UNEP/GEF SCS PROJECT TRAINING COURSE ON SUSTAINABLE MANGROVE MANAGEMENT
25 April - 8 May 2007, Penang, Malaysia

MANGROVE PLANT DIVERSITY IN SOUTHEAST AND EAST ASIA

by

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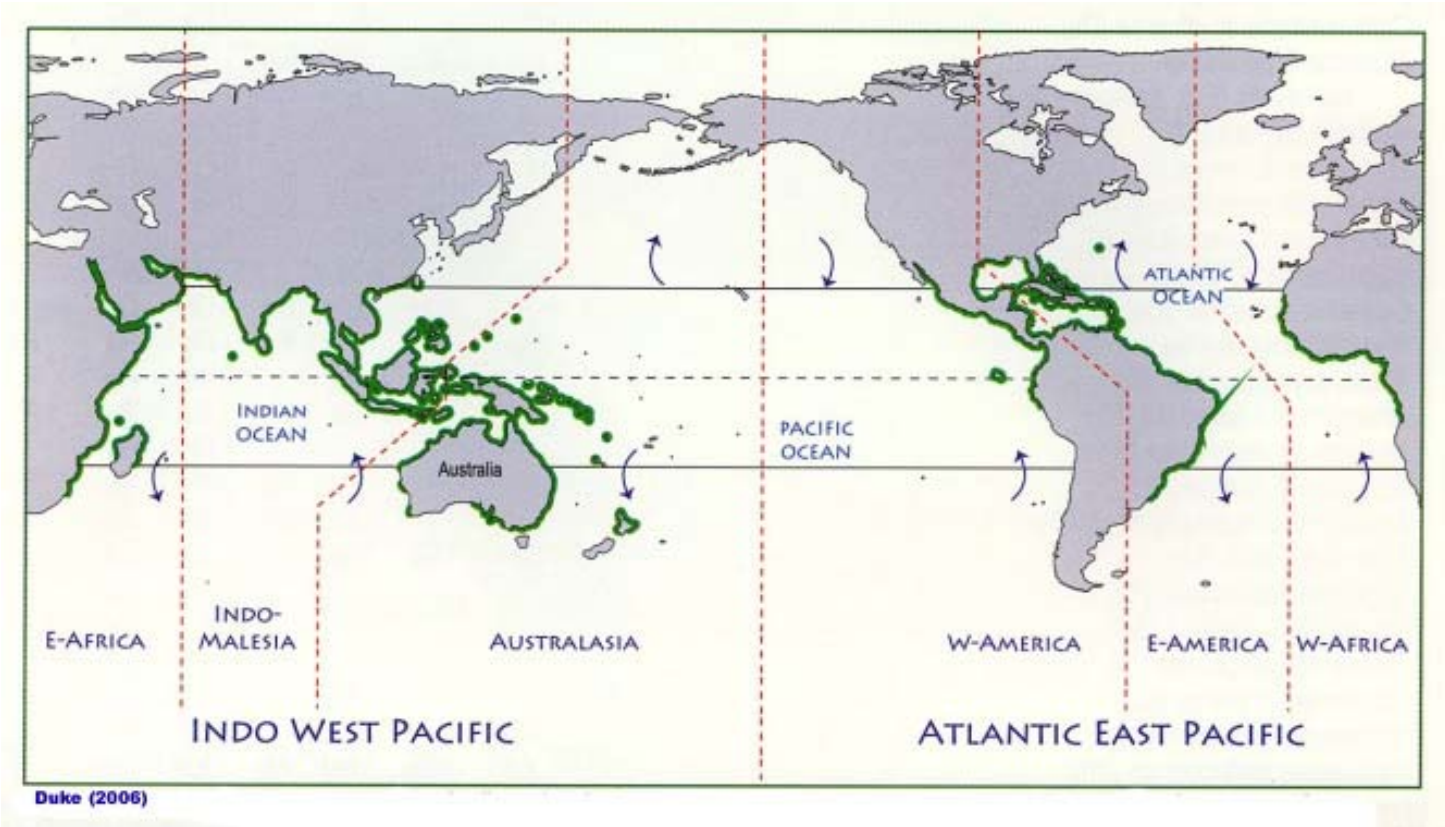
OUTLINE OF PRESENTATION

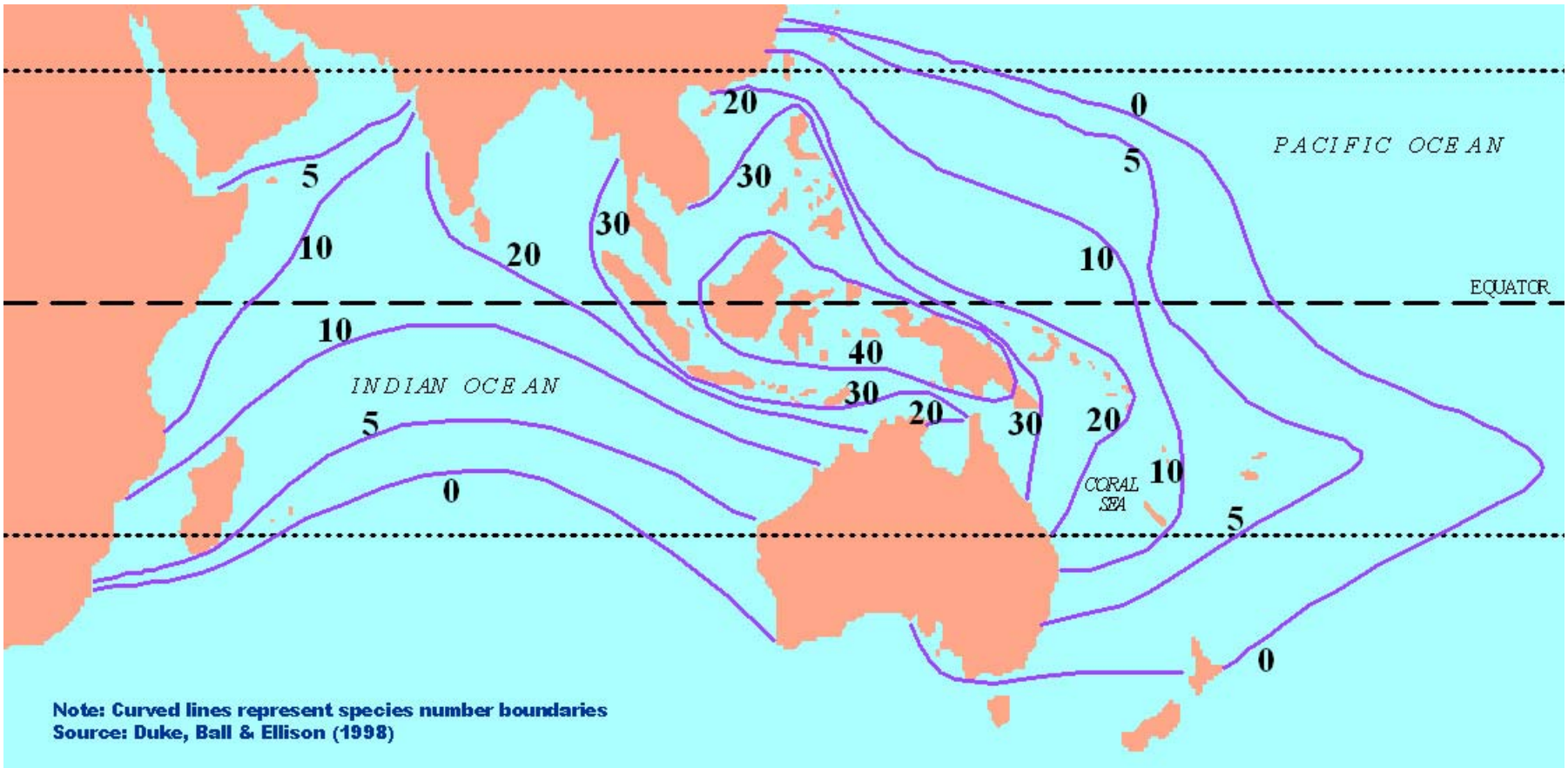
- Introduction – Mangrove Plant Biodiversity
- Source of Information
- Mangrove Plant Diversity in Southeast and East Asia
- Characteristics of Mangrove Plant Diversity in Southeast and East Asia
- Managing Mangrove Plant Diversity – Issues and Challenges

GLOBAL MANGROVE DISTRIBUTION

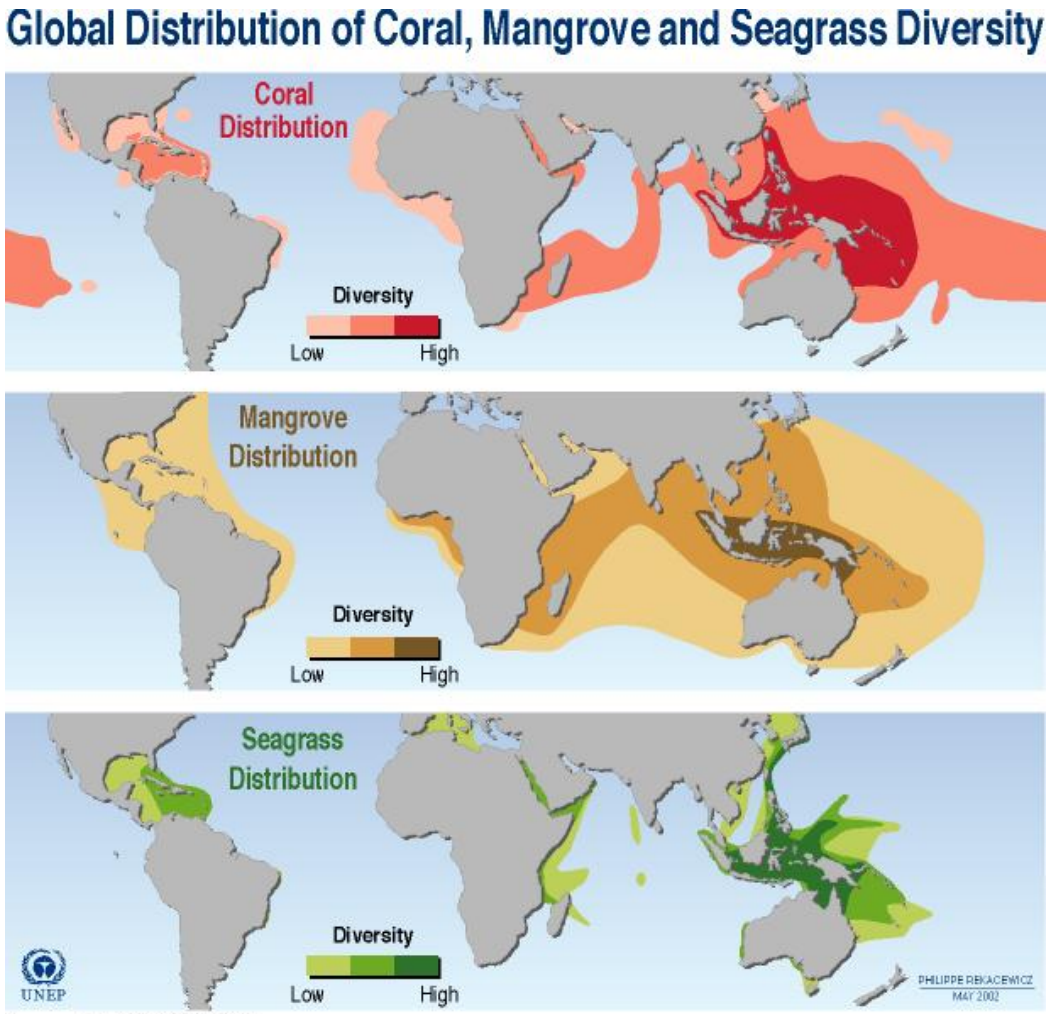


Duke (2006)

MANGROVE PLANT DIVERSITY IN THE INDO-WEST PACIFIC



MANGROVE PLANT DIVERSITY IN THE INDO-WEST PACIFIC



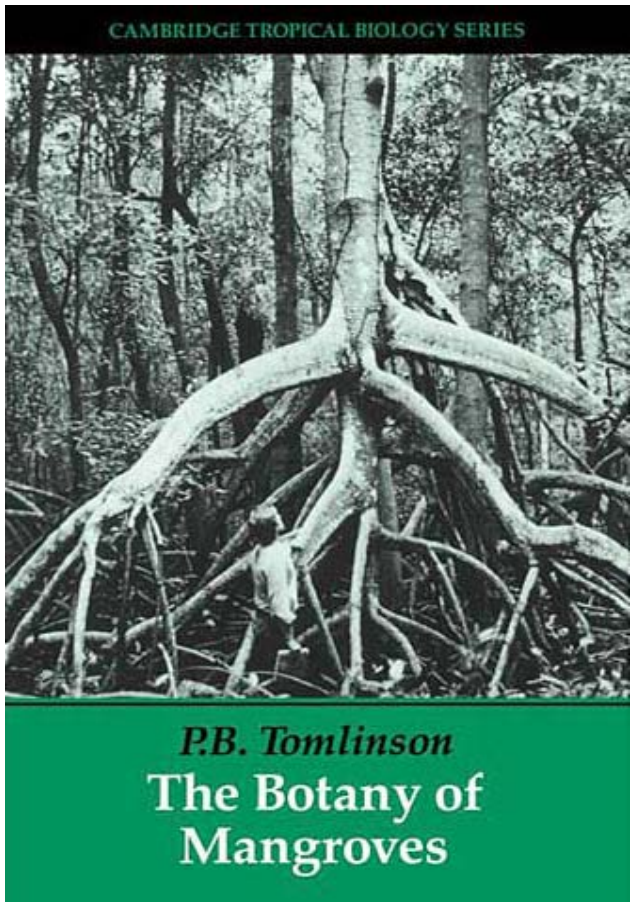
Source : UNEP-WCMC, 2001.

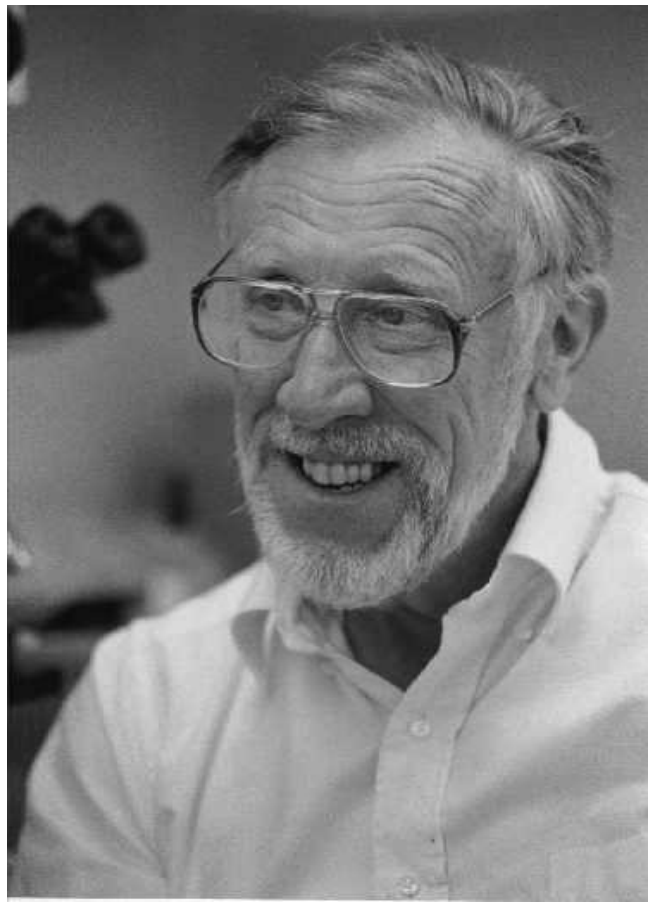
SOURCE OF INFORMATION

- Nation-wide field survey in Malaysia
- Field visits to Singapore, Brunei, Indonesia, Thailand, Philippines, Cambodia, Vietnam, China, Hong Kong, Australia, Bangladesh and India
- Mangrove guidebooks
- Literature review on mangrove taxonomy
- Consultation with "Mangrove Friends"




MANGROVE GUIDEBOOKS





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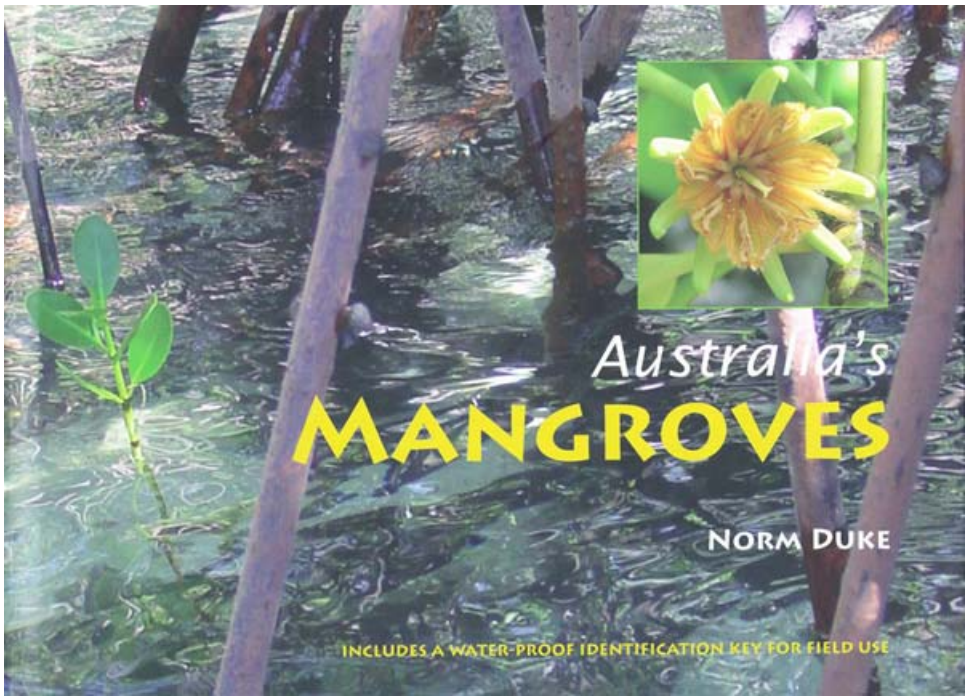
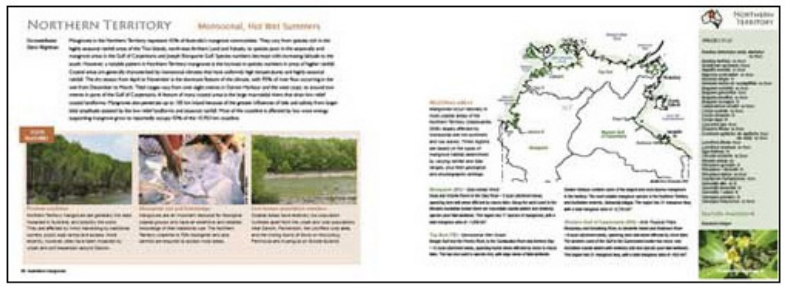




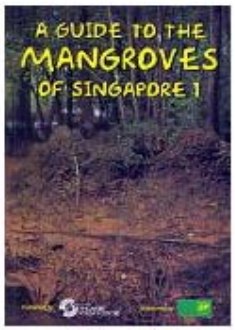
MANGROVE GUIDEBOOKS

Guide to the Mangroves of Singapore

Buy the guides — Peter K L Ng and N Sivasothi (editors)

Links to buy the guides on-line

Payment by credit cards and shipment overseas possible
The guides are also available at most bookstores in Singapore



Volume I
The Ecosystem and Plant Diversity

Select Bookstore
Sing$6.00 (before postage)
Volume I
Volume II

MPH On-line
Sing$5 (before postage)
Volume I
Volume II

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Sing$5.15 (before postage)
Volume I
Volume II

Volume II
Animal Diversity

What is mangrove?
Introduction

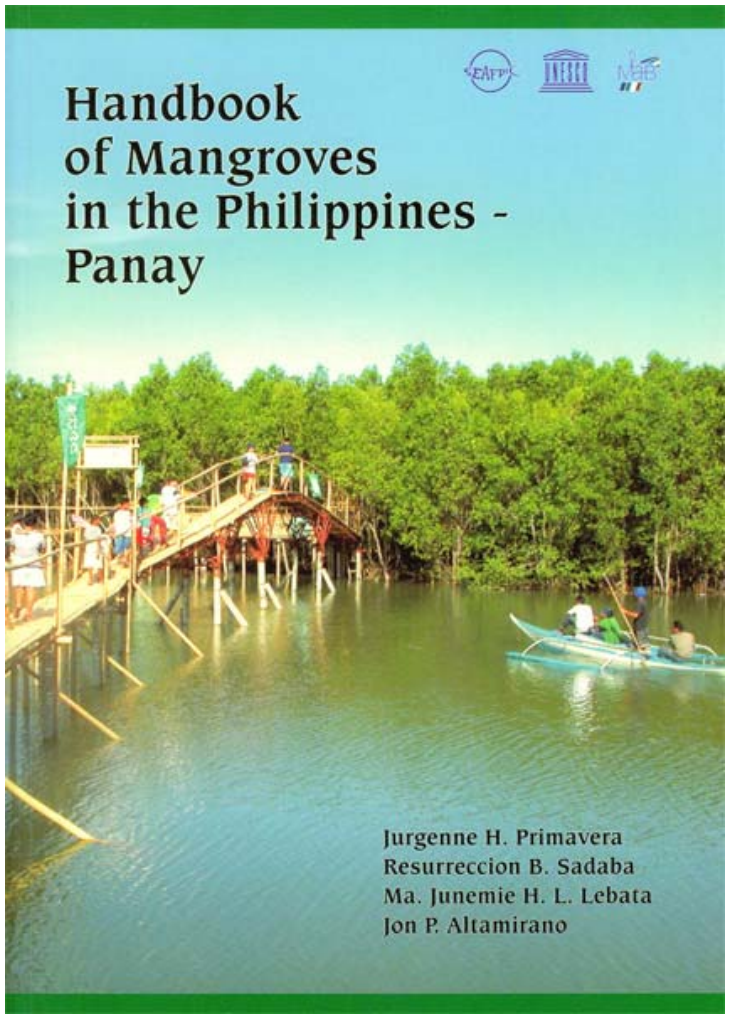
The Ecosystem
Abiotic
Biotic

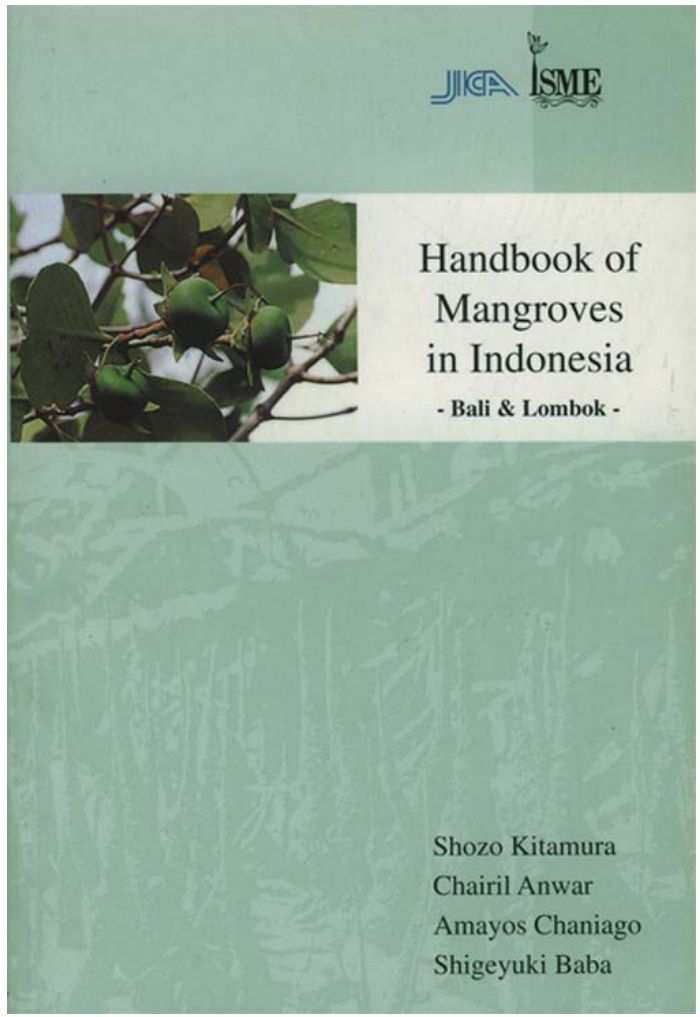
Value
Intro
Products
Indirect uses
Potential uses

About Mangroves in Singapore
History
Mangroves to visit
Conservation

From "A Guide to Mangroves of Singapore", Peter K. L. Ng and N. Sivasothi (editors)
Volume 1: The Ecosystem and Plant Diversity and Volume 2: Animal Diversity
Authors: Kelvin K. P. Lim, Dennis H. Murphy, T. Morgany, N. Sivasothi, Peter K. L. Ng, B. C. Soong, Hugh T. W. Tan, K. S. Tan & T. K. Tan
BP Guide to Nature Series published by the Singapore Science Centre, sponsored by British Petroleum

MANGROVE GUIDEBOOKS





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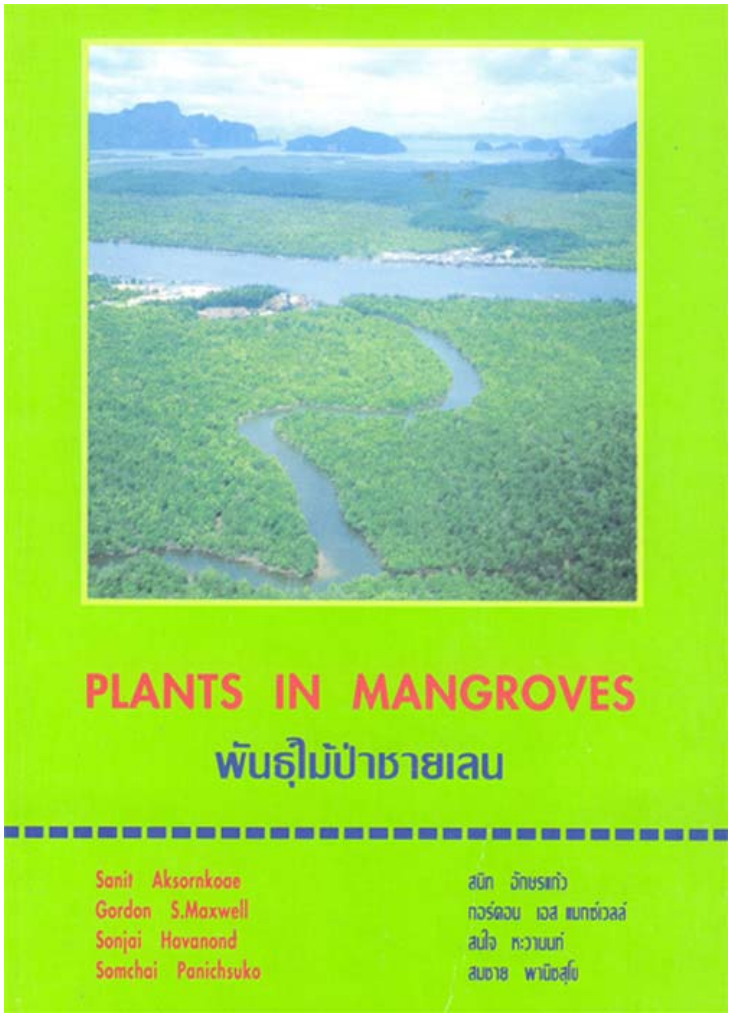

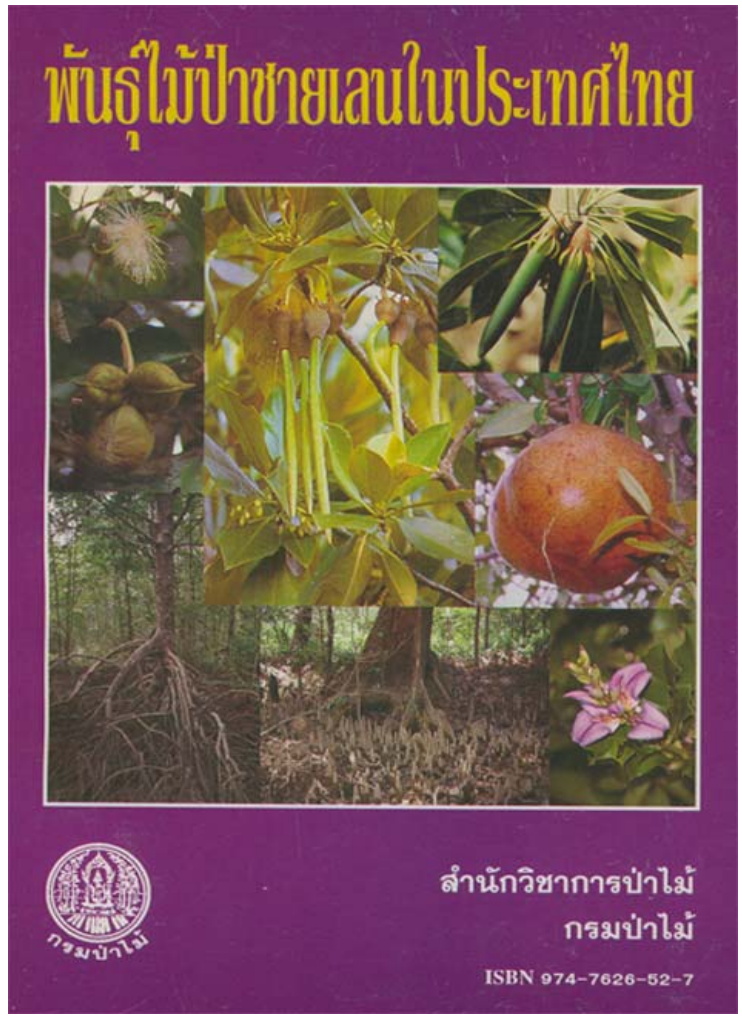

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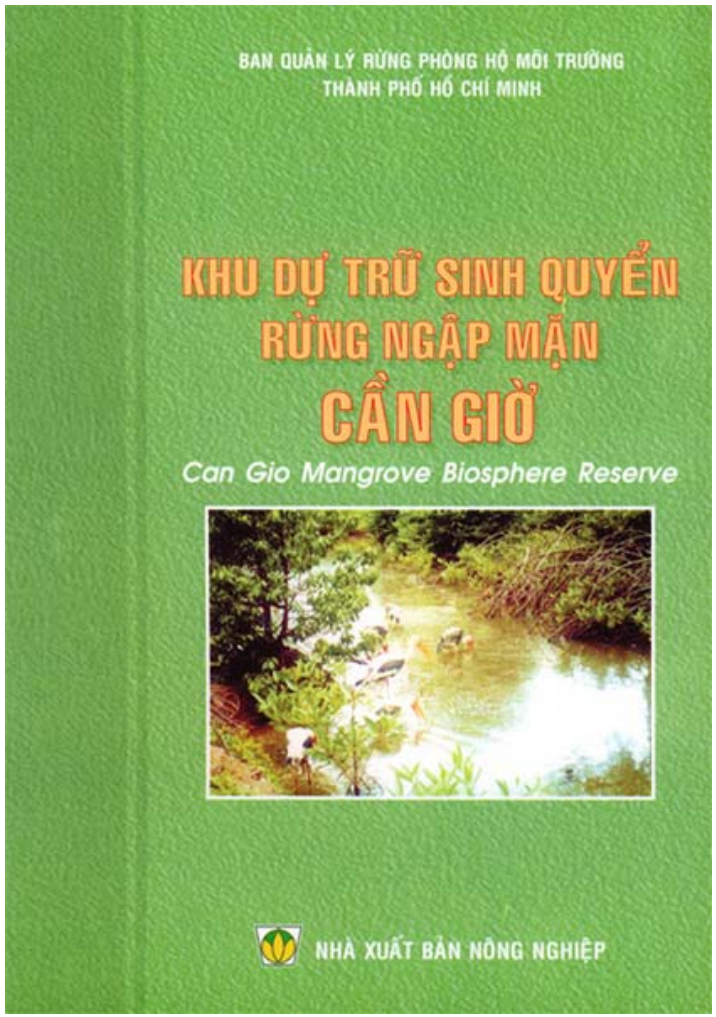

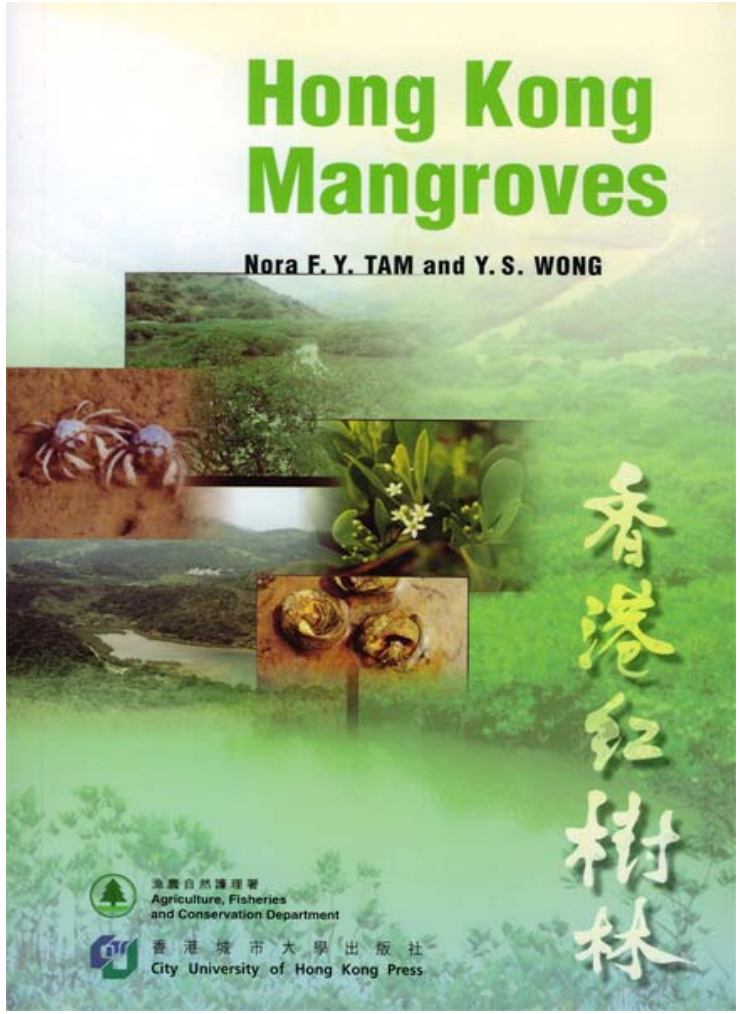

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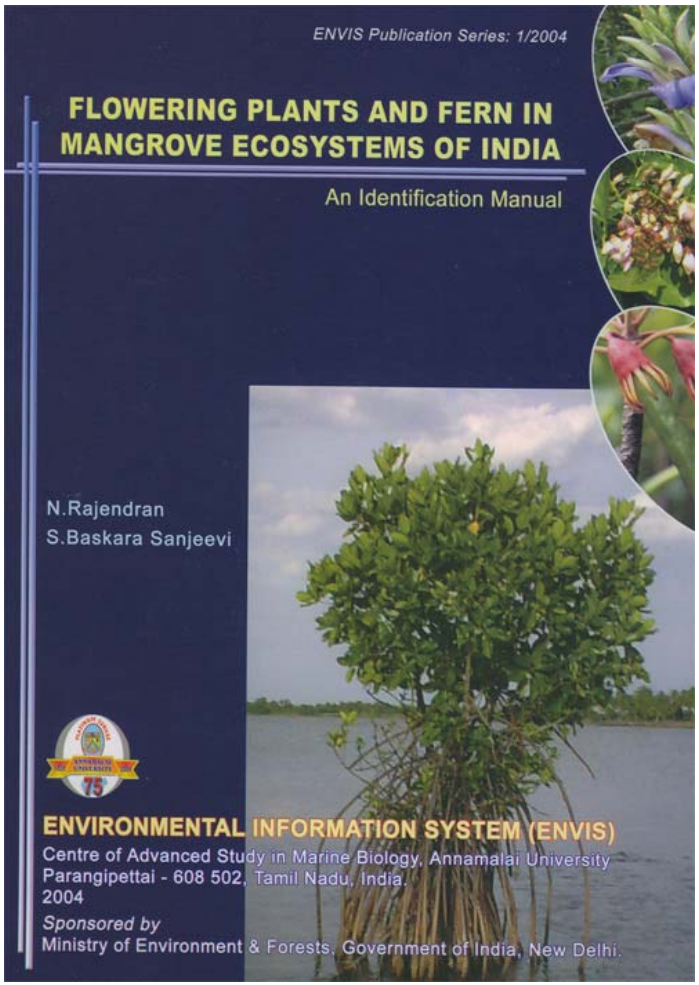

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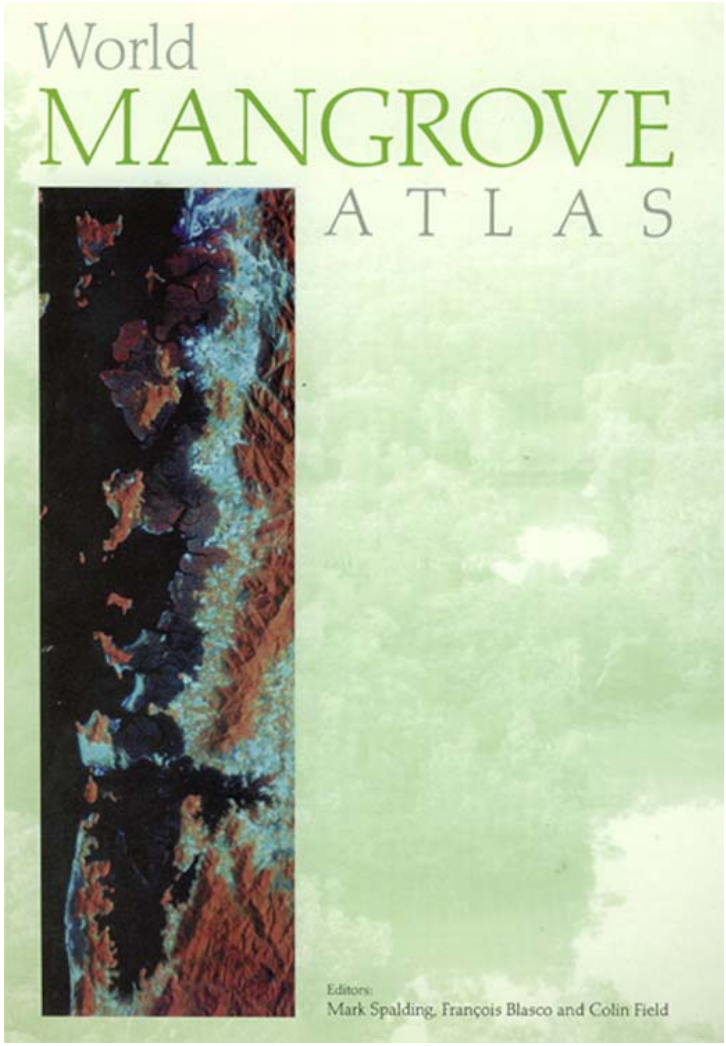

Table 5.1 Mangrove species list for South and Southeast Asia

	Bangladesh	Brunei Darussalam	Cambodia	China and Taiwan	Hong Kong	India - west	India - east	Indonesia	Japan	Malaysia	Myanmar	Pakistan	Philippines	Singapore*	Sri Lanka	Thailand	Vietnam
Acanthus ebracteatus		•		•			•	•		•			•	•		•	•
Acanthus ilicifolius	•	•		•	•	•	•	•		•			•	•	•	•	•
Acrostichum aureum	•	•		•		•	•	•	•	•	•		•	•	•	•	•
Acrostichum speciosum		•		•				•		•				•		•	
Aegialitis annulata								•									
Aegialitis rotundifolia	•						•				•					•	
Aegiceras corniculatum	•	•		•	•	•	•	•		•	•	•	•	•	•	•	•
Aegiceras floridum								•					•				•
Avicennia alba	•	•				•	•	•		•	•		•	•		•	•
Avicennia marina	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
Avicennia officinalis	•	•				•	•	•		•	•		•	•	•	•	•
Avicennia rumphiana								•		•			•				
Bruguiera cylindrica		•		•		•	•	•		•	•		•	•	•	•	•
Bruguiera exaristata								•									
Bruguiera gymnorrhiza		•	•	•	•	•	•	•	•	•	•		•	•	•	•	•
Bruguiera hainesii								•		•						•	
Bruguiera parviflora		•				•	•	•		•	•		•	•		•	•
Bruguiera sexangula	•	•		•				•		•	•		•	•	•	•	•
Camptostemon philippinense								•					•				
Camptostemon schultzii								•									
Ceriops decandra	•					•	•	•		•	•		•		•	•	•
Ceriops tagal	•	•		•		•	•	•		•	•	•	•	•	•	•	•
Cynometra iripa																•	
Dolichandrone spathacea		•						•		•			•	•	•	•	•
Excoecaria agallocha	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•
Excoecaria indica	•							•		•	•			•			
Heritiera fomes	•						•				•					•	
Heritiera globosa		•						•									
Heritiera littoralis	Ex	•		•			•	•	•	•			•	•	•	•	•
Kandelia candel	•	•		•	•	•	•	•	•	•	•			•		•	•
Lumnitzera littorea		•		•			•	•		•				•		•	•
Lumnitzera racemosa		•		•		•	•	•	•	•			•	•	•	•	•
Lumnitzera x rosea													•				
Nypa fruticans	•	•	•	•			•	•	•	•	•			•	•	•	•
Osbornia octodonta								•		•			•				
Pemphis acidula								•	•				•	•	•	•	
Rhizophora apiculata	•	•	•			•	•	•		•	•		•	•	•	•	•
Rhizophora mucronata	•	•	•	•		•	•	•		•	•	•	•	•	•	•	•
Rhizophora stylosa				•				•	•				•	•			•
Rhizophora x lamarckii							•	•		•							
Scyphiphora hydrophyllacea		•		•				•		•			•	•	•	•	•
Sonneratia alba		•		•		•	•	•	•	•			•	•	•	•	•
Sonneratia apetala	•					•	•				•				•		
Sonneratia caseolaris	•	•	•	•		•	•	•		•	•		•	•	•	•	•
Sonneratia griffithii							•			•	•					•	
Sonneratia lanceolata								•									
Sonneratia ovata		•		•				•		•				•		•	•
Sonneratia x gulngai		•						•		•							
Sonneratia x urama								•		•							
Xylocarpus granatum	•	•		•		•	•	•		•	•		•	•	•	•	•
Xylocarpus mekongensis	•							•			•			•		•	

Ex Extinct in that country

MANGROVE SPECIES CARD (SINGAPORE)

MANGROVE SPECIES CARD (SINGAPORE)

KEY REFERENCES (Books)

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- Tree Flora of Sabah and Sarawak (Volume 1 - 4)
- Tree Flora of Thailand
- Tree Flora of Burma

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KEY REFERENCES (General)

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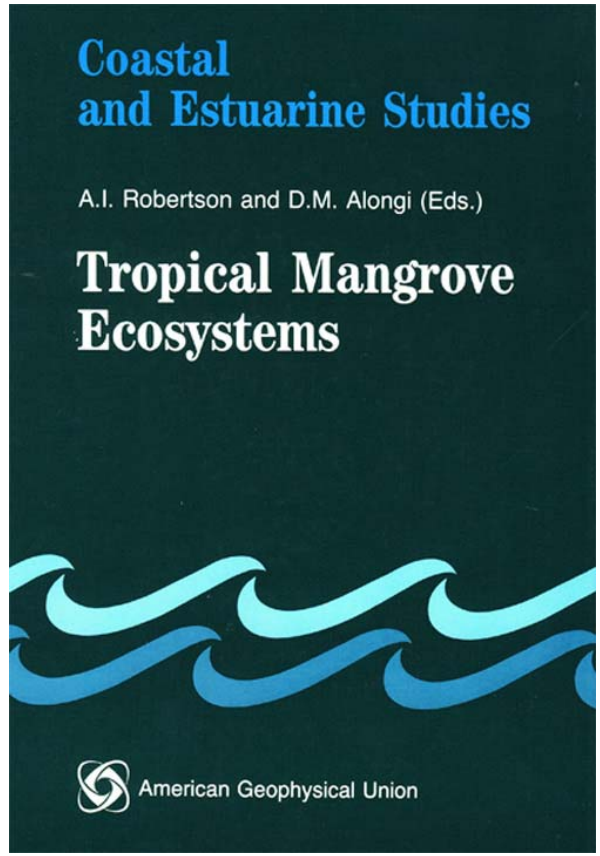

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MANGROVE PLANT DIVERSITY

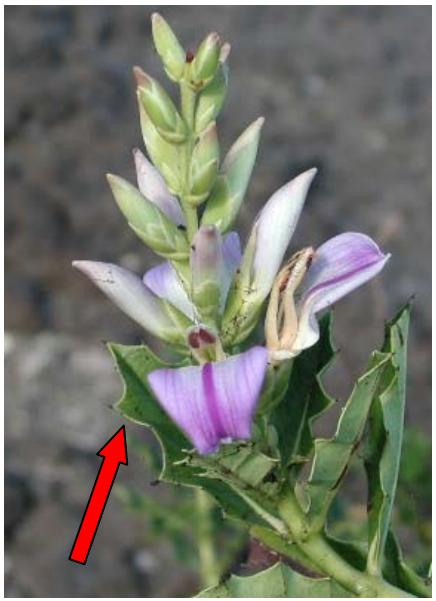
- Definition - Duke (1992)
- "A mangrove tree is a tree, shrub, palm or ground fern, generally exceeding one half metre....."
- "Commonly found in most of mangrove areas in this region"
- Exclude: some species (controversial species) - *Pemphis acidula, Dolichandrone spathacea, Xylocarpus rumphii, Cynometra* spp., etc.
- "Not a complete list"
- Identification based on morphological characters; field work; guidebook

TRUE MANGROVE SPECIES

- 50 true mangrove species from 14 families
- Not a complete list!
- More than 100 associate species
- Indo-West pacific region - rich in plant diversity
- Rare and endemic species

Acanthus (3 species)

Acanthus ilicifolius



Acanthus ebracteatus

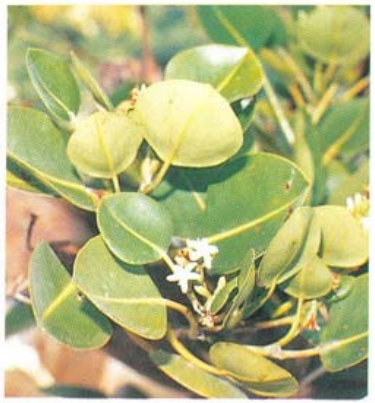
Acanthus volubilis

Acrostichum (2 species)

Acrostichum aureum

Acrostichum speciosum

Aegialitis (2 species)



Aegialites rotundifolia

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PLUMBAGINACEAE

Aegialitis annulata R.Br. 1810

CLUB MANGROVE

Aegialitis annulata belongs to the Plumbaginaceae Juss. (at times placed with its own family Aegialitidaceae Lincz. 1968), a cosmopolitan family of mainly herbs and low shrubs that often grow in saline conditions. Only the genus *Aegialitis* R.Br. (1810) occupies mangrove habitat. This distinctive genus is characterised by anomalous secondary thickening, abundant sclereids, and incipiently viviparous seeds. The genus comprises two species restricted to the tropical Indo-West Pacific region where they typically occupy exposed, often rocky or sandy sites. *Aegialitis annulata* rarely occurs within closed mangrove communities, preferring wave exposure and tidal action mostly, but not always. Although less common, the species occurs also in mid-high intertidal mangrove, often in areas bordering highly saline open saltpan and saltmarsh. *Aegialitis annulata* is distinguished from *A. rotundifolia* Roxb. by its dull upper leaf surfaces, short (7-8 mm L) calyx, and lesser number (9-10) corolla lobes. These species are apparently vicariant in distribution with no overlaps between *A. rotundifolia* in northern equatorial Asia, and *A. annulata* occupying southern largely tropical Australasia including northern Australia.

White flower

Leaf with fine salt encrustation across the surface

SPECIES FEATURE

SHAPE OF LEAVES WITH PETIOLE ENCLOSING THE STEM

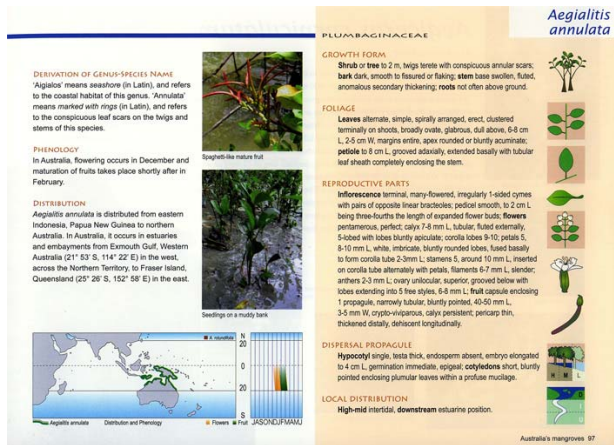
Knobbly stem base

Annular scars along the stem

Shrubs on a muddy tidal bank

Shrubs on an exposed rocky beach, Shoalwater Bay, Qld.

96 Australia's mangroves



Aegialitis annulata

PLUMBAGINACEAE

DERIVATION OF GENUS-SPECIES NAME

'*Aigialos*' means *seashore* (in Latin), and refers to the coastal habitat of this genus. 'Annulata' means *marked with rings* (in Latin), and refers to the conspicuous leaf scars on the twigs and stems of this species.

PHENOLOGY

In Australia, flowering occurs in December and maturation of fruits takes place shortly after in February.

DISTRIBUTION

Aegialitis annulata is distributed from eastern Indonesia, Papua New Guinea to northern Australia. In Australia, it occurs in estuaries and embayments from Exmouth Gulf, Western Australia (21° 53' S, 114° 22' E) in the west, across the Northern Territory, to Fraser Island, Queensland (25° 26' S, 152° 58' E) in the east.

Spaghetti-like mature fruit

Seedlings on a muddy bank

Aegialitis annulata Distribution and Phenology

Flowers Fruit

GROWTH FORM

Shrub or **tree** to 2 m, twigs terete with conspicuous annular scars; **bark** dark, smooth to fissured or flaking; **stem** base swollen, fluted, anomalous secondary thickening; **roots** not often above ground.

FOLIAGE

Leaves alternate, simple, spirally arranged, erect, clustered terminally on shoots, broadly ovate, glabrous, dull above, 6-8 cm L, 2-5 cm W; margins entire, apex rounded or bluntly acuminate; **petiole** to 8 cm L, grooved adaxially, extended basally with tubular leaf sheath completely enclosing the stem.

REPRODUCTIVE PARTS

Inflorescence terminal, many-flowered, irregularly 1-sided cymes with pairs of opposite linear bracteoles; pedicel smooth, to 2 cm L being three-fourths the length of expanded flower buds; **flowers** pentamerous, perfect; calyx 7-8 mm L, tubular, fluted externally, 5-lobed with lobes bluntly apiculate; corolla lobes 9-10; petals 5, 8-10 mm L, white, imbricate, bluntly rounded lobes, fused basally to form corolla tube 2-3mm L; stamens 5, around 10 mm L, inserted on corolla tube alternately with petals, filaments 6-7 mm L, slender; anthers 2-3 mm L; ovary unilocular, superior, grooved below with lobes extending into 5 free styles, 6-8 mm L; **fruit** capsule enclosing 1 propagule, narrowly tubular, bluntly pointed, 40-50 mm L, 3-5 mm W, crypto-viviparous, calyx persistent; pericarp thin, thickened distaly, dehiscent longitudinally.

DISPERSAL PROPAGULE

Hypocotyl single, testa thick, endosperm absent, embryo elongated to 4 cm L, germination immediate, epigeal; **cotyledons** short, bluntly pointed enclosing plumular leaves within a profuse mucilage.

LOCAL DISTRIBUTION

High-mid intertidal, **downstream** estuarine position.

Australia's mangroves 97

Aegialitis (2 species)

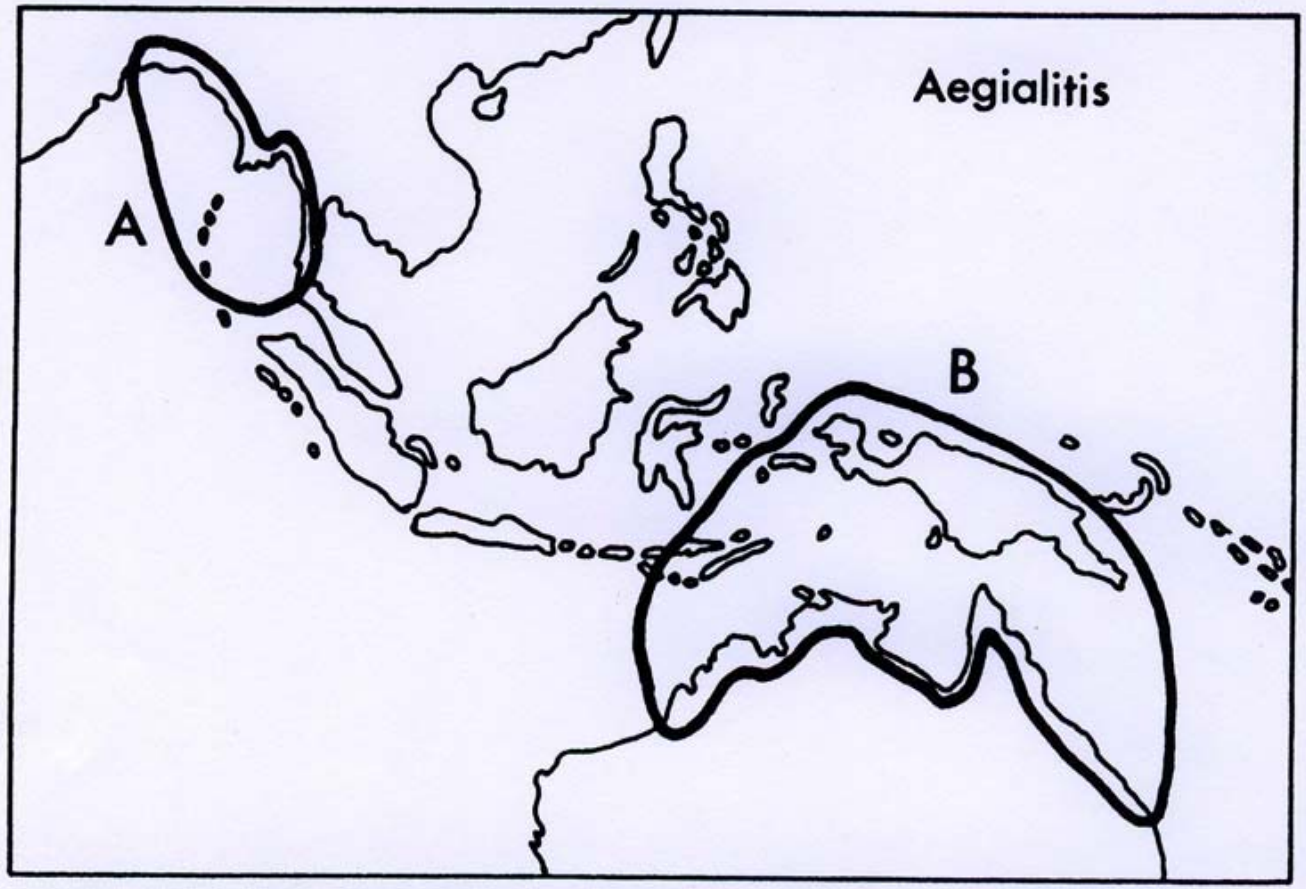


Figure 3.4. *Aegialitis*. Disjunct distribution of its two constituent species: *A. rotundifolia* (A) and *A. annulata* (B). (After van Steenis 1949). *A. annulata* is now known to range much farther south in western Australia (see the detailed distribution in Fig. 3.6).

Tomlinson (1986)

Aegiceras (2 species)

Aegiceras corniculatum

Aegiceras floridum

Aglaia cucullata

Avicennia (4 species)

Avicennia alba

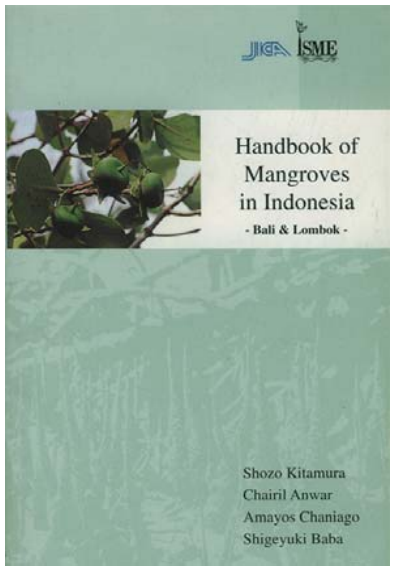
Avicennia marina

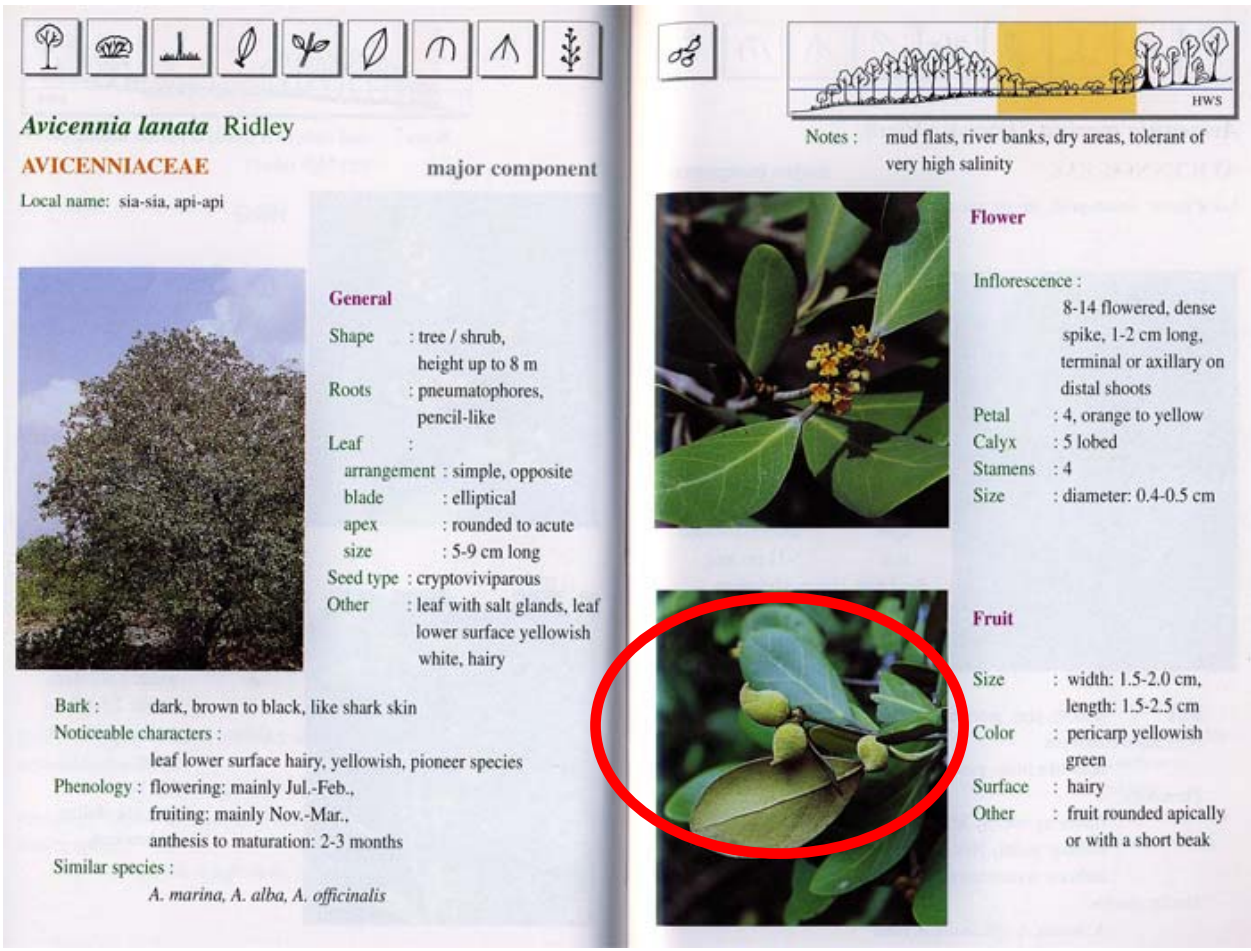
Avicennia officinalis

Avicennia rumphiana

Avicennia rumphiana (A. lanata)

Avicennia rumphiana (A. lanata)?





Avicennia lanata Ridley

AVICENNIACEAE — major component

Local name: sia-sia, api-api

General

Shape : tree / shrub, height up to 8 m
Roots : pneumatophores, pencil-like
Leaf :
arrangement : simple, opposite
blade : elliptical
apex : rounded to acute
size : 5-9 cm long
Seed type : cryptoviviparous
Other : leaf with salt glands, leaf lower surface yellowish white, hairy

Bark : dark, brown to black, like shark skin
Noticeable characters : leaf lower surface hairy, yellowish, pioneer species
Phenology : flowering: mainly Jul.-Feb., fruiting: mainly Nov.-Mar., anthesis to maturation: 2-3 months
Similar species : *A. marina, A. alba, A. officinalis*

HWS

Notes : mud flats, river banks, dry areas, tolerant of very high salinity

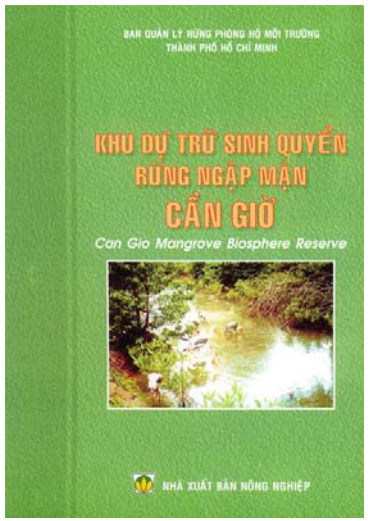
Flower

Inflorescence : 8-14 flowered, dense spike, 1-2 cm long, terminal or axillary on distal shoots
Petal : 4, orange to yellow
Calyx : 5 lobed
Stamens : 4
Size : diameter: 0.4-0.5 cm

Fruit

Size : width: 1.5-2.0 cm, length: 1.5-2.5 cm
Color : pericarp yellowish green
Surface : hairy
Other : fruit rounded apically or with a short beak

Avicennia rumphiana (*A. lanata*)?



MẮM QUĂN — *Avicennia lanata* Ridley

Họ Mắm — Avicenniaceae

Cây gỗ nhỏ, thường cao 6-7 m, phân cành sớm, khúc khuỷu; rễ thở mọc thẳng đứng từ dưới bùn. Lá hình trứng ngược hay bầu dục, đầu tròn đôi khi hơi nhọn, *mép cuộn quăn lại*, mặt trên màu lục, nhẵn, mặt dưới có nhiều lông màu trắng, có tuyến tiết màu đen. Cụm hoa ở đầu cành, gồm nhiều xim hợp thành đầu, hoa nhỏ, màu vàng cam. Quả nhỏ hơi có dạng hình tim, tròn, mũi rất ngắn, vỏ quả có lông xám, mịn; hạt nảy mầm trước khi quả rụng. Trái chín vào tháng 7 đến tháng 9.

Thường mọc trên đất bùn chặt ven bờ kênh rạch đất đã cao, đôi khi tái sinh trên những vùng đất thoái hóa nhưng vẫn còn ngập khi triều cao. Có thể gặp rải rác hoặc từng đám nhỏ ở các Tiểu khu 12, 17, 20, 21, 22.

Cây được sử dụng tại địa phương với một số công dụng tương tự hai loài Mắm trên.

Small tree, 6-7 m tall; branches sinuous, lower branches ramified; pneumatophores erect from mud. Leaves obovate or elliptic, obtuse or sometimes gently pointed at apex; *margin curled or rolled*; numerous minute white hairs above. Inflorescence capitate, terminal, flowers very small, orange-yellow. Capsule slightly heart-shaped, rounded or at most shortly beaked, silvery gray woolly hairs around the pericarp; viviparous seedling. Fruit ripens in July-September.

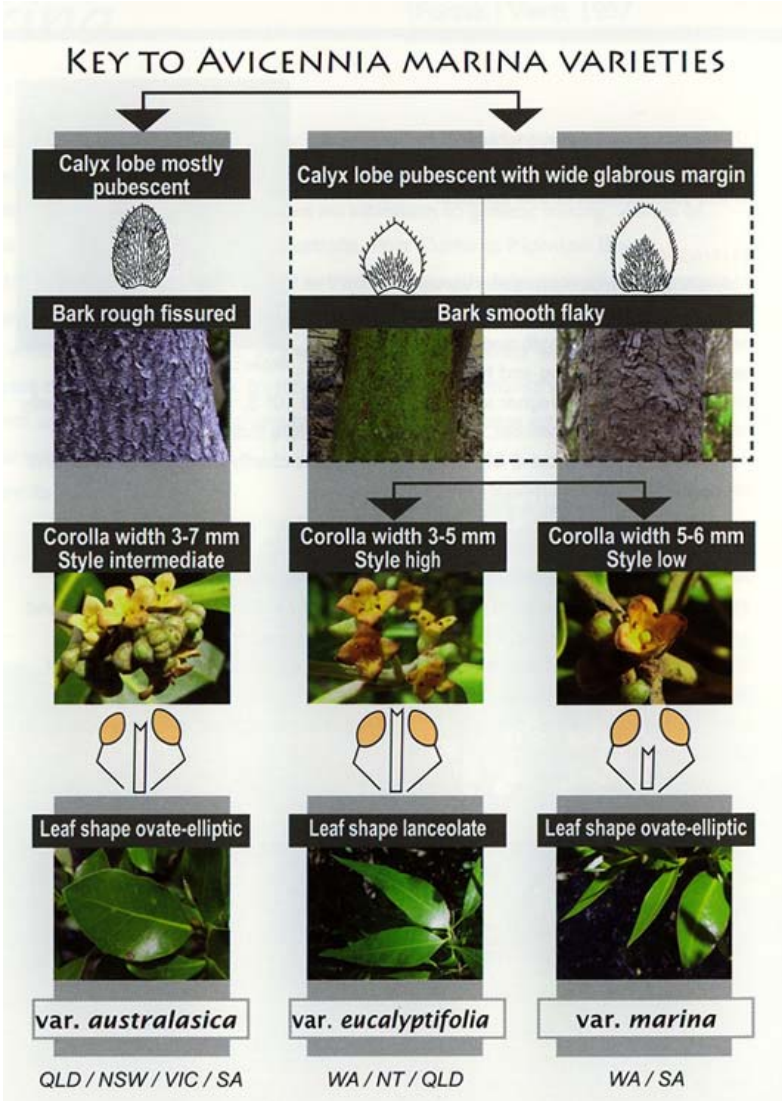
Grows on hard mud along rather high creek banks, sometimes regenerates on degenerate land flooded by high tide; scattered trees or small groups encountered in Compartments 12, 17, 20, 21 and 22.

Local use similar to *A. alba* and *A. officinalis*.

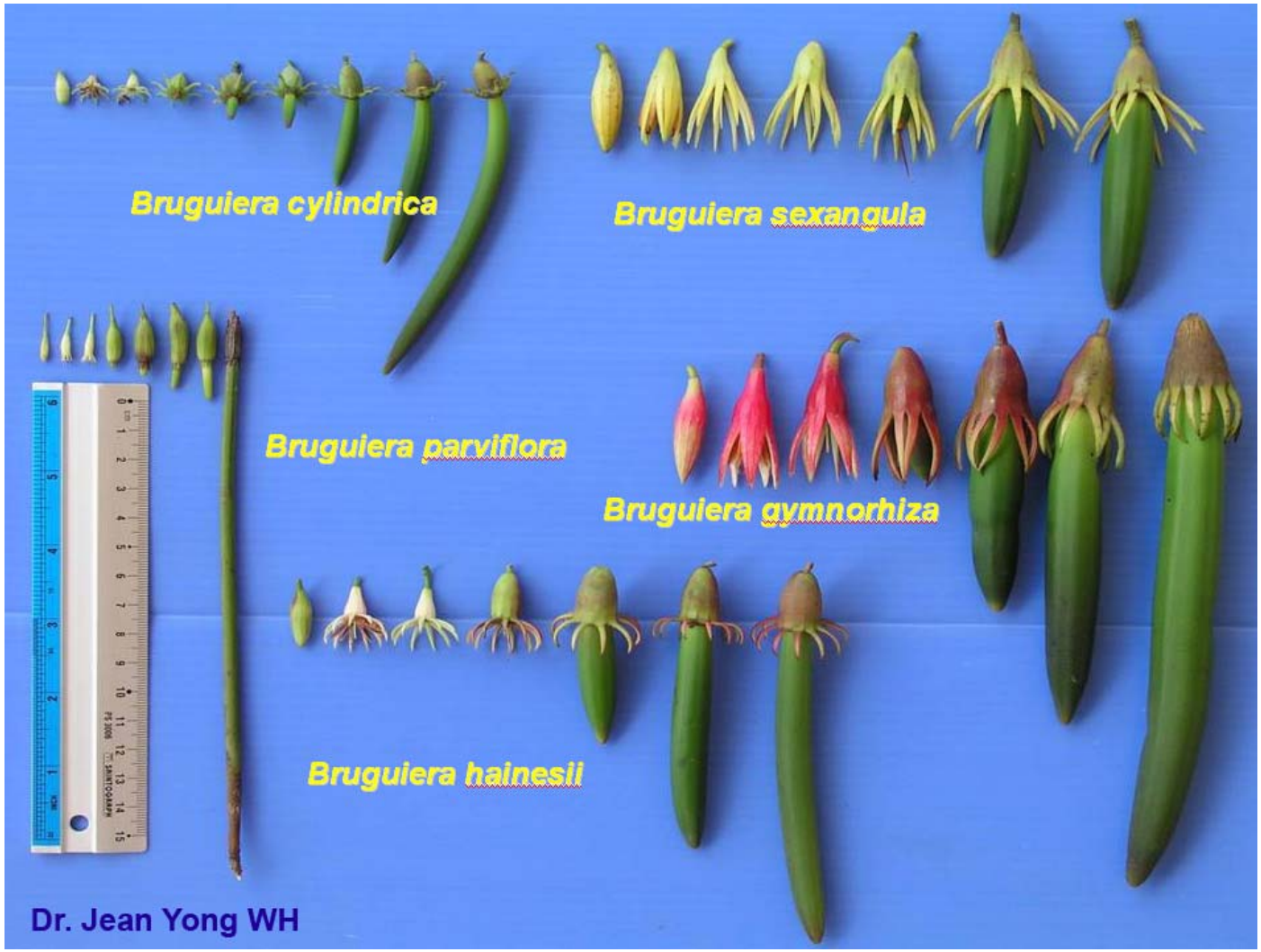
Lá, hoa và trái Mắm quăn - Leaf, flower and fruit of *A. lanata* Ridley

Cây phân cành sát mặt đất giống như dạng bụi
The much - divided lower branches give *A. lanata* a shrub - like appearance

Avicennia marina (3 varieties)



Bruguiera (6 species)



Bruguiera hainesii

Bruguiera hainesii
© Tan Kim Hooi

Bruguiera exaristata

RHIZOPHORACEAE

Flower with dehisced petals

Leaves clustered around apical shoots

Bruguiera exaristata

RIB-FRUITED ORANGE MANGROVE

Bruguiera exaristata is a common tree or shrub constituent of the upper intertidal mangrove zone. It is readily recognised by its buttressed trunk, knee-like pneumatophores, opposite glossy green leaves, and large mostly solitary flowers with 8-10 lobes. Furthermore, the calyces are distinguished by their light green colour with distinctive ribbing. The species is distinguished from other single flower *Bruguiera* by the absence of a spine between petal lobes, and the absence of bristles on petal lobes. In Australia, *B. exaristata* is found in a variety of habitats ranging from tidal backwaters, to stunted stands bordering saltpans and sandy beaches. Common associates include *Ceriops australis* and *Xylocarpus moluccensis*. As with other *Bruguiera*, *B. exaristata* has a distinctive explosive pollen release mechanism. Honey-eaters frequently visit the flowers to gather nectar.

Ding Hou 1957

Columnar small tree, Buffalo Creek, NT.

SPECIES FEATURE

OPEN FLOWERS HAVE BILOBED PETALS WITHOUT A BRISTLE BETWEEN LOBES

Bark is fissured with pustular lenticels

Stem base has stocky short buttresses

Knobbly knee roots provide aeration

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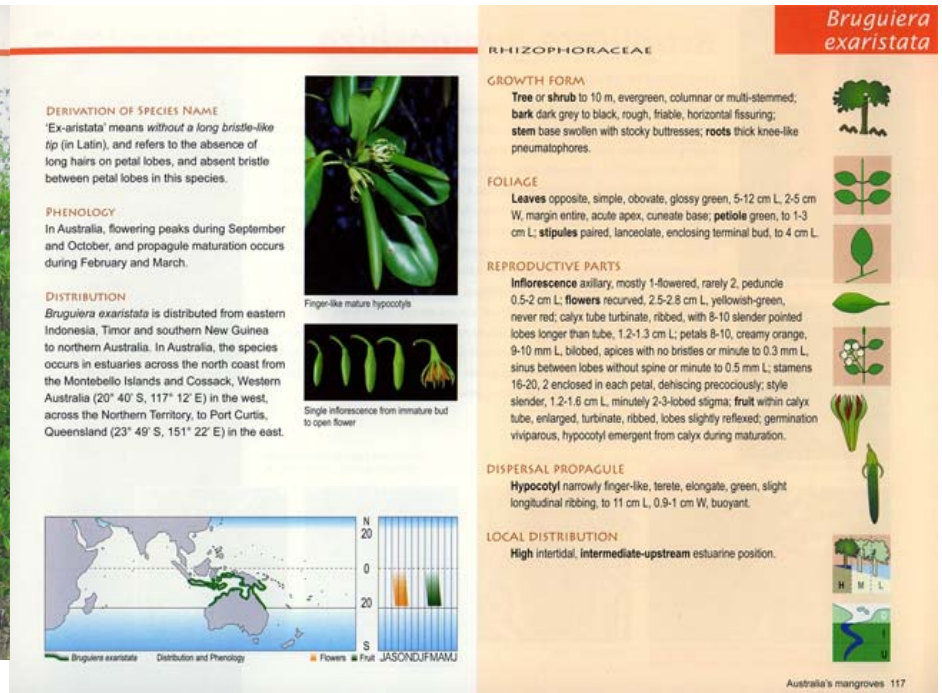

DERIVATION OF SPECIES NAME

'Ex-aristata' means *without a long bristle-like tip* (in Latin), and refers to the absence of long hairs on petal lobes, and absent bristle between petal lobes in this species.

PHENOLOGY

In Australia, flowering peaks during September and October, and propagule maturation occurs during February and March.

DISTRIBUTION

Bruguiera exaristata is distributed from eastern Indonesia, Timor and southern New Guinea to northern Australia. In Australia, the species occurs in estuaries across the north coast from the Montebello Islands and Cossack, Western Australia (20° 40′ S, 117° 12′ E) in the west, across the Northern Territory, to Port Curtis, Queensland (23° 49′ S, 151° 22′ E) in the east.

Finger-like mature hypocotyls

Single inflorescence from immature bud to open flower

N 20 0 20 S

Bruguiera exaristata Distribution and Phenology

Flowers Fruit JASONDJFMAMJ

RHIZOPHORACEAE

Bruguiera exaristata

GROWTH FORM

Tree or **shrub** to 10 m, evergreen, columnar or multi-stemmed; **bark** dark grey to black, rough, friable, horizontal fissuring; **stem** base swollen with stocky buttresses; **roots** thick knee-like pneumatophores.

FOLIAGE

Leaves opposite, simple, obovate, glossy green, 5-12 cm L, 2-5 cm W, margin entire, acute apex, cuneate base; **petiole** green, to 1-3 cm L; **stipules** paired, lanceolate, enclosing terminal bud, to 4 cm L.

REPRODUCTIVE PARTS

Inflorescence axillary, mostly 1-flowered, rarely 2, peduncle 0.5-2 cm L; **flowers** recurved, 2.5-2.8 cm L, yellowish-green, never red; calyx tube turbinate, ribbed, with 8-10 slender pointed lobes longer than tube, 1.2-1.3 cm L; petals 8-10, creamy orange, 9-10 mm L, bilobed, apices with no bristles or minute to 0.3 mm L, sinus between lobes without spine or minute to 0.5 mm L; stamens 16-20, 2 enclosed in each petal, dehiscing precociously; style slender, 1.2-1.6 cm L, minutely 2-3-lobed stigma; **fruit** within calyx tube, enlarged, turbinate, ribbed, lobes slightly reflexed; germination viviparous, hypocotyl emergent from calyx during maturation.

DISPERSAL PROPAGULE

Hypocotyl narrowly finger-like, terete, elongate, green, slight longitudinal ribbing, to 11 cm L, 0.9-1 cm W, buoyant.

LOCAL DISTRIBUTION

High intertidal, **intermediate-upstream** estuarine position.

H M L

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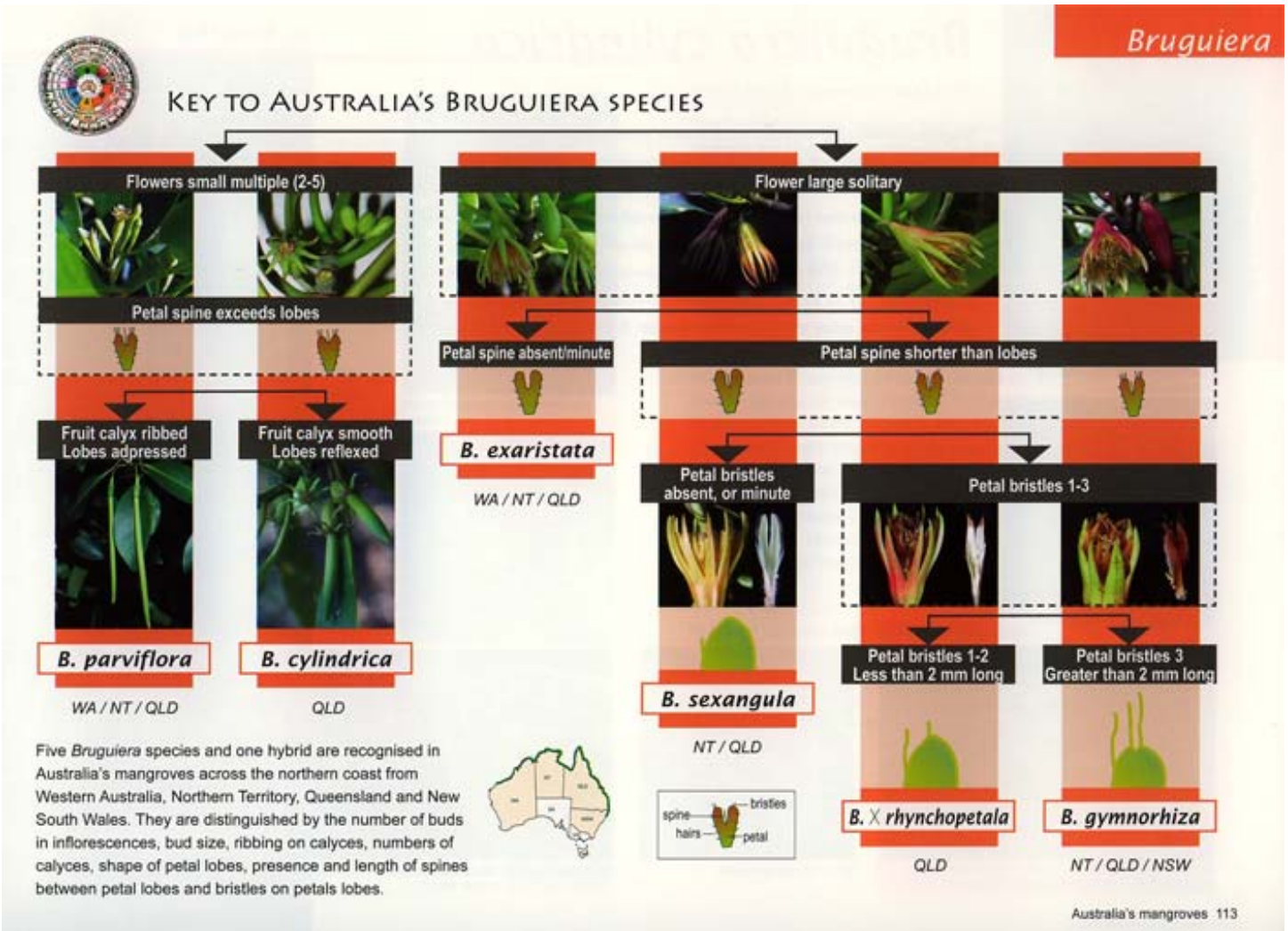
Bruguiera (hybrid)?



Camptostemon (2 species)

Family Bombacaceae

Camptostemon philippinensis (Vidal) Becc.

Local name: *gapas-gapas*

Also called *Camptostemon philippinense*, this species has small to medium-sized trees reaching 15 m tall and 50 cm DBH, along rivers and tidal creeks. The leaves are thick, covered with fine scales (like the buds and fruits), and crowded at the end. Surface roots emanate from the base of the trunk and spread out around mature trees – both the knobby roots and lower trunk have many lenticels and give the species a distinctive gnarled appearance. The capsule-shaped fruits have seeds covered by numerous thick white threads, hence the local name *gapas-gapas* meaning cotton (see opposite page, bottom left photo). The ground in a *C. philippinensis* grove appears white from the cottony threads of newly-fallen seeds. In Panay, the wood is used for fuel and elsewhere in the Philippines, for making household utensils and carvings.

General

Substrate:	muddy
Tidal level:	low, middle
Found with:	*C. decandra*, *A. rumphiana*

Form

Shape:	tree
Height:	5-15 m
DBH:	10-50 cm
Bark:	rough, brown-gray, irregular flakes; lenticellate
Aerial roots:	surface, gnarled, curling, with lenticels

Sampling sites:
- Barotac Nuevo, Iloilo
- Carles, Iloilo
- Makato River, Aklan
- Ibajay, Aklan

FLOWERING J F M A M J J A S O N D

FRUITING J F M A M J J A S O N D

Leaves

Arrangement:	simple, alternate, spiral
Blade shape:	obovate
Margin:	entire - smooth
Apex:	round to emarginate
Base:	acute
Upper surface:	leathery, dark green
Undersurface:	smooth, light green; with scales
Size:	8 (5-9) cm long, 5 (3-7) cm wide
Others:	fine salt crystals on leaves

Flowers

Inflorescence:	cyme, terminal
Petals:	5, white to reddish brown
Sepals:	5, green
Size:	1-1.3 cm diameter
Others:	3-4 flowers per cluster

Fruits

Shape:	rounded, dehiscent
Color:	green to brown
Texture:	cottony inside
Size:	1-2 cm long, 7 cm diameter
Others:	attractive to big red ants

Camptostemon (2 species)

BOMBACACEAE

Camptostemon schultzii Mast. 1872

KAPOK MANGROVE

Camptostemon schultzii belongs to the family of soft-wooded trees, the Bombacaceae Kunth, known for their simple leaves and conspicuous flowers with numerous stamens. One economically important relative includes the durian fruit, Durio zibethinus Murr., with which it shares scaly pubescence, cupular epicalyx and closed calyx. The genus *Camptostemon* Mast. (1872) consists entirely of two species of evergreen trees found in the high intertidal zone of mangrove habitat. Together they are distributed from Borneo, through the Moluccas and the Philippines, to New Guinea and Northern Australia. *Camptostemon philippinense* (Vidal) Becc. occurs in the northern part of this range, and is unknown in Australia. Distributions of the two species are not known to overlap, however records are largely incomplete because of diagnostic uncertainties. *Camptostemon schultzii* is distinguished from *C. philippinense* by leaves that are more glabrous on upper surfaces (not, sparsely but uniformly lepidote) and more elliptic in shape (not, obovate-oblong to lanceolate), and flowers reportedly having numerous (>5) stamens and bithecate (not polythecate) anthers.

Clusters of small silvery flowers

photo: Glenn Wightman

A cyme of three mature fruiting capsules

A tall emergent tree on a tidal bank in the South Alligator River, NT.

SPECIES FEATURE

LEAVES ARE SILVERY ON LOWER SURFACES, AS WELL AS COVERING TWIGS AND REPRODUCTIVE PARTS

Bark with numerous lenticels

Fluted stem base buttresses

Small clump of stream bank bushes

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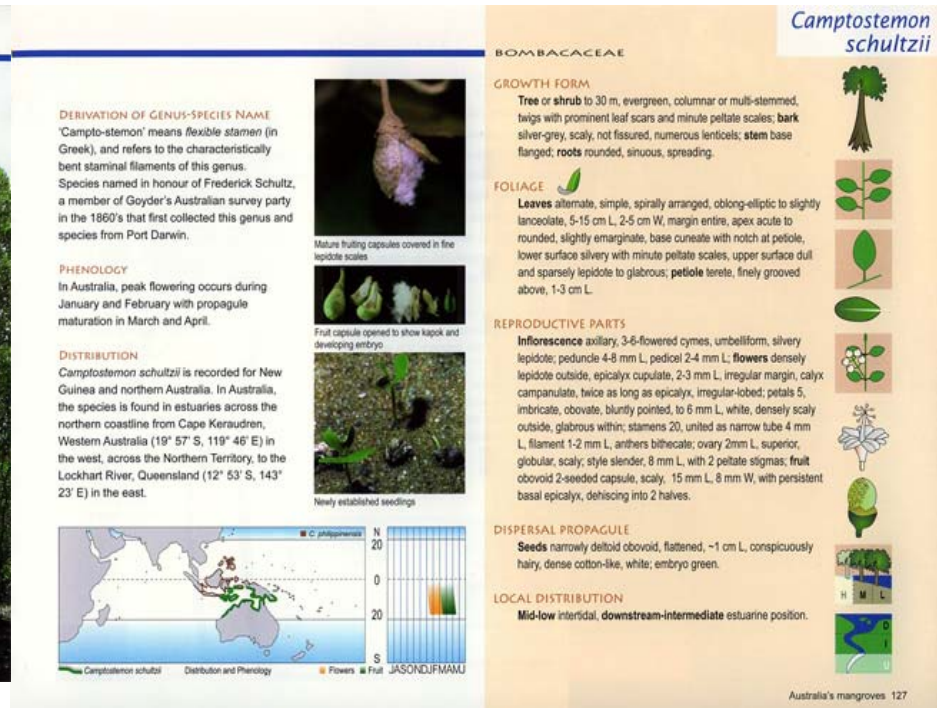

BOMBACACEAE

Camptostemon schultzii

DERIVATION OF GENUS-SPECIES NAME

'Campto-stemon' means *flexible stamen* (in Greek), and refers to the characteristically bent staminal filaments of this genus. Species named in honour of Frederick Schultz, a member of Goyder's Australian survey party in the 1860's that first collected this genus and species from Port Darwin.

PHENOLOGY

In Australia, peak flowering occurs during January and February with propagule maturation in March and April.

DISTRIBUTION

Camptostemon schultzii is recorded for New Guinea and northern Australia. In Australia, the species is found in estuaries across the northern coastline from Cape Keraudren, Western Australia (19° 57' S, 119° 46' E) in the west, across the Northern Territory, to the Lockhart River, Queensland (12° 53' S, 143° 23' E) in the east.

Mature fruiting capsules covered in fine lepidote scales

Fruit capsule opened to show kapok and developing embryo

Newly established seedlings

Camptostemon schultzii Distribution and Phenology

Flowers Fruit JASONDJFMAMJ

GROWTH FORM

Tree or **shrub** to 30 m, evergreen, columnar or multi-stemmed, twigs with prominent leaf scars and minute peltate scales; **bark** silver-grey, scaly, not fissured, numerous lenticels; **stem** base flanged; **roots** rounded, sinuous, spreading.

FOLIAGE

Leaves alternate, simple, spirally arranged, oblong-elliptic to slightly lanceolate, 5-15 cm L, 2-5 cm W, margin entire, apex acute to rounded, slightly emarginate, base cuneate with notch at petiole, lower surface silvery with minute peltate scales, upper surface dull and sparsely lepidote to glabrous; **petiole** terete, finely grooved above, 1-3 cm L.

REPRODUCTIVE PARTS

Inflorescence axillary, 3-6-flowered cymes, umbelliform, silvery lepidote; peduncle 4-8 mm L, pedicel 2-4 mm L; **flowers** densely lepidote outside, epicalyx cupulate, 2-3 mm L, irregular margin, calyx campanulate, twice as long as epicalyx, irregular-lobed; petals 5, imbricate, obovate, bluntly pointed, to 6 mm L, white, densely scaly outside, glabrous within; stamens 20, united as narrow tube 4 mm L, filament 1-2 mm L, anthers bithecate; ovary 2mm L, superior, globular, scaly; style slender, 8 mm L, with 2 peltate stigmas; **fruit** obovoid 2-seeded capsule, scaly, 15 mm L, 8 mm W, with persistent basal epicalyx, dehiscing into 2 halves.

DISPERSAL PROPAGULE

Seeds narrowly deltoid obovoid, flattened, ~1 cm L, conspicuously hairy, dense cotton-like, white; embryo green.

LOCAL DISTRIBUTION

Mid-low intertidal, **downstream-intermediate** estuarine position.

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Ceriops (4 species)

Ceriops tagal

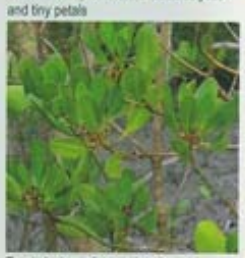
Ceriops zippeliana

Ceriops decandra

Ceriops (4 species)

RHIZOPHORACEAE

Flowers with prominent 5-lobed calyces and tiny petals



Erect clusters of spathulate leaves

Ceriops australis

SMOOTH-FRUITED YELLOW MANGROVE

Ceriops australis is closely comparable with *C. tagal*. The two were grouped as one until neighbouring trees were shown to be genetically isolated. The diagnostic characters used to identify them in the field is restricted to hypocotyl size and surface character. *Ceriops australis* is distinguished by its smooth rounded hypocotyls, rather than ribbed ones, that are also notably shorter, up to 10 cm long. Reliable identification can only be made when plants hold advanced reproductive material. For this reason, the distribution of the species is poorly defined beyond Australia and the southern New Guinea coast. In Australia, *C. australis* is typically the chief member of inner and drier mangrove stands. While it is unsuited to exposure of wave wash, currents and strong winds, it is however tolerant of low moisture and high salinities. These attributes are demonstrated where it commonly borders saltpans and arid landward margins. Such conditions are common along much of Australia's north coast, and the species dominates in these areas. *Ceriops australis* is found also in wetter regions, and it often co-exists with *C. tagal*, and to a lesser degree, *C. decandra*.

(C.T.White) Ballment, T.J.Sm. & J.A.Stoddart 1988

Dense stands of small slender trees in a wet region, Daintree River, Qld.

SPECIES FEATURE

MATURE HYPOCOTYLS ARE SMOOTH, ROUNDED AND RELATIVELY SHORT

Bark is orangy-pink with raised dark lenticels

Buttresses at stem base are short and stocky

Thickety shrubs growing along salt pan margins.

Excoecaria (1 species)

Excoecaria agallocha

Heritiera (3 species)

Heritiera littoralis

Heritiera globosa

Heritiera fomes

Kandelia (2 species)

Kandelia candel

Kandelia obovata

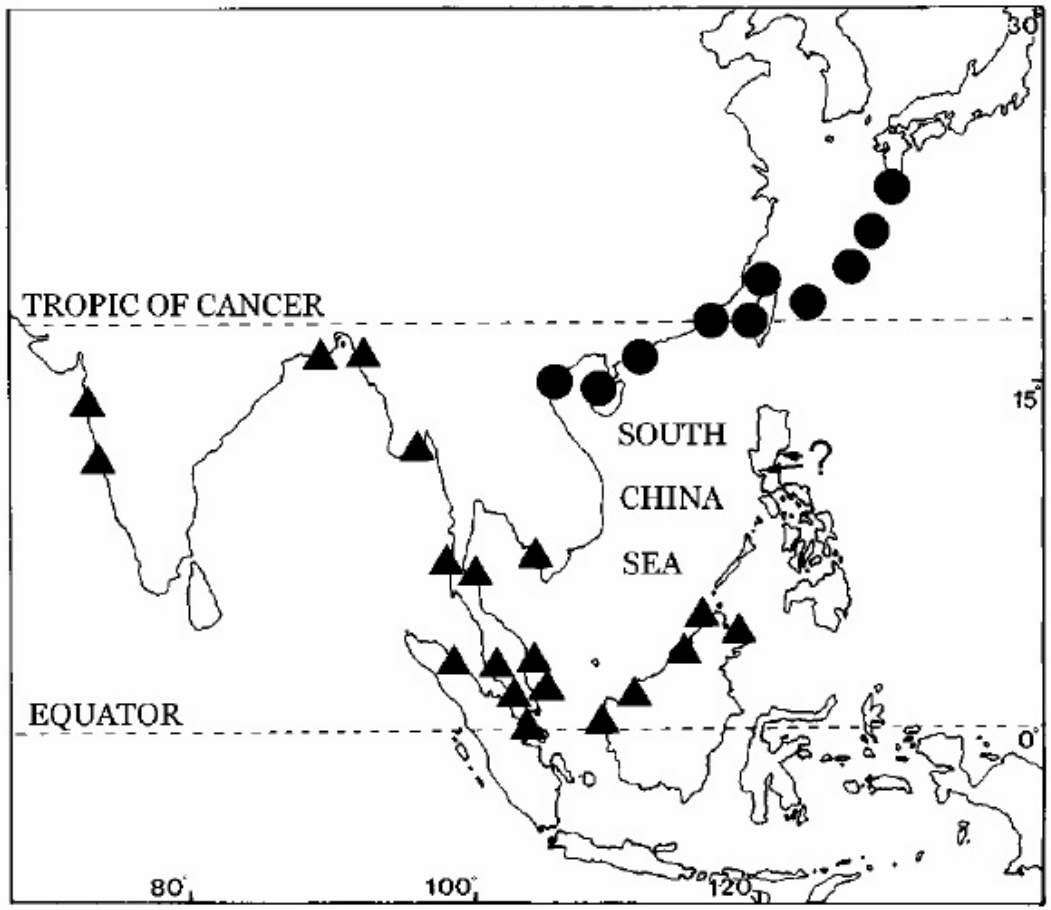


Fig. 4. Localities of *Kandelia candel* (triangles) and *K. obovata* (dots). Question mark refers to the doubtful localities in the Philippines. Sheue et al (2003)

Lumnitzera (2 species)

Lumnitzera racemosa

Lumnitzera littorea

Lumnitzera (hybrid)?

COMBRETACEAE

Lumnitzera × *rosea*

(Gaudich.) C.Presl ex Tomlinson, Bunt, Primack & N.C.Duke 1978

PINK-FLOWERED BLACK MANGROVE

Lumnitzera × *rosea* is the hybrid of *L. littorea* and *L. racemosa*. It is notable for its pink flowers, dense foliage on thickety shrubs with stems that are roughly fissured. The pink flowers offer confirmation of the intermediate identity of this showy hybrid. The habit of *L.* × *rosea* differs from its parents where it commonly borders mid to high intertidal margins of intermediate estuarine locations of notably moderate to wet climatic regions. These locations may be generally characterised as having seasonally lower salinities, but occasionally influenced by near dry sediments. Relatively little is known about this hybrid and its distribution. It is considered rare, but it may occur more widely once its identity is better known. For example, records for the Daintree River estuary and Bauer Inlet remain unconfirmed without photographs or samples. *Lumnitzera* × *rosea* is distinguished from putative parents by its terminal racemes of flowers with long, reflexed, pink petals nearly as long as stamens, and slightly eccentric style placement.

Showy pink flowers

Obovate leaves with immature flower buds

SPECIES FEATURE

TERMINAL RACEMES OF PINK FLOWERS

Small shrub

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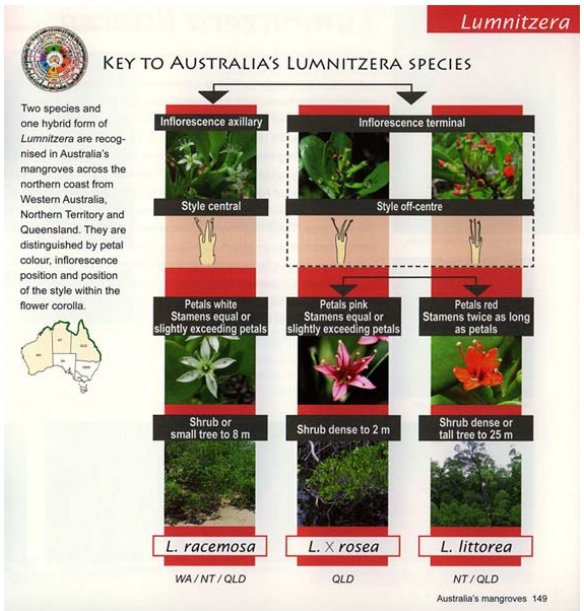

Lumnitzera

KEY TO AUSTRALIA'S LUMNITZERA SPECIES

Two species and one hybrid form of *Lumnitzera* are recognised in Australia's mangroves across the northern coast from Western Australia, Northern Territory and Queensland. They are distinguished by petal colour, inflorescence position and position of the style within the flower corolla.

Inflorescence axillary

Style central

Petals white
Stamens equal or slightly exceeding petals

Shrub or small tree to 8 m

L. racemosa

WA / NT / QLD

Inflorescence terminal

Style off-centre

Petals pink
Stamens equal or slightly exceeding petals

Shrub dense to 2 m

L. × *rosea*

QLD

Petals red
Stamens twice as long as petals

Shrub dense or tall tree to 25 m

L. littorea

NT / QLD

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Nypa (1 species)

Nypa fruticans

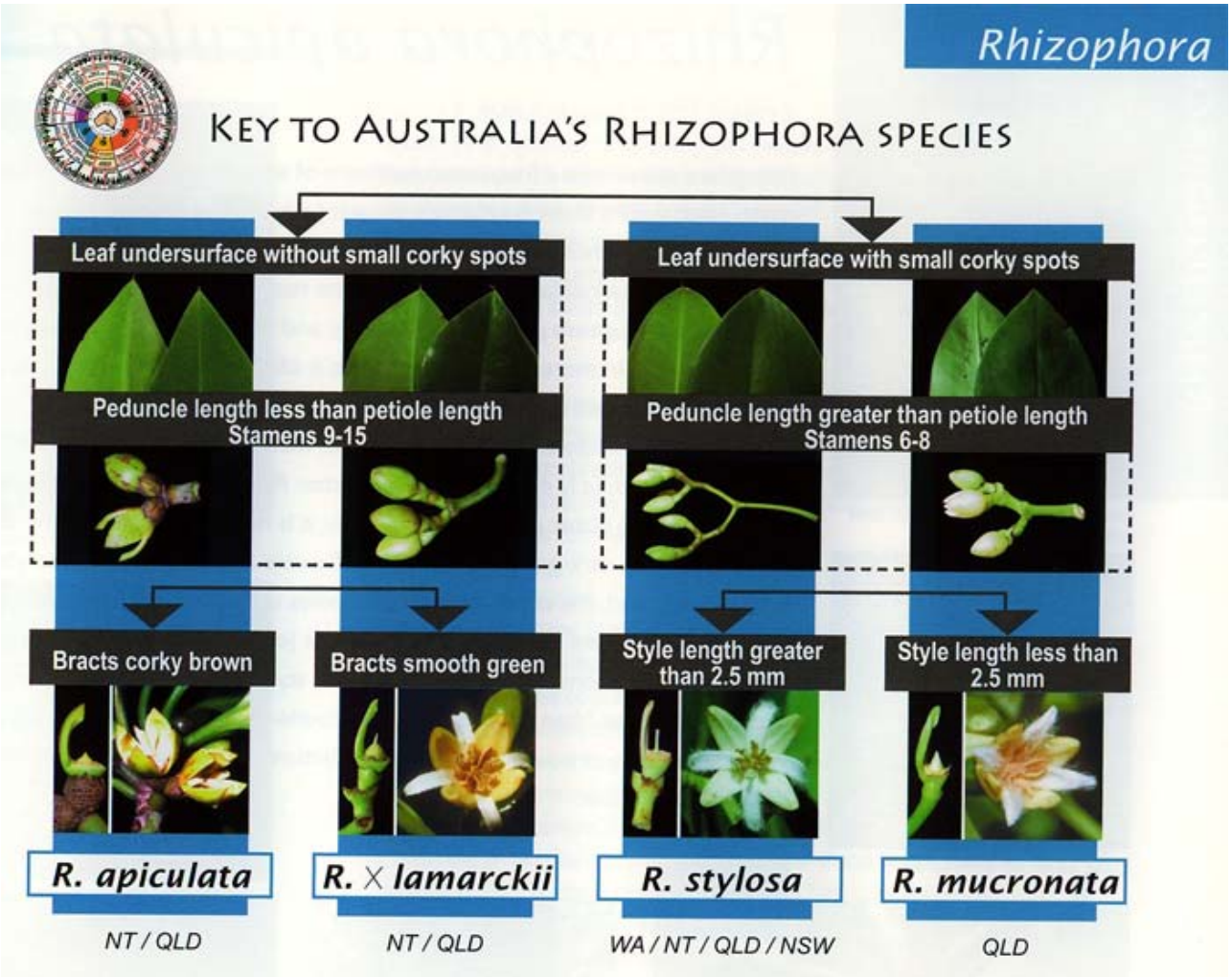
Osbornia (1 species)

Osbornia octondota

Phoenix (1 species)

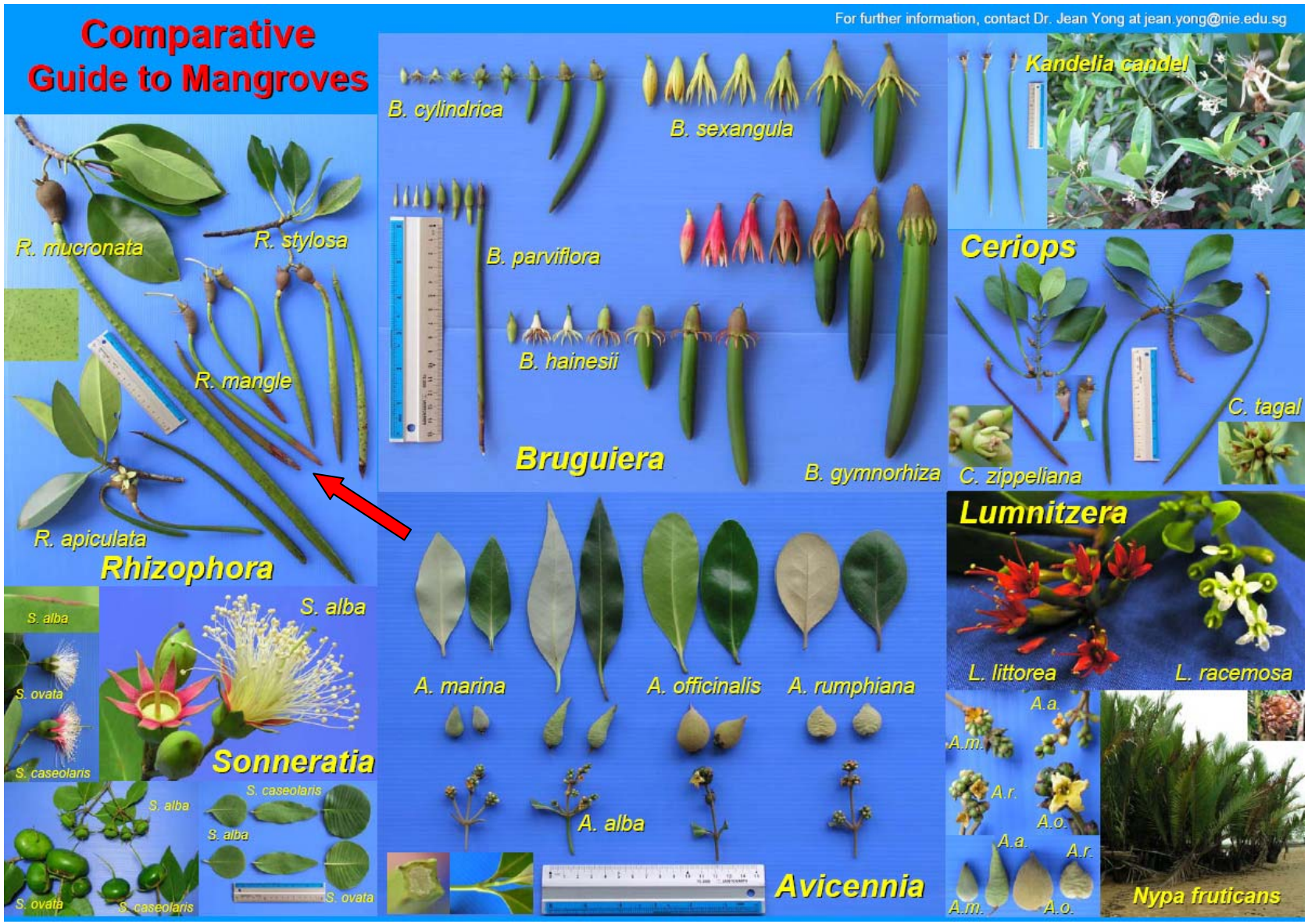
Phoenix paludosa

Rhizophora (3 species + 2 hybrids)



Rhizophora annamalayana (hybrid)

Rhizophora mangle in Singapore?



Scyphiphora (1 species)

Scyphiphora hydrophyllacea

Sonneratia (5 species)



Sonneratia alba


Sonneratia ovata



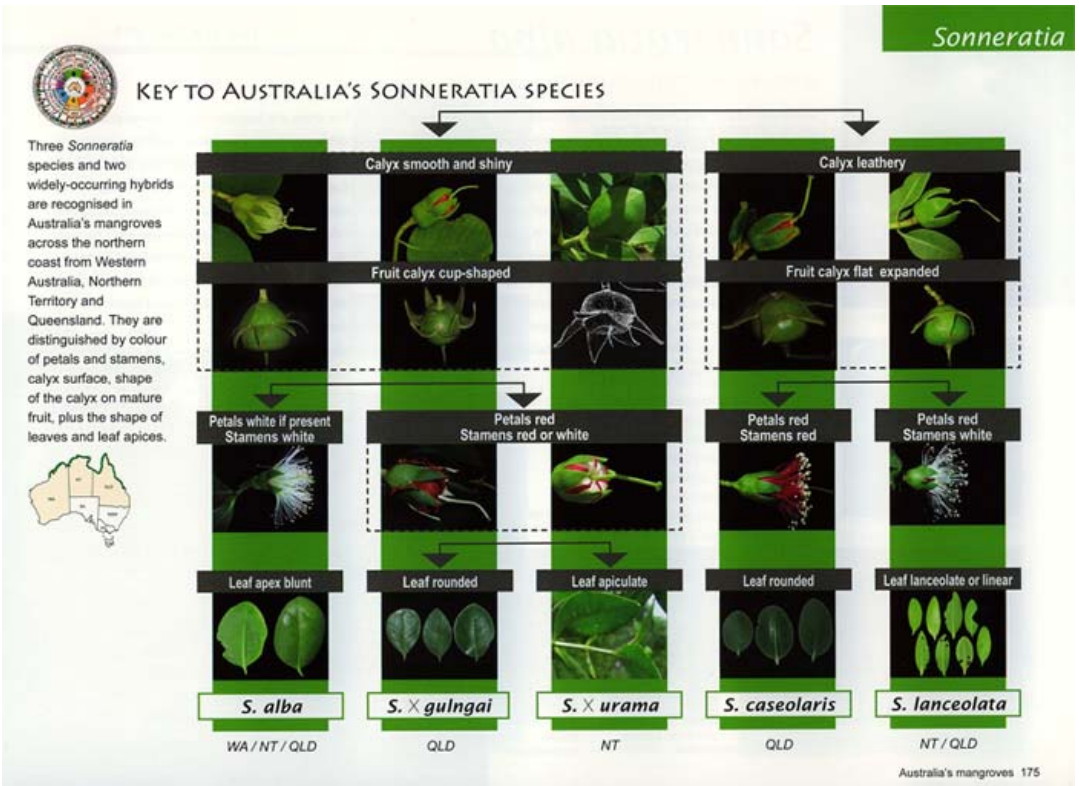
Sonneratia griffithii



Sonneratia apetala


Sonneratia caseolaris

Sonneratia (hybrid)

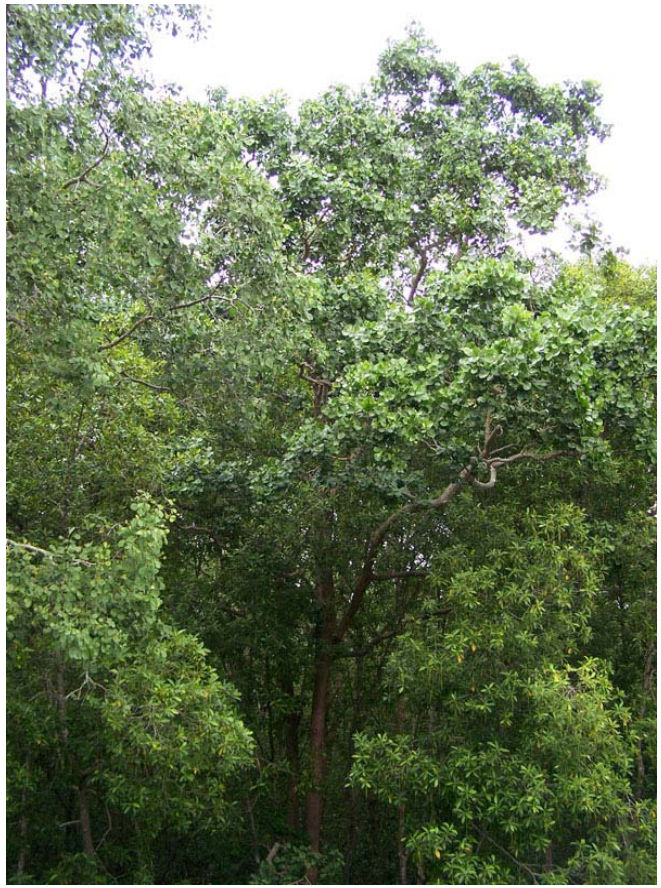


* *Sonneratia hainanensis* in Hainan (China)

- new species or hybrid?

Sonneratia (hybrid)?

S. ovata X S. caseolaris?



S. ovata X S. alba?

S. ovata X S. griffithii?

Xylocarpus (2 species)

Xylocarpus granatum

Xylocarpus moluccensis

Controversial species

- ***Pemphis acidula, Dolichandrone spathacea, Xylocarpus rumphii,* etc**

Characteristics of Mangrove Plant Diversity in Southeast and East Asia

- Mangrove zonation
- Endemism
- Disjunction
- Discontinuity
- Hybridization

MANGROVE HYBRID

- *Rhizophora, Sonneratia* & *Lumnitzera*
- Identification - sharing morphological characters of parental species.
- Taller than parental trees and thicker leaf
- Sterile or capable to reproductive?

Managing Mangrove Plant Diversity

- Reserve / protected area for hotspots - species richness, endemism, rare, discontinuity
- Classification of mangrove reserves
- *In situ* and *ex situ* conservation

Managing Mangrove Plant Diversity

Key Issues and Challenges:

- Rapid decline of mangrove resources
- Lack of mangrove reserves / protected areas with high species representation
- Rehabilitation / restoration of mangrove species - selecting the right species; introduction of species
- Interaction and connection with associated ecosystems - protection of marine bio-corridor
- Global climate change and rising of sea level - resilience of mangrove species and ecosystems

ACKNOWLEDGEMENTS

- Special thanks to MANGROVE FRIENDS:
  - Dr. Ong Jin Eong (Malaysia)
  - Dr. Norman C. Duke, University of Queensland (Australia)
  - Dr. Jean Yong WH, Nanyang Technological University (Singapore)
  - Dr. Jurgenne H. Primavera, SEAFDEC (Philippines)
  - Prof. Lu Chang-Yi, Xiamen University (China)
  - Prof. Nora Tam Fung-Yee, CITYU (Hong Kong, China)
  - Dr. Sheue Chiou-Rong, National Sun Yat-Sen University (Taiwan, China)
  - Dr. Sonjai Havanond, Department of Marine and Coastal Resources (Thailand)
  - Prof. Sanit Aksornkoae, Thailand Environment Institute (Thailand)
  - Prof. Phan Nguyen Hong, Vietnam National University (Vietnam)
  - Dr. Le Duc Tuan, Can Gio Mangrove Biosphere Reserve (Vietnam)
  - Prof. Sukristijono Sukardjo, Indonesian Institute of Sciences (Indonesia)
  - Prof. Shigeyuki Baba, University of the Ryukyus and ISME (Japan)
  - Prof. K. Kathiresan, Annamalai University (India)
  - Dr. Neaz Ahmad Siddiqi, Bangladesh Forest Research Institute (Bangladesh)

- Thanks to UNEP and GEF, and staff members of USAINS