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Webinar: Mangroves of Singapore

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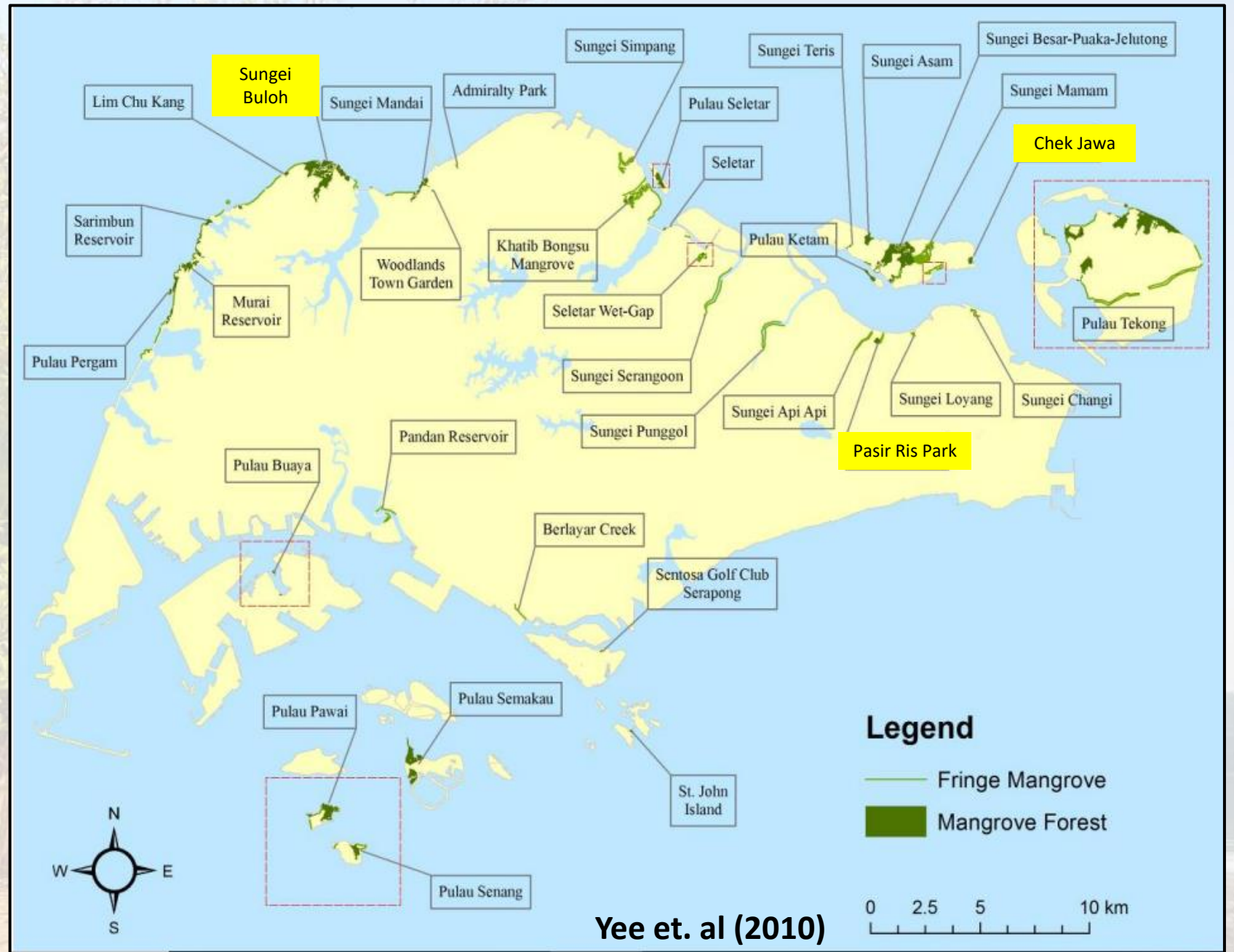


What are Mangroves?

- Tree, shrub, palm or ground fern, generally growing more than 0.5 m in height above mean sea level in the intertidal zone
- Also represents the habitat comprising such trees and shrubs.
- Major mangrove species dominate the community structure and can form pure stands
- Distinct morphological specialization such as aerial roots and vivipary (seedlings that germinated while still on the parent plant)

Mangroves of Singapore

- Lost **90%** of our historic **mangrove cover** due to land reclamation and reservoir construction.
- Only **735 ha** of mangroves left
- Singapore is home to **>30 species** of true mangroves, around half of the world's 70 true mangrove species
- Singapore's mangroves have an estimated carbon stock of **450,572 Mg C**, equivalent to the average annual carbon emissions of **621,000 residents**



Yee et. al (2010)

Pulau Ubin

- **Largest intact portion** of Singapore's mangroves
- Contains **34 species of true mangroves** including the rare species *Bruguiera hainesii*
 - Two individuals found on Ubin out of 250 wild mature individuals left in the world
- Restore Ubin Mangroves (RUM) project
 - Conducts **ecological mangrove restoration** at abandoned aquaculture areas at Pulau Ubin with volunteers
- **Jejawi Tower** along new Chek Jawa Mangrove Boardwalk



Sungei Buloh Wetland Reserve

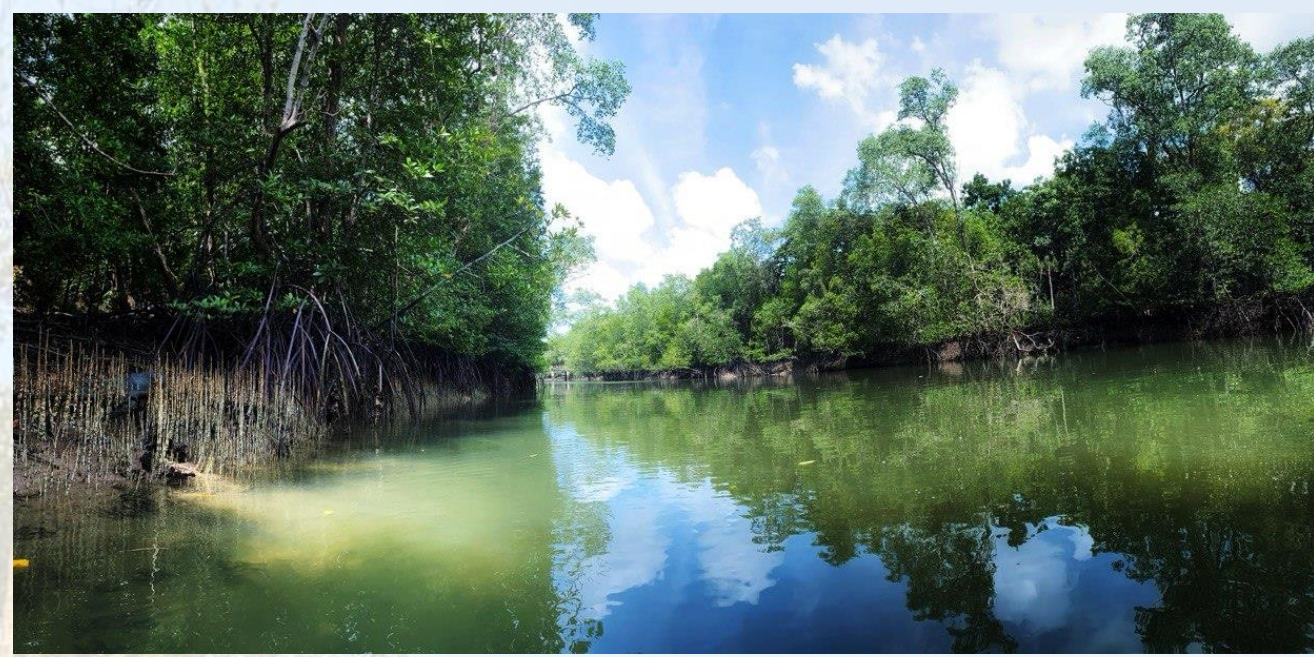
- **First gazetted wetland reserve** in Singapore in 1890 and one of four nature reserves in Singapore
- **30 species** of true mangroves including the locally 'Critically Endangered' **Tumu Berau** or ***Bruguiera sexangula***
- Important stopover and foraging ground for **migratory shorebirds** from **September to March**
- More than **220 bird species**
- Regular sightings of **saltwater crocodiles**, including one resident called 'Tailless'



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Pasir Ris Mangroves

- Mangroves grow along **two rivers**, Sungei Api Api and Sungei Tampines
- Has a mangrove nursery, with multiple *Sonneratia caseolaris* trees planted within Pasir Ris, a locally **‘Critically Endangered’** species
- **Firefly Species Recovery Programme** helps to reduce light pollution, increase habitat and monitor firefly populations. Pasir Ris has **2 resident firefly species** - the locally endangered *Pteroptyx valida* and *Pteroptyx malacca*
- Good view of mangroves from **boardwalks and birdwatching hides**, accessible by guided kayak tours
- Check out the documentary **‘Residents of the Park’**, showcasing wildlife around Pasir Ris Park by National Geographic award-winning filmmaker Jayaprakash Bojan





Major Mangroves



Minor Mangroves



Mangrove Associates

Types of Mangrove Plants

Major Mangroves

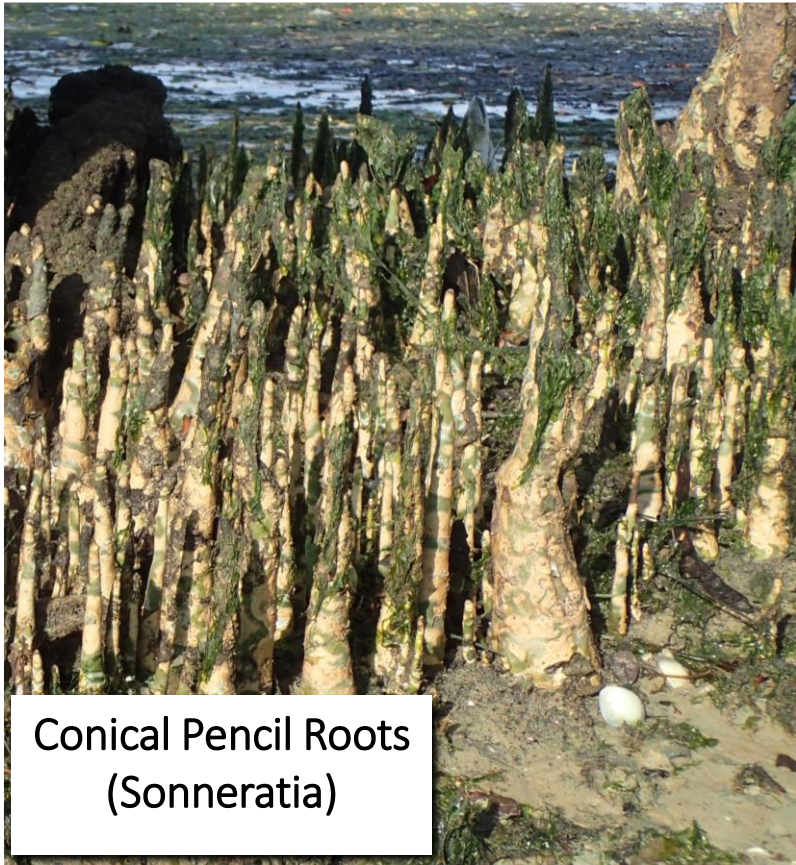
Family	Species	Common Name	Status
Avicenniaceae	<i>Avicennia alba</i>	Api-api putih	LC
	<i>Avicennia marina</i>	Api-api jambu	CR****
	<i>Avicennia officinalis</i>	Api-api ludat	NT*
	<i>Avicennia rumphiana</i>	Api-api bulu	LC
Combretaceae	<i>Lumnitzera littorea</i>	Teruntum merah	EN***
	<i>Lumnitzera racemosa</i>	Teruntum bunga putih	EN***
Palmae	<i>Nypa fruticans</i>	Nipah	VU**
Rhizophoraceae	<i>Bruguiera cylindrica</i>	Bakau putih	LC
	<i>Bruguiera gymnorhiza</i>	Tumu	NT*
	<i>Bruguiera hainesii</i>	Berus mata buaya	CR****
	<i>Bruguiera parviflora</i>	Lenggadai	EN***
	<i>Bruguiera sexangula</i>	Tumu berau	CR****
	<i>Ceriops zippeliana</i>	Tengar	EN***
	<i>Ceriops tagal</i>	Tengar	VU**
	<i>Kandelia candel</i>	Pisang pisang	CR****
	<i>Rhizophora apiculata</i>	Bakau minyak	LC
	<i>Rhizophora mucronata</i>	Bakau kurap	NT*
	<i>Rhizophora stylosa</i>	Bakau	VU**
Sonneratiaceae	<i>Sonneratia alba</i>	Perepat	LC
	<i>Sonneratia caseolaris</i>	Berembang	CR****
	<i>Sonneratia ovata</i>	Gedabu	CR****

Minor Mangroves

Family	Species	Common Name	Status
Euphorbiaceae	<i>Exoecaria agallocha</i>	Buta-buta	NT*
Lythraceae	<i>Pemphis acidula</i>	Bungor	CR****
Meliaceae	<i>Xylocarpus granatum</i>	Nyrieh bunga	NT*
	<i>Xylocarpus moluccensis</i>	Nyrieh batu	EN***
	<i>Xylocarpus rumphii</i>	Nyrieh	CR****
Myrsinaceae	<i>Aegiceras corniculatum</i>	Kacang-kacang	EN***
Pteridaceae	<i>Acrostichum speciosum</i>	Piai laut	VU**
	<i>Acrostichum aureum</i>	Piai raya	NT*
Rubiaceae	<i>Scyphiphora hydrophyllaceae</i>	Chengam	NT*
Sterculiaceae	<i>Heritiera littoralis</i>	Dungun	EN***

Conservation Status The Singapore Red Data Book 2008

Alias	Category	Subcategory	Description
EX	Globally Extinct	Nil	The species is extinct the world over, in the wild or in cultivation
NE	Presumed Nationally Extinct	Nil	The species is extinct in Singapore but it still survives outside Singapore. Species has not been recorded within the last 30 years for plants, or 50 years for animals.
CR****	Critically Endangered	Category D	There are fewer than 50 mature individuals, OR if more than 50 mature individuals but less than 250, with some evidence of decline or fragmentation.
EN***	Endangered	Category D	There are fewer than 250 mature individuals, and no other evidence of decline or fragmentation
VU**	Vulnerable	Category D	There are fewer than 1000 mature individuals but more than 250 and there may or may not be any other evidence of decline, small range size, or fragmentation
NT*	Near Threatened	-	Approaching but not yet reaching the threshold for the above criteria (not included in this book)
LC	Least Concern	-	Not approaching the above criteria (and not included in this book)
DD	Data Deficient	-	Information is not adequate to make an informed assessment.



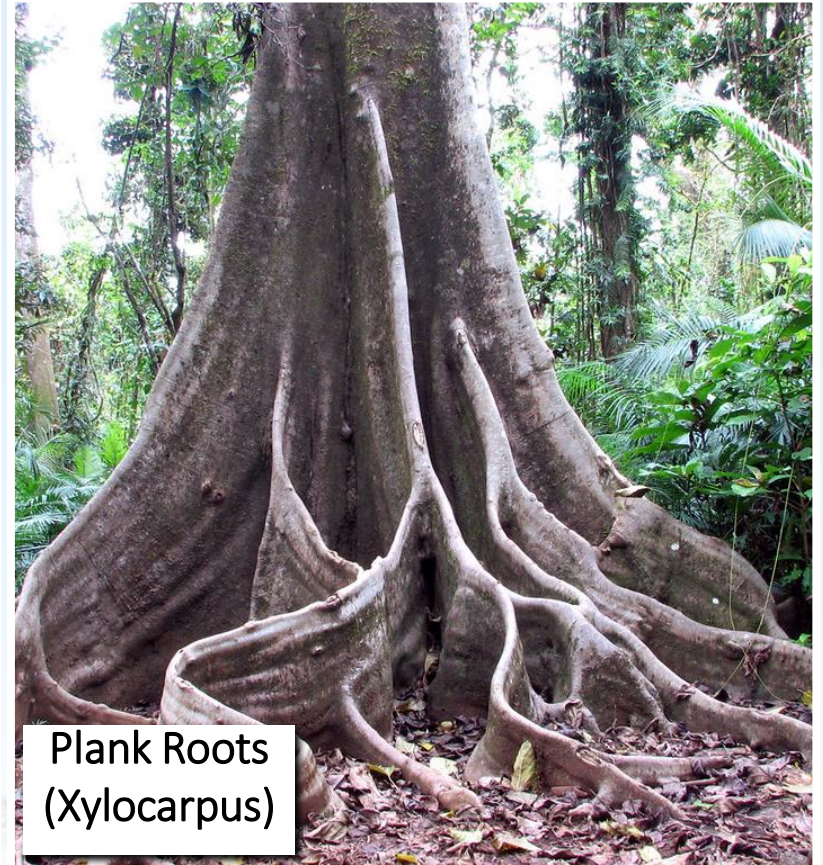
Conical Pencil Roots
(*Sonneratia*)



Straight Pencil Roots
(*Avicennia*)



Prop/Stilt Roots
(*Rhizophora*)



Plank Roots
(*Xylocarpus*)



Knee Roots
(*Bruguiera*)

Mangrove identification through root structures

Avicennia spp.

(Api-api)

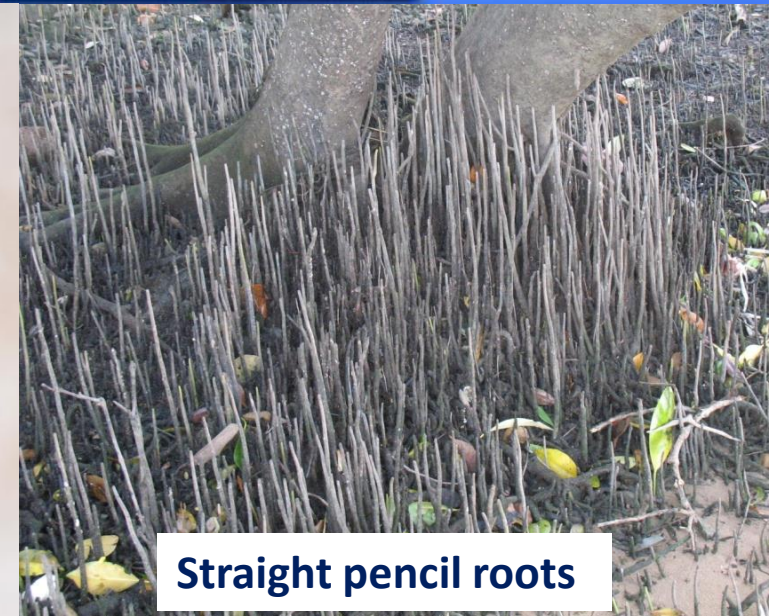


Key Features

- Square stem
- Straight, pencil roots or pneumatophores
- Teardrop-shaped fruits
- Small yellow flowers
- Known as 'black mangroves' for the dark-coloured roots and trunks

Uses and Importance

- Api = Fire in Malay, because it is known to attract fireflies
- Excretes salt onto leaves which is edible
- Fruits used as insect repellent, as a substitute for flour and ingredient in traditional desserts



Straight pencil roots

Bruguiera spp.

(Tumu)

Key Features

- Knee roots or pneumatophores
- Long, cigar-shaped propagules (miniature seedlings rather than actual fruits)
- Calyx looks like a bucket hat
- Reproduces via vivipary
- Leathery elliptical leaves with pointed tips
- Has lenticels (porous tissues) on trunks, nicknamed 'Eye of the Crocodile'

Uses and Importance

- Tannin is extracted from the bark and used as dyes
- Leaves and stem of *B. gymnorrhiza* contain vanillic acid, which has antioxidant, analgesic and antidiarrhoeal properties, used in traditional medicine



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Knee roots



Acanthus spp.

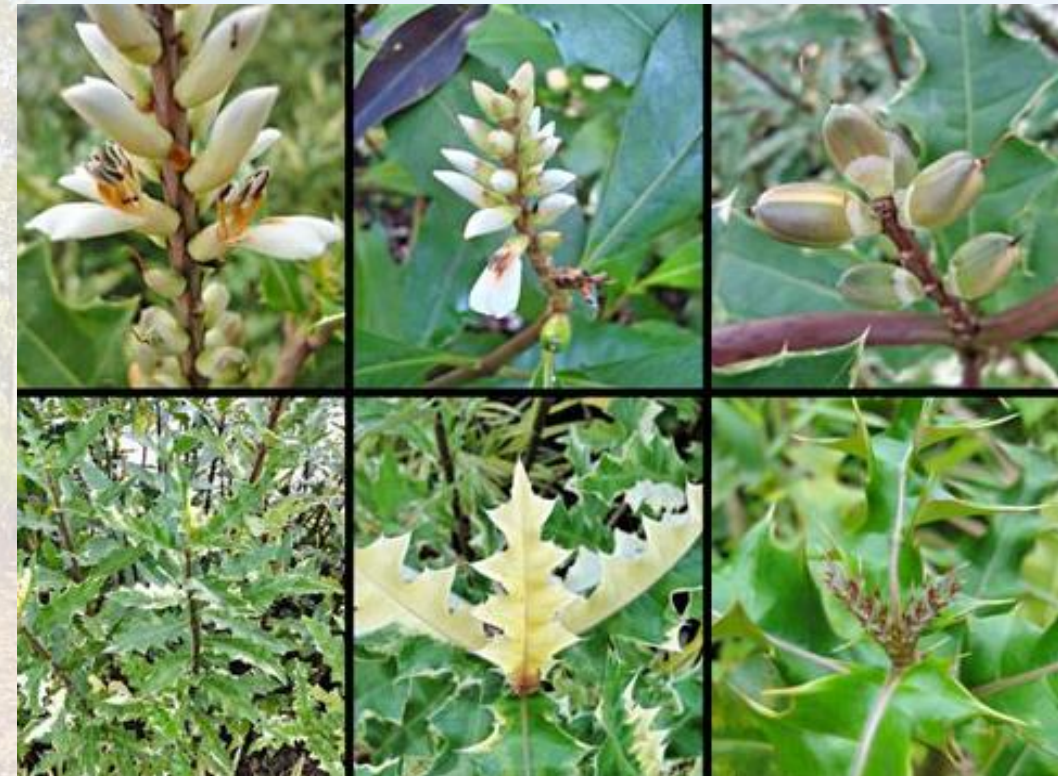
Mangrove Holly

Key Features

- Leaves sometimes jagged, resembling holly
- Purple or white flowers pollinated by bees or small birds
- Shiny green, oval seed pod that propels seeds away from the plant using a spring loading mechanism.
- Not a true mangrove, but a mangrove associate usually found in the landward parts of back mangroves

Uses and Importance

- Leaves can be used to make keropok chips or dried to create a herbal tea.
- Multiple medicinal properties from cures for coughs, boils, shingles, rheumatism, snakebite and more



Mangroves support a diverse range of fauna!



Biodiversity Enhancement Project at Kingfisher Wetlands

- Foster a sense of community by **involving the public with the planting** and **growth of the mangroves** over time.
- **Introduce public to Blue Carbon** and educate them on the potential of utilising coastal ecosystems to sequester carbon.
- Assess the **possibility of scaling up this project** and extending its reach beyond Singapore and into other urban cities in **Southeast Asia**.



Citizen Science Monitoring

- Since its opening last November, the Kingfisher Wetlands has **more than 200 mangroves and mangrove associates**
- Members of the public will learn first-hand how mangroves are monitored using a **science-based approach**, learn about blue carbon and discover the importance of mangroves and coastal ecosystems. During the activity, participants will learn techniques to **monitor mangrove health** and conduct **fauna survey**.
- Project was awarded the Ministry of National Development (MND) Minister's Award 2022
- Join us for these sessions at:
<https://www.gardensbythebay.com.sg/wonderfulwetlands>



Mangrove Monitoring Methods

1. Plants are tagged with waterproof labels with marked GPS locations
2. Regular monitoring of each individual plant with photograph documentation
3. Measurements and numbers of roots, leaves, branches, girth at breast height
4. Reproductive health status (Flowering, fruiting)
5. Photosynthetic health
6. Stress symptoms



Stress Symptoms

Thickening — Developing new leaves and new shoots are thickened, fleshy, and may be enlarged.



Leaf Scorch — Sudden death or browning of foliage at edges due to sudden intense heat, burns, or plasmolysis



Cankers — Dark spots on the leaves. Cankers may be swollen, cracked or sunken, surrounded by raised tissue



Chlorosis — Yellowing leaves due to destruction of chlorophyll



Wilt — Leaves drooping



Russet — Rust-coloured pigmentation on leaves



Other survey works at Kingfisher Wetlands



Water quality



Sediment quality



Sediment rate

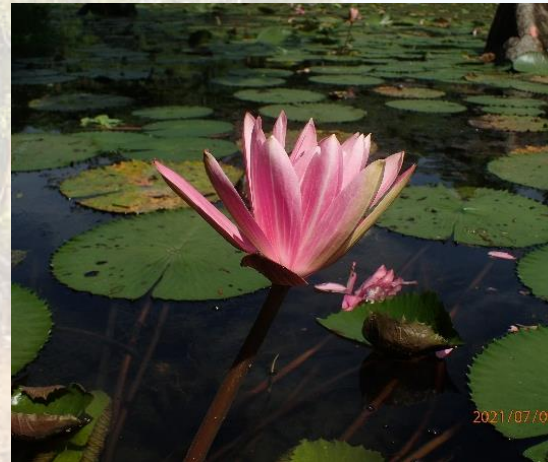


Terrestrial flora

© DHI



Terrestrial fauna



Aquatic flora



Aquatic fauna

Blue Carbon Assessment at Gardens by the Bay



Soil gas flux: to measure CO_2 due to autotrophic and heterotrophic activity in the sediment



Ecosystem carbon stock: Estimation of aboveground and belowground carbon stock of mangroves using established species-specific allometric equations



Leaf litter trap: Measurements of organic carbon content (autochthonous carbon) in leaf litter



Thank you! Any questions?