

**INTERNATIONAL CONFERENCE ON BIODIVERSITY  
UGM YOGYAKARTA, 19 MARCH 2016**

# **The Mangrove Aerial Plants & an Update of the two IUCN Critically Endangered Mangroves**

The  
**Mangrove Aerial Plants &**  
**an Update of the two IUCN**  
**Critically Endangered Mangroves**

Jean W. H. Yong (“John” 杨远方), W. S. Wong, & C. R. Sheue



SINGAPORE UNIVERSITY OF  
TECHNOLOGY AND DESIGN

Established in collaboration with MIT





Diversity of “True” mangroves



Batam, Indonesia



# Comparative Guide to Mangroves

For further information, contact Dr. Jean Yong at [jyong@sutd.edu.sg](mailto:jyong@sutd.edu.sg)





19.07.2009 11:14

Seram, Indonesia



# Mangrove Species Checklist

OPEN  ACCESS Freely available online

 PLOS ONE

## The Loss of Species: Mangrove Extinction Risk and Geographic Areas of Global Concern

Beth A. Polidoro<sup>1\*</sup>, Kent E. Carpenter<sup>1</sup>, Lorna Collins<sup>2,3</sup>, Norman C. Duke<sup>4</sup>, Aaron M. Ellison<sup>5</sup>, Joanna C. Ellison<sup>6</sup>, Elizabeth J. Farnsworth<sup>7</sup>, Edwino S. Fernando<sup>8</sup>, Kandasamy Kathiresan<sup>9</sup>, Nico E. Koedam<sup>10</sup>, Suzanne R. Livingstone<sup>1</sup>, Toyohiko Miyagi<sup>11</sup>, Gregg E. Moore<sup>12</sup>, Vien Ngoc Nam<sup>13</sup>, Jin Eong Ong<sup>14</sup>, Jurgenne H. Primavera<sup>15</sup>, Severino G. Salmo, III<sup>4,16</sup>, Jonnell C. Sanciangco<sup>1</sup>, Sukristijono Sukardjo<sup>17</sup>, Yamin Wang<sup>18</sup>, Jean Wan Hong Yong<sup>19</sup>

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**Table: List & Conservation status of the “True” mangrove species at Merbok, Kedah (2013)**

**“True” Mangrove species (Peninsula Malaysia, Sabah and Sarawak) as defined by Polidoro *et al.* (2010)**

	<b>Species</b>	<b>Family</b>	<b>Conservation status*</b>	<b>Malaysia</b>	<b>Kedah</b>	<b>Merbok</b>	<b>Langkawi</b>
1	<i>Acanthus ilicifolius</i>	Acanthaceae	-	✓	✓	✓	✓
2	<i>Acanthus ebracteatus</i>	Acanthaceae	-	✓	✓	✓	✓
3	<i>Acanthus volubilis</i>	Acanthaceae	-	✓	✓	✓	Absent
4	<i>Acrostichum aureum</i>	Pteridaceae	-	✓	✓	✓	✓
5	<i>Acrostichum speciosum</i>	Pteridaceae	-	✓	✓	✓	✓
6	<i>Aegiceras corniculatum</i>	Myrsinaceae	-	✓	✓	✓	✓
7	<i>Aegiceras floridum</i>	Myrsinaceae	Endangered (Malaysia)	✓ (Sabah)	Absent	Absent	Absent
8	<i>Aglaia cucullata</i>	Meliaceae	Data Deficient IUCN Global	✓	✓	✓	Absent
9	<i>Avicennia alba</i>	Acanthaceae	-	✓	✓	✓	✓
10	<i>Avicennia marina</i>	Acanthaceae	-	✓	✓	✓	✓
11	<i>Avicennia officinalis</i>	Acanthaceae	-	✓	✓	✓	✓
12	<i>Avicennia rumphiana</i>	Acanthaceae	-	✓	Absent	Absent	Absent
13	<i>Brownlowia argentata</i>	Tiliaceae	Critically Endangered IUCN Global Data Deficient	✓ (S. Kerian, Perak)	May occur?	Absent	Absent
14	<i>Brownlowia tessa</i>	Tiliaceae	-	✓	✓	✓	✓
15	<i>Bruguiera cylindrica</i>	Rhizophoraceae	-	✓	✓	✓	✓
16	<i>Bruguiera gymnorhiza</i>	Rhizophoraceae	-	✓	✓	✓	✓
17	<i>Bruguiera parviflora</i>	Rhizophoraceae	-	✓	✓	✓	✓
18	<i>Bruguiera hainesii</i>	Rhizophoraceae	Critically Endangered; IUCN Global Critically Endangered	✓ (< 150 ?)	✓ (< 50 trees ?)	✓ (3 trees)	✓ (> 20 trees)
19	<i>Bruguiera sexangula</i>	Rhizophoraceae	-	✓	✓	✓	✓
20	# <i>Bruguiera</i> hybrids/sp nov ( <i>B X rhynchosperala</i> )	Rhizophoraceae	Endangered (Malaysia)	✓	✓	✓	✓
21	<i>Campostemon philippinense</i>	Bombacaceae	Endangered IUCN Global	✓ (Sabah)	Absent	Absent	Absent
22	<i>Ceriops decandra</i>	Rhizophoraceae	Endangered IUCN Global	✓	✓	Absent	✓ (new record)

# **Limitations of the Current Approach**

Medan, Sumatra, Indonesia



No aerial plants in “Monoculture” plantation mangrove forest

# Epiphytes

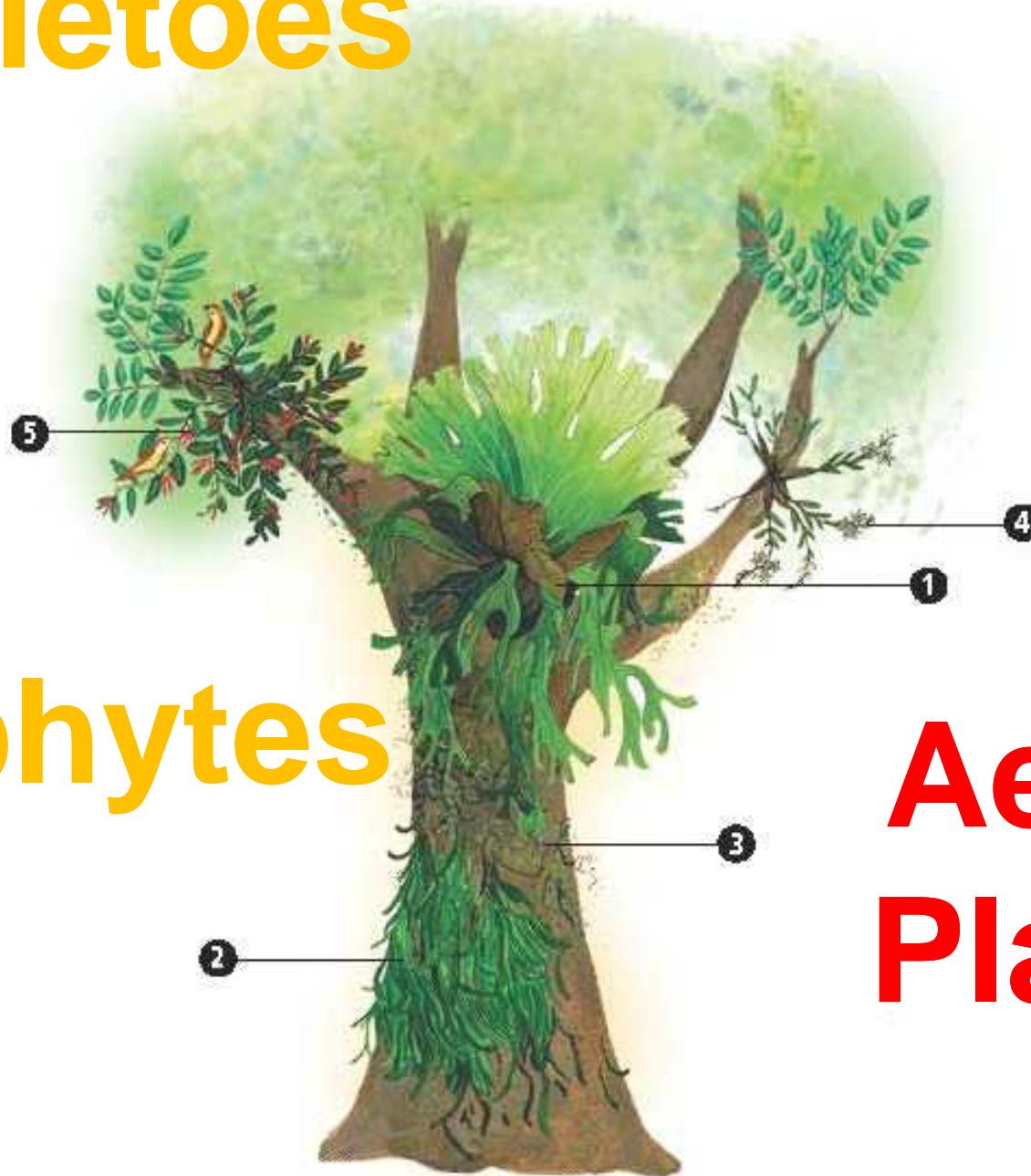
Bird's Nest fern  
*Asplenium nidus*

Rabbit's Foot fern  
*Davallia denticulata*

C<sub>3</sub> mode of photosynthesis

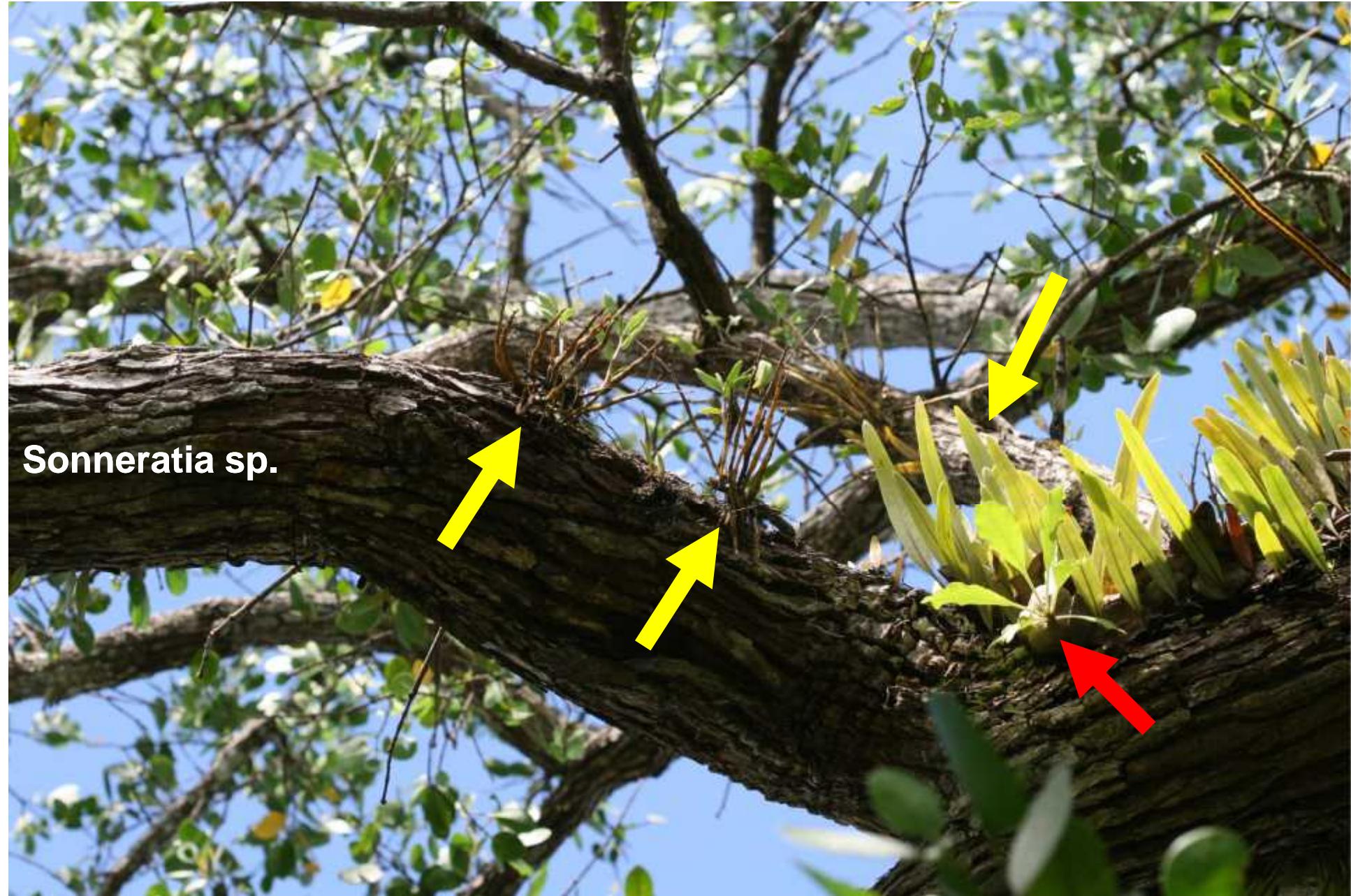
Host tree: Raintree  
*Samanea saman*

# Mistletoes



**Epiphytes**

**Aerial  
Plants**



Sonneratia sp.

Mangrove Aerial Plants



Sonneratia sp.

Manado, Sulawesi, Indonesia

# Mangrove Epiphytes



Oak-leaf fern  
(*Drynaria quercifolia*)



Pigeon orchids  
(*Dendrobium crumenatum*)



*Cymbidium  
finlaysonianum*

Common  
mangrove  
epiphytic orchids

# Climbers

## Terrestrial



Money plant  
(*Epipremnum aureum*)

# Climbers

## Mangroves



*Finlaysonia obovata*

Host tree: *Rhizophora apiculata*

# Climbers Mangroves



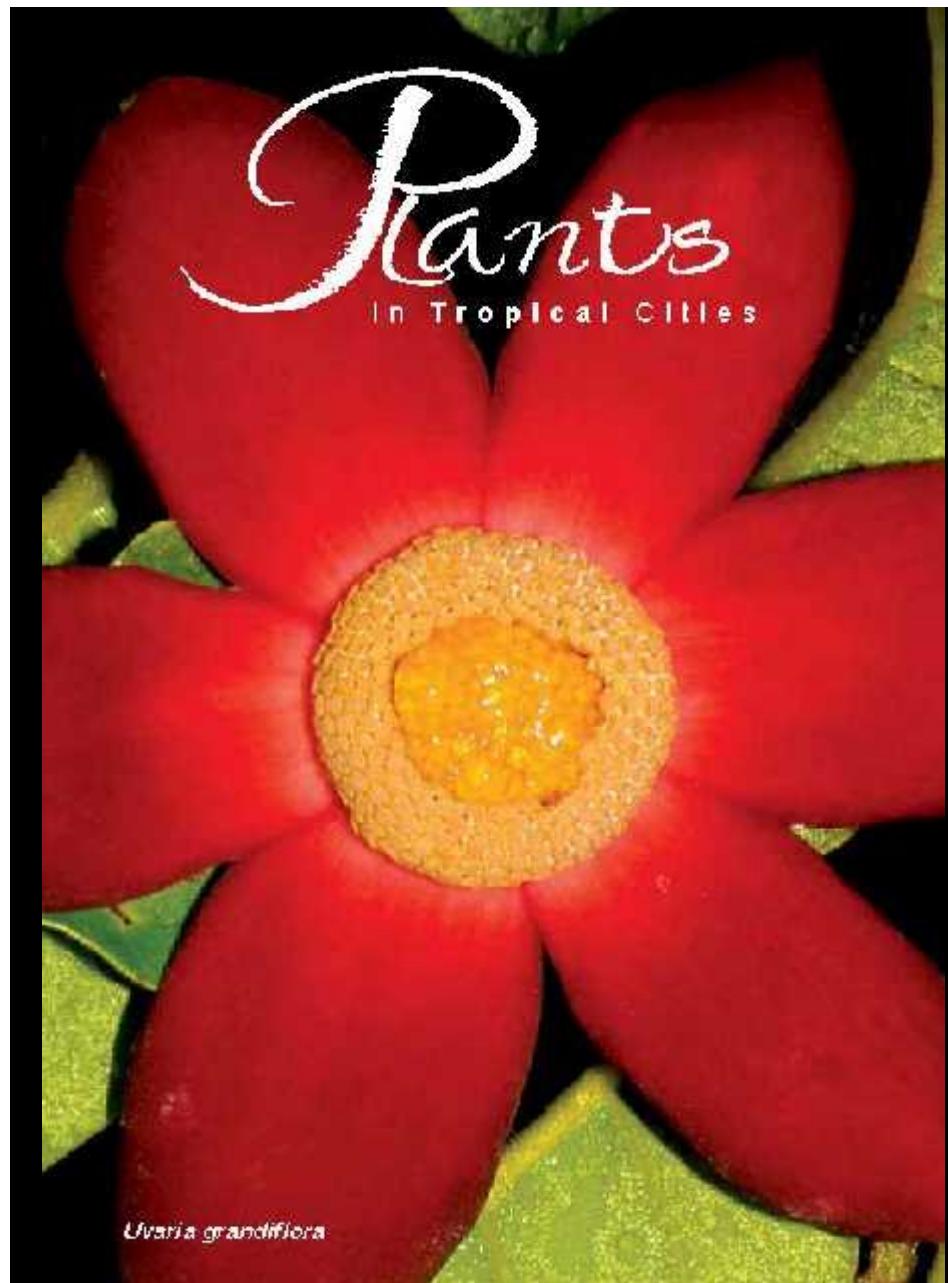
***Derris trifoliata***





**Mangrove Climbers  
are also SALT TOLERANT**

***Finlaysonia obovata***



*Uvaria grandiflora*

# Plants in Tropical Cities



## Climbers

Climbers are woody plants adapted to climb over other plants or any object or support to better access sunlight. Many climbers typically have soft, thin, round stems with a small diameter. This is in opposition to woody vines, which have a much thicker, woody, supporting structure. Other climbers may even develop specialized aerial root structures like in ivy, plantain lily (convolvulus), or wrapping around tree trunks like in climbing monstera. Climbers are very useful in many landscaping applications as these plants provide vertical green cover for man-made structures such as fences or walls. When combined to evergreen shrubs or trees as hedges, climbers have the added advantage of taking up less space for establishment (less root volume). For decades, vines are increasingly being used as planting materials for more vertical greening projects in our Capital urban space.

2	21	50
15	31	51
24	32	52
28	33	53
30	48	54
34	49	55
35	50	56
		57
		58
		59
		60
		61
		62
		63
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		69
		70
		71
		72
		73
		74

Koh Kong, Cambodia



No aerial plants in “Monoculture” plantation mangrove forest



Ant plants

Pulau Pawai, Singapore

Aerial plant *Hydnophytum* in a “**PRISTINE**” mangrove forest

# Ant plants



# Mangrove Epiphytes



***Hydnophytum formicarum* (Rubiaceae) in  
the mangrove forest canopy**

**Lumnitzera littorea**

**Myrmecodia sp (Rubiaceae) in the mangrove forest canopy**



**Bruguiera parviflora**



**Rhizophora apiculata**

Seram, Indonesia

# Mangrove Epiphytes



*Lumnitzera littorea*

**Myrmecodia** sp (Rubiaceae) in the mangrove forest canopy



*Sonneratia alba*

+ *Dischidia major*

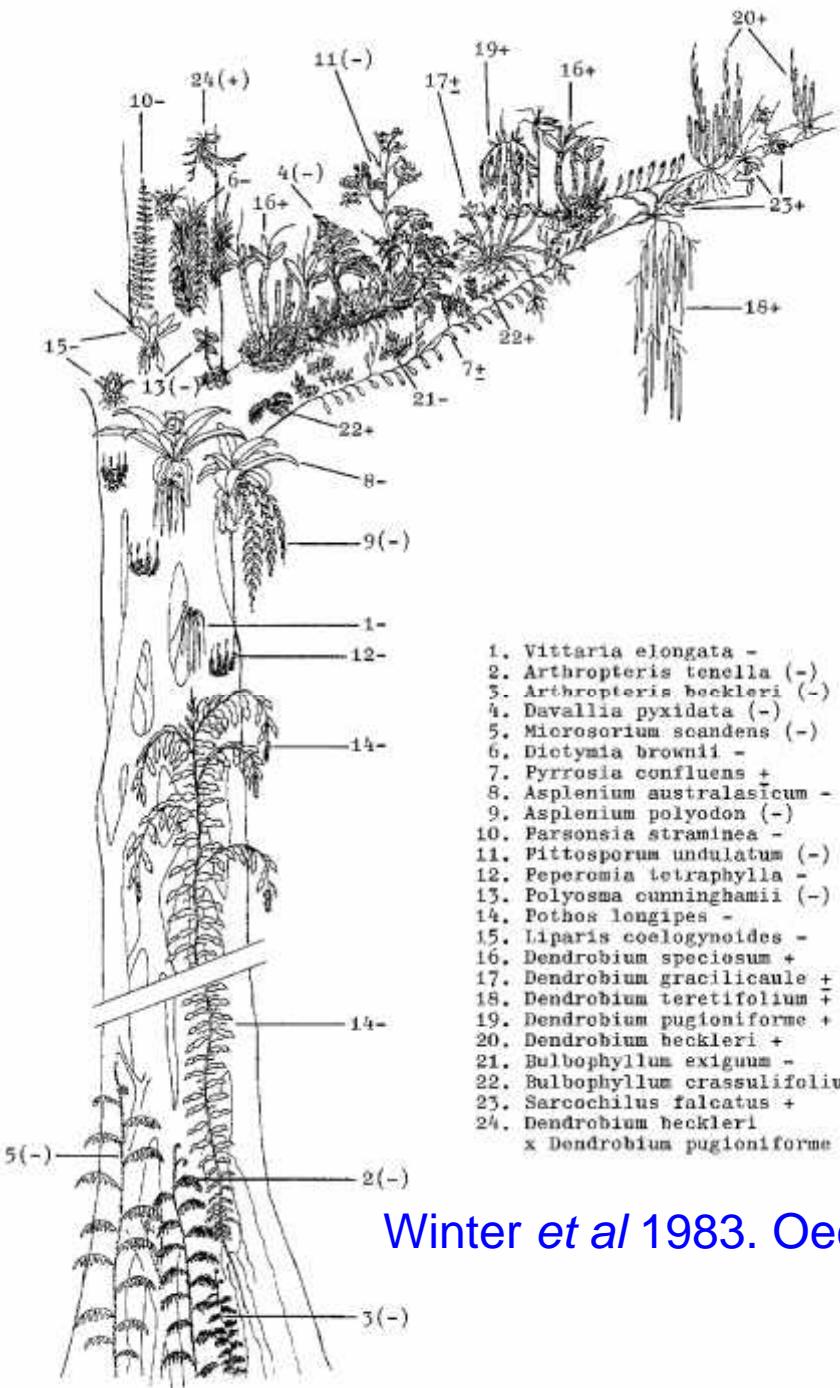
Pulau Ubin, Singapore



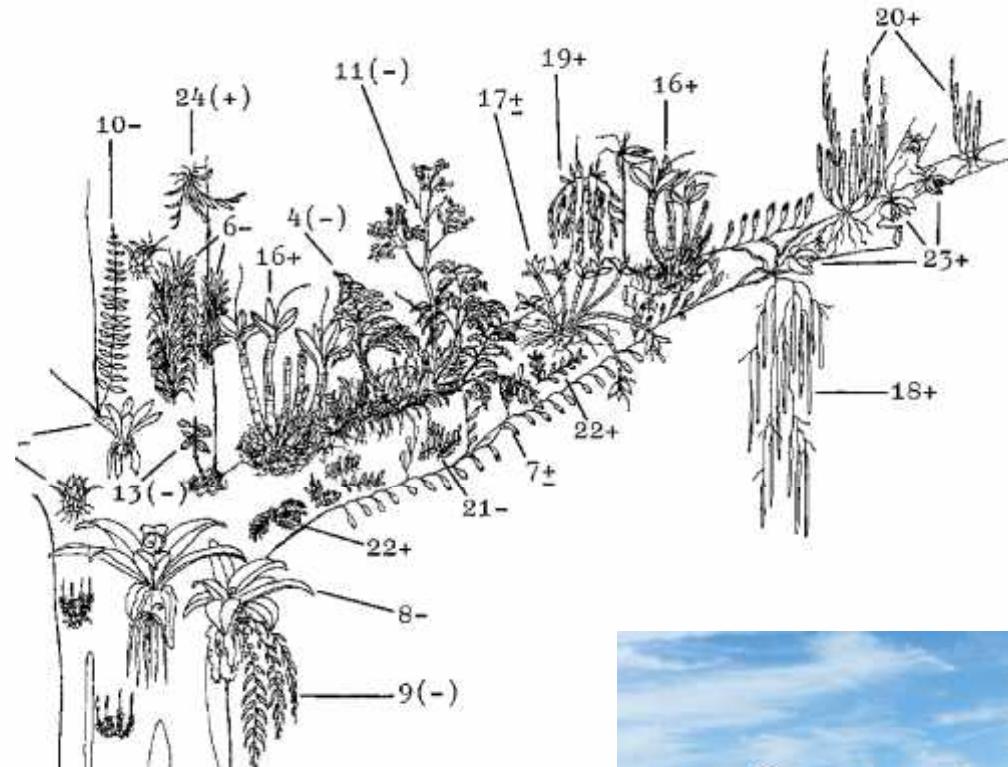
*Avicennia officinalis*

+ *Hoya diversifolia*

Pulau Ubin, Singapore



Winter et al 1983. Oecologia



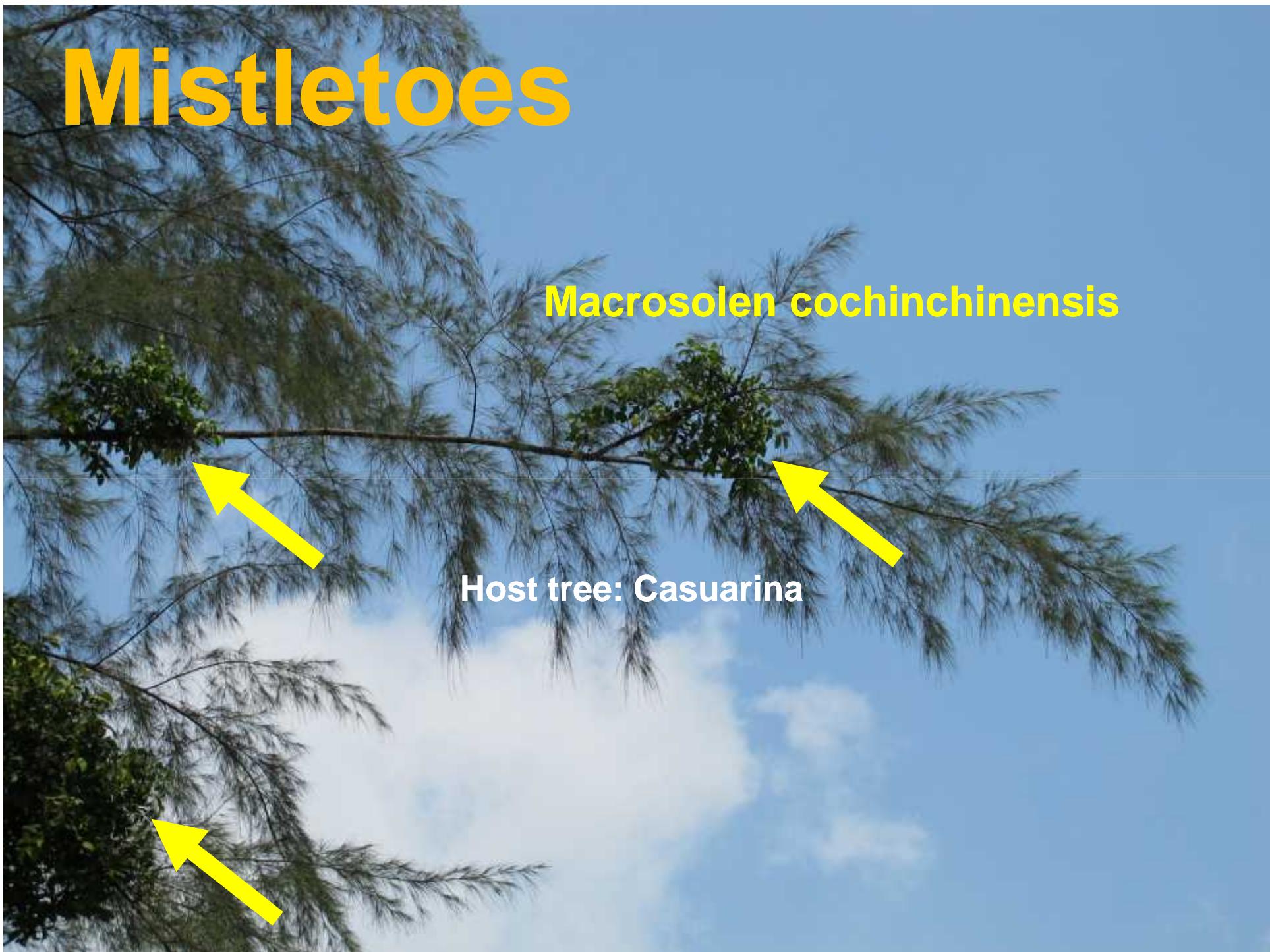
Dr Klaus Winter &  
Prof Joe Holtum



# Mistletoes

*Macrosolen cochinchinensis*

Host tree: Casuarina



**A Eucalyptus tree can tolerate over 50% mistletoe  
(Amyema sp) infestation.**



**Canberra, Australia**

Merbok mangroves, Kedah, Malaysia

# Mangrove Mistletoes



# Mangrove Mistletoes



Trat, Thailand

*Excoecaria agallocha*

*Viscum ovalifolium*

# Mangrove Mistletoes



Host tree:  
*Xylocarpus granatum*

**Scurrula sp**

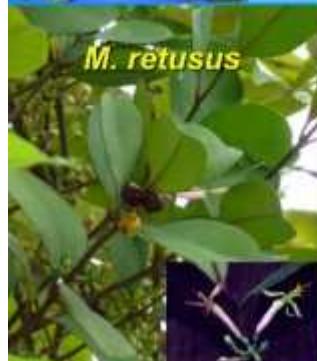
# Mangrove Mistletoes



Scurrula sp.

Xylocarpus granatum

# Mistletoes of Singapore

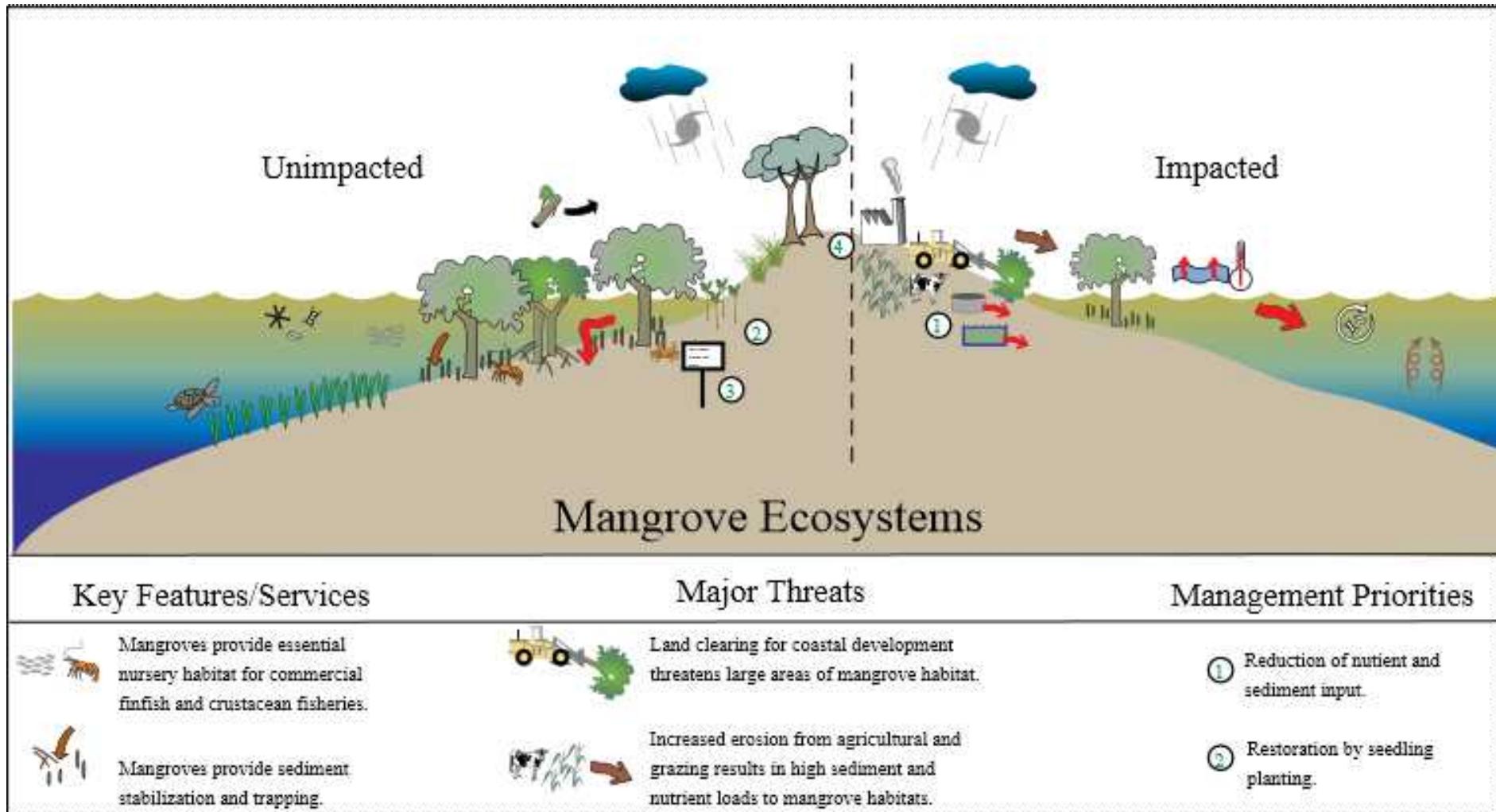


For further information, contact Dr. Jean Yong at [jyong@sutd.edu.sg](mailto:jyong@sutd.edu.sg)

## Scurrula



# Unimpacted versus Impacted

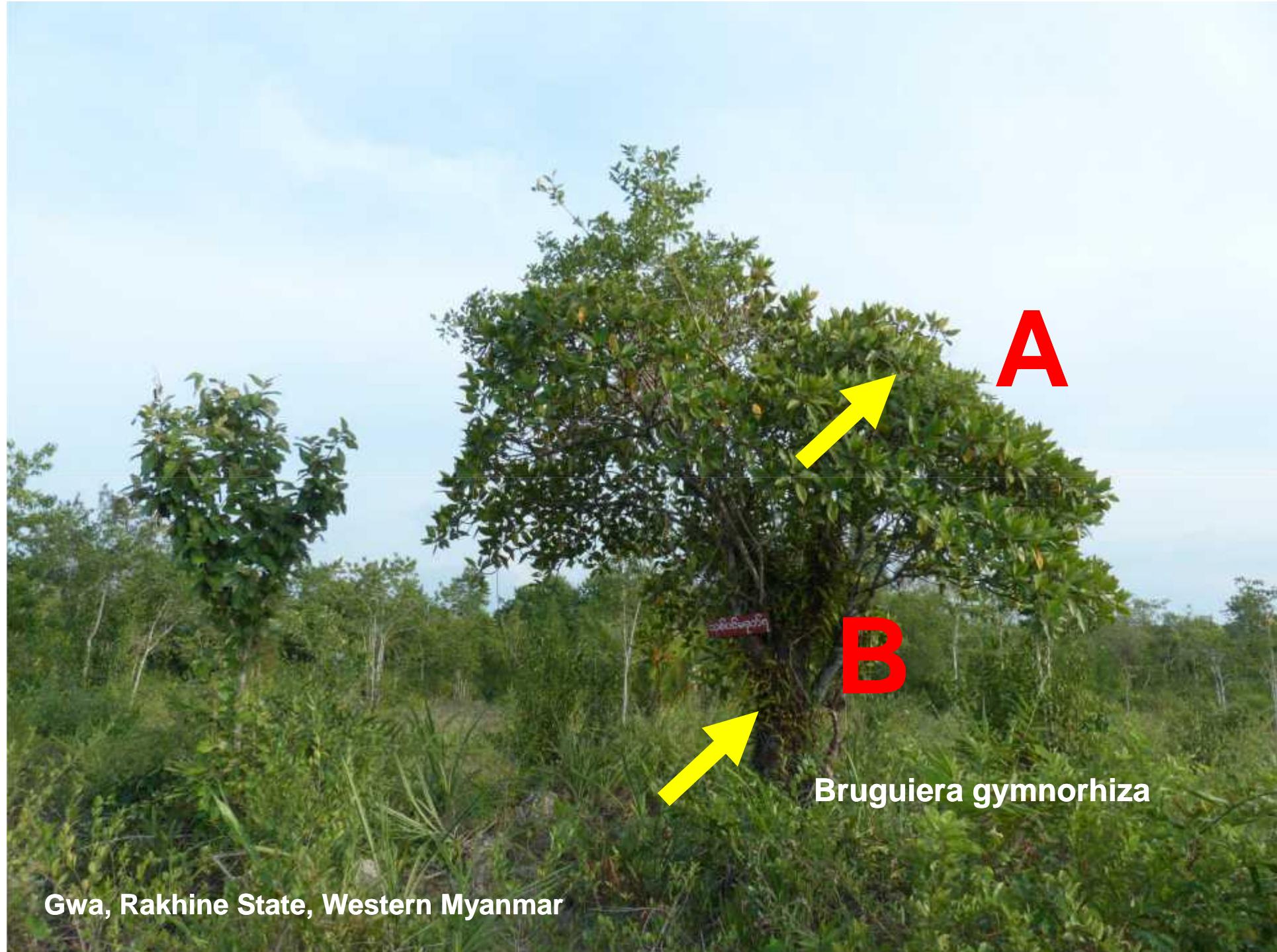


## Mangrove Ecosystems

Credit: University of Maryland Center for Environmental Science

## **Case study**

Aerial plants increased the biodiversity value of a mangrove forest in Western Myanmar



Gwa, Rakhine State, Western Myanmar



Gwa, Rakhine State, Western Myanmar

A

Mangrove Mistletoes

Gwa, Rakhine State, Western Myanmar

B



Mangrove Epiphytes

# Aerial Plants

Provide more information about  
the biodiversity value of a  
mangrove forest

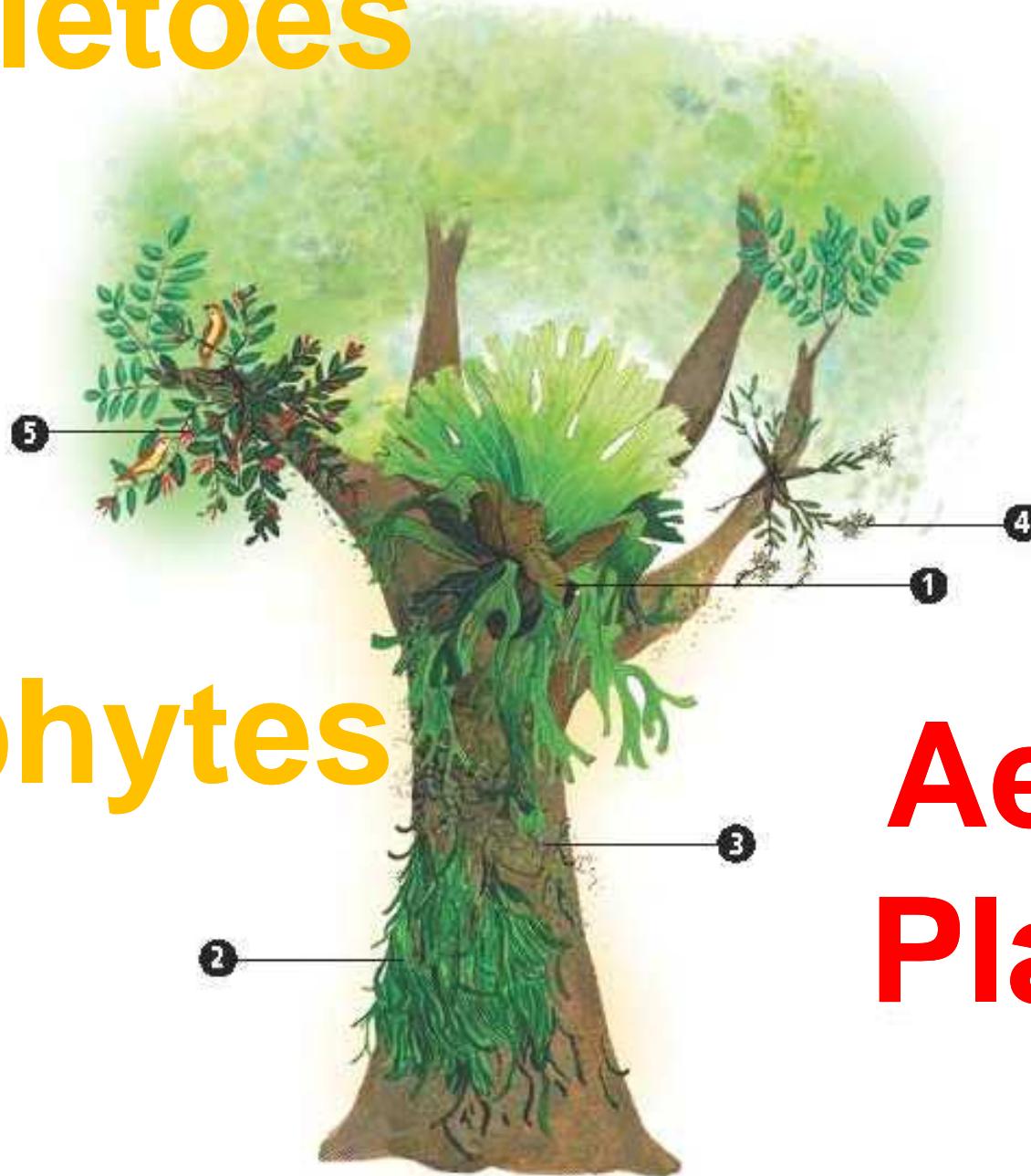
“True” Mangrove species (Peninsula Malaysia, Sabah and Sarawak) as defined by Polidoro *et al.* (2010)

	Species	Family	Conservation status*	Malaysia	Kedah	Merbok	Langkawi
26	<i>Dolichandrone spathacea</i>	Bignoniaceae	-	✓	✓	✓	✓
27	<i>Ecoecaria agallocha</i>	Euphorbiaceae		✓	✓	✓	✓
28	<i>Heritiera fomes</i>	Sapotaceae	Critically Endangered (Malaysia)	✓	✓ (40? trees)	✓ (40? trees)	Absent
29	<i>Heritiera globosa</i>	Sapotaceae	Endangered IUCN Global	✓ (Sabah; Sarawak?)	Absent	Absent	Absent
30	<i>Heritiera littoralis</i>	Sapotaceae	-	✓	✓	✓	✓
31	<i>Kandelia candel</i>	Rhizophoraceae	-	✓	Absent	Absent	Absent
32	<i>Lumnitzera littorea</i>	Combretaceae		✓	✓	✓	✓
33	<i>Lumnitzera racemosa</i>	Combretaceae		✓	✓	✓	✓
34	<i>Nypa fruticans</i>	Arecaceae		✓	✓	✓	✓
35	<i>Osbornia octodonta</i>	Myrtaceae	Endangered (Malaysia)	✓ (Sabah)	Absent	Absent	Absent
36	<i>Pemphis acidula</i>	Typhaceae		✓	?	Absent	?
37	<i>Phoenix paludosa</i>	Arecaceae	Vulnerable	✓	✓	✓	✓
38	<i>Rhizophora apiculata</i>	Rhizophoraceae		✓	✓	✓	✓
39	<i>Rhizophora mucronata</i>	Rhizophoraceae	-	✓	✓	✓	✓
40	<i>Rhizophora stylosa</i>	Rhizophoraceae	-	✓	✓	✓	✓
41	<i>R X ammalayana</i>	Rhizophoraceae	Endangered (Malaysia)	✓	✓	✓	✓

Merbok mangroves: 1<sup>st</sup> report of a mistletoe  
**Viscum ovalifolium** (dedalu) parasitizing  
**Rhizophora mucronata**.



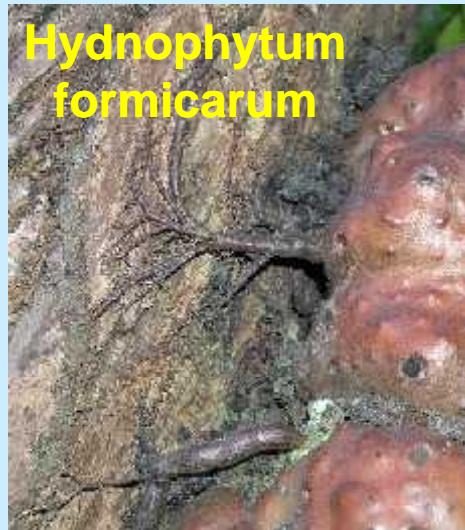
# Mistletoes



**Epiphytes**

**Aerial  
Plants**

# Epiphytes & Climbers



Ferns & orchids

No vascular  
connections but  
anchorage

# Mistletoes



Haustorium

Vascular  
connections

Host tree-aerial  
plant  
“Connections”  
influence the  
physiology of  
aerial plants



**Viscum ovalifolium on  
Rhizophora apiculata**



**Scurrula parasitica on  
Xylocarpus granatum**

Merbok mangroves, Kedah, Malaysia



**Merbok mangroves, Kedah, Malaysia**

## Merbok mangroves, Kedah, Malaysia



Forestry Research  
Institute of  
Malaysia (FRIM)



# Mangrove Mistletoes

Host tree:  
*Ceriops tagal*

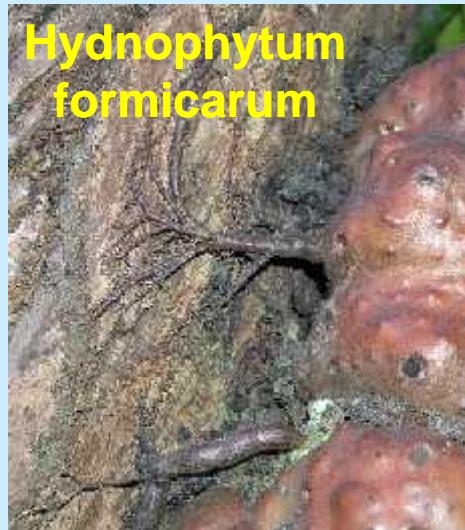


*Amyema mackayense*



**Amyema mackayense**

# Epiphytes & Climbers



Ferns & orchids

No vascular  
connections but  
anchorage

# Mistletoes



Haustorium

Vascular  
connections

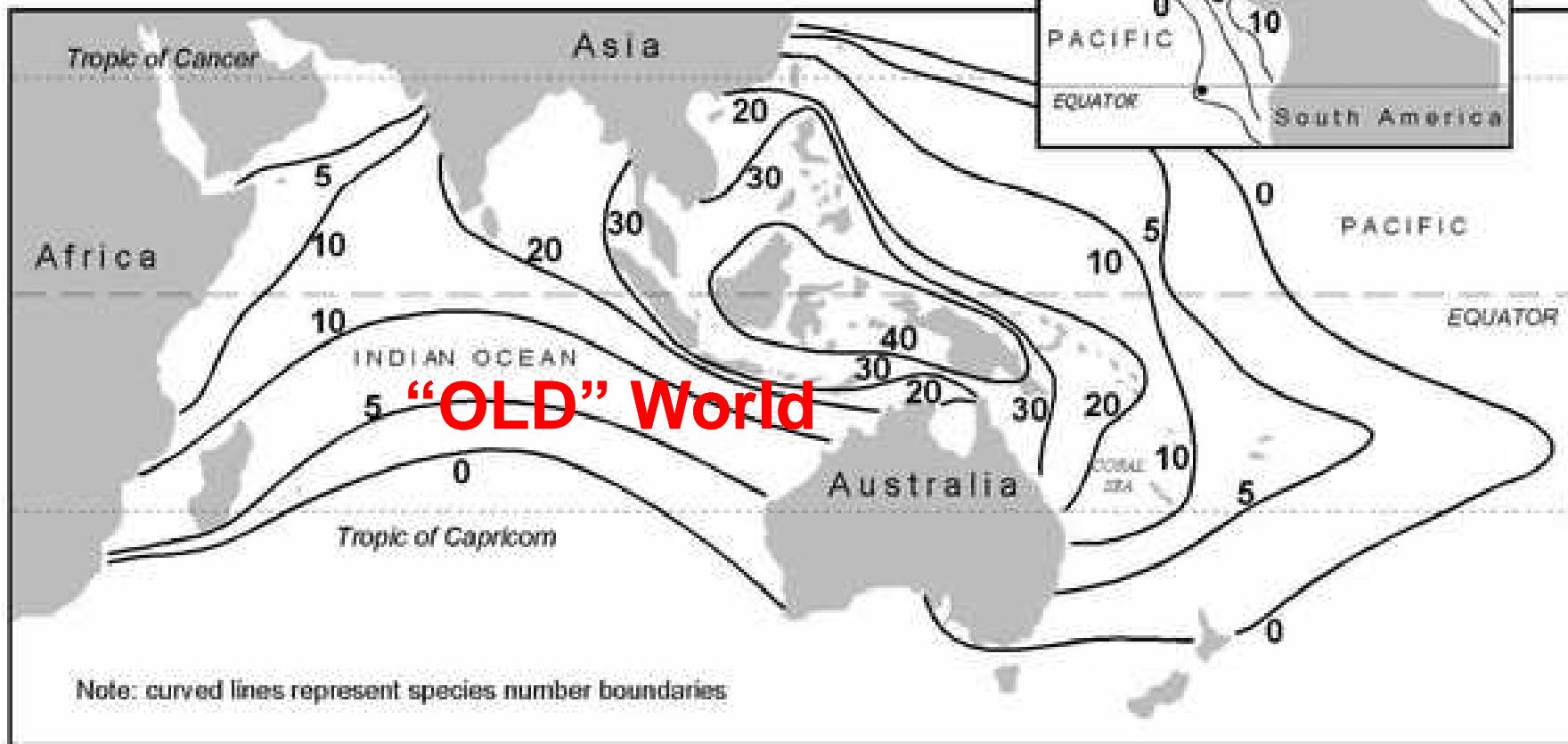
Host tree-aerial  
plant  
“Connections”  
influence the  
physiology of  
aerial plants

# **Aerial Plants of the Old World Tropics**

## **Mangroves**

# Global mangrove species distribution

(a) Indo West Pacific (IWP)



# Observations from New World Tropics





**Tea mangrove or *Pelliciera rhizophorae*  
(Tetrameristaceae)**

**Learning from the  
New World tropics**

**Rio Sierpe, Costa Rica**



Boca Chita, Panama



# Aerial Plants

Epiphytic bromeliads

Rio Sierpe, Costa Rica

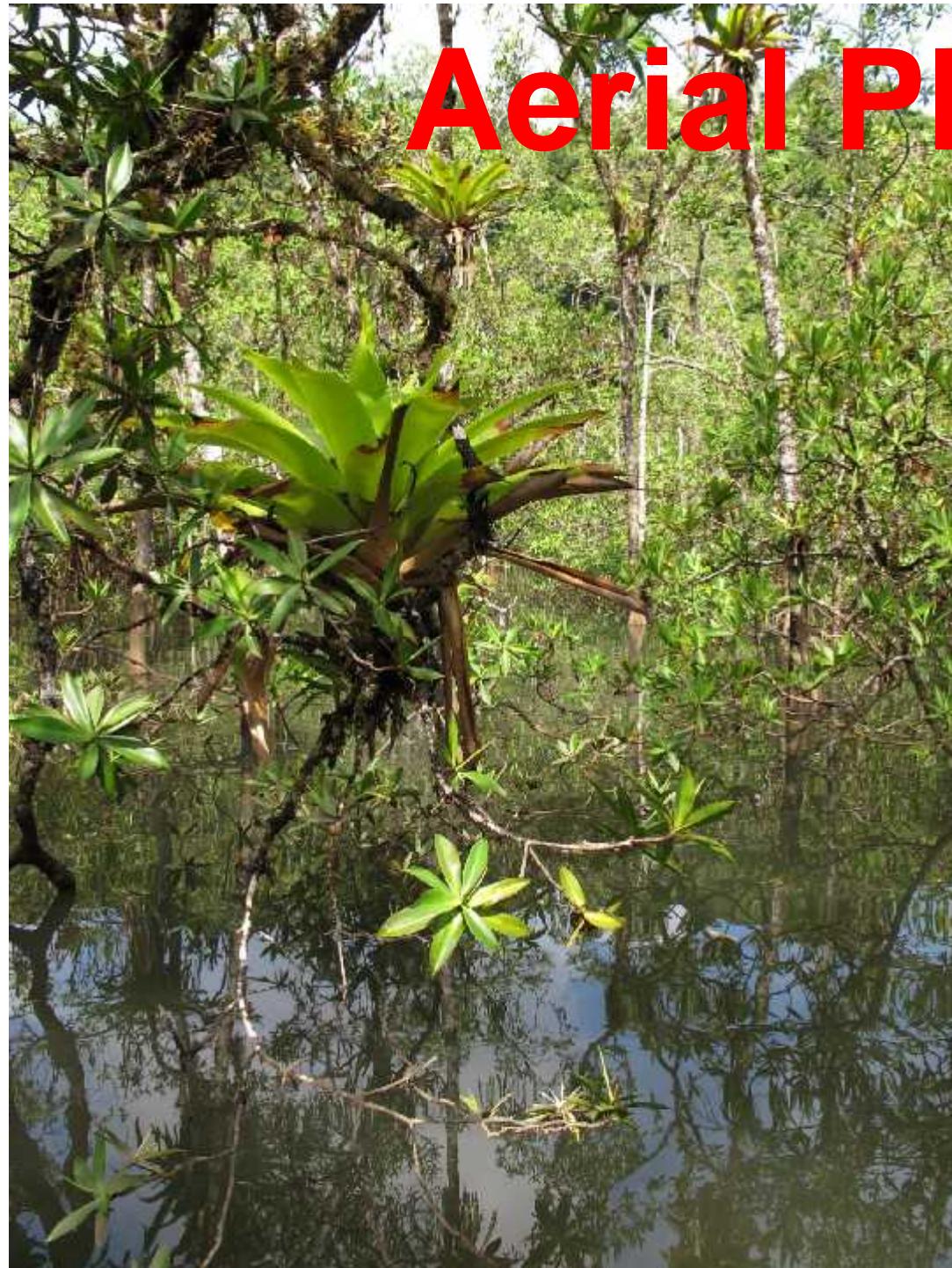


**Pelliciera rhizophorae  
dominated-mangrove  
forest**



# Learning from the New World tropics

Rio Sierpe, Costa Rica



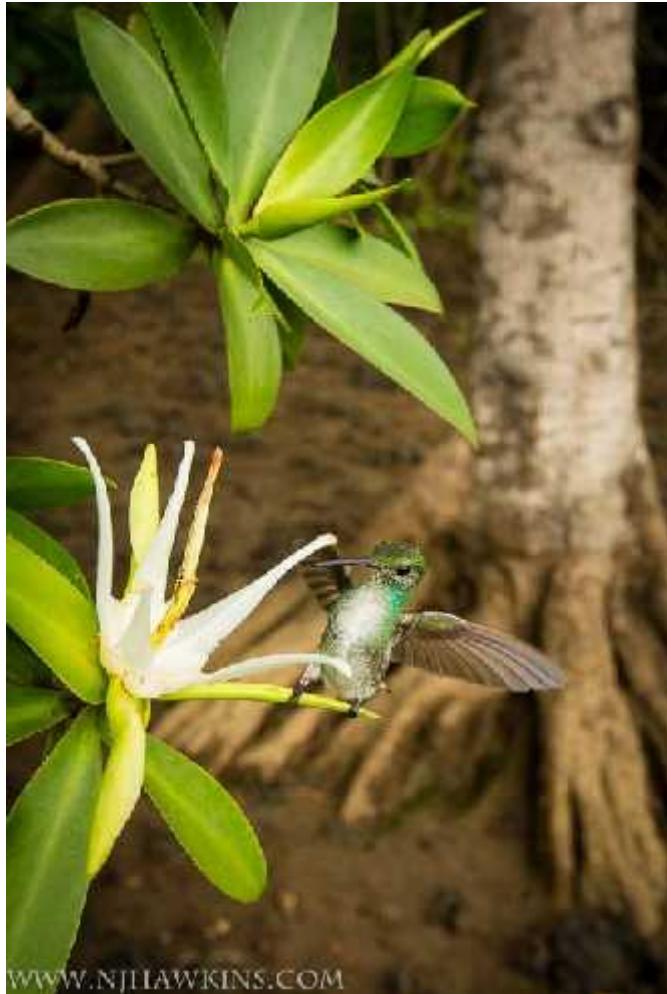
# Aerial Plants

Epiphytes in  
mangroves

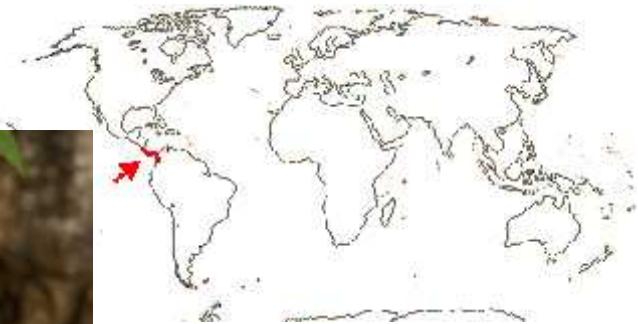
Rio Sierpe, Costa Rica.

# Mangrove Hummingbird

(*Amazilia boucardi*)



WWW.NJLAWKINS.COM



<http://uniondeornitologos.com/?topic=colibri-de-manglar-amazilia-boucardi>  
<http://birdsofnicoya.blogspot.com/2014/01/the-mangrove-hummingbird.html>

**Ornithophily**



# Aerial Plants

Mistletoes in  
mangroves

Boca Chita, Panama



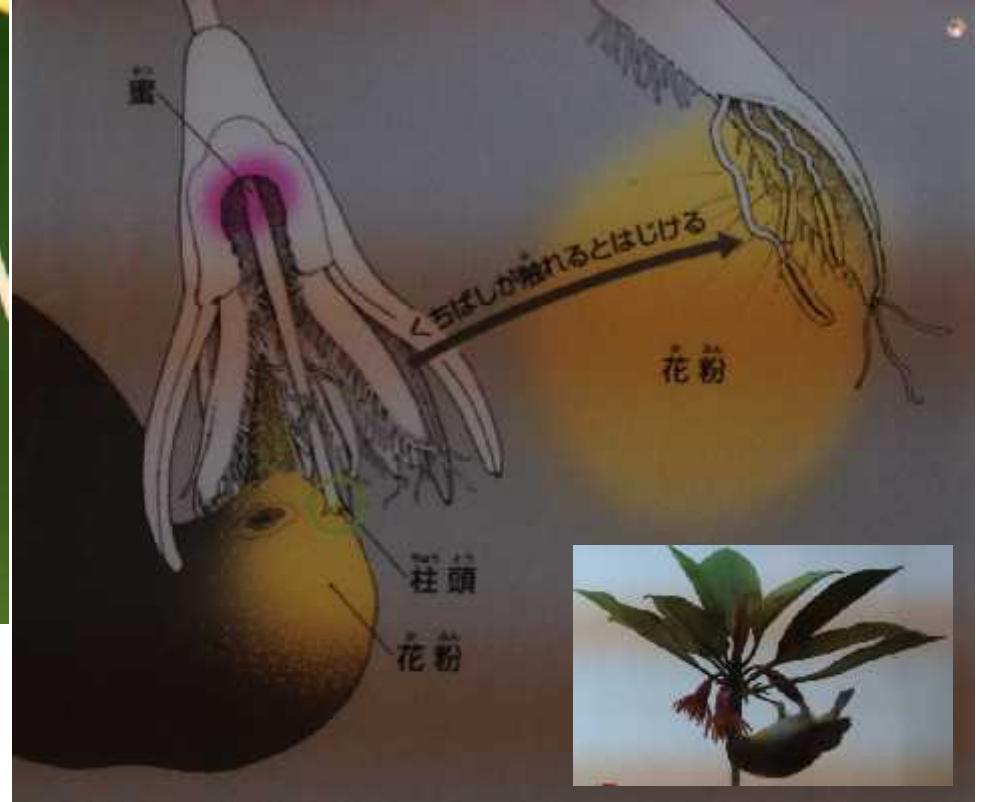
# New World Mistletoes



# **Current & Future Research**

**Salient observations**

# Certain birds are important for pollinating certain mangroves



## Pollination

**Observations:** Sunbirds, flowerpeckers and others, pollinate various *Bruguiera* species.

**Questions:** How will the absence of specific mangrove aerial species affect the **“Eco-system functioning”** of the entire mangrove forests and the adjacent natural habitats?

For example, the birds that pollinate the flowers of several *Bruguiera* species do feed on the berries of certain mistletoes that parasitize both mangrove and non-mangrove (terrestrial forest) trees?

**Certain birds are important for  
pollinating certain mistletoes growing on  
mangroves**



**Pollination  
Observations:** Sunbirds, flowerpeckers and others, pollinate  
various mangrove mistletoes.



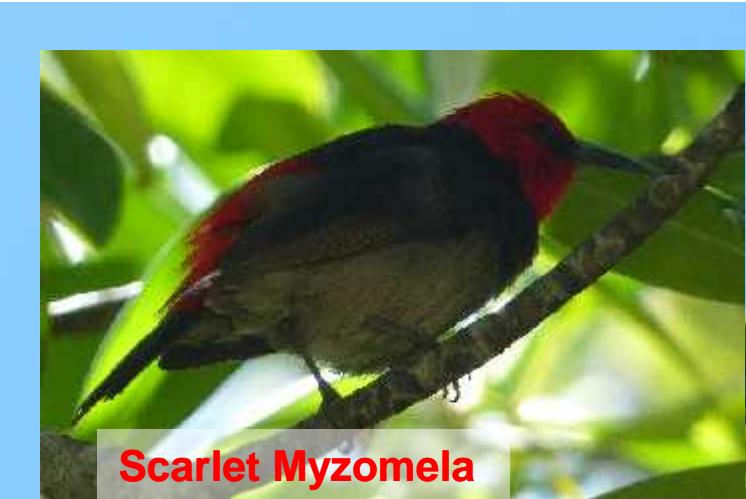
**Dendrophthoe  
pentandra**

**Lumnitzera littorea**



The  
Common Malayan  
mistletoe  
*(Dendrophthoe pentandra)*

# Mistletoes



Scarlet Myzomela



*Bruguiera exaristata*



Scarlet Myzomela



Darwin, NT, Australia

# Certain birds are important for dispersal of mangrove mistletoes' fruits



*Dendrophthoe  
pentandra*



## Fruit dispersal

**Observations:** Sunbirds, flowerpeckers and others, feed on mangrove mistletoes' berries.



**Lumnitzera littorea**

## Questions:

With the gradual demise of mistletoe populations (due mainly to anthropogenic disturbances) within the back mangrove forest and its adjacent terrestrial forest, what will be reproductive success for these *Bruguiera* species?

There are certainly many unanswered and interesting research questions about mangal aerial plants that require future and in-depth studies.



**Heritiera fomes  
host tree**

*B. gymnorhiza*



Host tree:  
*Heritiera fomes*

Gwa, Rakhine  
State, Western  
Myanmar

# Connectivity - mistletoes

**Scurrula sp**

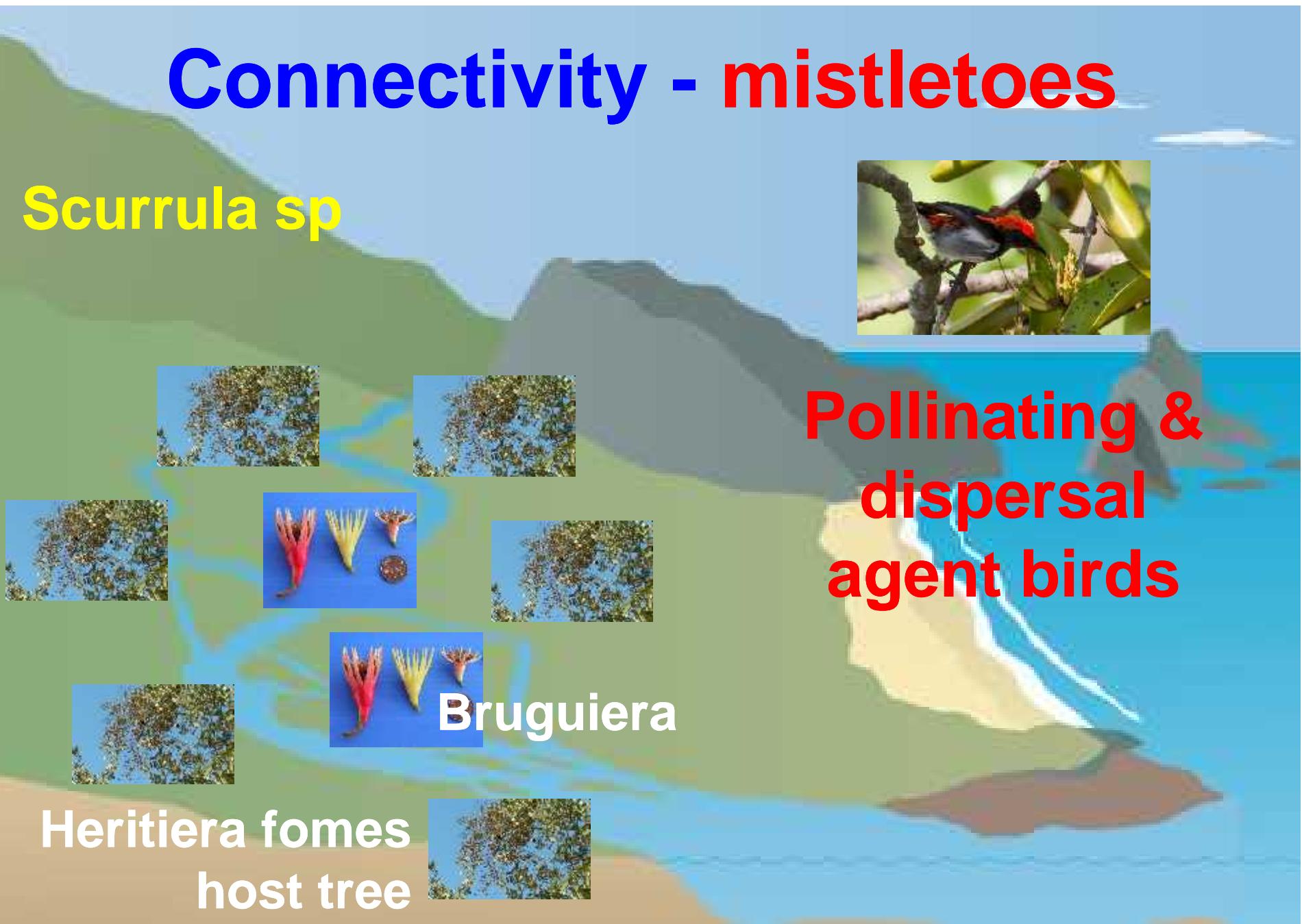


**Bruguiera**

**Heritiera fomes  
host tree**



**Pollinating &  
dispersal  
agent birds**



# Connectivity - bats



2012 © Merlin D. Tuttle



2012 © Merlin D. Tuttle



<http://www.merlintuttle.com/2012/10/27/dawn-bats-pollinating-parkia-and-wild-banana/>

[http://www.ecologyasia.com/news-archives/2003/jan-03/thestar\\_20030204\\_1.htm](http://www.ecologyasia.com/news-archives/2003/jan-03/thestar_20030204_1.htm)



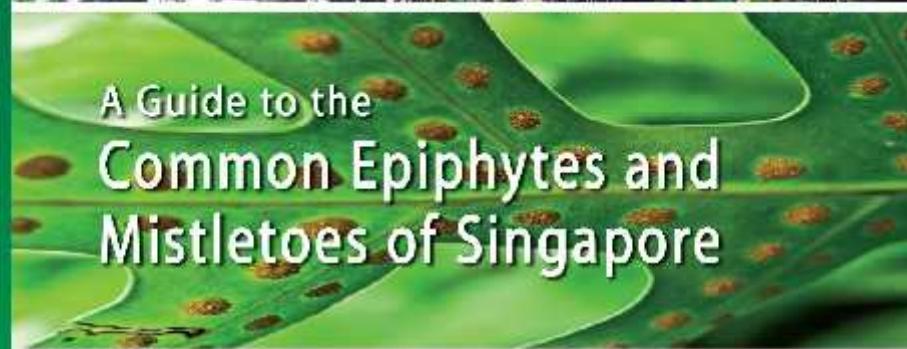
# Take Away Message

- **Mangrove Aerial plants**
  - No vascular connection
    - **Epiphytes** - Truly aerial
    - **Climbers** – ground-based, varying degrees of salt tolerance
  - Vascular connection
    - **Mistletoes** – Truly aerial and parasitic; unclear about their salt tolerance.
- **Synthesis of idea(s)** arising from field observations
- **“Quality”** of mangrove forest can, perhaps, be assessed a concomitant **Aerial Plants Biodiversity Checklist**, in addition to the (regular) “Tomlinson” checklist?
- **Connectivity** between **mangrove forests** and **adjacent forests** (coastal and other terrestrial) is an important consideration for in landuse planning and conservation.

A Guide to the  
Common Epiphytes and Mistletoes of Singapore

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## A GUIDE TO THE COMMON EPIPHYTES AND MISTLETOES OF SINGAPORE

Dr. W.H. Yong  
James Wang Wei  
Joanne Y.T. Chew  
Sheue Chiou Rong  
Wong Wei San



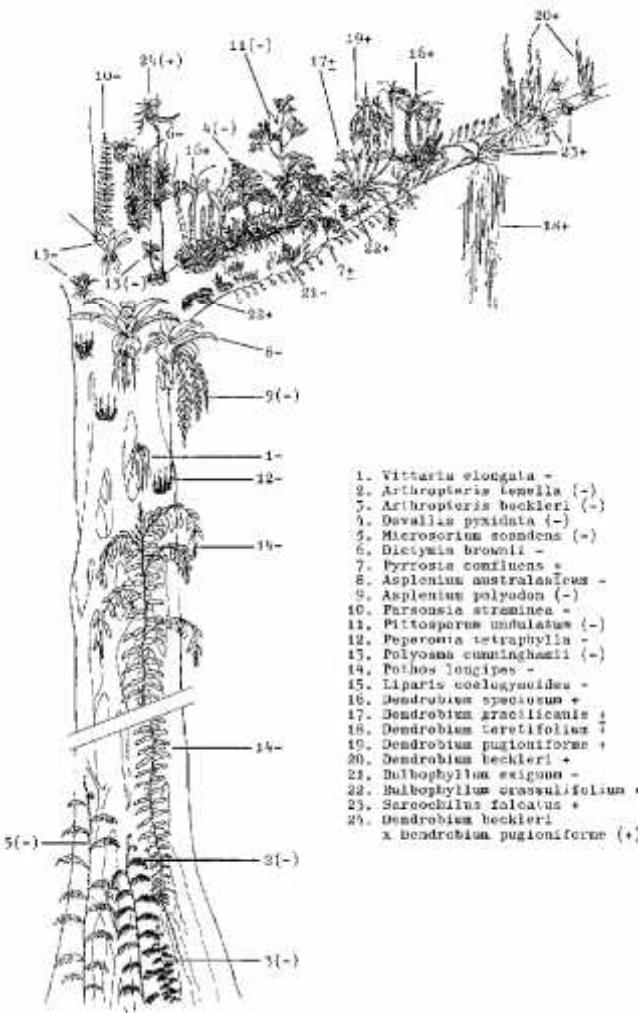
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# Aerial plants' Connections!



Hew  
Yong

THE PHYSIOLOGY OF TROPICAL  
ORCHIDS IN RELATION  
TO THE INDUSTRY

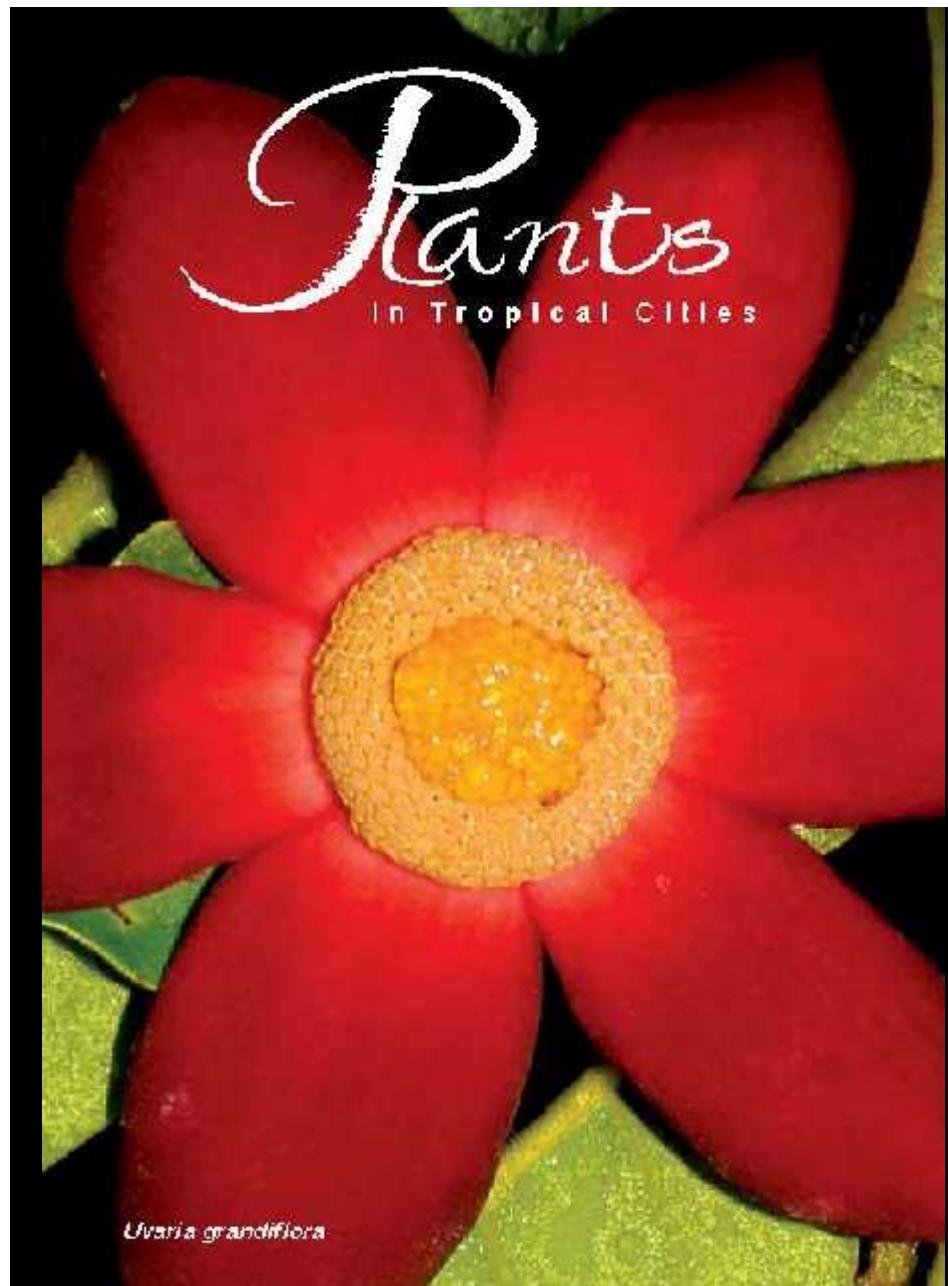
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TROPICAL  
ORCHIDS  
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Second Edition





**Epiphytes**

Epiphytes are aerial plants which perch themselves without being anchored to the surface of a living host plant. Unlike other parasitic plants like mistletoes or dodders, epiphytic plants do not tap into the vascular system of their host tree to get their food. Epiphytes develop structures which allow them to acquire their nutrient requirements from non-living sources such as rain, steam flow, or organic litter. Epiphytes are often used in air purifying exercises for schools and office buildings in cities. Epiphytes may be grown on green roofs, vertical walls or even the mounted floral structures (e.g. cactus) available in most florist shops, without taking away a billion cubic feet space in any urban building envelope. Although mistletoes are not true epiphytes, those plants may be introduced as aerial plants into our indoor environment.

<i>Aechmea chantinii</i> 19	<i>Coleus blumei</i> 246	<i>Dendrobium nobile</i> 20+
<i>Aechmea Arachne</i> 18	<i>Davallia solida</i> 255	<i>Dendrobium discolor</i> 28+
<i>Aechmea Algeana</i> 19	<i>Davallia solida</i> 25c	<i>Dendrobium discolor</i> (White f.l.) 20+
<i>Aechmea longissima</i> 83	<i>Davallia solida</i> 25c	<i>Dendrobium ovata</i> 282
<i>Asplenium nidus</i> 84	<i>Davallia solida</i> 25c	<i>Dendrobium speciosissimum</i> 282
<i>Bromelia wagneriana</i> 124	<i>Davallia solida</i> 25c	<i>Dyaphne pinnatifida</i> 291
<i>Cladodes</i> 292	<i>Dendrobium concolor</i> 257	<i>Epiphyllum oxypetalum</i> 9;3
<i>Cladodes</i> 293	<i>Dendrobium dendrobieum</i> 258	<i>Epidendrum</i> 25;4
	<i>Davallia solida</i> 25c	

The  
Mangrove Aerial Plants &  
an Update of the two IUCN  
**Critically Endangered Mangroves**

Jean W. H. Yong (“John” 杨远方), W. S. Wong, & C. R. Sheue



SINGAPORE UNIVERSITY OF  
TECHNOLOGY AND DESIGN

Established in collaboration with MIT



# **Bruguiera hainesii C. G. Rogers**

**(Berus mata buaya or the  
“Eye of the crocodile”)**



Bruguiera hainesii  
© IUCN Red List

**Species of the Day: Eye of the Crocodile**

The Eye of the Crocodile ('Berus mata buaya' in the Malay language), *Bruguiera hainesii*, is classified as 'Critically Endangered' on the IUCN Red List of Threatened Species™. This species is found across Singapore, Malaysia, Thailand, Indonesia and Papua New Guinea, with an estimated 200 individuals left in the wild.

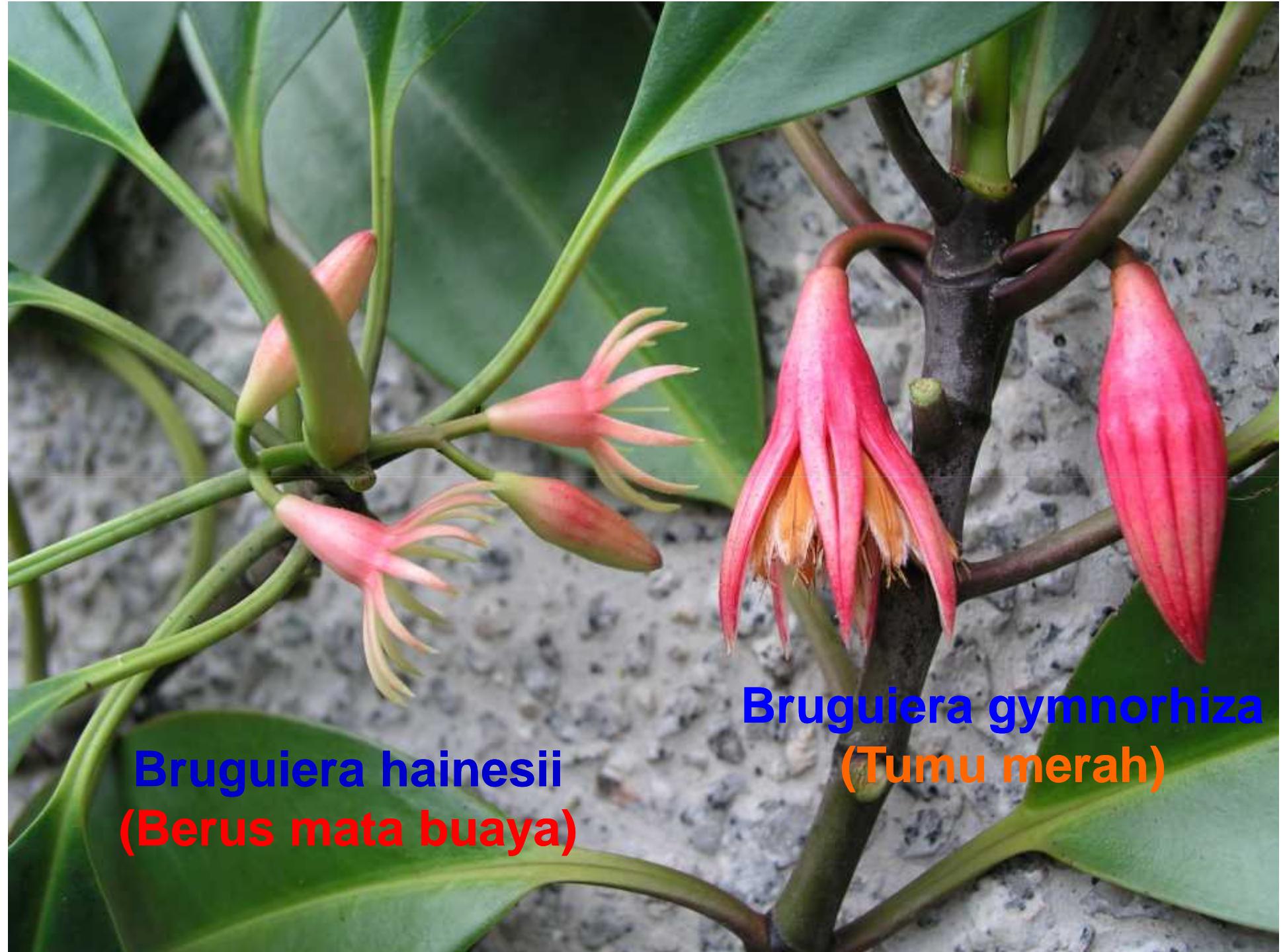
The Eye of the Crocodile is a mangrove species that grows in an area known as the 'back mangrove'. This habitat type is at risk of destruction, as it can easily be converted into plantations, agricultural land and shrimp farms.

Several propagation studies have been carried out on the Eye of the Crocodile in an attempt to restore population numbers, but unfortunately it is a slow and frequently unsuccessful process. Further research is needed to fully understand the status of the various populations of this species, and its rate of decline.

**RED LIST**

**IUCN** **TRSSC** **ARKive** **2010** **Species of the Day** **UNEP**

The publication of this IUCN Red List is supported by the IUCN Species Survival Commission. It is also part of the IUCN Red List Program, which includes the IUCN Red List of Threatened Species™, the IUCN Red List of Ecosystems, the IUCN Red List of Plants, and the IUCN Red List of Invertebrates, and the IUCN Red List of Non-Extinct Species.



**Bruguiera hainesii**  
**(Berus mata buaya)**

**Bruguiera gymnorhiza**  
**(Tumu merah)**

**Bruguiera hainesii**  
**(Berus mata buaya)**



**Bruguiera gymnorhiza**  
**(Tumu merah)**



# ***Bruguiera hainesii* – emergent trees**



**Gwa, Rakhine  
State, Western  
Myanmar**



Gwa, Rakhine  
State, Western  
Myanmar



# **Bruguiera hainesii (Berus mata buaya)**

## **Current tree population (under-estimation)**

Bangladesh:	?
Brunei:	?
Fiji:	1+ tree
<b>Indonesia:</b>	<b>95+ trees</b>
<b>Malaysia:</b>	<b>50+ trees</b>
<b>Myanmar:</b>	<b>1700+ trees</b>
<b>Papua New Guinea:</b>	<b>???</b>
Philippines:	?
Singapore:	14+ trees
Thailand:	20+ trees
Vietnam:	5+ trees

**1700 +**



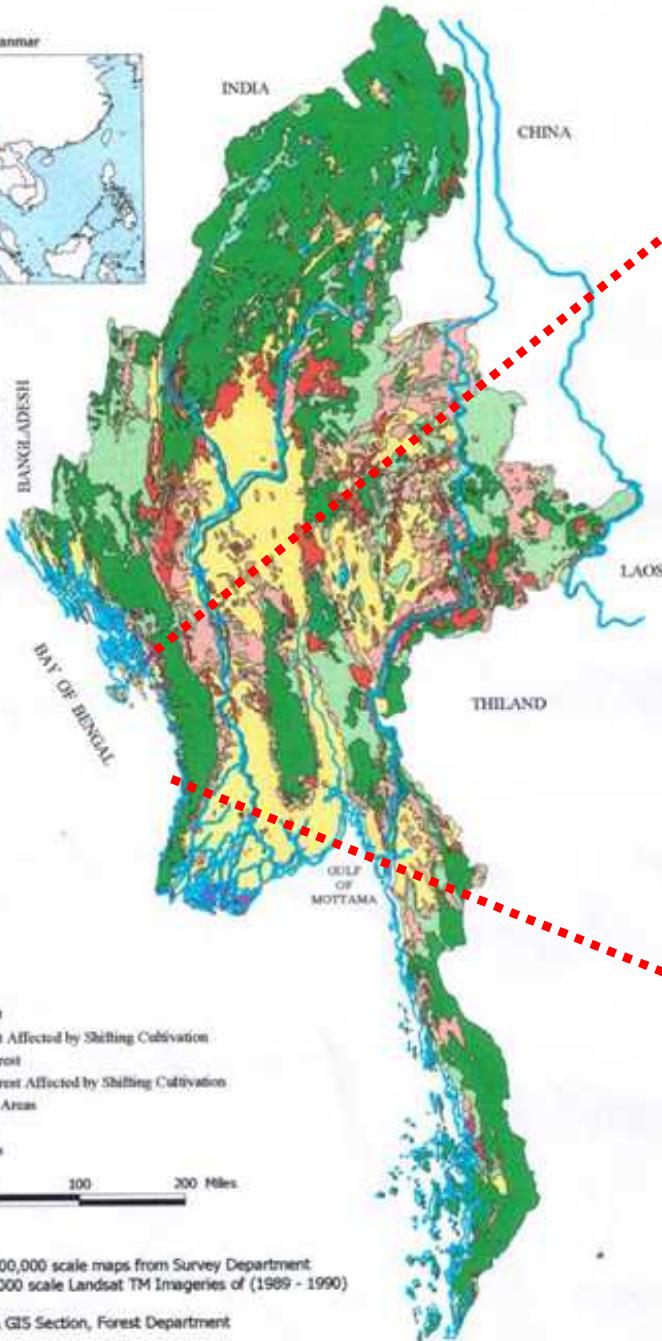
## ***Bruguiera hainesii* (*Berus mata buaya*)**

From Bangladesh, Myanmar to the Solomon islands

## FOREST COVER STATUS MAP OF MYANMAR (1989)



Location Map of Myanmar



### LEGEND

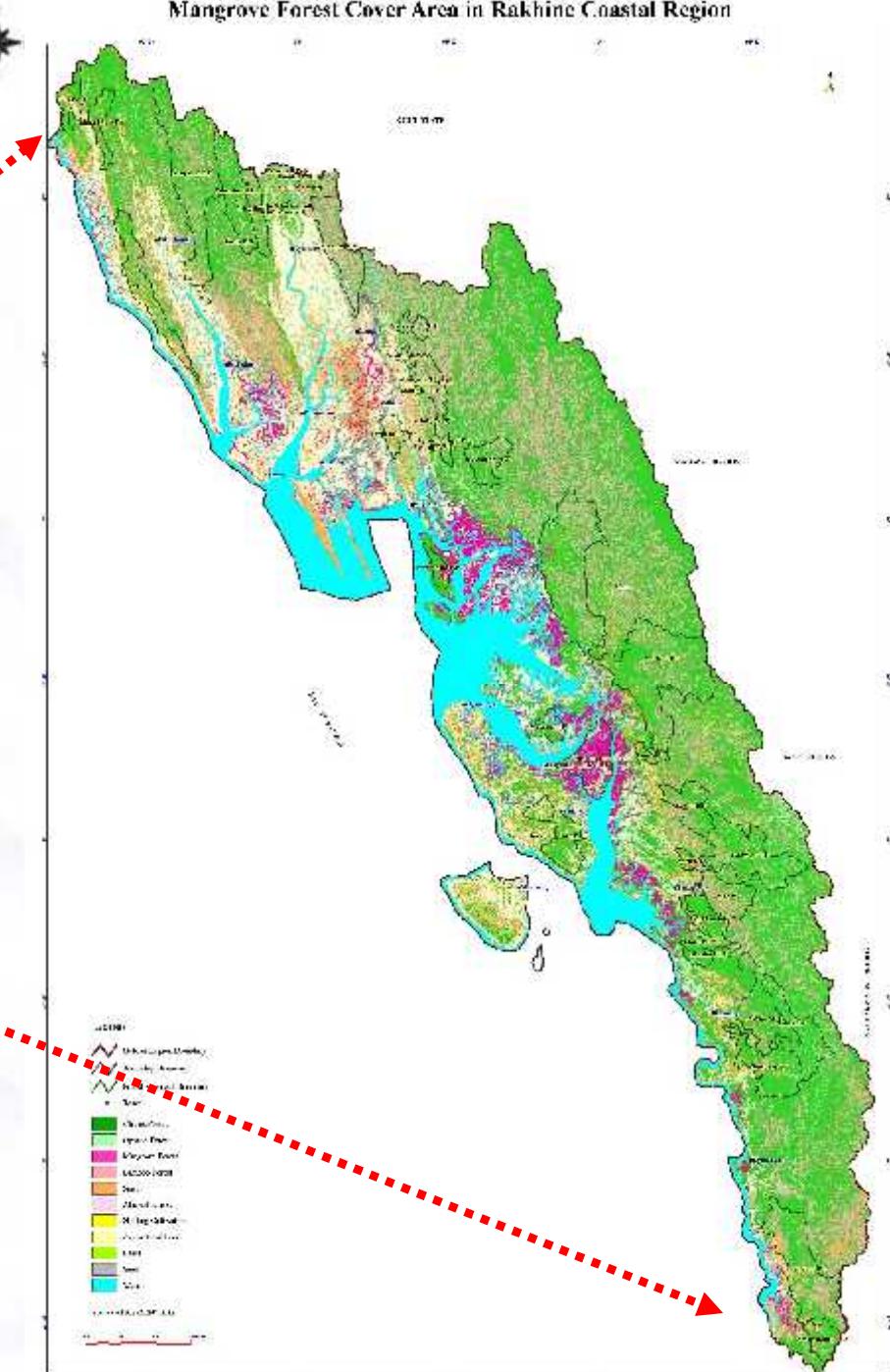
- Closed Forest
- Closed Forest Affected by Shifting Cultivation
- Degraded Forest
- Degraded Forest Affected by Shifting Cultivation
- Non-Forest Areas
- Mangrove
- Water Bodies

100 0 100 200 Miles

Source :  
Boundary - 1 : 1,000,000 scale maps from Survey Department  
Land Use - 1 : 50,000 scale Landsat TM Imageries of (1989 - 1990)

Remote Sensing & GIS Section, Forest Department

## Mangrove Forest Cover Area in Rakhine Coastal Region





## Bruguiera hainesii

Near Gwa

“Special tree”





Gwa, Rakhine  
State, Western  
Myanmar



Gwa, Rakhine  
State, Western  
Myanmar



**Gwa, Rakhine  
State, Western  
Myanmar**



Gwa, Rakhine  
State, Western  
Myanmar

Gwa, Rakhine  
State, Western  
Myanmar





**Watson  
Class**

**1**

Class	Flooded By	Height above chart datum in feet (meters)	Flooding Frequency (times/month)
1	All high tides	0-8 [2.44]	56-62
2	Medium high tides	8-11 [3.35]	45-59
3	Normal high tides	11-13 [3.96]	20-45
4	Spring high tides	13-15 [4.57]	2-20
5	Abnormal (equinoctial tides*)	15	2

**Where can we find *Bruguiera hainesii*?**

**SEA FRONT**

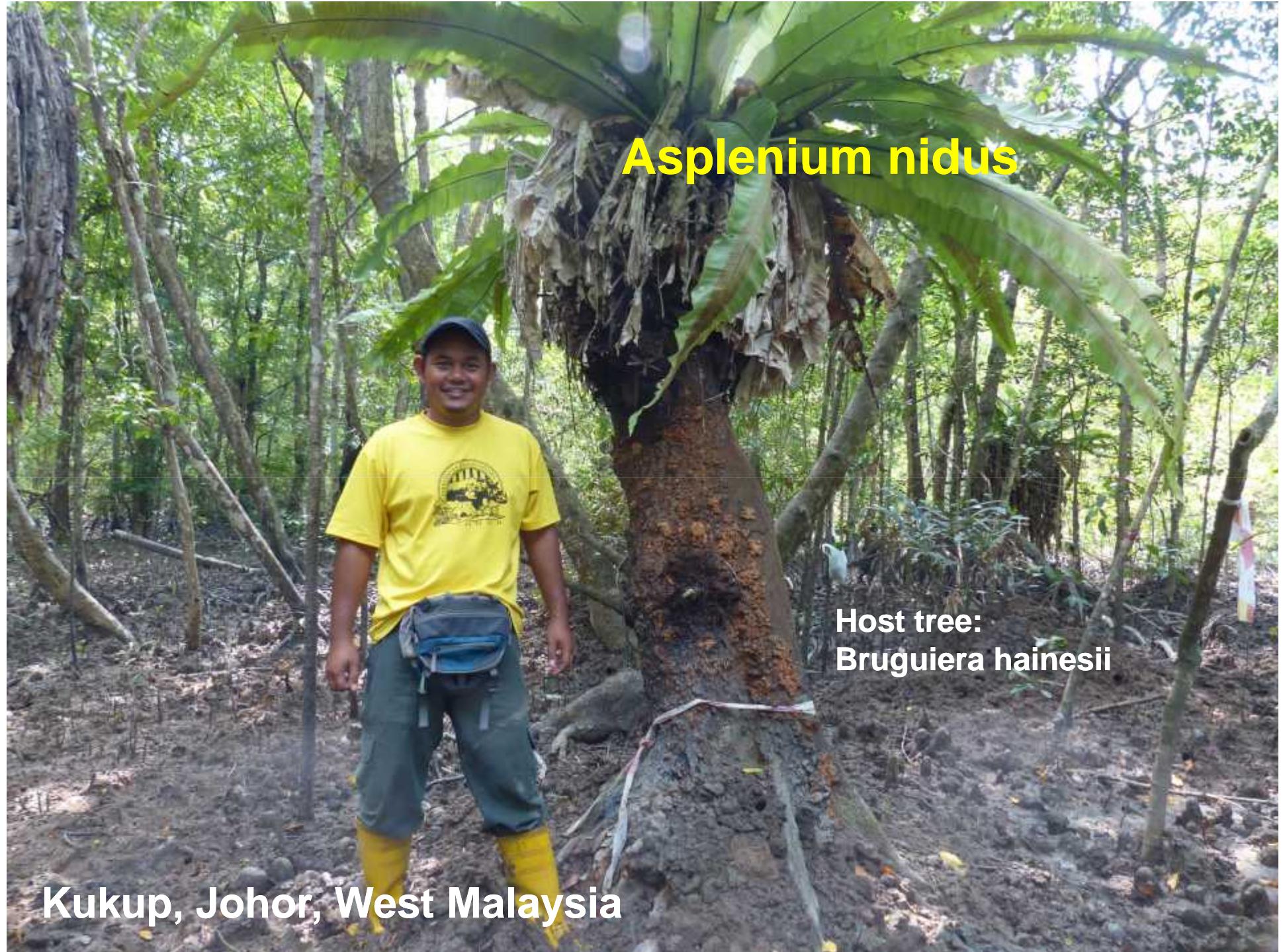
**Watson Class 5**

**TERRESTRIAL**



P. Manukan,  
Sabah, Malaysia





**Asplenium nidus**

**Host tree:**  
***Bruguiera hainesii***

**Kukup, Johor, West Malaysia**

# *Sonneratia alba*





# **Sonneratia griffithii Kurz**

**(Perapat daun lebar)**



**Sg Merbok,  
Kedah, West  
Malaysia**

Possibly the world's largest tree (?)



Gwa, Rakhine  
State, Western  
Myanmar

*Sonneratia griffithii*





Sg Merbok,  
Kedah, West  
Malaysia

*Sonneratia griffithii*  
(Perapat daun lebar)



# Conservation measures for *Sonneratia griffithii* (Perapat daun lebar)





# Summary

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- With more than 1700 individuals of *B. hainesii* found at Western Myanmar, perhaps it is time to re-visit the IUCN Critically Endangered (CR) species category?
- *B. hainesii* trees are not necessarily restricted to a certain zonation – back mangroves.
- A novel mode of vegetative reproduction was observed for the knee-roots of *B. hainesii*.
- Active replanting of *B. hainesii* can be carried out using propagules, and rooting of knee-roots derived saplings.
- We have started to survey & monitor *Sonneratia griffithii* throughout its range.
- *S. griffithii* propagation carried out using seeds under certain conditions.





# Thank You!

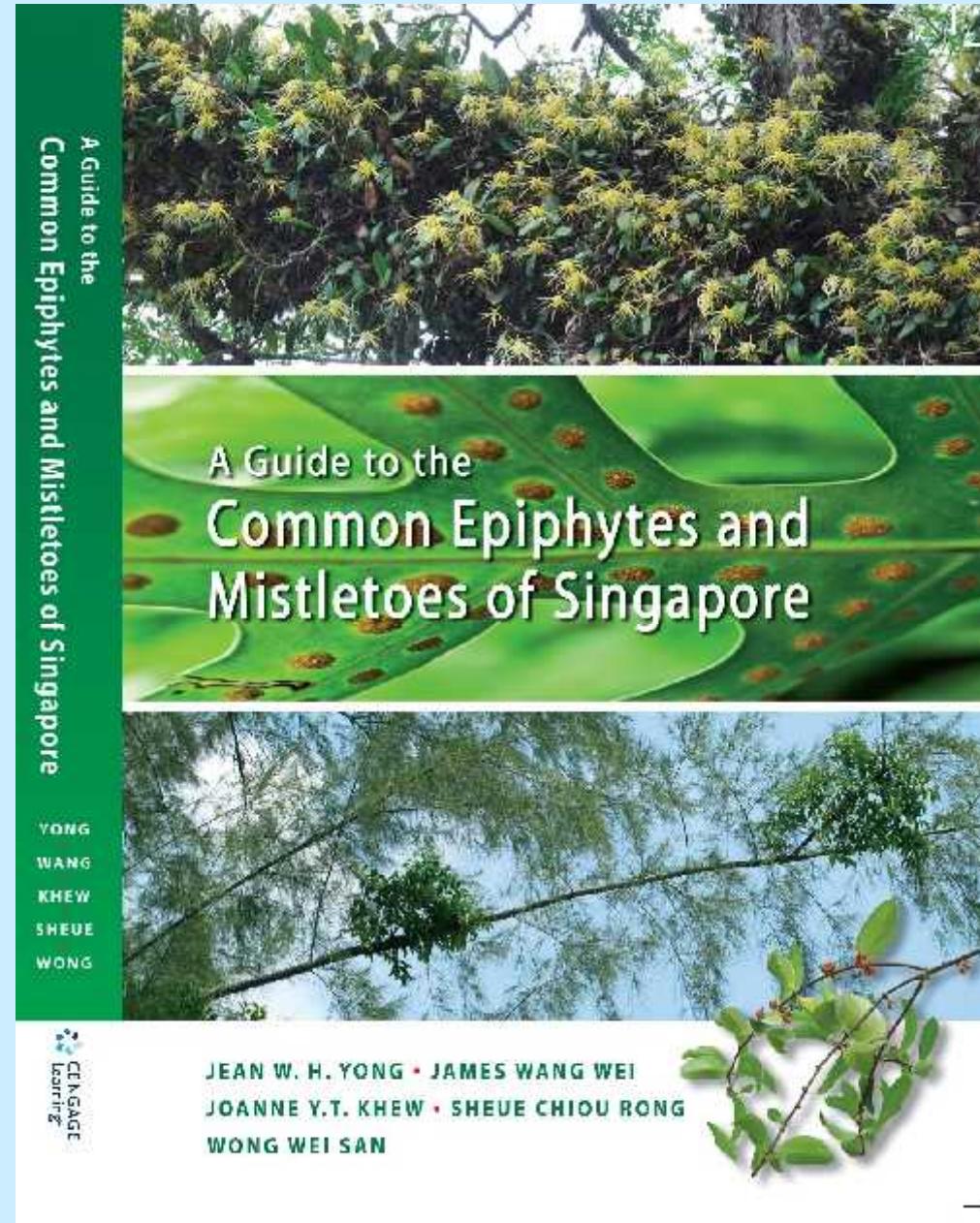
For more information,

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# Acknowledgements

- International: We thank Prof Sukristijono Sukardjo (Indonesia); Dr. Vien Ngoc NAM (Vietnam); Dr Wijarn Meepol (Thailand); Mr Win Maung (Myanmar); Prof Ong J. E., Prof Maketab Mohamed, Wong Yun Yun and Stanley Tan (Malaysia);
- Local: Koh Kwan Siong, Ali Ibrahim, Ria Tan, Wong Wei San, Chua Jit Chern, Boo Chih Min, Ang Hui Ping, Robert Teo, Rachel Lim, and Yang Shufen (Singapore); for sharing their observations, unpublished data and photos with us generously.
- We are grateful to Prof. Tan Swee Ngin (Nanyang Technological University, Singapore) for her continual support.

# **Bruguiera species**

- **Small-flowered type**
  - *B. parviflora*
  - *B. cylindrica*
- **Large-flowered type**
  - *B. gymnorhiza*
  - *B. sexangula*
  - *B. exaristata*  
*(Northern Terr., Aust)*

**Insect-pollinated**

**Bird-pollinated**

**“Problem” of a biological “misfit”:**  
***B. hainesii***

- considered to be the small-flowered type
- BUT, bird-pollinated!

(Noske, R.A. 1993. *Bruguiera hainesii*: another bird-pollinated mangrove? *Biotropica* **25**, 481-483)



***Bruguiera cylindrica***



***Bruguiera sexangula***



***Bruguiera parviflora***



***Bruguiera gymnorhiza***

***Bruguiera hainesii***



*B. gymnorhiza*



*B. sexangula*



*B. hainesii*



*B. cylindrica*   *B. parviflora*



**B. parviflora** **B. cylindrica**



**B. hainesii**



**B. exaristata**



**B. sexangula**



**B. gymnorhiza**





*B. parviflora*

*B. cylindrica*

*B. sexangula*

*B. exaristata*

*B. hainesii*

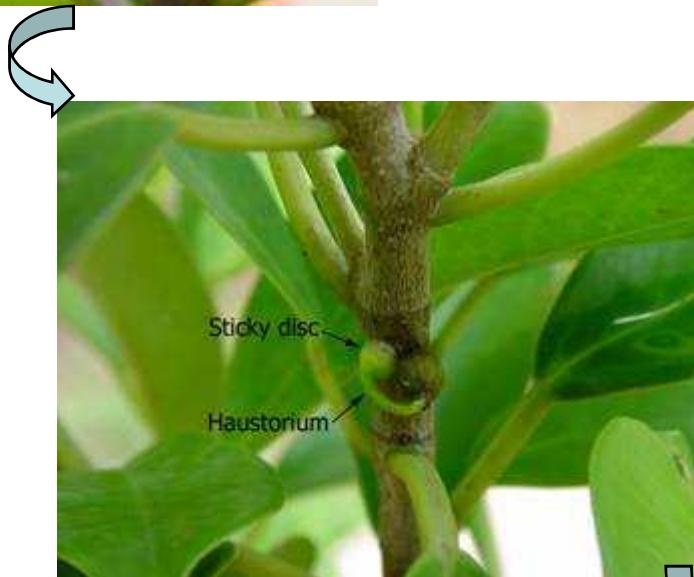
*B. gymnorhiza*



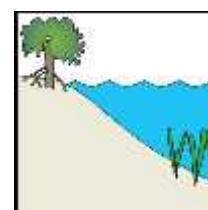
Thank  
you!



# Mistletoe Germination Process



# Do your homework?



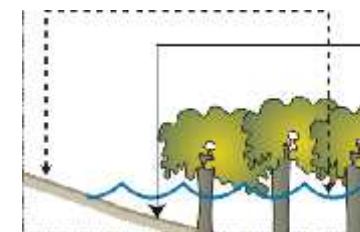
**Nature**



**Biological interactions**



**Humans**



**Infrastructure Interactions & environment**

