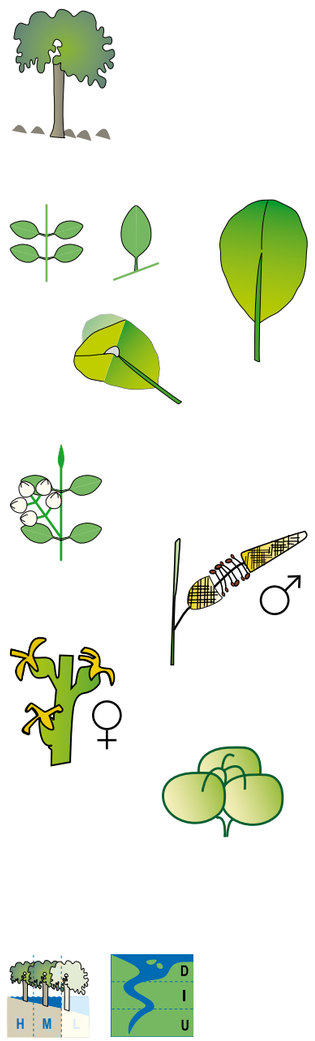
DISTRIBUTION

Excoecaria agallocha is distributed from India and Sri Lanka to Hainan and the Ryu-Kyu Islands, through Indonesia to Australia. In Vietnam, the species is found along the coast from north to south.



BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 15 m, shrubby or columnar, often multi-stemmed, dioecious, sometimes deciduous in dry season
Bark	grey, vertically fissured, pustular with lenticels
Stem	simple to slightly flanged buttresses
Roots	serpentine at surface, knotted, lenticellate
FOLIAGE	
Leaves	opposite, simple, ovate-elliptic to obovate, green above and below, upper surface slightly shiny, 6.5-10.5 cm L, 3.5-6 cm W, margin serrate but variably conspicuous to entire, apex rounded to bluntly acuminate, slightly emarginate, base cuneate, somewhat fleshy with abundant exuding milky-white sap when broken; basal blade glands 2(-4) on each side of petiole insertion
Petiole	terete 0.5-3 cm L, pale yellowish-green; stipules minute
REPRODUCTIVE PARTS	
Inflorescence	axillary, 3-7 cm L, catkins within leaf-bearing part of shoot, differ in male and female trees
Male	inflorescence to 7-11 cm L, series of spirally arranged, often glandular bracts, each subtend a flower; calyx lobes 3, narrow laciniate; stamens 3, yellow, anthers 1 mm L, pistillode absent, filament 2-5 mm L
Female	inflorescence to 3 cm L, pedicel to 5 mm L, bracts glandular, basal bracteoles 2; calyx lobes 3, somewhat cupulate; staminodes absent; ovary tri-locular; styles 3, short, simple, stigma lobes 3 mm L
Fruit	3-lobed capsule, 7-14 mm W, becoming brown and dehiscing to release 3 seeds; pericarp somewhat but not fleshy
DISPERSAL PROPAGULE	
Seeds	spherical, pepper-corn like, black or dark brown, streaked, 3-5 mm W, endosperm absent, buoyant, germination epigeal; cotyledons somewhat cuneiform
LOCAL DISTRIBUTION	
	High-mid intertidal **downstream to upstream** estuarine position



Heritiera littoralis

Kelled-pod Mangrove | Cui biển

Heritiera littoralis belongs to the *Sterculiaceae*, a family of tropical and subtropical trees and shrubs with alternate simple leaves (i.e. not divided into leaflets). The Cocoa Tree is one well-known relative with universal commercial importance. Just one genus is represented in Indo-West Pacific mangroves.

HERITIERA

Kelled-pod Mangrove

1 species in Kien Giang Province, Vietnam

Heritiera consists of 29 species of mostly rainforest trees distributed from Africa to India, Asia and the Pacific. It is distinguished by its leaves being silvery white underneath. In upland species, the pod's keel is winged to facilitate wind-dispersal, but for water-dispersed mangrove species it is much reduced. Three species are considered mangrove inhabitants, although only one is recorded for Vietnam. *Heritiera littoralis* is distinguished from *H. globosa* and *H. fomes* by its smooth, ovoid fruits that are slightly flattened on one side with an extended keel, and leaves with short petioles (leaf stalk) less than 2 cm long. Fruits float with the keel upward, presumably functioning as a sail, and they readily germinate in muddy sediments at the upper interidal zone.

Derivation of Species Name

Genus named in honour of French magistrate and one of the great amateurs of botany, Charles-Louis L'Heritier de Brutelle (1746-1800) – a survivor of the French revolution, and the one who first described *Eucalyptus* from Australia. 'Littoral-is' means *within the littoral zone* (in Latin) and refers to the tidal habit of this species.

Species Feature

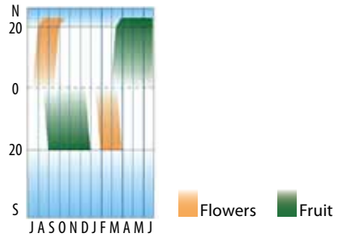
Keeled-pod of maturing fruits.

Flowers

Fruits

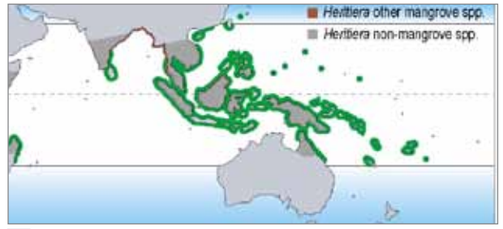
PHENOLOGY

In Vietnam, flowering occurs in July and September and fruits mature mostly during March to June.



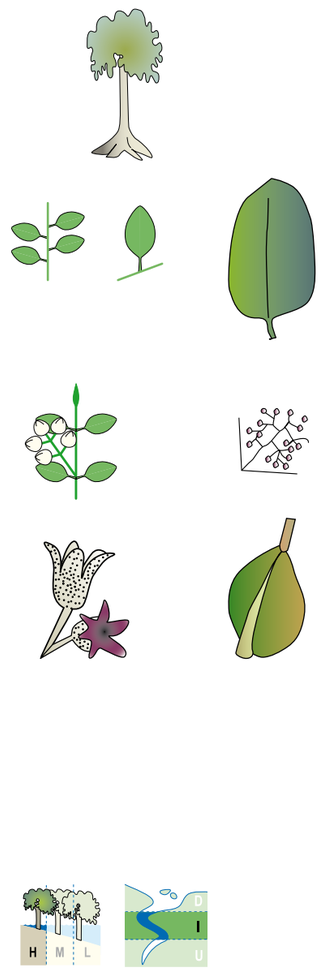
DISTRIBUTION

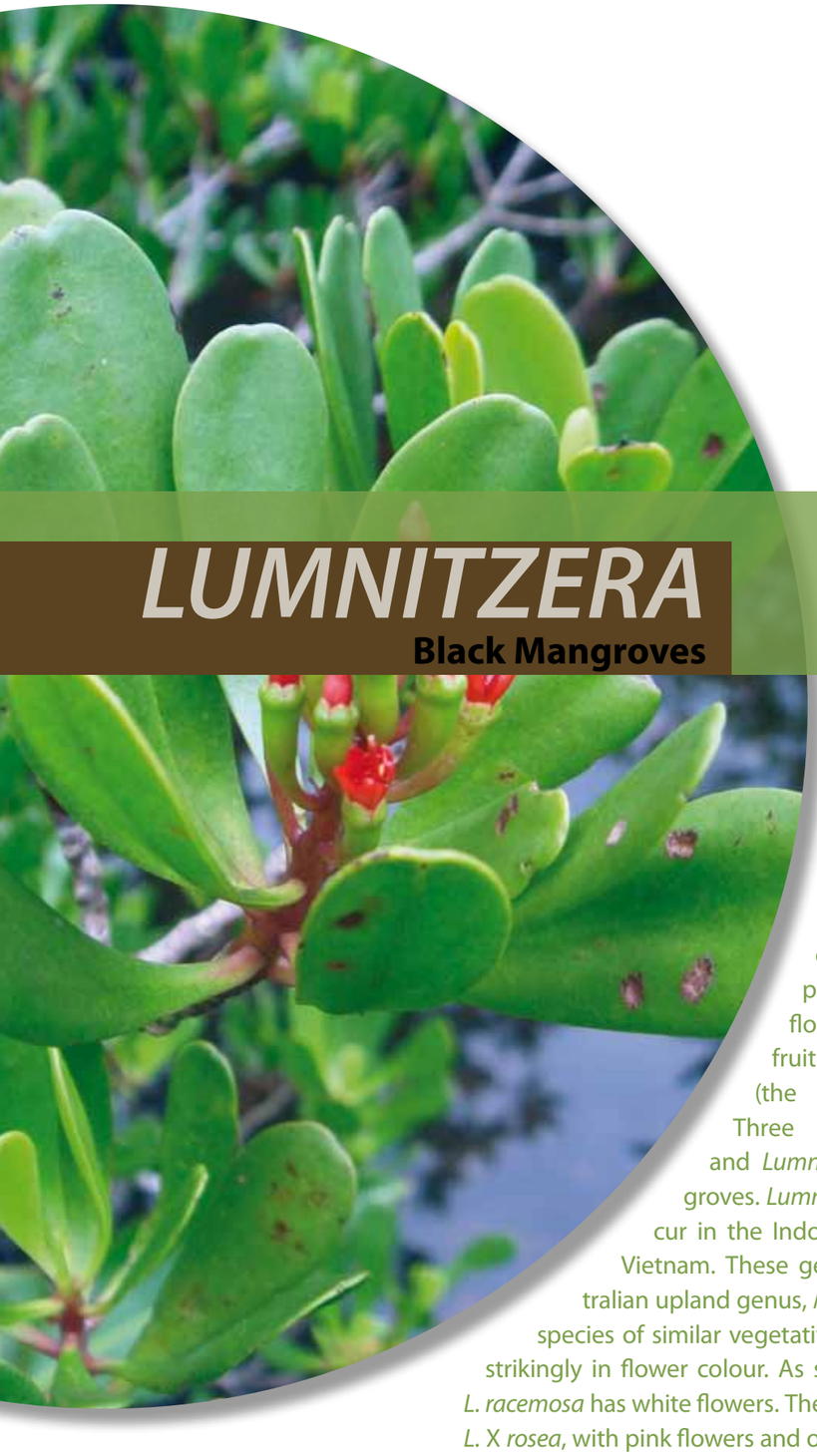
Heritiera littoralis is distributed from East Africa and Madagascar to Asia and the Pacific. In Vietnam, the species is found in estuaries from north to south.



BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 25 m, columnar, monoecious, evergreen, twigs greyish-white with stellate scales
Bark	grey to pale grey, patchy, fissured and flaky
Stem	base with large plank buttresses, spreading and sinuous
Roots	emergent lenticular above ground
FOLIAGE	
Leaves	alternate, simple, broad and floppy, oblong or ovate-elliptic, coriaceous, dark green above, pubescent pale green below, 10-20 cm L, 5-10 cm W, margins entire, apex obtusely pointed, veins prominent below
Petiole	1-2 cm L, bi-pulvinate
Stipules	in pairs at each node, 1 cm L
REPRODUCTIVE PARTS	
Inflorescence	subterminal, complex tomentose panicles, unisexual flowers
Flowers	4-5 mm L, 3-4 mm W, pedicel short, male smaller; calyx cup-shaped, reddish hairy inside, green hairy outside, 4-5(-6) short pointed lobes; petals absent; male flower stamens, 4-5(-6) fused, pistode; female flower staminodes minute, styles 4-5(-6) united, recurved stigmas
Fruit	keeled capsules, pendulous clusters, fall as propagules
DISPERSAL PROPAGULE	
Fruit capsule	1-seeded, shiny yellow-green to brown, slightly flattened ellipsoidal, 6-8 cm L, 5-6 cm W, keel 5 mm high, epicarp woody, fibrous and hard
Seeds	semi- or oblong-ellipsoid, embryo as fused cotyledons, radicle directed ventrally, buoyant with capsule, germination hypogeal
LOCAL DISTRIBUTION	
	High intertidal **intermediate** estuarine position





LUMNITZERA

Black Mangroves

Derivation of Genus Name

Named in honour of the German botanist, Stefani Lumnitzer (1750-1806), who pioneered the systematic description of Central European plants.

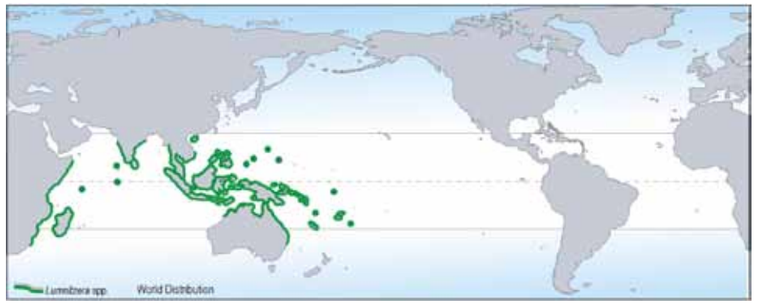
Genus Feature

Flat, spatule-like leaves with emarginate (i.e. notched) tips.

Lumnitzera is a member of the moderately large tropical woody family, the Combretaceae, of some 20 genera and 500 species. The family is characterised by flowers with an inferior, unilocular (having a single cavity or chamber) ovary with usually two pendulous ovules, a well-developed floral disc, and one-seeded, drupe-like fruit (pseudocarp) without endosperm (the food reserve tissue in a seed). Three genera, *Laguncularia*, *Conocarpus* and *Lumnitzera*, are found typically in mangroves. *Lumnitzera* is the only one of these to occur in the Indo-West Pacific mangroves, including Vietnam. These genera are close relatives of an Australian upland genus, *Macropteranthes*. *Lumnitzera* has two species of similar vegetative appearance, although they differ strikingly in flower colour. As such, *L. littorea* has red flowers and *L. racemosa* has white flowers. There is a rare, reportedly sterile hybrid, *L.* X *rosea*, with pink flowers and other intermediate characters.

Distribution

Lumnitzera is an Indo-West Pacific mangrove genus distributed from East Africa to the Western Pacific including Fiji and Tonga and northern Australia. One species, *L. racemosa*, dominates the western part of this range, while *L. littorea* dominates the eastern part. Hybrid occurrences occur within the central zone of overlap between parent species.



2 species in Kien Giang Province, Vietnam

Lumnitzera racemosa
Lumnitzera littorea

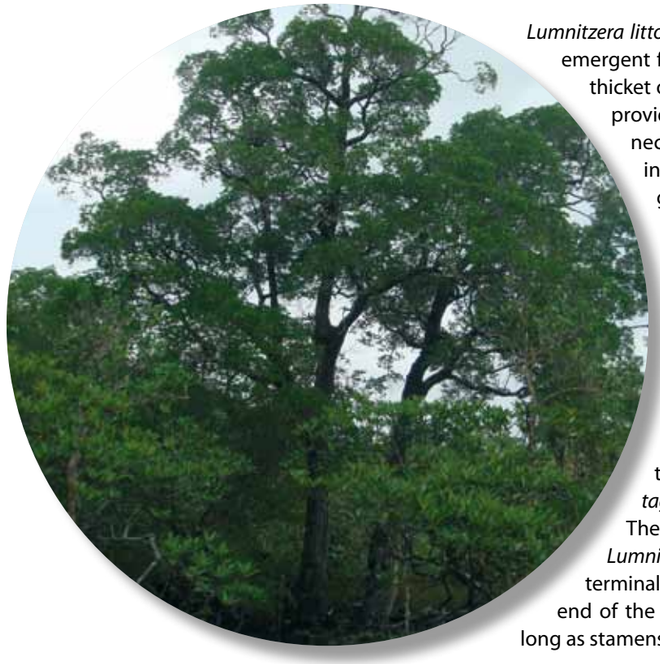
Key to genus *Lumnitzera* found in Kien Giang Province

Inflorescence (flower cluster) axilliary (situated laterally)	**Inflorescence** (flower cluster) terminal (situated at end of stem)
	
Petals white, stamens equal or slightly exceeding petals	**Petals** red, stamens twice as long as petals
	
Shrub or **small tree** to 8 m	**Shrub** or **small tree** to 15 m
	
Lumnitzera racemosa	***Lumnitzera littorea***

Species of *Lumnitzera* are distinguished by petal colour, inflorescence position and position of the style within the flower corolla.

Lumnitzera littorea

Red-flowered Black Mangrove | Cóc đỏ



Lumnitzera littorea occurs either as a spectacular tall columnar tree, emergent from the surrounding forest, or as a gnarled shrubby thicket of twisted stems. In both cases, the showy red flowers provide a colourful display that also attracts aggressive nectar gatherers, like noisy parrots. The snapped-off inflorescences (flower clusters) these birds leave on the ground beneath the tall trees provides a convenient means to sample the foliage and identify the species. Pollinators are usually also birds, but less destructive ones like honeyeaters and sunbirds. The habit differs from *L. racemosa* where the red-flowered species favours intermediate estuarine locations well within the tidal range. These sites may be characterised by relatively lower salinities and more constant moist sediments. *Lumnitzera littorea* rarely occurs as monotypic stands, even when it forms thickets in association with other species like *Ceriops tagal*, *Rhizophora stylosa* and *Bruguiera gymnorhiza*. The two *Lumnitzera* species occasionally grow together. *Lumnitzera littorea* is distinguished from *L. racemosa* by its terminal racemes (unbranched flower clusters situated at the end of the stem) of flowers with short, erect, red petals half as long as stamens, and eccentric style placement.

Species Feature

Flowers with red petals and eccentric-placed style, plus stamens twice as long as petal lobes.

Derivation of Species Name

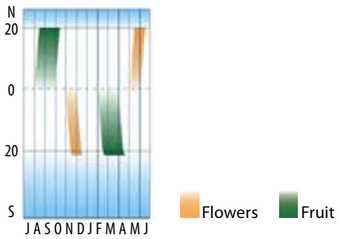
'Littorea' means *belonging to the littoral zone* (in Latin) and refers to the coastal habit of this species.

Flowers

Fruits

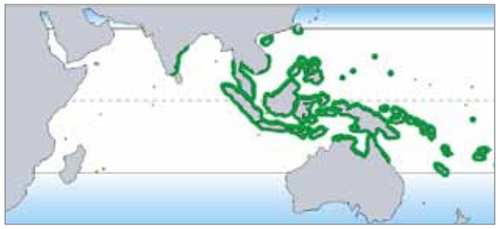
PHENOLOGY

In Vietnam, flowering peaks around May-June and fruits mature during August and October.



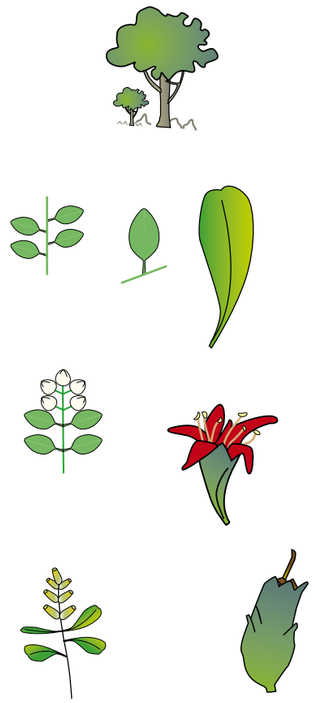
DISTRIBUTION

Lumnitzera littorea occurs from India to China through Asia, and into the south-western Pacific and northern Australia. In Vietnam, the species is distributed along the coastline in the south mostly.



BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 25 m, columnar or multi-stemmed and sprawling, evergreen; twigs smooth, green becoming brown
Bark	dark brown-grey, deeply fissured and flaky
Stem	base simple, short buttresses, if any
Roots	knees, slender, wiry, often looped above-ground, 10 cm L
FOLIAGE	
Leaves	alternate, simple, flat and succulent, narrowly obovate-elliptic, dark green, 4-9 cm L, 1-2.5 cm W, entire, glabrous, apex rounded and emarginate, base narrowly cuneate
Petiole	rounded, 3-5 mm L
Stipules	absent
REPRODUCTIVE PARTS	
Inflorescence	terminal racemes, 5-15 flowered, 2-3 cm L
Flowers	perfect, 16-18 mm L, slightly zygomorphic, shortly pedicellate with a pair of short bracteoles inserted on reddish-green calyx tube, glabrous, 8-15 mm L; calyx lobes 5, ovate, rounded with pointed apex, 1 mm L; petals 5, deep red to bright orangy-red, glabrous, ovate with pointed apex, 3-4 mm L, erect; stamens 10, on inner rim of calyx cup, twice as long as petals; style simple, glabrous, persistent, positioned to one side of deep calyx cup filled with abundant nectar
Fruit	cluster of drupes, fall as propagules
DISPERSAL PROPAGULE	
Fruit drupe	1-seeded, hard, oblong-ellipsoid, flattened, glabrous, green to reddish brown, to 1.5 cm L, 0.5 cm W, style and calyx lobes persistent, epicarp fibrous, buoyant as drupe; seed linear, germination hypogeal
LOCAL DISTRIBUTION	
	Mid intertidal **intermediate** estuarine position



Lumnitzera racemosa

White-flowered Black Mangrove | Cóc vàng (Cóc trắng)

Lumnitzera racemosa often occurs as scattered sparse shrubs along upland mangrove margins of relatively arid areas. In such conditions, they also border relatively open high intertidal margins and exposed saltpans of intermediate estuarine locations. These locations are characterised by higher salinities and near dry sediments. In some places, *L. racemosa* often forms diminuitive forests of slender trees in association with *Avicennia alba*, *Excoecaria agallocha*, *Bruguiera cylindrica* and occasionally *Ceriops zippeliana*. *Lumnitzera racemosa* is identified generally by its light green, relatively sparse foliage, and dark roughly-fissured stems. It is distinguished from its near relative, *L. littorea*, by its axillary racemes (unbranched flower clusters arising from the axil) of flowers with large, reflexed (i.e. bent sharply backwards), white petals nearly as long as stamens, and its centrally-placed style. The white flowers attract faunal visitors with the most likely pollinators being insects, like butterflies and wasps.

Species Feature

White flowers on axillary racemes with centrally placed style, and stamens barely equal to petal lobes.

Derivation of Species Name

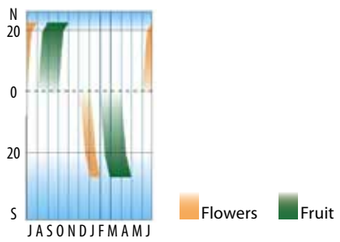
'Racemosa' means *with racemes* (in Latin) and refers to the stalked inflorescence structure of this species.

Flowers

Fruits

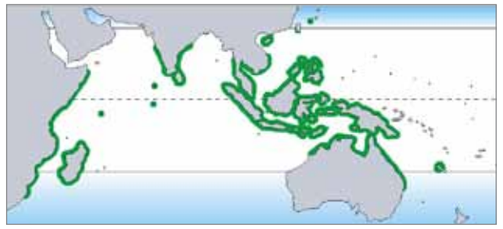
PHENOLOGY

In Vietnam, flowering peaks in June-July and fruits mature during August and October.



DISTRIBUTION

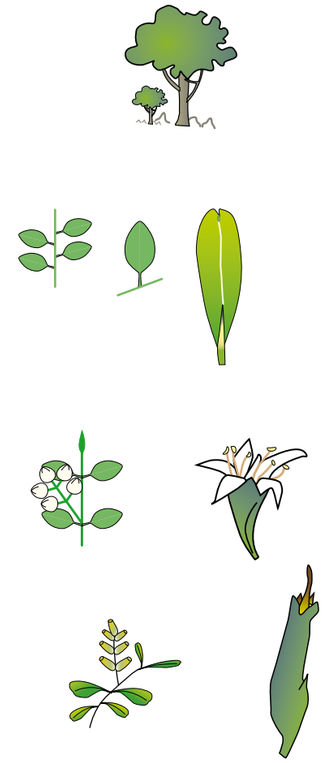
Lumnitzera racemosa is distributed from East Africa to India, Asia and Australia. In Vietnam, the species is found in estuaries and embayments along the coast from north to south.



Lumnitzera racemosa

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree or shrub	to 15 m, columnar or scrubby and multi-stemmed, evergreen; twigs smooth, green becoming brown, young parts often pubescent
Bark	grey, fissured and flaky
Stem	base simple, short buttresses, if any
Root	knees slender, wiry, occasionally looped above-ground, 5 cm L
FOLIAGE	
Leaves	alternate, simple, flat and succulent, narrowly obovate-elliptic, light green, 4-6 cm L, 2 cm W, entire, sericeous when young becoming glabrous, apex rounded and emarginate, base narrowly cuneate
Petiole	rounded, 3-5 mm L
Stipules	absent
REPRODUCTIVE PARTS	
Inflorescence	axillary racemes, 1-7 flowered, 2-3 cm L
Flowers	perfect, 16-18 mm L, actinomorphic, sessile with a pair of short bracteoles inserted on green calyx tube, glabrous or pubescent, 6-8 mm L; calyx lobes 5, ovate, 0.5-1 mm L, pointed apex; petals 5, white, glabrous, narrow elliptic or oblanceolate, reflexed, 3-5 mm L, 1 mm W; stamens 10, on inner rim of calyx cup, equal to petals; style simple, glabrous, 4-6 mm L, persistent, positioned centrally in deep calyx cup filled with nectar
Fruit	cluster of drupes, fall as propagules
DISPERSAL PROPAGULE	
Fruit drupe	1-seeded, hard, oblong-ellipsoid, flattened, green, 1-1.5 cm L, style and calyx lobes persistent, epicarp fibrous, buoyant as drupe; seed linear, germination hypogeal
LOCAL DISTRIBUTION	
	High-mid intertidal **intermediate** estuarine position



Nypa fruticans

Mangrove Palm | Dừa nước

Nypa fruticans belongs to one of the largest monocotyledonous families, the Arecaceae (at times placed in its own family, Nypaceae), consisting of over 200 genera and 2600 species characterised by their usually unbranched woody trunks and large pinnately compound leaves (where there is a row of leaflets on either side of the extended leaf stem) in a terminal crown - collectively called palms. *Nypa* is the only genus with a mangrove representative and it has just one species.

NYPA

Mangrove Palm

1 species in Kien Giang Province, Vietnam

Nypa fruticans is distinguished from other palms by its rhizomatous (i.e. with horizontal stems that lay at or under the soil surface), under-ground growth with dichotomous branching (i.e. with branches forking into two more or less equal parts) that facilitates asexual reproduction. It also has a large, densely-packed, globose fruiting head with numerous fibrous fruits. *Nypa* features prominently in the fossil record where its ancient distributional range extended to France and England, to Brazil and Africa, and to Tasmania in southern Australia. Today, *N. fruticans* is found naturally only in larger river-dominated estuaries of the wet tropical Indo-West Pacific. This much reduced extant range has prompted speculation as to whether it is the result of changing climatic conditions, or possibly the loss of more versatile genotypes. In either case, the circumstances that once favoured the widespread distribution of *Nypa* are clearly no longer present.

Derivation of Species Name

Genus named for the traditional name, 'Nipa', used in the Moluccas and southern Philippines – as recorded in 1743 by Dutch naturalist, Georgius Rumphius in Ambon. 'Fruticans' means *shrubby* (in Latin) and refers to the stemless habit of this species.

Species Feature

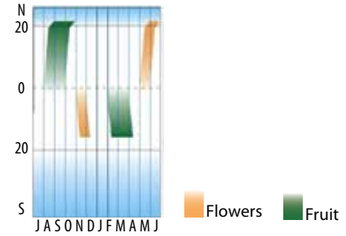
Large spherical fruiting head of 'mini-coconuts'.

Flowers

Fruits

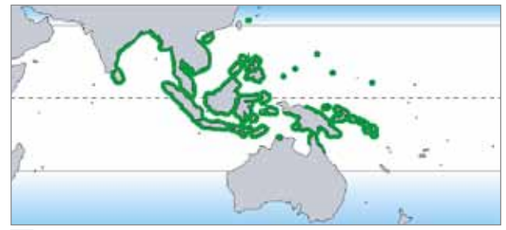
PHENOLOGY

In Vietnam, flowering has been observed in May-June and mature fruits in August and October.



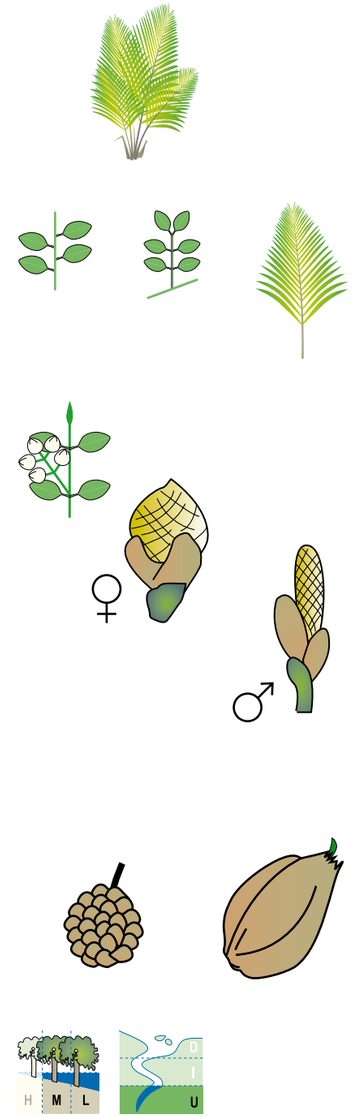
DISTRIBUTION

Nypa fruticans is distributed from Sri Lanka through Asia to Australia and the Western Pacific Islands. In Vietnam, the species occurs from north to south, but mostly in the south.



BOTANICAL DESCRIPTION

GROWTH FORM	
Palm	to 10 m, terminal shoots support erect leaves, trunkless, evergreen
Leaf base	submerged in mud, sometimes exposed by erosion
Roots	rhizomatous, dichotomously branched below ground, leaf scars obliquely raised
FOLIAGE	
Leaves	alternate, paripinnate compound, oblong or ovate-elliptic, erect to recurved, 3-10 m L; leaflets numerous 30-40, chartaceous, lanceolate, rigid with longitudinal ribs and folds, glossy bright green above, 0.7-1.2 m L, apex narrowly pointed, midrib single prominent adaxial
Petiole	terete, smooth, shiny, 1-2 m L, base bulbous enclosing stem
REPRODUCTIVE PARTS	
Inflorescence	axillary, flowers on long sturdy peduncles, main axis and several lateral branches, erect initially, different male and female inflorescences
Female	inflorescence on main axis as globose cluster of congested flowers, hanging down as fruit matures flowers with 6 calyx lobes, 4-5 mm L, stigmas sessile, funnel-shaped
Male	inflorescence on lateral axes as club-shaped spike of densely arranged flowers; flowers with 6 calyx lobes, 4-5 mm L, stamens 3, united as central column
Fruit	aggregate of 40-60 densely packed fertile and sterile carpels, spherical, to 30 cm W; propagules crypto-viviparous
DISPERSAL PROPAGULE	
Fruit carpel	1-seeded drupe, smooth, dark brown, angular, oblong-ellipsoid, distal end bulbous, 7-10 cm L, 5-6 cm W, epicarp woody, mesocarp fibrous, endocarp thick, buoyant as carpel
Seeds	grooved, endosperm usually hollow in centre, embryo small, basal; germination incipiently viviparous, essentially hypogeal, but initiated on fruiting head with plumule protruding as carpel is released
LOCAL DISTRIBUTION	
	Mid-low intertidal **upstream** estuarine position



RHIZOPHORA

Stilt Mangroves

Derivation of Genus Name

'Rhizo-phora' means root bearing (in Greek) and refers to the characteristic stilt roots of this genus.

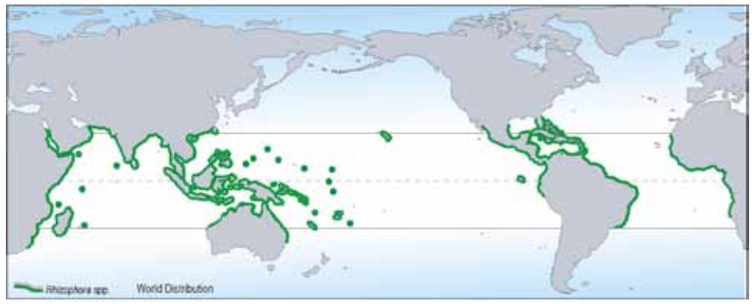
Genus Feature

Bark is smooth, pale yellow-pink, flaking with lenticels (pores in the bark). Foliage is yellow-green in appearance.

Rhizophora is a pantropic genus and key member of the small family Rhizophoraceae, known as 'the mangrove family'. The family consists of 16 genera and around 120 species of trees and shrubs. Four genera are found exclusively in the mangroves and these are conspicuously viviparous (whereby seeds germinate before they detach from the parent plant), including *Bruguiera, Ceriops, Kandelia* and *Rhizophora*. These genera, in particular Rhizophera, dominate mangrove forests around much of the world's tropics. *Rhizophora* are distinguished from the other genera by their stilt roots and flower calyces (the collective of sepals that form an outer whorl) with 4 pointed lobes, 6 - 16 stamens and the separate fruiting body and viviparous propagule. The genus consists of two broad regional groupings of species, including: the Indo-West Pacific 'stilt' mangroves, *R. mucronata, R. stylosa, R. X lamarckii, R. X annamalayana* and *R. apiculata*; and the Atlantic East Pacific 'red' mangroves. *Rhizophora* mangroves have similar shaped leaves but stilt species are readily distinguished from red mangroves by a prominent spiked, mucronate tip (i.e. short, abrupt point) at the leaf apex, instead of a blunt recurved tip (i.e. bent backwards).

Distribution

Rhizophora are widely distributed along tropical and subtropical coastlines from east Africa across to Asia, the Malay Peninsula and the Philippines to the western Pacific Islands and northern Australia. All Indo-West Pacific species of *Rhizophora* are found in Vietnam, that is, except for the hybrid *R. X lamarckii*, present only in Australasia centred around northern Australia and New Guinea.



2 species in Kien Giang Province, Vietnam

Rhizophora apiculata
Rhizophora mucronata

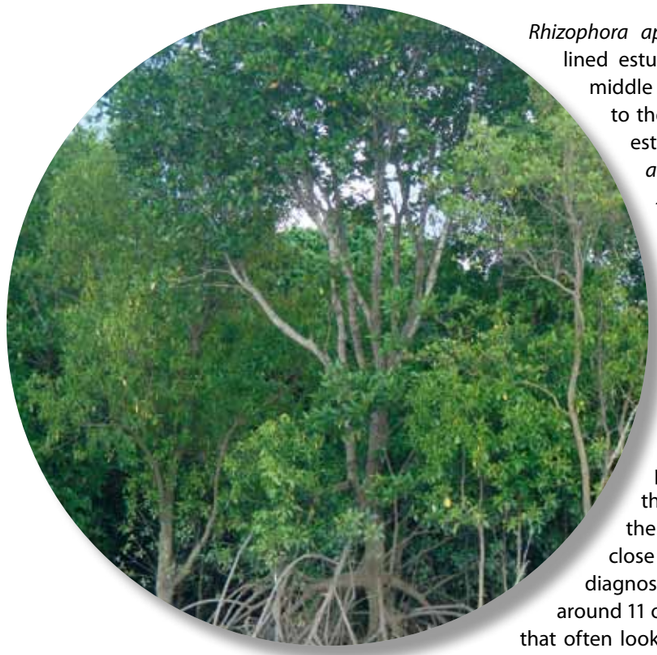
Key to genus *Rhizophora* found in Kien Giang Province

Leaf undersurface without small corky spots	**Leaf undersurface** with small corky spots
	
Peduncle (stalk of flower cluster) length less than **petiole** (leaf stalk) length, stamens 9-15	**Peduncle** (stalk of flower cluster) length greater than **petiole** (leaf stalk) length, stamens 6-8
	
Bracts (reduced leaves close to flower cluster) corky brown, **style** (long stalk supporting the stigma) length 0.5 - 1.3 mm	**Style** (long stalk supporting the stigma) length less than 2.5 mm
	
Rhizophora apiculata	***Rhizophora mucronata***

Species of *Rhizophora* are distinguished by style length, petal hairiness, hypocotyl shape, and relative lengths of peduncles and petioles.

Rhizophora apiculata

Corky Stilt Mangrove | Đước (Đước đôi)



Rhizophora apiculata is a dominant constituent of mangrove-lined estuaries and along the coast. The species is found in middle to upper tidal reaches of many systems extending to the upland fringe in areas of highest rainfall. In middle estuarine reaches, it is often associated with *Avicennia alba* and *Bruguiera gymnorhiza* generally, and including *Xylocarpus* species in some areas. In more upstream locations, it often occurs with *Sonneratia lanceolata*. The most developed stands of *R. apiculata* are predominantly monotypic as observed typically in the middle estuarine reaches with muddy sediments. *Rhizophora apiculata* is distinguished from other *Rhizophora* species by the colour and shape of the plants generally. Specifically, it is readily distinguished by its: large, apiculate (i.e. having a short, sharply pointed tip), glossy dark-green leaves; paired flowers and maturing hypocotyls (the stem of the embryo or young seedling) below leafy crowns; and, the corky-swollen bracteoles (secondary reduced leaves close to the flower cluster) of flowers and fruits. Additional diagnostic characters include: stamen numbers commonly around 11 or 12; style length usually less than 1 mm; and, the bark that often looks a bit like crocodile-skin. In Malaysia, this species is highly valued in forestry production for the manufacture of charcoal fuel and domestic construction timber.

Species Feature

Flower buds with brown corky bracts (reduced leaves close to the flower cluster) underneath.

Derivation of Species Name

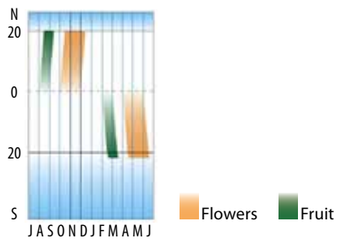
'Apiculata' means *to end abruptly* (in Latin) and refers to the distinctive leaf apices of this species.

Flowers

Fruits

PHENOLOGY

In Vietnam, peak flowering occurs during October to December, and propagule maturation around August and September.



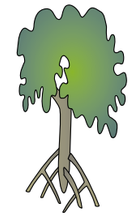
DISTRIBUTION

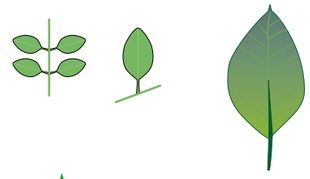
Rhizophora apiculata is distributed from India and Sri Lanka across Asia and well into the western Pacific plus northern Australia. In Vietnam, the species is found in estuaries along the coast in the south only.

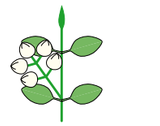
Rhizophora apiculata

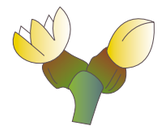
BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 25 m, columnar or sprawling with multiple stems, evergreen
Bark	often crocodile-skin like with smooth blackish angular patches separated by greyish off-white pustular horizontal and vertical fissures, or grey-brown rough
Stem	base diminished below insertion of stilt roots
Roots	sturdy props, arching above ground to 2 m, lenticels scattered across surface, aerial roots extend from limbs
FOLIAGE	
Leaves	opposite, simple, elliptic, glabrous, dark green, glossy above, dull below, 7-19 cm L, 3-9 cm W, margins entire, apex pointed with mucronate spike to 6 mm L, under-surface spots absent
Petiole	sometimes reddish, 1-4 cm L
Stipules	paired, lanceolate, enclose terminal bud, to 7 cm L
REPRODUCTIVE PARTS	
Inflorescence	axillary, 2(-4)-flowered, branching dichotomous, stout, maturing below leafy crown; peduncles 0.3-2 cm L, 0.5 cm W; bracts short, cupular connate; bracteoles corky, bulbous
Flowers	perfect, ellipsoid, pale-yellowish-green, brown fissuring, to 1.5 cm L, 1 cm W; calyx lobes 4, thick, stiff, valvate, apices acute; petals 4, greenish white, glabrous, linear, delicate, 9 mm L, 2 mm W, not enclosing stamen; stamens 9-15; style with bilobed stigma, to 1.3 mm L, mounted on tent-like ovary
Fruit	inverted pear-shape, brown, coriaceous to corky, seated in persistent calyx, 1.8-2.7 cm L, 1.7-2.4 cm W, lobes erect; germination viviparous, hypocotyl emergent from distal end of fruit; cotyledonary collar appears prior to abscission, 1-2 cm L
DISPERSAL PROPAGULE	
Hypocotyl	elongate, terete, dark green, smooth, to 37 cm L, distal half widest, 1.7 cm W, tip bluntly pointed, lenticels raised, plumule 1-2 cm L, buoyant
LOCAL DISTRIBUTION	
	Mid intertidal **intermediate** estuarine position





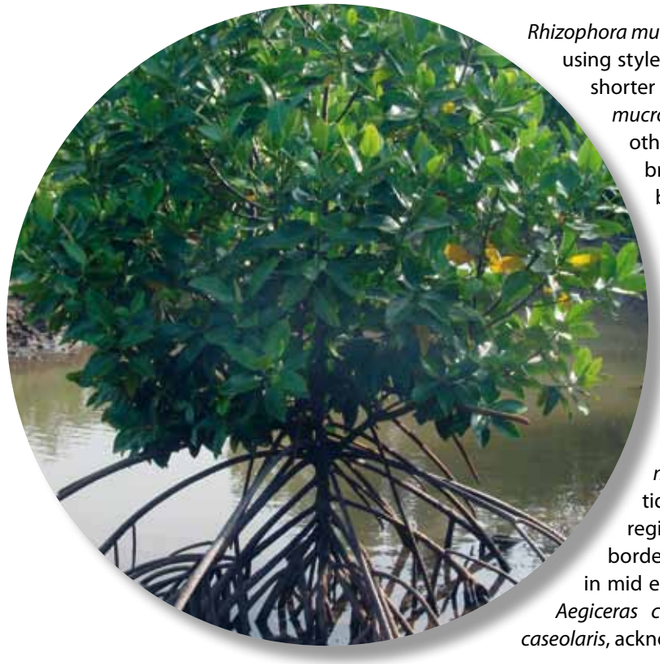




Rhizophora mucronata

Upriver Stilt Mangrove

Đưng (Đước bộp)



Rhizophora mucronata is readily distinguished from other *Rhizophora* using style length and other attributes. The style is consistently shorter with *R. mucronata* than for *R. stylosa*. *Rhizophora mucronata* is distinguished further from *R. stylosa* and other Indo-West Pacific *Rhizophora* by its: minute bracts (reduced leaves close to the flower cluster) and bracteoles (secondary reduced leaves close to the flower cluster) instead of distinct ones; 1-2 flowered inflorescences (flower clusters) instead of 4-16 flowered ones; irregular obovoid closed flower buds instead of regular ovoid-elliptic ones; and generally much longer propagules reaching 80 cm in length instead of 65 cm. *Rhizophora mucronata* and *R. stylosa* are arguably varieties of the same species. If this were the case, the scientific name for this mangrove would be *R. mucronata* var. *mucronata*. *Rhizophora mucronata* is characterised by its occurrence in upper tidal reaches of river-dominated estuaries in wet tropical regions of many areas. It is common in frontal stands bordering estuarine channels associated with *R. apiculata* in mid estuary locations, while upstream it is associated with *Aegiceras corniculatum*, *Sonneratia lanceolata* and *Sonneratia caseolaris*, acknowledged upriver specialists.

Species Feature

Flower bud open showing the short style.

Derivation of Species Name

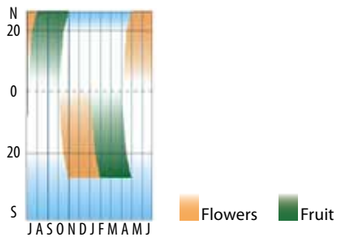
'Mucronata' means *with a short, sharp point* (in Latin) and refers to the pointed tip at leaf apices of this species.

Flowers

Fruit

PHENOLOGY

In Vietnam, flowering observed during April to July, and propagule maturation during July to October.



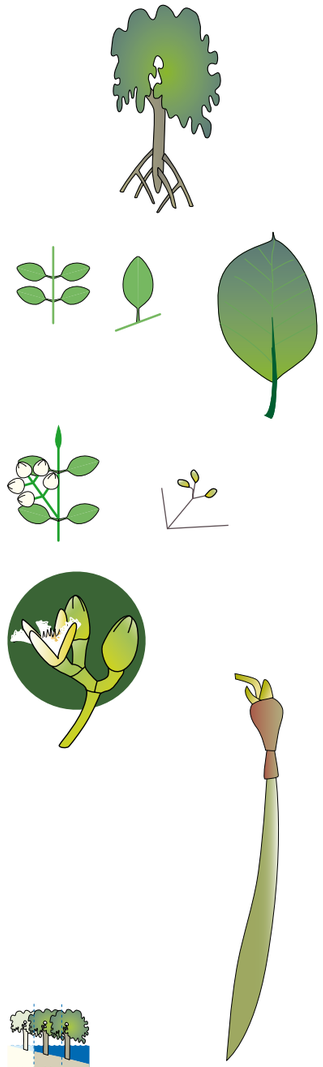
DISTRIBUTION

Rhizophora mucronata is distributed from East Africa and India through Asia and Indonesia, to the western Pacific and northern Australia. In Vietnam, the species is found in estuaries in the south only.

Rhizophora mucronata

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 15 m, columnar mostly, evergreen
Bark	grey to dark grey, to heavily fissured, rough
Stem	base diminished below insertion of stilt roots
Roots	sturdy props, arch above ground to 2 m, lenticels scattered across surface, aerial roots extend from upper limbs
FOLIAGE	
Leaves	opposite, simple, obovate-elliptic, floppy, glabrous, bright green, waxy above, dull below, 10-17 cm L, 5-11 cm W, margins entire revolute, apex pointed with mucronate spike to 6 mm L, under-surface evenly covered in small reddish-brown spots
Petiole	green, 2-5 cm L
Stipules	paired, lanceolate, enclose terminal bud, to 9 cm L
REPRODUCTIVE PARTS	
Inflorescence	axillary, 1-2(-4)-flowered, branching dichotomous, slender, maturing within leafy crown; peduncle 1.2-7 cm L, 0.3 cm W; bracts minute cupular connate; bracteoles minute
Flowers	perfect, irregularly obovate wider toward base, pale yellowish-green, to 2 cm L, 1.1 cm W; calyx lobes 4, thin, flexible, valvate with broadly acute apices; petals 4, ephemeral, creamy white, very woolly, lanceolate, involute enclosing stamen, 9-10 mm L, 3 mm W; stamens (7-)8; style terete, with bilobed stigma, 0.6-2.3 mm L, mounted on a highly conical ovary
Fruit	inverted pear-shape, brown-olive, coriaceous, seated in persistent calyx, 3.4-6 cm L, 1.9-3.7 cm W, lobes rounded reflexed; germination viviparous, hypocotyl emergent from distal end of fruit; cotyledonary collar appears prior to abscission, 1-2 cm L
DISPERSAL PROPAGULE	
Hypocotyl	elongate, terete, green, smooth, to 80 cm L, distal half widest, 1.7 cm W, tip pointed, lenticels raised, plumule 1-2 cm L, buoyant
LOCAL DISTRIBUTION	
	Mid-low intertidal **intermediate-upstream** estuarine position



Scyphiphora hydrophylacea

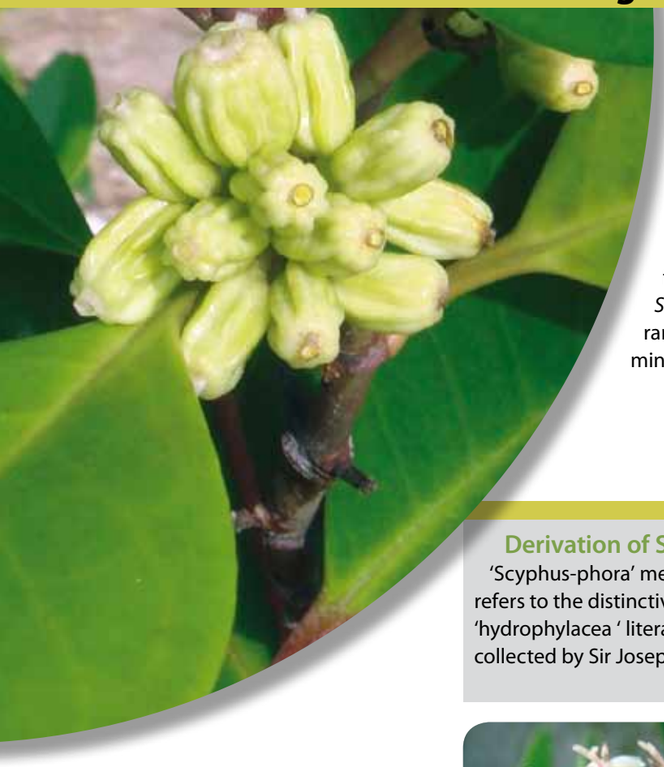
Yamstick Mangrove | Cui biển

Scyphiphora hydrophylacea belongs to a large cosmopolitan family, the *Rubiaceae*, consisting of about 500 genera with over 6000 species of mainly tropical woody plants. Coffee trees are familiar relatives. The family is recognised for its interpetiolar stipules with glandular structures that often persist on mature stems and protect the terminal buds. *Scyphiphora* is a monotypic genus with the only mangrove representative.

SCYPHIPHORA

Yamstick Mangrove

1 species in Kien Giang Province, Vietnam



Scyphiphora hydrophylacea is distinguished by its rounded glossy leaves, fringed stipules (paired leaf-like structures at the base of the leaf stalk), small white flowers, and 8-ribbed drupe-like fruits. Terminal nodes and shoots are also distinctively covered by a resinous substance. *Scyphiphora hydrophylacea* often occurs along the high intertidal zone of mid estuarine reaches where it occurs as isolated shrubs scattered amongst other species, like *Ceriops australis* and *Lumnitzera racemosa*. Occasionally it forms dense but patchy thickets. For the most part, however, *S. hydrophylacea* is uncommon. So, coupled with its low stature rarely exceeding 2 m in height, the species is often considered a minor constituent of the mangrove habitat.

Derivation of Species Name

'Scyphus-phora' means *ancient two-handled cup bearing* (in Greek) and refers to the distinctive two armed-style of this genus. The species epithet 'hydrophylacea ' literally means *resembling Hydrophylax* (in Latin) a plant collected by Sir Joseph Banks. Sometimes erroneously spelt with 'll'.

Species Feature

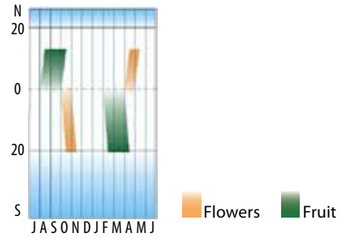
Small fruit are pale-green, cylindrical and ribbed.

Flowers

Fruit

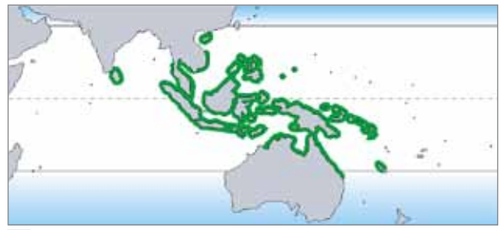
PHENOLOGY

In Vietnam, flowering peaks around April-May and fruit maturation occurs during August and October.



DISTRIBUTION

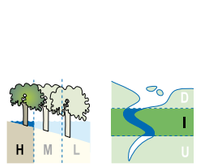
Scyphiphora hydrophylacea is distributed from India through Asia and China, to the Western Pacific and northern Australia. In Vietnam, the species is found sparingly in locations from north to south.



Scyphiphora hydrophylacea

BOTANICAL DESCRIPTION

GROWTH FORM	
Shrub	to 2 m, multi-stemmed, evergreen, twigs green tending brown
Bark	pale brown
Stem	base simple
Roots	not often above ground
FOLIAGE	
Leaves	opposite, simple, decussate, pale-green, fleshy, glabrous, glossy-coriaceous, oblong-ovate, 4-9 cm L, 2-5 cm W, margin entire, apex rounded to slightly emarginate, base acute-cuneate
Petiole	pale-green, 1-2 cm L
Stipules	rounded, short 1-2 mm, minutely hairy on margin, united into ciliate sheath
REPRODUCTIVE PARTS	
Inflorescence	axillary in terminal leaves, 3-7(-13)-flowered, condensed cymes; bracteoles obscure; peduncle 2-15 mm L; flowers sessile or obscurely pedicellate
Flowers	perfect, tetramerous; calyx tube glabrous, 3-5 mm L, free portion scarsely 2 mm L, entire with 4(-5) obscure teeth; corolla tube 3-4 mm L, with 4(-5) white or slightly pink petal lobes bluntly pointed, reflexed at anthesis; throat of corolla tube occluded with dense hairs; stamens 4(-5) inserted on the mouth of the corolla tube, filament short 1 mm, anthers 2 mm L; style slender with a club-shaped bilobed stigma
Fruit	4-seeded drupe, pale-green, falls as propagule
DISPERSAL PROPAGULE	
Fruit drupe	pale-green becoming brown, glabrous, shortly cylindrical with 8(-10) longitudinal ridges, 0.6-1 cm L, crowned with persistent calyx, outer layer fleshy, inner corky, buoyant with calyx
Seeds	4 or fewer, smooth, glabrous, embryo straight, endosperm present, testa thin; germination hypogeal
LOCAL DISTRIBUTION	
	High intertidal **intermediate** estuarine position



SONNERATIA

Apple Mangroves

Derivation of Genus Name

Named for the French naturalist, Pierre Sonnerat (1748-1814) remembered for his explorations of New Guinea, Moluccas and China, including the first European description of lychee fruit.

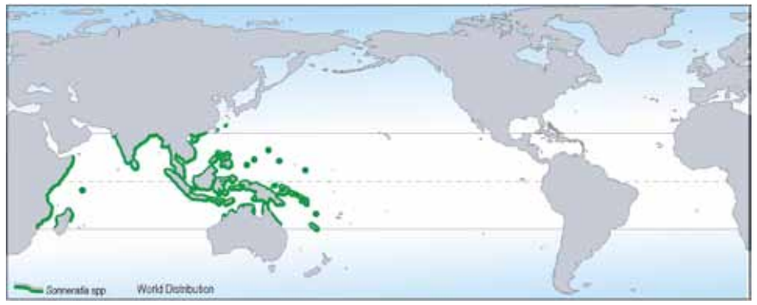
Genus Feature

Mature fruits have a persistent star-shaped calyx (collective of sepals forming an outer whorl).

The genus *Sonneratia* belongs to the Sonneratiaceae, a small tropical family of the order Myrtales with just two genera restricted to the Indo-West Pacific region. *Sonneratia* consist entirely of mangrove trees, while the other genus *Duabanga* is made up of small evergreen rainforest shrubs from Indo-Malaya. *Sonneratia* are notable for their large showy flowers with numerous red or white stamens and their berry-shaped fruit seated on a persistent calyx with 6-8 erect pointed lobes. Fruits enclose a firm pulp imbedded with numerous small seeds that commonly germinate on exposed mud banks. *Sonneratia* grow mostly along banks of tidal rivers, creeks and within sheltered bays of offshore islands and reef cays. In estuaries, they occupy distinct upriver ranges where: sibling species, *S. caseolaris* and *S. lanceolata*, occur in upstream reaches of river-dominated estuaries; *S. alba* occurs in downstream stands and offshore island embayments; and *S. X gulngai* and *S. X urama*, hybrids occur in small intermediate stands between the respective parents. Another species, *S. ovata*, prefers a different habit, occurring at the high tide margin.

Distribution

Sonneratia occur throughout the Indo-West Pacific region from East Africa to China, through Asia and Indonesia, to New Guinea, the western Pacific and northern Australia. In Vietnam, there are three species and two hybrids.



3 species in Kien Giang Province, Vietnam

Sonneratia alba
Sonneratia lanceolata (= S. caseolaris)
Sonneratia ovata

Key to genus *Sonneratia* found in Kien Giang Province

Petals white, sometimes tinged green or pink at base linear to spatulate (i.e spatula-shaped), sometimes absent	**Petals** red, linear	**Petals** absent
		
Calyx tube often ribbed beneath lobe fusion points, surface shiny smooth	**Calyx** (collective of sepals forming an outer whorl) lobes flat, expanded; surface dull smooth	**Calyx** lobes reflexed, adpressed (i.e. pressed closely together), surface warty
		
Leaves rounded	**Leaves** narrowly elliptic to lanceolate leaf apex mucronate (i.e tipped with a short, abrupt point)	**Leaves** rounded to truncate (i.e. squared off at the tip) to subcordate (i.e. nearly heartshape)
		
Sonneratia alba	***Sonneratia lanceolata***	***Sonneratia ovata***

Species of *Sonneratia* are distinguished by colour of petals and stamens, calyx surface, shape of the calyx on mature fruit, plus the shape of leaves and leaf apices.

Sonneratia alba

White-flowered Apple Mangrove | Bần trắng (Bần đắng)

Sonneratia alba is another widely distributed mangrove species. The trees are found mostly at lower tidal contours within frontal stands of downstream lower estuarine reaches and offshore island enclaves in regions of high to moderate rainfall where tidal ranges exceed one metre. The species is commonly associated with *Rhizophora stylosa*, *Aegiceras corniculatum*, *Avicennia marina* and *Avicennia alba* that together grow in a range of sediment types from sand, gravel or soft river muds. *Sonneratia alba* is distinguished from other *Sonneratia* by: its white stamens rarely tinged pink at the base; petals that are variably present and often intermediate in shape with stamens; rounded dull leaves being pale grey-green with rounded apices; sickle-shaped seeds; and, a cup-shaped calyx (collective of sepals forming an outer whorl) beneath the mature fruit, being an erect-sided globose (i.e. almost spherical) berry with a dull surface. The occurrence of intermediate or apetalous (i.e. without petals) forms appear related to marginal habitats and certain ecological factors. For instance, in cool latitudes apetalous and semi-petalous forms appear more common. In equatorial areas, by contrast, fully-petalled forms are common in riverine estuaries while less-petalled forms occur more frequently offshore on smaller rocky islands and coral cays.

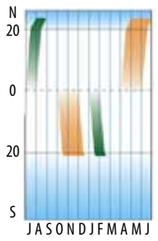
Species Feature

Showy and numerous white stamens with sometimes diminutive to absent white petals.

Derivation of Species Name

'Alba' means *white* (in Latin) and refers to the distinctive white stamens and petals of this species.

PHENOLOGY



In Vietnam, flowering is common in April and June, and fruiting occurs mainly around August to September.

Flowers

Fruit

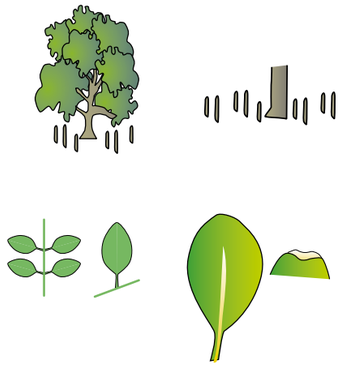
DISTRIBUTION

Sonneratia alba is the most widespread of all *Sonneratia* species, distributed from East Africa to India and southern China, through Asia and Indonesia to the western islands of the Pacific Ocean including New Caledonia, Solomon Islands and northern Australia. In Vietnam, the species is found along the coast in the south mostly.

Sonneratia alba

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 20 m, broadly spreading to columnar, much branched, evergreen
Bark	smooth or lightly fissured flaky, dark grey to pale fleshy green
Stem	base simple
Roots	pneumatophores cone-shaped, to 30 cm L, tip bluntly pointed, branched or twisted occasionally, base stout
FOLIAGE	
Leaves	opposite, simple, leathery, glabrous, obovate-ovate to broadly elliptic, pale green, dull upper, satiny below, 5-12 cm L, 2.5-9 cm W, margin entire, apex obtuse with small thickened mucro recurved under
Petiole	0.6-1.5 cm L, pale green to tinged red, terete
Stipules	absent
REPRODUCTIVE PARTS	
Inflorescence	terminal or axillary, 1-3(-5)-flowered dichasia
Flowers	closed bud ellipsoidal, constricted medially, green, glossy, smooth, slightly angular, 2-3.3 cm L, 1.2-2.2 cm W, apex acute to obtuse; calyx lobes 6-7(-8), valvate, ovate-oblong, 1.3-2 cm L, 0.5-1 cm W, apex acute, inner often reddish; petals 0-6-7(-8), white, occasionally tinged green or red at base, linear or spathulate to stamen-like, membranous if linear, 1.3-3 cm L, 1-2 mm W, sometimes absent; stamens numerous along corolla rim, white, 1.5-4.5 cm L; ovary 12-20 locular; style terete, green, coiled in bud, extended at anthesis to 4.3 cm L, stigma fungiform to 3 mm W
Fruit	berry erect-globose, to 2.7 cm L, 2.2-4.6 cm W, persistent withered style; pericarp green, glabrous, dull; calyx persistent, tube broadly cupulate, base rounded, green, shiny, 2.5-4.1 cm W, lobes 6-7(-8) spreading pointed, 1.7-2.6 cm L; seeds numerous within fleshy pulp of placenta
DISPERSAL PROPAGULE	
Seeds	irregular, sickle-shaped, falcate, to 12 mm L, buoyant; germination epigeal
LOCAL DISTRIBUTION	
	Low intertidal **downstream** estuarine position



Sonneratia lanceolata

Lanceolate-leafed Apple Mangrove | Bần chua (Bần se)

Sonneratia lanceolata occurs at lower tidal contours in 'willowy' frontal stands or as isolated trees in upstream estuarine positions in rivers subjected to relatively high levels of freshwater runoff. Species associated with *S. lanceolata* include: *Avicennia alba*, *Nypa fruticans* and *Bruguiera sexangula*. A common substrate type is the fine soft silt found on accreting inside banks of river meanders. *Sonneratia lanceolata* is distinguished from other *Sonneratia* by: its white staminal filaments; petals that are always narrowly ribbon-like and red; pale green mostly lanceolate leaves with pointed apices; numerous small irregular seeds; and, a flat calyx (collective of sepals forming an outer whorl) tube beneath the mature fruit being a rounded globose berry with a finely leathery surface. This species is similar to *S. caseolaris* especially where each is usually found in upriver locations of larger riverine tropical estuaries influenced by high to moderate rainfalls.

Species Feature

Leaves are distinctively lanceolate in shape.

Derivation of Species Name

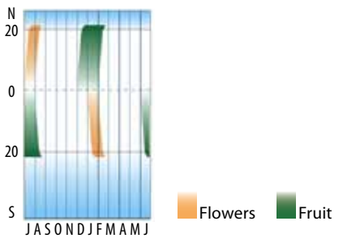
'Lanceolata' means *narrow* (in Latin) and refers to the distinctive linear to lanceolate leaves of this species.

Flowers

Fruit

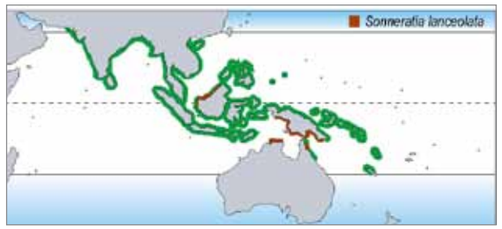
PHENOLOGY

In Vietnam, flowering peaks through July to August, and propagule maturation occurs in December to February.



DISTRIBUTION

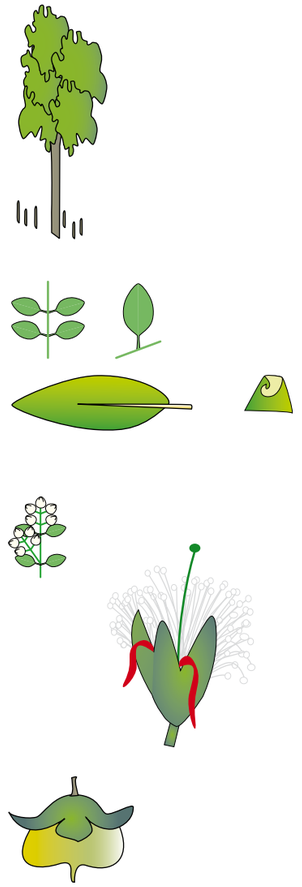
Sonneratia lanceolata (= *S. caseolaris*) is found in Australia, Indonesia, New Guinea and Vietnam. There is considerable uncertainty and confusion because of the morphological similarities with *S. caseolaris*. In Vietnam, *S. lanceolata* occurs in locations from north to south.



Sonneratia caseolaris

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 20 m, spreading or columnar, often willowy foliage, evergreen
Stem	base simple
Bark	smooth or lightly fissured and flaky, grey to pale fleshy green
Roots	pneumatophores cone-shaped, slender, to around 20 cm L, narrowly pointed, branched
FOLIAGE	
Leaves	opposite, simple, leathery, glabrous, elliptic to lanceolate, pale green, dull upper and below, 6.1-12.4 cm L, 1.2-3.8 cm W, margin entire, apex acute with small thickened mucro recurved under
Petiole	2-7 mm L, green, flattened
Stipules	absent
REPRODUCTIVE PARTS	
Inflorescence	terminal or axillary, 1(-2)-flowered
Flowers	closed bud ovoidal, no medial constriction, slightly coriaceous, green, rounded, 2-2.6 cm L, 1.2-1.8 cm W, apex acute to obtuse; calyx lobes 5-7, valvate, ovate-oblong, 1.3-1.4 cm L, apex acute, inner rarely red-streaked; petals 5-7, rarely doubled, red, narrowly linear, membranous, 1.2-3.8 cm L, 2-4 mm W; stamens numerous along corolla rim, white, 4.5 cm L; ovary 12-17 locular; style terete, green, coiled in bud, extended at anthesis to 5.6 cm L, stigma fungiform to 3 mm W
Fruit	berry broadly globose, to 1.8 cm L, 2.5-3.8 cm W, persistent withered style; pericarp green, glabrous, glossy, coriaceous; calyx persistent, tube tending flat-expanded, green, glabrous, 2.4-3 cm W, lobes 5-7 spreading pointed, 1.4-1.9 cm L; seeds numerous in fleshy pulp of placenta.
DISPERSAL PROPAGULE	
Seeds	irregular, angular, to 7 mm L, buoyant; germination epigeal
LOCAL DISTRIBUTION	
	Low intertidal **upstream** estuarine position



Sonneratia ovata

Round-leafed Apple Mangrove

Bần ổi

Sonneratia ovata occurs on the landward margins of mangrove swamps in brackish water and muddy soil. It is a columnar tree that can be locally abundant, but uncommon as a species. It is found as individual trees scattered among other mangroves, such as *Excoecaria agallocha* and does not form pure stands. *Sonneratia ovata* is distinguished from other *Sonneratia* by: its leaf shape, which is broad and absent of a mucronate (i.e. tip) apex; absence of petals; and, the presence of a fine verruculose (i.e. warty) texture on the fruit calyx surface.

Species Feature

Large glossy ovate leaves and stipuled surface of bud calyces (collective of sepals forming an outer whorl) .

Derivation of Species Name

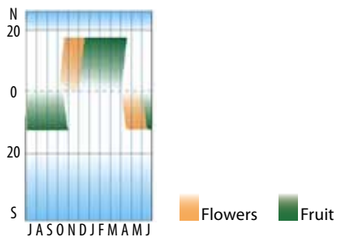
'Ovata' means *rounded* (in Latin) and refers to the distinctive ovate shaped leaves of this species.

Flowers

Fruit

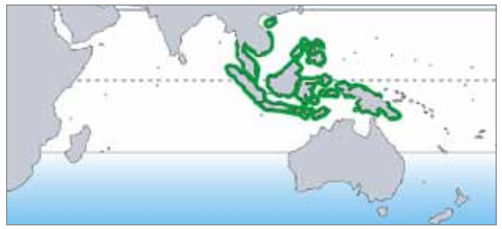
PHENOLOGY

In Vietnam, flowering is common in October and December, and fruiting occurs mainly around December-April.



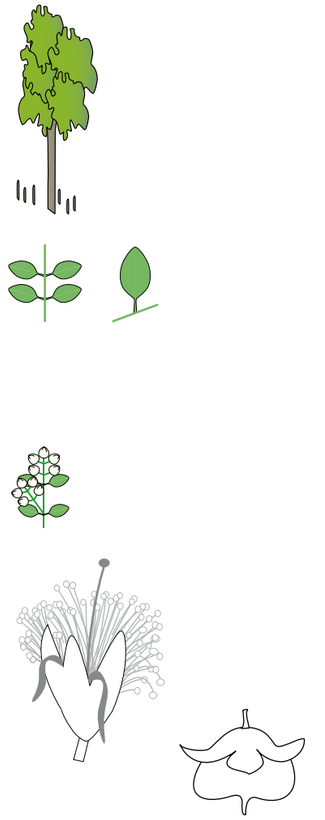
DISTRIBUTION

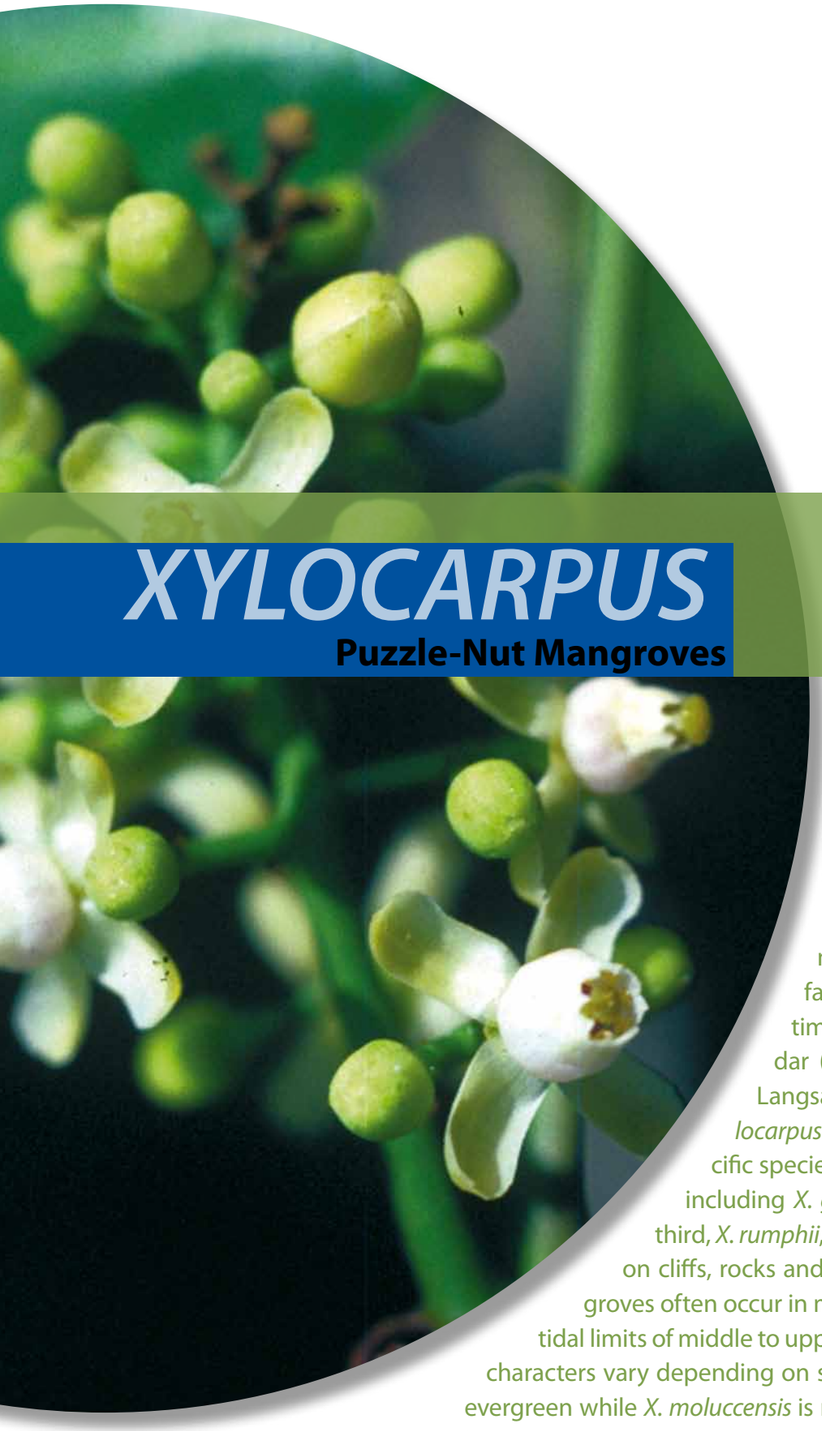
Sonneratia ovata is found from Malaysia, Indonesia to New Guinea, and into Torres Strait. In Vietnam, the species is found along the coast in the south only.



BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 20 m, broadly spreading, much branched, evergreen
Bark	smooth or lightly fissured flaky, dark grey
Stem	base simple
Roots	pneumatophores cone-shaped, to 30 cm L, tip bluntly pointed, branched occasionally, base stout
FOLIAGE	
Leaves	opposite, simple, leathery, glabrous, mostly ovate, dark green, glossy upper, satiny below, 4.3-5.6 cm L, 3.6 - 4.7 cm W, margin entire, apex obtuse with small thickened mucro recurved under
Petiole	0.5-0.6 cm L, green, terete
Stipules	absent
REPRODUCTIVE PARTS	
Inflorescence	terminal or axillary, 1-3(-5)-flowered dichasia
Flowers	closed bud ellipsoidal, constricted medially, green, glossy, stipuled, rounded, 1.3 - 1.7 cm L, apex blunt; calyx lobes 6, valvate, ovate, 1.4 - 1.5 cm L, apex obtuse, inner green; petals absent; stamens numerous along corolla rim, white, 1.9 cm L; ovary 10 locular; style terete, green, coiled in bud, extended at anthesis to 2.6 cm L, stigma fungiform to 0.2 mm W
Fruit	berry globose, to 2-2.1 cm L, 4.2-5.3 cm W, persistent withered style; pericarp green, glabrous, dull; calyx persistent, tube flat expanded, green, stipuled, 2.6-2.7 cm W, lobes 6 spreading obtuse, 1.8-2.0 cm L; seeds numerous within fleshy pulp of placenta
DISPERSAL PROPAGULE	
Seeds	irregular, to 5 mm L, buoyant; germination epigeal
LOCAL DISTRIBUTION	
	High intertidal **intermediate** to downstream estuarine position





XYLOCARPUS

Puzzle-Nut Mangroves

The genus *Xylocarpus* belongs to a large tropical family, the Meliaceae – the mahogany trees. These consist of 50 genera and over 1000 species - recognised by their unisexual flowers with stamens united by expanded filaments to form a staminal tube. The family is known for its high-quality timber species like Australian Red Cedar (*Toona australis*) and fruit trees like Langsat (*Lansium domesticum Correa*). *Xylocarpus* is comprised of three Indo West Pacific species with: two occurring in mangroves, including *X. granatum* and *X. moluccensis*; and a third, *X. rumphii*, normally growing above high water on cliffs, rocks and sandy upland areas. The two mangroves often occur in mixed stands within middle to upper tidal limits of middle to upper estuarine reaches. Trunk and bark characters vary depending on species. Furthermore, *X. granatum* is evergreen while *X. moluccensis* is notably deciduous with leaves turning red and orange before falling in the dry winter season. Flowers are small and do not differ between taxa. Fruits are large and globate enclosing a number of angular woody seeds. Fruits vary between species in size and number of seeds. Newly separated seed segments may be pieced back together with some difficulty, hence the common name.

Derivation of Genus Name

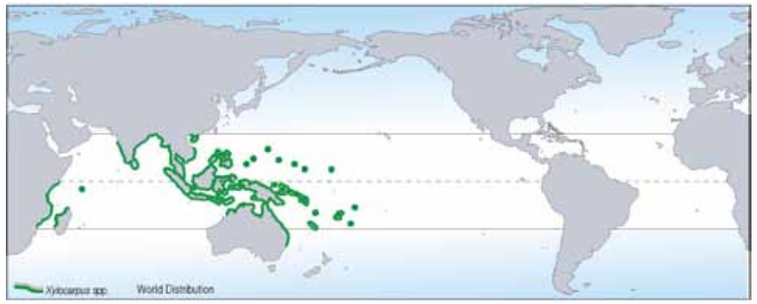
'Xylo-carpus' means *woody fruit* (in Latin) and refers to the large and distinctly woody fruit and seeds of this genus.

Genus Feature

Cannonball shaped fruits fall and split to reveal seeds.

Distribution

Xylocarpus occurs in coastal localities from East Africa and India to China, through Asia and Indonesia to New Guinea and northern Australia. In Vietnam, *X. granatum* and *X. moluccensis* are both present.



2 species in Kien Giang Province, Vietnam

Xylocarpus granatum
Xylocarpus moluccensis

Key to genus *Xylocarpus* found in Kien Giang Province

Buttresses plank-like, pneumatophores (above ground respiratory roots) absent	**Buttresses** small, pneumatophores (above ground respiratory roots) concial
	
Bark pale orangy, flaky patches, smooth	**Bark** grey, vertical fissured, flaky rough
	
Mature fruit 10-25 cm diameter	**Mature fruit** 8-12 cm diameter (deciduous in early Spring)
	
Xylocarpus granatum	***Xylocarpus moluccensis***

Species of *Xylocarpus* are distinguished by the presence of pneumatophores and buttresses, the bark and the size of mature fruit.

Xylocarpus granatum

Cannonball Mangrove | Xu ổi (= Su ổi)

Xylocarpus granatum occurs towards the high tidal zone in mangroves along tropical coastlines and within tidal estuaries influenced seasonally by freshwater flows. Other mangroves associated with this species include *Heritiera littoralis*, *Ceriops tagal*, *Excoecaria agallocha* and *Bruguiera gymnorhiza*. The species is evergreen, and the leaves are compound in structure with around 2-6 leaflets each in mature trees. Juveniles may have simple leaves (i.e. not divided into leaflets). The trunk base is usually smoothly round and lumpy with large sinuous plank buttresses, and ribbon-like sinuous and serpentine surface roots. The species is commonly found in a variety of substrates from oozy mud to fine river sands. *Xylocarpus granatum* is distinguished from other *Xylocarpus* species by its smooth patchy bark, plank buttresses, often spreading evergreen foliage, and distinctively large globose (i.e. almost spherical) fruits.

Species Feature

Buttresses are plank-like with serpentine surface roots.

Derivation of Species Name

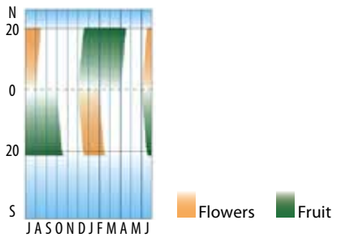
'Granatum' means *having many seeds* (in Latin) and refers to the many-seeded large fruit of this species.

Flowers

Fruit

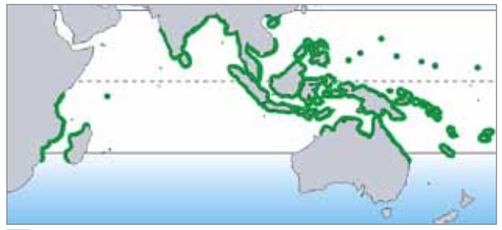
PHENOLOGY

In Vietnam, peak flowering occurs during June and August, and peak fruiting occurs during December to April.



DISTRIBUTION

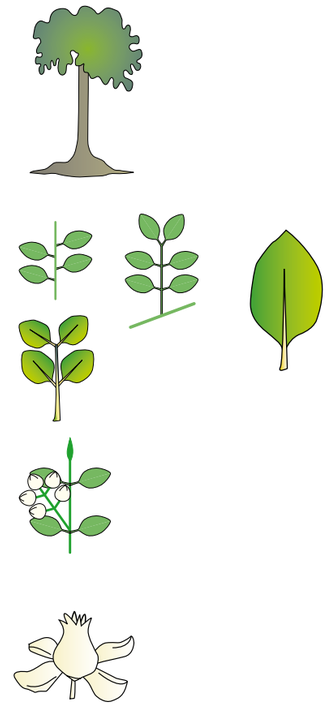
Xylocarpus granatum is found in estuaries from East Africa, Madagascar, Sri Lanka, India, through Asia and Indonesia to New Guinea, the south west Pacific Islands and northern Australia. In Vietnam, the species occurs in estuaries and embayments along the coast from north to south.

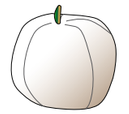


Xylocarpus granatum

BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 22 m, columnar to spreading, evergreen
Bark	smooth, blotchy pale brown to orangy, flaky, thin, peeling in patches, lenticels not conspicuous
Stem	base smooth, buttresses plank-like sinuous
Roots	radiating, serpentine ribbon-like
FOLIAGE	
Leaves	alternate, compound, smooth, to 20 cm L
Leaflets	2-6, elliptic to obovate, green to yellow-green, 4.5-17 cm L, 2.5-9 cm W, margins entire, apices broadly rounded, variably acuminate, base cuneate, ~1 cm L
Petioles	2-4 cm L
REPRODUCTIVE PARTS	
Inflorescence	axillary, many-flowered panicle to 7 cm L, spreading, irregularly branched, monoecious, male and female flowers in same inflorescence, few differences; pedicel clavate, 4-10 mm L; bracteoles minute
Flowers	tetramerous, glabrous, 3-5 mm W; calyx lobes 4, green, valvate, shortly united below, 1-2 mm L; petals 4, creamy white, oval, 3-7 mm L, ~2 mm W; stamens united as staminal tube, spherical, white to pink or yellowish-orange, 2.5-5 mm L, upper margin bears 8 erect apiculate lobes; anthers sessile, yellowish-green, oblong on inner tube surface, 1 mm L; ovary globose, nearly filling staminal tube; stigma disc-like, broad, orange-red, level with staminal lobes, 1 mm W; male flower with non-functional slender ovary; female flower with non-functional stamens
Fruit	woody capsule with 4 indistinct valves, globose, green to brown, coriaceous, shiny, to 25 cm W, splits naturally after falling to reveal 8-20 seeds
DISPERSAL PROPAGULE	
Seeds	angular, more or less tetrahedral, dull pale brown, smooth, buoyant, 7-10 cm L, testa corky; germination hypogeal, radicle developing as taproot
LOCAL DISTRIBUTION	
	High-mid intertidal **intermediate** estuarine position





Xylocarpus moluccensis
(=X.mekongensis)

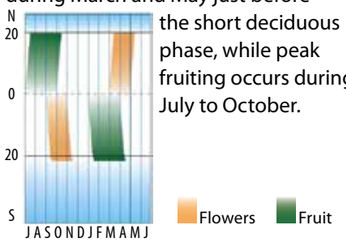
Cedar Mangrove | Xu sung (= Su sung, Su Mekong)

Xylocarpus moluccensis is commonly found in middle reaches at the mid to upper tidal limit of most river estuaries. Other mangroves associated with this species include *Bruguiera parviflora*, *Rhizophora apiculata*, *Ceriops zippeliana*, *Acanthus ilicifolius*, and occasionally *X. granatum*. *Xylocarpus moluccensis* is a small to medium sized tree with a relatively sparse canopy. The species is deciduous, a character which is not shared by any mangrove, except in a partial sense by one other mangrove species, *Excoecaria agallocha*. The normally bright green leaves turn yellow, red, orange and fall chiefly during the period from April to May. The leaves are compound in structure with around 4-6 leaflets each in mature trees. Juveniles may have simple leaves (i.e. not divided into leaflets). The trunk base is usually cylindrical with occasional small plank buttresses. Often surrounding the base are characteristic conical woody pneumatophores (above ground respiratory roots) which typify this species. These pneumatophores may be less frequent, when growing in aerated sandy substrates. The species is commonly found in a variety of substrates from soft oozy mud to sand and coarse gravel. *Xylocarpus moluccensis* is distinguished from other *Xylocarpus* species by the largely unbuttressed columnar tree with distinctive sturdy, conical pneumatophores, roughly fissured bark, smaller fruits, and winter deciduous habit.

Species Feature
Peg-like conical pneumatophores surround the slightly buttressed stem.

Derivation of Species Name
Named for the Moluccas region, also known as the Spice Islands, of eastern Indonesia where this species is also common. This description includes all Australian occurrences previously identified as *X. mekongensis* and *X. australasicus*.

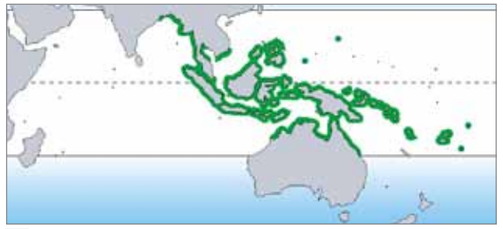
PHENOLOGY
In Vietnam, peak flowering occurs during March and May just before the short deciduous phase, while peak fruiting occurs during July to October.




Flowers

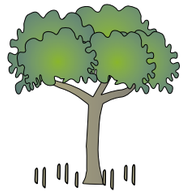

Fruit

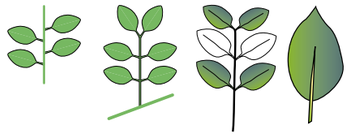
DISTRIBUTION
Xylocarpus moluccensis occurs through Asia and Indonesia to New Guinea, the south-western Pacific Islands and northern Australia. In Vietnam, the species occurs in estuaries and embayments along the coast in the south only.

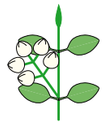

Xylocarpus moluccensis

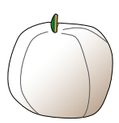
BOTANICAL DESCRIPTION

GROWTH FORM	
Tree	to 15 m, columnar, deciduous
Bark	light brown to grey, lightly fissured or coarsely flaky, lenticels pale brown; stem base columnar, occasional small fin-like buttresses
Stem	base columnar, occasional small fin-like buttresses
Roots	conical pneumatophores, stout, erect, to 20 cm L, 2-4 cm W, apex blunt
FOLIAGE	
Leaves	alternate, compound, smooth, 8-15 cm L
Leaflets	4-6, bright green, often papery, elliptic to ovate, 3-10 cm L, 2.5-7 cm W, margins entire, apices obtuse, base cuneate, <5mm L
Petioles	slender, ~2 cm L
REPRODUCTIVE PARTS	
Inflorescence	axillary, many-flowered panicle to 8 cm L, slender, main axis distinct, monoecious, male and female flowers in same inflorescence, few differences; pedicel clavate, 2-4 mm L; bracteoles minute
Flowers	tetramerous, glabrous, 3-5 mm W; calyx lobes 4, green, valvate, shortly united below, ~1 mm L; petals 4, creamy white, oblong, ~3 mm L, ~1.5 mm W; stamens united as staminal tube, spherical, creamy white, ~2 mm L, upper margin bears 8 erect apiculate lobes; anthers sessile, orange, oblong on inner tube surface, 0.5-1 mm L; ovary globose, nearly filling staminal tube; stigma disc-like, broad, yellow to orange-red, level with staminal lobes, 0.5 mm W; male flower with non-functional slender ovary; female flower with non-functional stamens
Fruit	woody capsule with 4 indistinct valves, globose, green, coriaceous, shiny, 8-9 cm W, splits naturally after falling to reveal 8-16 seeds
DISPERSAL PROPAGULE	
Seeds	angular, more or less tetrahedral, dull pale brown, smooth, buoyant, 4-5 cm L, testa corky; germination hypogeal, radicle developing as taproot
LOCAL DISTRIBUTION	
	High-mid intertidal **intermediate** estuarine position









PART 3

Glossary

A

Abaxial	the leaf surface facing away from the stem of the plant
Abscission	process by which leaves, stems or fruits are separated from the parent plant
Acute	sharp, ending in a point
Accreting	build up of sediment or other matter
Actinomorphic	a flower that is radially symmetrical
Acuminate	a leaf shape that gradually tapers to a long point
Adaxial	the leaf surface facing the stem of the plant
Adventitious roots	roots arising from the plant above the ground, able to absorb oxygen from the air
Aerial root	a root descending from a branch but not penetrating into the soil
Alternate	one leaf, or other structure, per node
Angular	sharp cornered
Annular	in the form of a ring
Anomalous	unusual, abnormal
Anther	the portion of a stamen which bears the pollen
Anthesis	the act of a flower opening; the period of coming to full bloom
Apetalous	without petals
Apex	tip of leaf, root or shoot
Apices	plural of apex
Apiculate	Ending as an abrupt tip which is not stiff
Axillary	arising from the axil, as in an axillary bud

B

Basal	arising from the base of a stem
Bifurcate	forked in two
Bilobed	two lobes
Bilocular	two compartments in the ovary, anther, or fruit
Bithecate	double or paired container
Blade	the expanded, flattened part of the leaf
Bract	a small modified leaf which subtends a flower or a cluster of flowers
Bracteoles	a small bract, often scaly, borne on the pedicel
Bristle	relatively stiff, hairs on top of petal lobes, in Bruguiera
Buttress	flattened projection or outgrowth from lower trunk which joins lateral roots to stem
Buttress root	a stout vertically flattened root growing from near the base of the stem and helping to support the tree

C

Cable root	a slender root which spreads horizontally outwards from the plant just below the soil surface, often giving rise to pneumatophores
Caducous	falling off early
Calyx	the outer covering of a flower base, often called sepals
Campanulate	shaped like a bell
Canopy	the uppermost layer of branches and leaves of a single tree or forest
Capitate	forming a head, rounded and compact
Capsular	shaped like a capsule
Capsule	a single, or many seeded fruit with a hard case that dries at maturity and often bursts to release seeds

Carpel	a simple pistil or single-celled ovary or seed vessel, or one of the parts of a compound pistil, ovary, or seed vessel
Cartilaginous	firm and tough, yet flexible
Catkins	a slender, spikelike flower cluster, sometimes drooping
Chartaceaous	papery in texture
Ciliate	fringed with hairs
Circumscissile	splitting or opening along a circumference, with the top coming off as a lid
Clavate	club shaped
Columnar	column like
Compound leaf	leaf divided into 2 or more leaflets on a single leaf stalk
Cuneate	wedge shaped at base
Cuneiform	shaped like a wedge
Connate	the base of two opposite leaves grown together at the node
Cupulate	shaped like a cup
Cupuliform	like a cup
Coriaceous	leathery
Connate	like a cone
Corolla	the petals, either free or united
Cotyledons	the seed-leaves or embryonic leaf
Cotyledonary collar	extended tube formed by fusion of cotyledons, remains on plant after seedling drops, in Rhizophoraceae
Crenulated	a leaf margin shaped in rounded waves
Crypto-viviparous	a germinated seedling attached to the parent plant but covered by the intact fruit wall, called the pericarp
Cylindrical	long and tubular
Cymes	a flat topped inflorescence in which the centre flower opens first

D

Deciduous	leaves shed at the end of the growing, or dry, season
Decussate	growing in pairs, each of which is at right angles to the next pair above or below
Deltoid	shaped like a triangle
Dehisce	the action of a plant naturally releasing its seed as a method of scattering its offspring further abroad
Dentate	sharply toothed, with the points sticking straight out from the margin
Dichasia	a cyme having two lateral flowers or branches originating from opposite points beneath a terminal flower
Dichotomous key	a two branched key that can help you quickly identify plants in the field. Each line in the key has two choices
Dioecious	with male and female flowers on different plants
Dorsal	the back
Drupe	a soft covered fruit, like a stone fruit

E

Ellipsoidal	elliptic in outline, but solid
Elliptic	oval-shaped, longer than wide and widest in the middle, usually with pointed apex and base
Emarginate	notched at the tip or apex
Endemic	native only to one small area or one country and found nowhere else as a native
Endosperm	a tissue containing stored food, surrounding and nourishing the embryo

Entire	continous or undivided, continuous simple margin
Ephemeral	flowers that last for a short duration, of 1-2 days
Epicalyx	a series of bracts subtending and resembling a calyx
Epicarp	outermost layer of the pericarp of fruits as the skin
Epigeal	referring to plants growing above ground, or the emerging cotyledon during the germination process
Erect	vertical or upright
Estuarine	of, relating to, or found in an estuary
Evergreen	a plant that retains its leaves year-round
Exserted	projecting beyond, such as stamens projecting from the corolla
Exude	to flow out of, or to bleed slowly, describes the sap of a plant

F

Facultative	optional, not obligatory
Family	major unit of taxonomic classification comprising related genera
Filament	the stalk of the stamen which supports the anther
Filiform	thread like
Fissured bark	bark that splits or cracks
Fissure	long, narrow, sometimes deep cracks on a surface
Flaky bark	barks that falls of in flakes or thin sheets
Flower	the organ bearing the reproductive parts of a plant
Foliaceous	like a leaf in shape
Friable	crumbly
Frond	palm leaf
Fungiform	shaped like a mushroom

G

Genus	unit in the taxonomic hierarchy, subordinate in rank to the family, but above species level. A group consisting of related species, and with similar other genera comprising a family
Germination	the beginning of growth by a seed, or a pollen grain
Glabrate	almost glabrous or becoming glabrous with age or maturity
Glabrous	smooth, without hairs
Gland	group of cells which secrete special chemical substances like nectar or resin
Glaucous	covered with a waxy bloom or whitish material that rubs off easily
Globose	almost globular or spherical
Glossy	smooth and shining
Gnarled	twisted, knobby, contorted

H

Habit	the general appearance of a plant
Hairs	fine hairs, like those along sides of petal lobes, in Bruguiera and Rhizophora
Halophyte	a plant which grows in saline soil, adapted to highly saline habitat
Hyaline	resembling glass, as in translucence or transparency, glassy
Hybrid	individual produced as a result of cross between two different species, often infertile and expressing vigorous growth
Hypocotyl	the portion of the stem of a seedling below the cotyledons
Hypogeal	of, or relating to, seed germination in which the cotyledons remain below the surface of the ground

I

Imbricate	overlapping in regular order, as the scales on a snake
Indented	with very irregular edge, as if broken into with teeth
Inflorescence	arrangement of flowers or flower cluster
Interpetiolar	of stipules inserted on the stem between opposite leaves
Intertidal	land zone affected by tides, between high and low levels
Intrapetiolar	between petioles
Involute	rolled inward or toward the upper surface

J

Jugate	joined in, or forming, pairs or a pair
Juvenile	immature, not yet adult

K

Keel	projecting ridge on a surface, like the keel of a boat
Knee roots	above ground roots shaped like a knee

L

Laciniate	shaped, or formed, like a fringe, as a ligament, slashed into narrow pointed lobes
Lamina	the leaf blade
Lanceolate	lance-shaped, much longer than wide with broad base tapering to the apex
Leaflet	one of the blades of a compound leaf, several leaflets form a leaf on a common petiole
Leathery	tough, leather-like structure
Lenticel	brown corky spots on the bark, used for gas exchange
Lepidote	covered in small scaly leaves
Lobe	division of a leaf
Loculus	having small compartments
Linear	long and very narrow

M

Medial constriction	narrow wasted, middle diameter smaller than overall diameter
Medifixed	attached in the middle
Mesocarp	the middle, usually fleshy layer of a fruit wall
Midrib	large central vein of a leaf
Monoecious	male and female flowers separate but on the same plant
Mucronate	leaf apex usually broad, terminated by a short stiff point called a mucro
Mucilage	slimy, glue

N

Neap tide	a tide of minimum range occurring at the time of quarter and three quarter moon
Nectariferous	having nectar
Node	point where leaves or branched arise from a stem

O

Oblong	elongated, two or four times longer than broad
Obovate	inversely egg-shaped, with the broader end upward
Obovoid	pear shaped
Oblanceolate	leaf shape that is broader at the apex gradually narrowing to the base, opposite of lanceolate
Obtuse	blunt at the end, forming greater than right angle
Opposite	two leaves borne on either side of a branch at a single node
Orbicular	a leaf that is nearly circular
Ovary	the portion of the flower which contains the ovules, matures to a fruit and bears seeds
Ovate	shaped like an egg, broader at the base
Ovoid	like an egg
Ovule	the immature seed

P

Panicle	an inflorescence divided into branches, compound
Pan-tropical	occurring throughout the tropics
Paraphyses	one of the erect sterile filaments often occurring among the reproductive organs of certain fungi, algae, and mosses
Paripinnate	having pairs of leaflets opposite each other along a central stem, with a single leaf at the end
Pedicel	the stalk of a flower in a cluster
Pedicellate	a stalk that supports a fruiting or spore-bearing organ
Peduncle	a single inflorescence stalk bearing a cluster of flowers
Peltate	a leaf with the stalk usually attached centrally beneath the leaf blade
Pendulous	having branches or flower heads that bend downward, drooping or weeping
Pentamerous	five parts, or 5 lobed
Perennial	a plant that will live for three years or more under normal conditions
Pericarp	the wall of the ripe ovary
Persistent	remaining attached for a long time
Petiole	the leaf stalk
Petiolar	of, relating to, or growing on a petiole, a petiolar sheath
Petiolar scales	scales on the petiole
Phenology	occurrence of flowering and fruiting events
Pilose	hairy, usually with long and distinct hairs
Pin	dominant pistol with knob like stigma, a counter to 'Thrum'
Pinnae	a leaflet on the second division of a bipinnate leaf
Pinnate	having leaflets growing in rows on both sides of a petiole, or leaf stem, as in a fern, feather like in appearance
Pistillate	a flower that has only female reproductive components
Plank roots	vertically flattened, lateral extensions of buttress root
Plumular	shaped like a plumule
Plumule	the embryonic shoot
Pneumatophore	a respiratory root which rises above the soil surface, spongy or corky aerial roots arising from cable roots, variable in shape including peg, conical, pencil, knee, 'breathing roots'
Prop roots	aerial roots that form on the stem above ground, also called stilt roots
Propagule	seed or seedling capable of producing a new plant, often applied to Rhizophoraceae, e.g. Rhizophora, Bruguiera, Ceriops
Pubescent	softly hairy, covered with short, soft fine hairs
Puberulent	covered with fine soft hairs or down; synonym: pubescent
Pulvinate	a swelling at the base of the petiole, often facilitating leaf motion
Pustular	covered in pustules, raised lumps, often flaking

R

Raceme	an inflorescence having stalked flowers arranged singly along an elongated unbranched axis
Radicle	the embryonic root
Recurved	bent or curved backwards
Reflexed	a sharp bend downward or backward
Reticulate	like a net
Revolute	rolled downwards or to the lower side
Rhizome	an underground, horizontal stem
Ridge	angular with lengthwise lines
Rosette	a radiating cluster of leaves as in a dandelion
Rugose	wrinkled

S

Scales	small dry flakes covering leaf or fruit surface
Scarious	scratched surface
Semi-orbicular	semi-circular, usually a leaf
Sepal	outermost part of a flower, collectively called the calyx
Sericeous	silky
Serpentine	snake like
Sessile	without a stalk
Sheath	a tubular covering that surrounds part of a plant
Sickle-shaped	shaped like a sickle, a curved knife
Sinuous	curving like a meandering stream
Simple	single, undivided piece, applied to leaves
Sinus	the base of a gap between lobes
Smooth	leaf texture not rough
Spathe	a bract or pair of bracts, often large, enclosing the flowers
Spathulate	like a small spathe, a flat spoon
Species	a naturally occurring population of individuals which are reproductively isolated from similar species
Spicate	like ears of corn
Spike	elongated, unbranched inflorescence like a raceme, but flowers are sessile
Spine	relatively stiff, needle like thread between petal lobes, in Bruguiera
Stalk	petiole, peduncle or stem
Sporangia	specially developed spore cases found on the underside of fern fronds
Spore	the reproductive structures of ferns
Spring tide	tides of maximum range occur during both new and full moon
Stamen	the male organ of the flower consisting of the pollen-bearing anther and its stalk the filament
Staminate	like a stamen
Staminodes	a sterile stigma, often modified in shape and size
Stellate	star shaped
Sterile	infertile, non-reproductive, not able to reproduce
Strigose	with pointed, rigid, hair-like scales or bristles
Stigma	the portion of the style which receives the pollen
Stilt root	a root arising from the stem some distance above the ground and affording support to the plant, often called prop roots

Stipule	a leaf-like or scale-like appendage, often in pairs at the base of the leaf petiole
Subtended	joined to
Subterminal	near terminal shoots or buds
Succession	the order in which one vegetation type or ecological community replaces another following some change or disturbance
Stomata	openings of the leaf connected to internal air spaces
Stylar beak	pointed end of a fruit formed from the spent style
Style	an often slender portion of the pistil which arises from the ovary and supports the stigma
Succulent	juicy or fleshy, thick
Superior	above the part
Suture	line where two parts are joined, and often split apart

T

Taproot	central main root evident in deep rooted species
Taxon /taxa	a category of classification such as family, genera, species, variety and form
Terete	circular in transverse section, cylindric and usually tapering
Terminal	borne at the end or apex
Testa	hard shell
Tetrahedral	angular shaped, often 4 sided
Tetramerous	4-part shape
Thecate	like a container
Thicket	dense growth of shrubs and small trees
Thrum	a threadlike part of a flower, a stamen, a counter to 'Pin'
Tomentose	densely woolly, the hairs are soft and matted
Translucent	allows light through
Tree	higher woody plant, usually with one major trunk
Tri-locular	having three compartments
Turbinate	shaped like a turbin

U

Umbelliform	shaped like an umbel
Umbel	an inflorescence consisting of a number of flower stalks or pedicels, nearly equal in length and spreading from a common centre, like umbrella ribs
Unilocular	single compartment
Urceolate	shaped like a pitcher or urn

V

Valvate	shaped like a valve
Variety	taxonomic unit within the species
Venation	patterns in the veins of a leaf blade, typically parallel veined or net-veined
Vestige	remnant piece
Viviparous	a germinated seedling that has developed while still attached to the parent plant

Z

Zygomorphic	a flower that is bilaterally symmetrical

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