

something is out there. These are usually tell-tale signs that be a horseshoe crab) to rustling leaves. any kind, from 'moving mud' (it might may find! Look out for movement of animals. You'll be surprised at who you sounds and try tracing the call to the

4

Be observant. Listen for calls or forests, you may say, but mangroves provide many A seemingly small percentage of the world's Mangroves used to cover about 13% of Singapore, but have been reduced to about 0.5% today due to our rapid development and land reclamation. The mangroves you see today in Sungei Buloh is part of the 0.5% that's left.

3

Be patient. Animals found here are spotted. It takes time to spot animals in their natural environment.

2

Tread softly. This includes not running on the boardwalk. when you're quiet. surprised at what a difference it makes they do not keep to this rule. You'll be people miss seeing animals because thing to being a good observer. Many

1

Keep quiet. This is the most important thing to being a good observer. Many people miss seeing animals because they do not keep to this rule. You'll be surprised at what a difference it makes when you're quiet.

As a nature reserve the animals found here are wild. They would be disturbed by loud noises and would run away. As visitors to their home and in order to see them, some guidelines should be observed:

Some things to take note of:

Mangroves are part of the many ecosystems that Mother Nature has provided us. Adverse actions, such as pollution, excess sedimentation, deforestation and ignorance about this ecosystem will do us more harm than good.

Mangroves are also a source of food to other grow in. They are also a source of food to other crabs which utilize mangroves as nurseries to provide a home for wildlife, such as fish and They prevent shoreline erosion and act as sewage uses, both economic and non-economic to man. forests, you may say, but mangroves provide many A seemingly small percentage of the world's Mangroves used to cover about 13% of Singapore, but have been reduced to about 0.5% today due to our rapid development and land reclamation. The mangroves you see today in Sungei Buloh is part of the 0.5% that's left.

The term 'mangrove' is used broadly to describe the trees that make up the mangrove ecosystem or of tropical rain forest, the only type that is directly influenced by seawater.

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The pneumatophores are actually roots that are branched upwards from the main horizontal roots that grow below the soil. These roots allow the absorption of atmospheric oxygen through specialized root cells known as lenticels. This adaptation is important as the mud that the mangrove trees grow in is extremely low in oxygen, a condition called anaerobic.

Algae
Do you see something green growing on the roots of the mangrove trees and also forming a carpet over the mud? It's not moss as most people would think. It is actually a kind of algae. It spreads by breaking off and floating along with the tide. It re-establishes itself when it comes across something firm to grow on.

Mud Lobster Mounds
You may have noticed mini volcano-like mounds of mud as you move along the boardwalk. They are made by the mud lobster. It is a very important member of the mangrove ecosystem. It excavates below the surface of the mud, pushing mud to the surface and making its home higher as it digs. In this way it helps to bring nutrients from deep underground to the surface, helping in the recycling of nutrients in the ecosystem. Other inhabitants such as the Mud Shrimp, Tree-climbing Crab and others also make their homes in the mound.

Station 5
Acanthus ebracteatus
Sea Holly, Jeruju Hitam (Malay name)
This rare erect herb can grow to 2.5m tall. Three species of this plant can be found here. This species has spiny leaves that resemble the Christmas Holly, hence the common name Sea Holly. It secretes excess salt through special cells in the

Station 6
Bruguiera cylindrica
Berus Putih (Malay name)
A common mangrove tree here, it grows to a height of 25m tall. The grey bark has many pores or lenticels that allows for gas exchange, an adaptive feature to the low oxygen content in the mud. A special condition exists in many mangrove trees called vivipary, in which the seeds germinate while on the parent plant. The seedling can take root immediately when it falls on the substrate. The wood of this tree is used for firewood.

Station 7
Avicennia alba
Api Api Puteh (Malay name)
This is the most common *Avicennia* species found in the reserve. All *Avicennia* species have the ability to excrete excess salt from their leaves through special salt glands found in the leaf cells. The term *alba* refers to the whitish under leaf surface. Its common name in Malay also makes reference to this feature (Puteh = white).

Station 8
Rhizophora mucronata
Bakau Kurap (Malay name)
The bark of this rare mangrove tree is rich in tannin and is used for tanning and dyeing. The timber is used for fuel and charcoal making. Look out for the hypocotyl (seedling) that is longer and more warty than that of *Rhizophora apiculata*. The flowers are borne on a long slender yellow stalk.

leaves, giving them a shiny appearance. The seeds are pounded and used to cure boils. The leaves are used to ward off spirits and treatment of wounds from poison arrows as well as various ailments such as rheumatism.

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Station 9
Excoecaria agallocha
Blind-Your-Eyes, Buta Buta (Malay name)
This is usually a multi-stemmed tree or shrub that can reach 15m tall. The leaf is slightly toothed and yellow, withering to a scarlet red. Commonly called 'Blind-your-eyes', it exudes sap from broken parts. The sap can be utilized as fish poison and may cause temporary blindness and skin irritation.

We hope that this guidemap will leave you with a greater appreciation of mangroves and the delicate ecosystem that it supports.

In addition, there are signboards throughout the boardwalk. They provide information on the plants and animals that may be found.

There are location signs in the map to inform you of your current location at the boardwalk and what you may see.

This guide map is designed to take you through this 500m long boardwalk and give you with a better understanding of the mangrove habitat and its inhabitants.



mangrove boardwalk

Welcome to the Mangrove Boardwalk.

Station 1
Derris trifoliata
Sea Derris, Akar Ketuil (Malay name)
A climber with pinnate leaves, the Sea Derris will "choke" trees in its quest to the canopy for sunlight. Look out for trees that have "choke" marks on them. They are likely to be caused by this plant. It bears small pink flowers. The pod is flat and contains one seed. The roots contain a poison called saponin that is used to catch fish.

Station 2
Acrostichum speciosum
Swamp Fern, Piai Lasa (Malay name)
A fern associated with mangroves, the Mangrove Fern is frequently seen growing on Mud Lobster mounds. The leaves are brownish when young. In fertile fronds, the lower surface of the leaves are completely covered with dark brown spores.

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Station 4
Pencil roots of Avicennia spp.
These are thin, pencil-like roots (also called pneumatophores), belonging to the *Avicennia* species of mangrove trees.

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Station 9

Nypa fruticans

Commonly known as Nipah, the fronds of this palm may grow up to 9m in length. Pollen fossils of this plant have been found in deposits dating back to 70 million years ago! Extensive stretches may form along river edges. The large, brown fruits are dispersed through water. The young seeds are soaked in sugar and eaten as a snack (attap-chee) and are also used in the local dessert ice kachang. Sap is extracted from the inflorescence and used to make vinegar and a type of beer called toddy. The sap is also boiled to make sugar.

Station 10

Rhizophora apiculata

Bakau Minyak (Malay name)

A rare mangrove tree with long hypocotyl (about 30cm). It can be seen growing in clumps on the deep soft mud of mangroves. Its cream-coloured flowers are borne in pairs. Notice at the prop roots that support the tree in the soft substrate. The seedlings are shaped like little javelins, enabling them to stick to the substrate and take root shortly after dropping. They are also capable of withstanding long periods in saltwater, germinating at suitable sites away from the parent plant.

Mudskippers

You may also notice mudskippers darting around on the mud. There are 3 species of mudskippers in Sungei Buloh. The largest species may reach up to 30cm in length! It carries water in its gill chambers and cheek which stores oxygen that it utilize when it is out of water. The small pools of water you see are created by them. To replenish its depleted store of oxygen it goes into the pool and exchanges its mouthful of water for a new one.

Station 11

Barnacles

Look at the boardwalk support beams and the aerial roots of the mangrove trees and see if they are encrusted with barnacles. Barnacles are actually crustaceans, which include members such as prawns and crabs. The young larvae spent their lives floating as plankton. Once they find a suitable site, they attach themselves head-first to the support by secreting a strong protein cement, forming strong calcareous plates around themselves. These animals feed during high tide using their legs like a filtering device, sieving plankton from the water during high tide to their mouths. When the tide recedes, they retreat to the safety of their shells, closing the valves to protect themselves from drying out.

Station 12

Isognomon ehippium Leaf Oyster

Look for the Leaf Oysters, usually attached to the roots of the mangrove trees. A rather flat-looking bivalve that is edible but not popular due to its minimal flesh. Dead shells are commonly found on the mud.

Cerithidea obtuse

Chut Chut, Matah Merah (Malay name)

Sold live at wet markets, the *chut chut* is eaten fried with chili by locals. It is usually seen on sluice gates and tree trunks during high tide, above the tide level.

Nerita lineata

Common Nerita, Siput Timba (Malay name)

This snail is commonly seen throughout the reserve. It is herbivorous and graze on algae. During high tide it can be seen on tree trunks and various structures.

Chicoreus capucinus Drill

One of the commonest predators of bivalves here, the Drill, as the name suggests, drills a hole in its victim using a boring organ under its foot and carbonic acid produced by the organ. Several hours may pass before it can consume its meal, as excavating the hole is a tedious process which depends on the thickness of its victim's shell. The eggs are usually laid attached to rocky surfaces and are yellow in colour.

Station 13

Avicennia rumphiana

Api Api Bulu (Malay name)

This is the largest of the *Avicennia* species found here, capable of growing up to 30m tall. As with all *Avicennia* species it has slender pencil-like breathing roots (pneumatophores). It is distinguished from *Avicennia alba* by the pale brown woolly young twig and under leaf surface. The fruit of this tree is also woolly and is tear-dropped in shape. A rare species, it is found mainly in the middle to higher intertidal positions. The wood is used as firewood and burnt to smoke fish.

Station 14

Episesarma spp., *Rhizophora apiculata* Tree-climbing Crabs, Bakau Minyak (Malay name)

Rhizophora trees may grow to massive heights, sending large prop roots down for support. The prop roots of these trees are favourite perches for Tree-climbing Crabs, which climb up the roots of these trees as well as tree trunks during high tide, to escape from the many predators that lurk in the water. Look at the mud around the trees. Do you see any seedlings or young saplings? These saplings are the future of the existing trees, replacing trees that die over the years.

Station 15

Bruguiera gymnorhiza

Tumu

One of the species of *Bruguiera* mentioned earlier (Station 6), this rare mangrove tree also has prop roots for support. The fruits are cigar-like in shape and the calyx (modified leaves forming a protective layer around the flower) is red, making the tree look very attractive when it flowers.

Todiramphus chloris

Collared Kingfisher

The most easily seen kingfisher here, the Collared Kingfisher is easily identified by its turquoise blue upper-parts and head and white collar. A noisy fellow, you will hear it even if you cannot see it! It has a loud and harsh cackling call that advertises its presence. You can sometimes see it chasing off another Collared Kingfisher who has strayed too close to its territory. It feeds on fish, frogs, small snakes, insects and lizards.

Station 16

Look above you and you'll notice the many colourful tiles that make up the roof of the shelter. Each of these tiles are hand-painted by the students of Commonwealth Secondary School. They depict the message that the 'artists' wanted to convey: Love the mangroves and let the wildlife thrive!

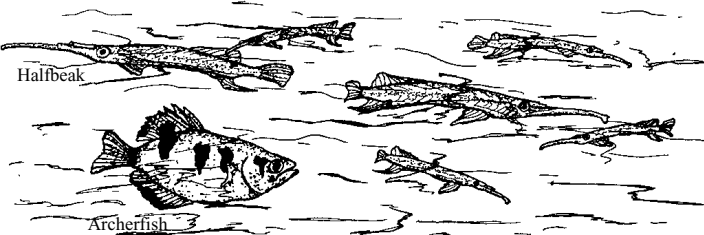
Tide level



The mangroves are exposed to two high tides and two low tides in a 24-hr period. During high tide the mangrove area is flooded and you'll see a 'submerged' forest, and the trees look like they're floating on water. When the tide recedes the mud is exposed. You can see the mangrove tree roots and the animals that live among them. Is the tide high or low now? You can see how high the tide reaches by looking at the watermark left by the water when the tide recedes.

Fishes

Many fishes can be seen when the tide comes in. Some of them include the Archerfish, which is easily identified by its black bands. The Halfbeak is the most common fish seen. It skims the water surface for food. Small schools of young fishes can be seen seeking shelter among the mangrove roots.



Station 17

Knead roots of *Bruguiera* spp.

Do you see any roots that look like bent knees? Knead roots are characteristic of *Bruguiera* species of mangrove trees commonly seen here. These roots spread over a wide area, improving the anchorage of the tree on the mud.



Cicada

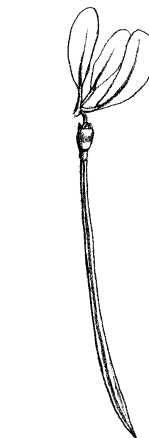
By now you would have be intrigued (or irritated!) by the incessant shrill calls that fill the air. The shrill calls are made by a brown insect called the Cicada. It calls by vibrating a membrane located on its abdomen.

Station 18



You have almost reached the end of the Mangrove Boardwalk. Why not take a breather and think about what you've seen so far and what it means to us?

Mangroves are more important to us than we realize. Not only do they provide us with a variety of uses, they are also home to many animals that make up the ecosystem, contributing to the diversity of organisms on this planet. Inhospitable the mangroves may seem to us, but not to the variety of animals and plants that inhabit them.



Station 19

Ceriops tagal Tengar (Malay name)

Another rare species of mangrove tree, *Ceriop tagal* can be found. It can be identified by its flattened stipule, inverted egg-shaped leaf and sharply angular seedling. It has kneed roots like *Bruguiera* (Station 6). It is used for firewood and tannin is extracted from its bark for tanning.

Station 20

Asplenium nidus Bird's Nest Fern

This is a huge epiphyte (a plant that grows on another plant) called the Bird's Nest Fern. This fern is well adapted to life above the ground. Its leaves are arranged in a rosette shape that traps fallen leaves. These are then decomposed to form a rich organic matter called humus, which is absorbed by the roots, hence the fern is able to grow in places where there's no soil.

The journey ends...

We hope that you have had an enjoyable and educational experience. Mangroves support a diversity of organisms, plants and animals alike, and perform many useful functions for the environment and us. If we look beyond the dark mud of the mangroves, we would find a place full of life, a place beautiful and wondrous in its unique way.

We look forward to seeing you again soon.



NParks' Publication



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