KAUST MANGROVES

جامعة الملك عبدالله للعلوم والتقنية
King Abdullah University of Science and Technology

Health, Safety and Environment

Between the Land and the Sea

KAUST is fortunate because it lies on an area of the Red Sea that has a considerable area of natural mangrove habitat. KAUST is committed to nurturing this natural environment, not only by protecting its existing mangrove areas, but by also promoting further expansion. This exhibition, and an accompanying booklet, aim to inform the KAUST community and visitors about this fascinating habitat, the creatures that live there, and why it is such a valuable resource. We hope you are encouraged to visit these mangrove areas and experience first hand the natural world at your fingertips.

This exhibition has been the result of a collaboration between several KAUST Departments, namely, Health Safety and Environment, the Red Sea Research Centre and the Office of Enrichment.

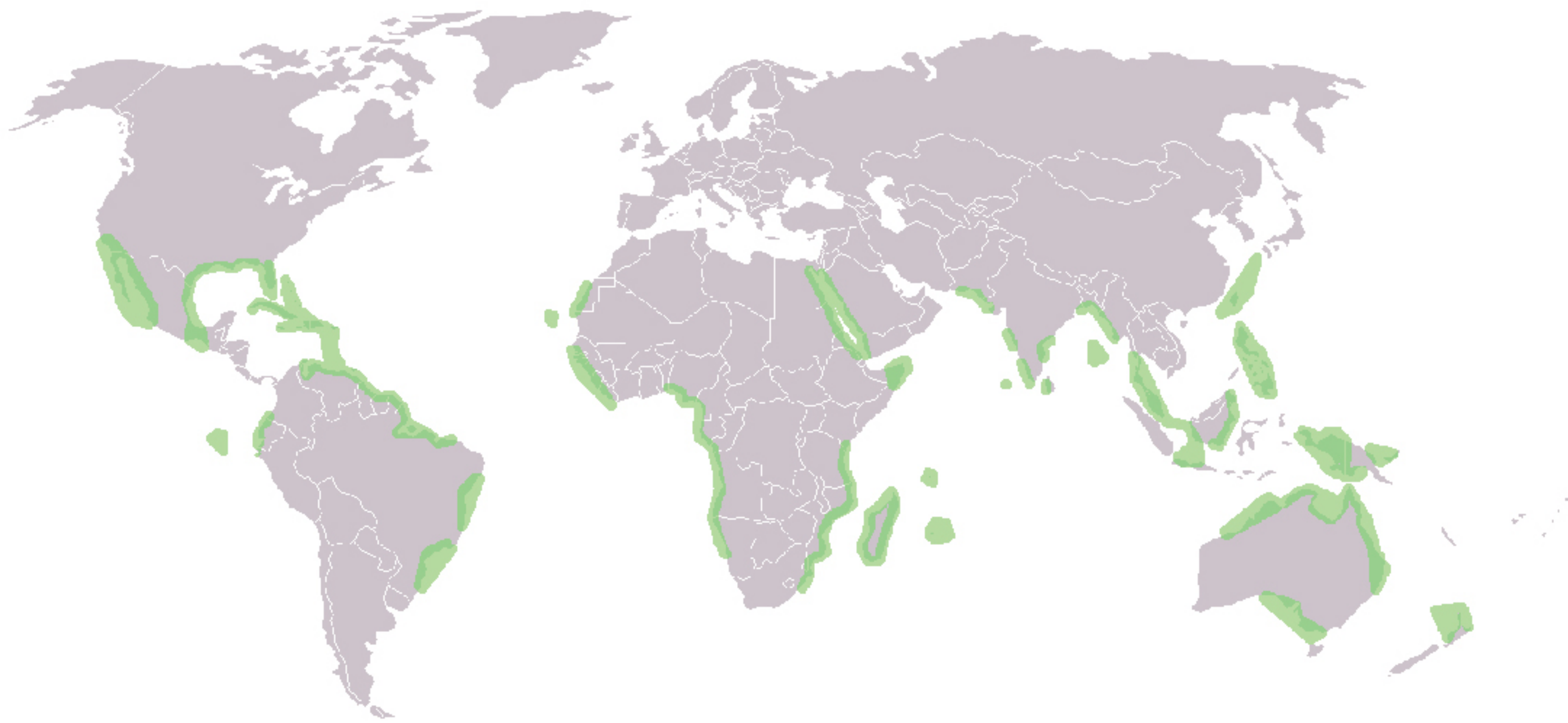
The photographs were taken either by students at the Red Sea Research Centre or Brian James of HSE.

One way to explore the mangroves is to sign-up for one of the HSE Guided Bird Walks to the mangroves.

Mangroves at KAUST

Mangroves habitats are thriving at KAUST. From 2005 until 2016 the area of mangrove habitat at KAUST increased from 75.2 hectares to 91.2 hectares. The increase is partly due to natural expansion but also because of KAUST's mangrove afforestation program. 150,000 saplings have been planted at locations around KAUST.

In other Red Sea regions mangrove habitats are also expanding, but elsewhere in the world many are under threat.

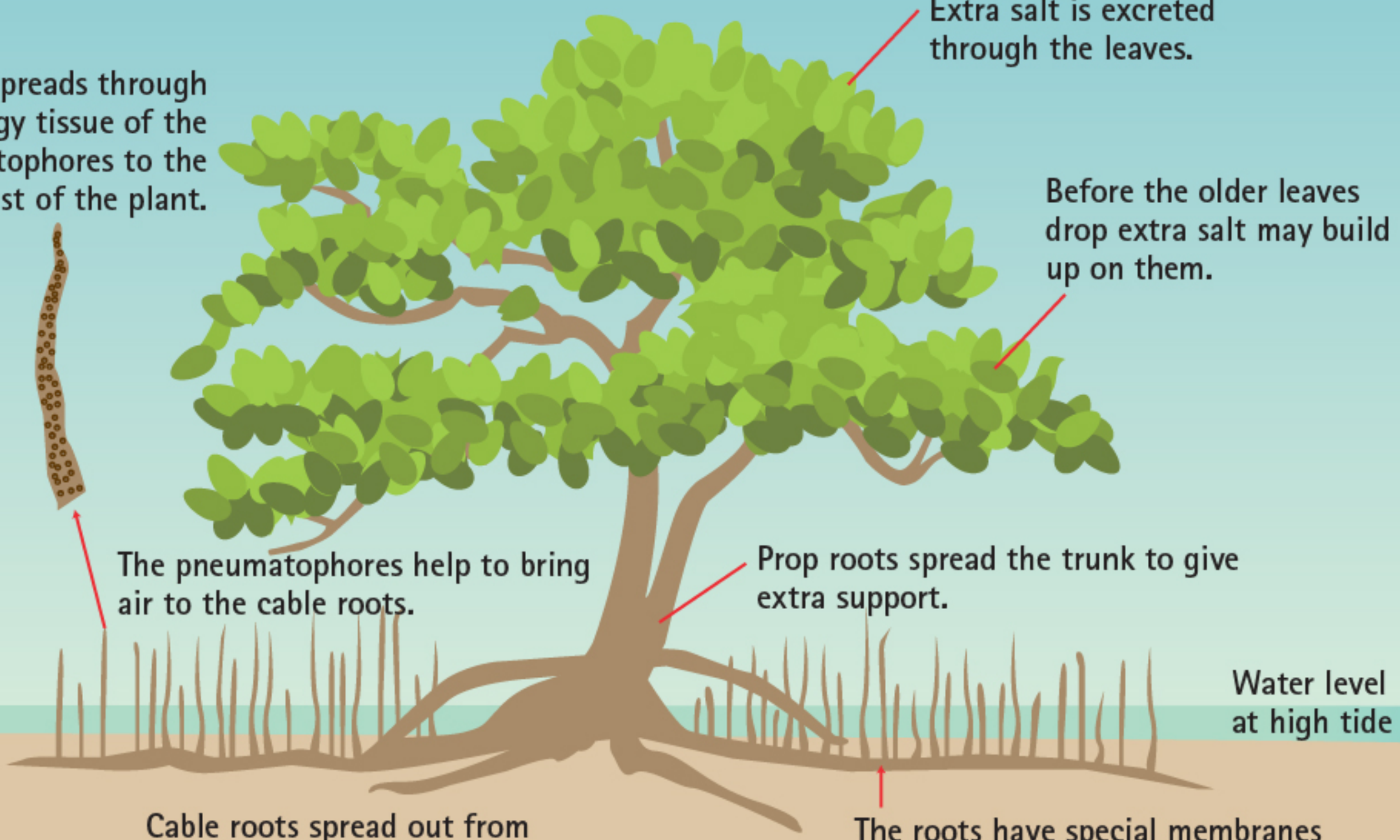


Mangroves Worldwide

Mangrove forests have been found in 110 countries around the world. Mangroves grow best in regions that are within 25 degrees, north or south of the Equator.

There are about 80 different species of mangrove. On most types of mangrove the roots grow up towards the main branches of the plant. This makes it look as if the mangrove is growing on stilts. The mangroves in North America and South East Asia are mostly like this. They look very different to avicenna marina.

Mangrove Adaptations



The Red Sea Mangrove

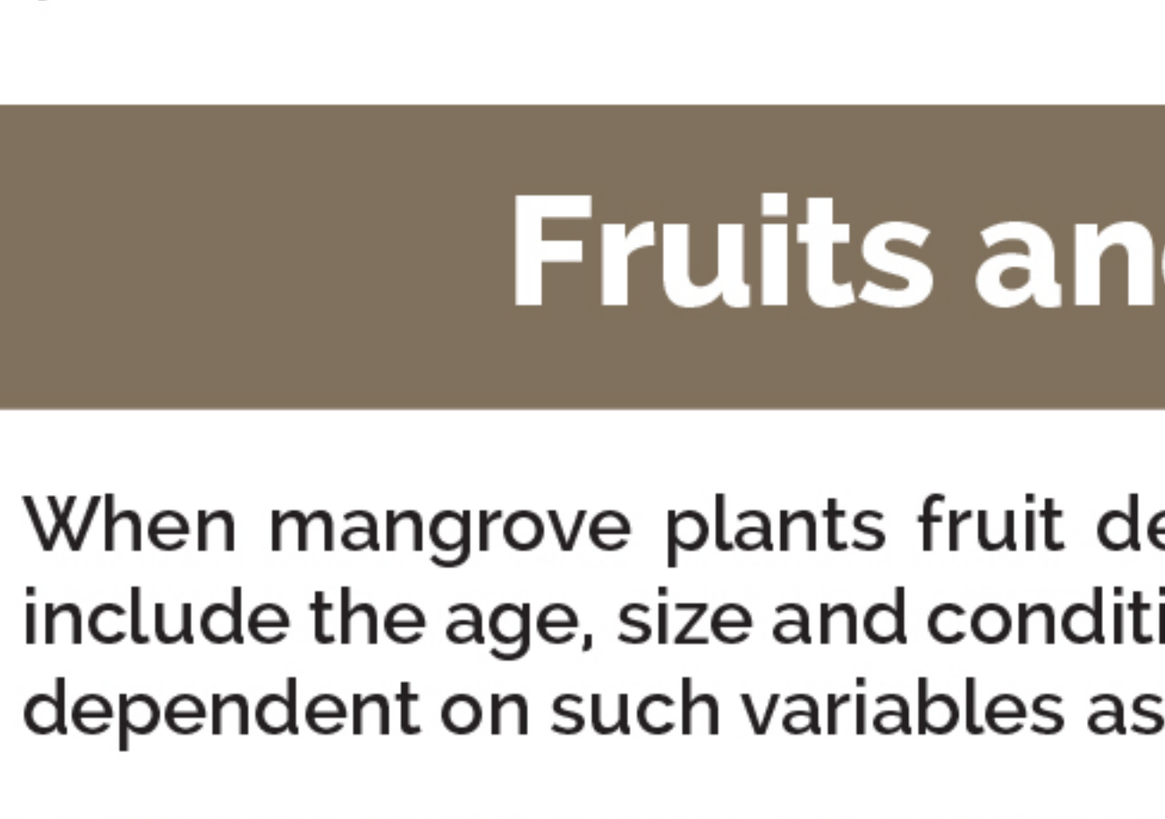
The mangrove plant found at KAUST has the scientific name of 'Avicennia marina'. It is commonly called the grey mangrove or white mangrove because the plant's leaves and stalks are often colored with salt crystals. The tallest trees at KAUST reach a height of 5 meters. However, in some parts of the world its height may reach 25 meters.

Pneumatophores (Aerial roots)

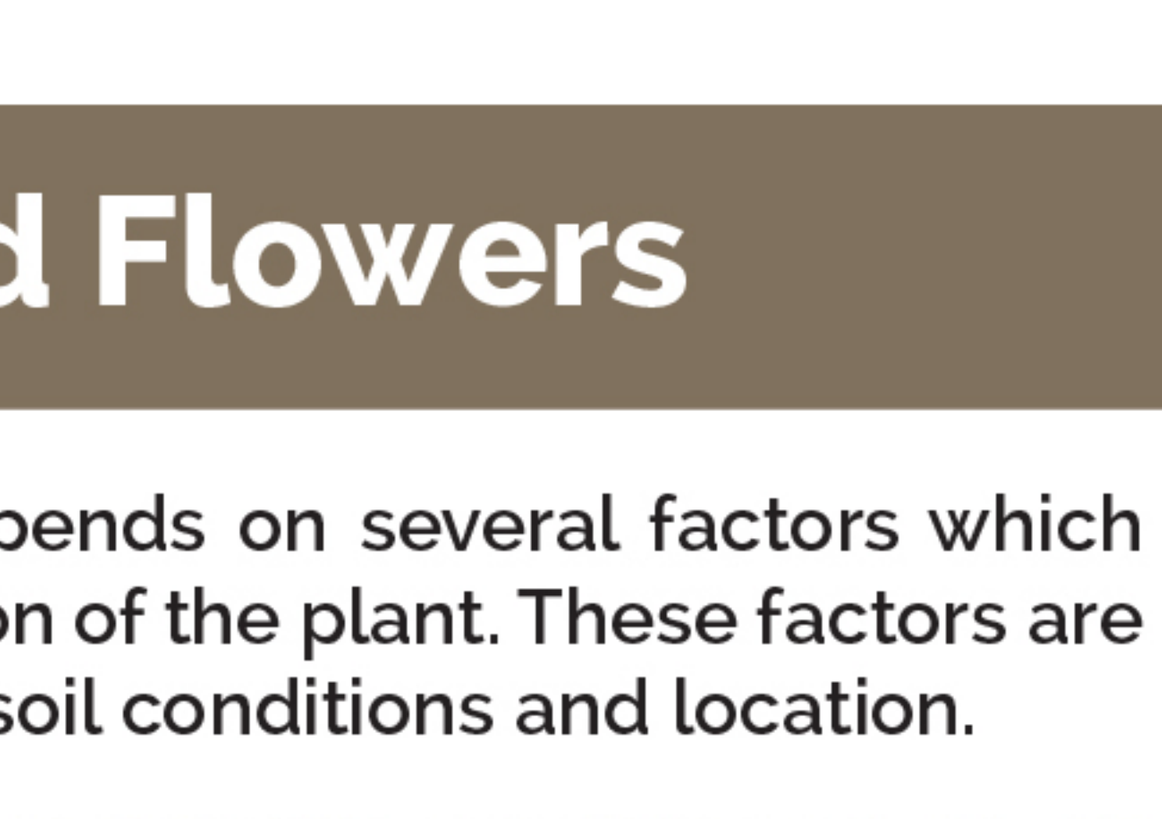
The roots of the mangrove plant do not grow deeply but instead spread out across the mud or sand in lines. The roots send up pneumatophores (aerial roots) which act as 'snorkels' collecting oxygen from the air and transporting it to the roots, enabling the plant to breathe.

Fruits and Flowers

When mangrove plants fruit depends on several factors which include the age, size and condition of the plant. These factors are dependent on such variables as soil conditions and location.



Fruits



Flowers

Avicennia marina is a viviparous plant. The fruit is ready to sprout roots if it falls near sediment. However, it also survives if it falls into water and takes time to float to a suitable location to grow.

At KAUST most plants flower between September and April. The flowers have a scent that attracts bees which pollinate the plant.

Sea Water Filters

A Very Special Adaptation

The average salt content of seawater is 35% but in the Red Sea it is around 40%. This level of salinity would kill most plants but avicennia marina is adapted to survive these conditions. The cells in its roots are tiny. This limits the amount of salt which is absorbed. Any excess salt can be excreted through its leaves. This is why mangrove plant leaves are often covered in salt crystals.

Dicotyledons

Two Seed Leaves

Mangroves belong to the group of flowering plants known as dicotyledons (or dicots). This simply means the plant starts life with two leaves emerging from the seed pod. Each leaf has veins which branch out from the central stalk. Daisies and oak trees are also dicotyledons.

Shoreline Stabilisers

Mangrove plants help to slow down shoreline erosion. The roots slow down wave actions and prevent sediment from being washed away. The sediment contains nutrients which are vital to the ecosystem.

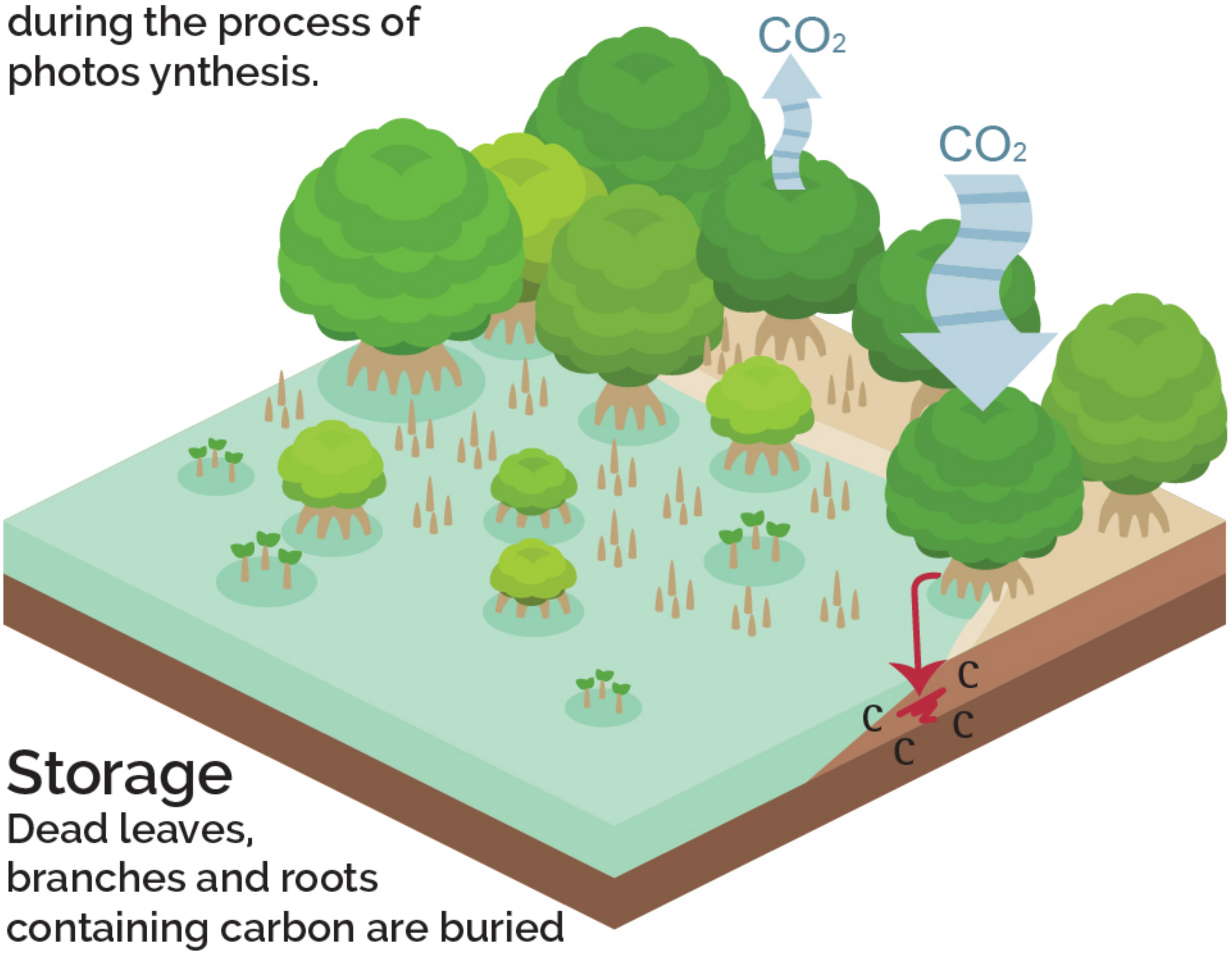
Island and Habitat Makers

The seed of the mangrove plant is inside the fruit. When the fruit falls into water it floats with the tide. If it lands in sand or mud it starts to form a new plant. As the plant grows, sediment forms around the plant and new land starts to form. There are many small islands developing at KAUST. These become habitats for communities of living things.

Sequstration

Carbon dioxide in the atmosphere is taken in by trees and plants during the process of photos ynthesis.

Some carbon is lost back to the atmosphere through respiration. The rest is stored in the leaves, branches an roots of the plants.



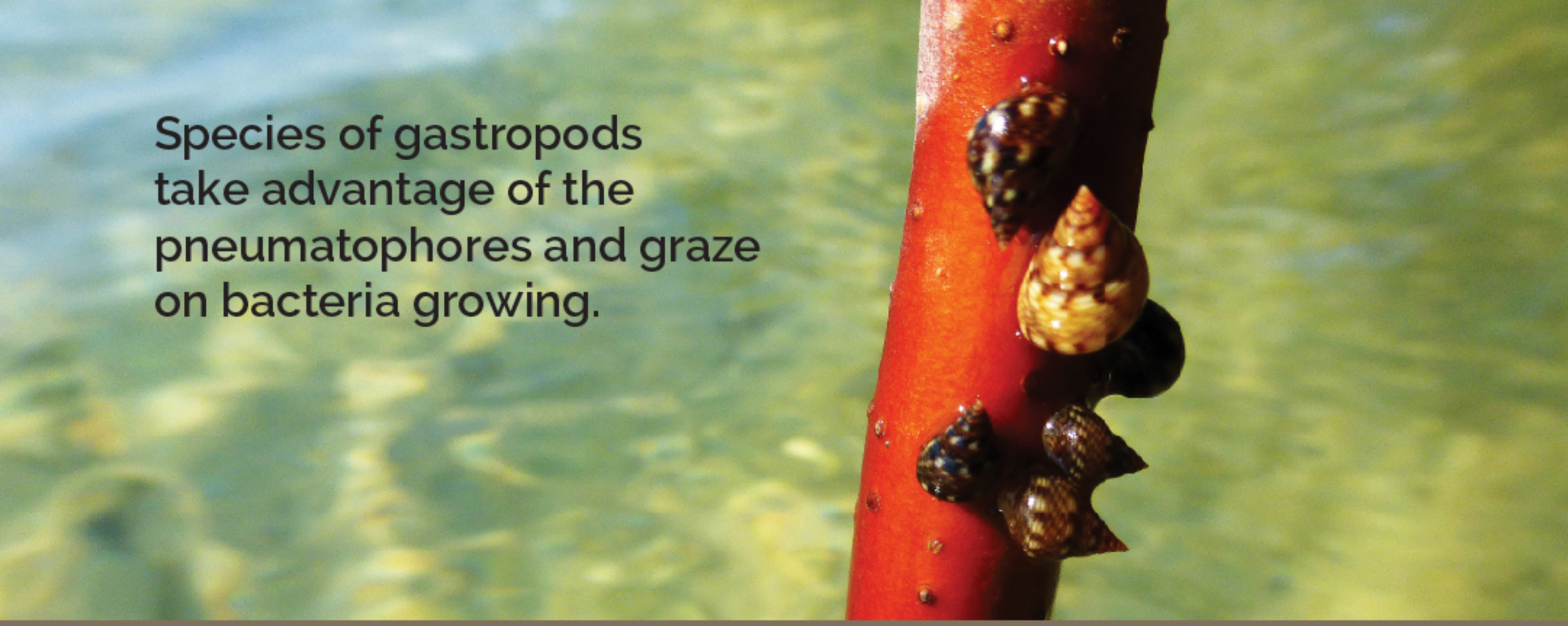
Storage

Dead leaves, branches and roots containing carbon are buried in the soil, which is frequently, if not always, covered with tidal waters. This oxygen-poor environment causes very slow break down of the plant materials, resulting in significant carbon storage.

Blue Carbon

Marine ecosystems, like mangroves, play an important role in preventing climate change. The plants take carbon dioxide from the air and store it. This is known as 'sinking' and the carbon storage as 'blue carbon'. Mangrove areas 'sink' blue carbon even more efficiently than terrestrial forests.

However, throughout the world blue carbon ecosystems are being lost. UNESCO estimates that 67% of mangroves have already been destroyed. Fortunately, in the Red Sea area this is not the case and the area covered with mangroves has increased by up to 30 per cent. KAUST is committed to maintaining the mangrove ecosystem and playing its part mitigating climate change.



Species of gastropods take advantage of the pneumatophores and graze on bacteria growing.

Mangroves as Food Suppliers

Mangrove leaves and propagules (new buds that grow on the stems) provide food for creatures such as crabs. They also feed on mangrove litter, such as leaves and bark which fall down into the water. Some of it is eaten directly but most is broken down further by bacteria and fungi and then provides food for fish and prawns. Their waste may then be eaten by smaller crustaceans and, in turn, their waste provides food for zooplankton.

Nurseries for young fish

The young of many fish species use the mangroves as it offers them a safe nursery. They come to the mangroves after they have hatched elsewhere and most leave after around one year. The mangroves offer safety in several ways. Larger predator fish cannot swim into the shallow mangrove waters to hunt them. The nutrient rich waters also provide food for the fish. The fish are well camouflaged in the murky waters and therefore hard for predators to find. After, they return to their more natural habitats in the seagrass forests or the coral reefs.

It can be very hard to spot the young fish in the murky water.

Crabs and Mangroves - Symbiosis in Action

Crabs are the most abundant and important large invertebrate in the mangroves at KAUST. When they dig holes they help to improve the flow of water through the mangroves. This helps the plant flush out excess salt. The burrows also allow oxygen to reach the roots by creating air pockets in the mud. Up to 100 burrows can be found inside 1 square meter.

Crabs eat large amounts of fallen mangrove litter. They help to breakdown the detritus so that zooplankton and algae can eat it. In this way they are helping to recycle nutrients, in particular nitrogen.

Osprey

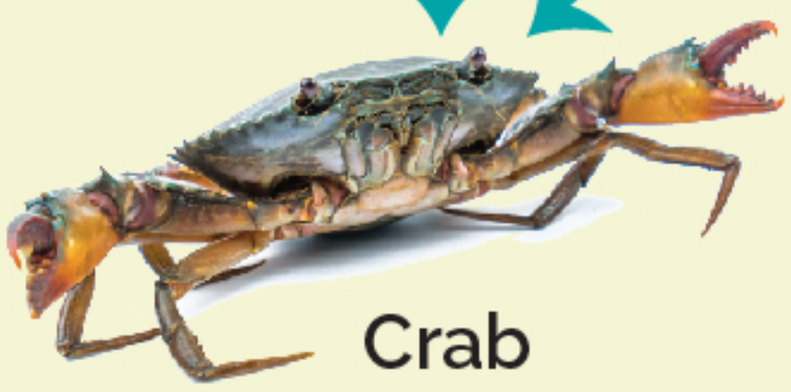
Crab Plover

Human

Arrows go from eater to food

Fish

Shrimp

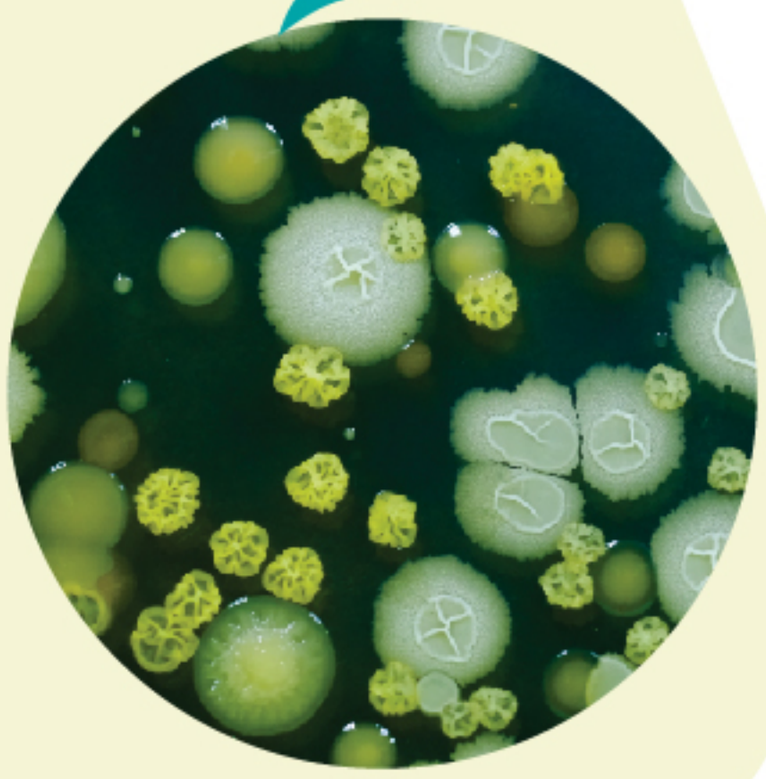


Crab

Molluscs

Mangrove

Rotting Leaves



Bacteria, Algea, Fungi

Mangrove Food Web

Mangrove plants produce lots of litter. Some is eaten by crabs but a great deal is broken down by fungi and bacteria. They produce waste that is eaten by consumers such as mollusks, shrimps, crabs and small fish. One teaspoon of mud may have 10 billion bacteria! Crabs, prawns and mollusks may be eaten by secondary consumers such as fish or birds. Many of the small fish are eaten by secondary consumers such as larger fish. Larger birds such as Ospreys or herons are the predators at the top of the food chain.

Crabs at KAUST

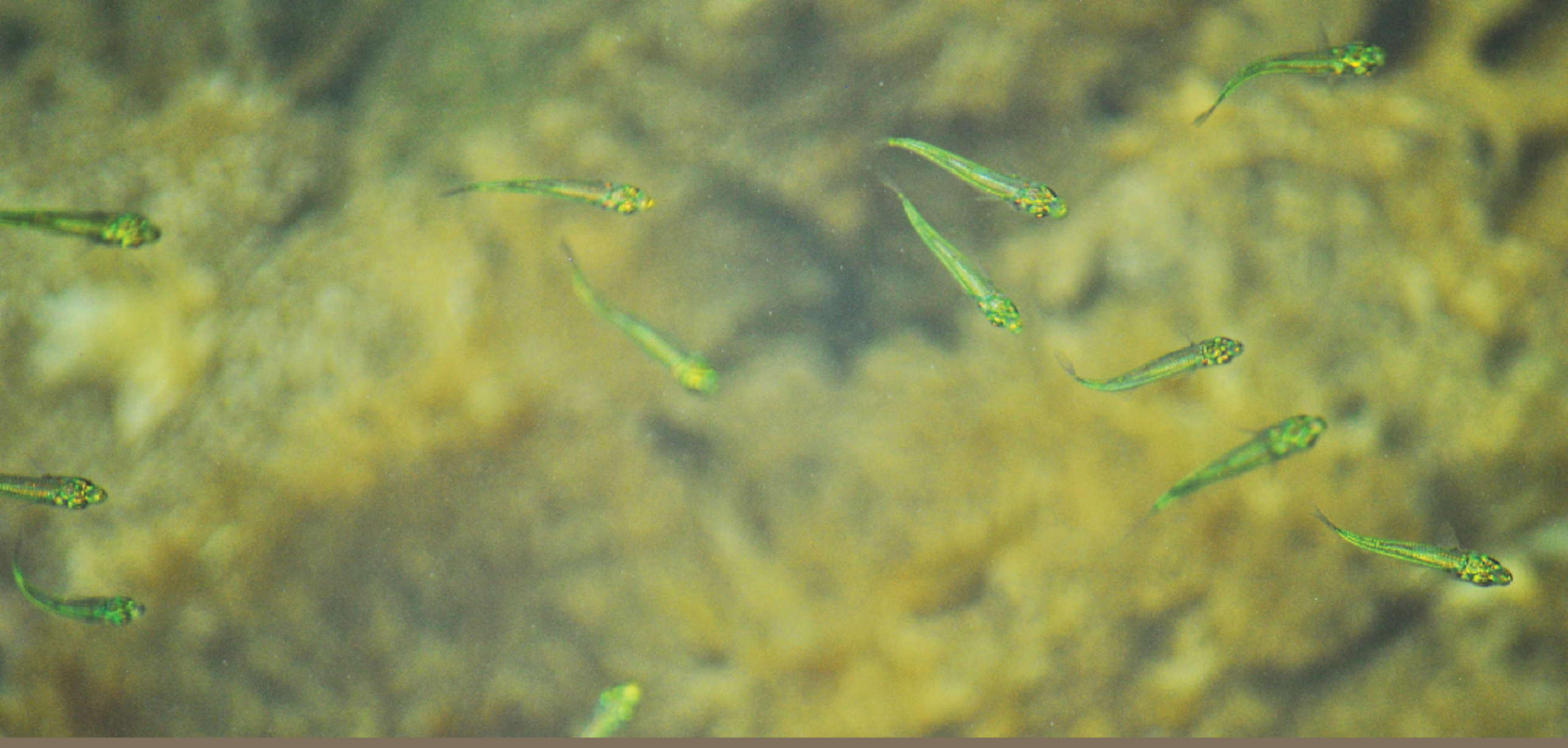
Crabs are decapods, with their claws counting as one of the pairs of legs. Their shell (exoskeleton) protects the organs underneath. Most crabs move sideways but some may run up and down. They communicate by waving their claws. Males will defend their territories from rivals.

Species of Crab

So far 10 crab species have been found in the mangroves at KAUST but they have a wide variety of lifestyles. Fiddler crabs (ocypodidae) and sand bubble crabs (dotillidae) graze in sediment filtering out bacteria and microalgae, Marsh crabs (Grapsoidea) though are omnivores. They feed on on almost any organic matter. Other crabs are swimming predators (Portunidae) and hunt other crabs and small fishes.

Dotilla Sulcata

Metopograpsus messo



Fish of the Mangroves

Most fish seen in the mangroves are young ones. It is an ideal habitat for them because;

1) There is a plentiful supply of food including zooplankton, bacteria, invertebrates, and the mangroves themselves.
2) The shallow water offers a safe haven from larger fish predators and the young fish are well camouflaged in the murky waters.

Porcupine fish are well camouflaged. They inflate their bodies by swallowing water or air to almost double their size. They also have sharp spines which radiate out from their bodies. These defences mean they have few enemies.

The Blue-spotted stingray (taenitura lymna) can grow up to 90 cm in length. They have pebble-like teeth and the tail has venomous barbs at its base. Their shape allows them to swim into shallow water where they feed on mollusks and shrimps. Their flat shape enables them to move around in the shallow waters.

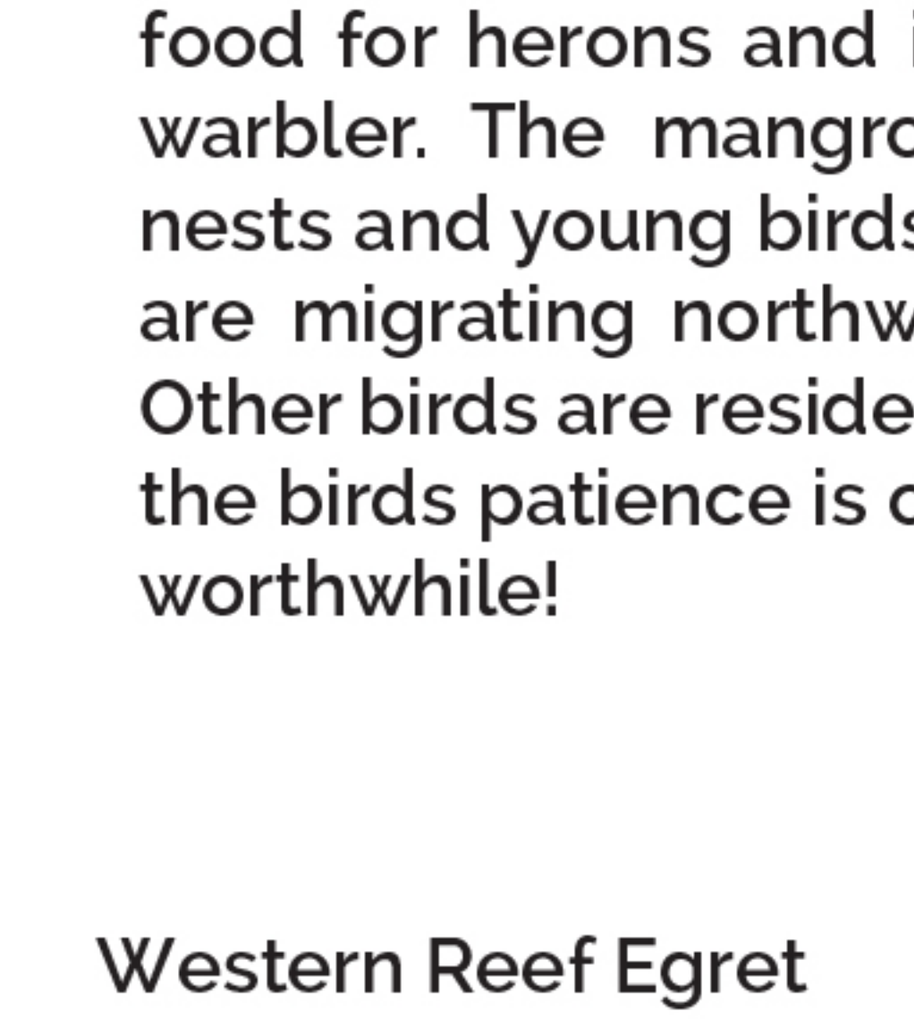
Blue-spotted stingray

Porcupine

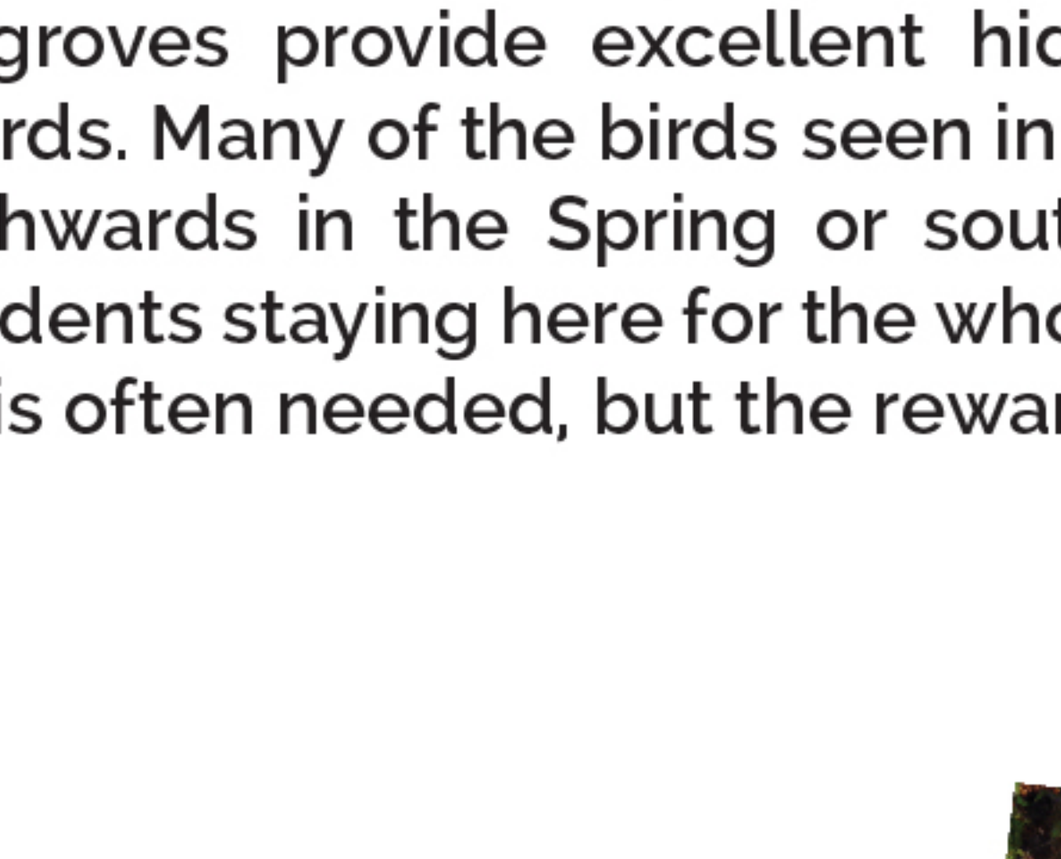
Birds of the KAUST Mangroves

Over 100 species of birds have been recorded in the KAUST mangroves or accompanying mudflats. The nutrient rich mud provides food for many species of invertebrates, which in turn are eaten by birds such as waders or small herons. Fish provide food for herons and insects are the prey of several species of warbler. The mangroves provide excellent hiding places for nests and young birds. Many of the birds seen in the mangroves are migrating northwards in the Spring or southwards in Fall. Other birds are residents staying here for the whole year. To spot the birds patience is often needed, but the rewards may be very worthwhile!

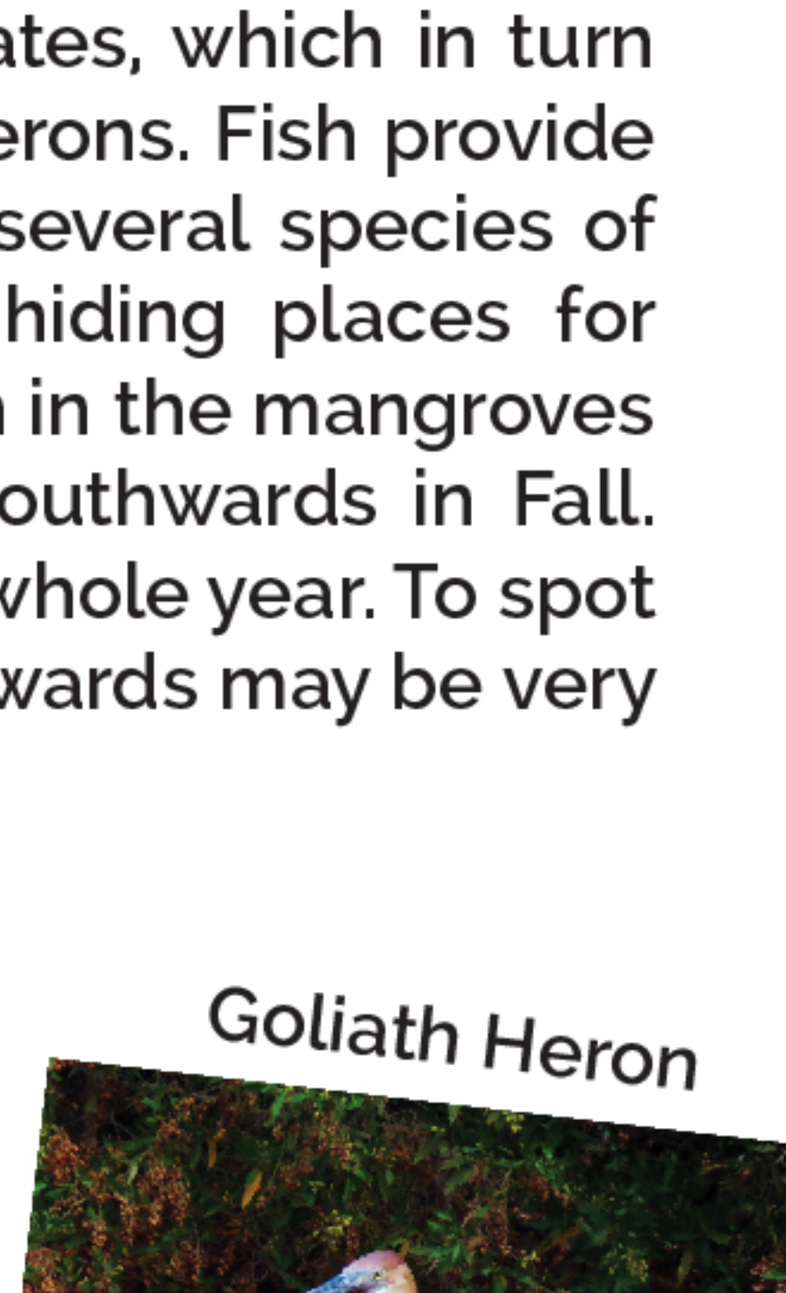
Western Reef Egret



Little Bittern



Goliath Heron



Herons and Egrets

12 Herons species have been recorded in the mangroves.

Birds of the KAUST Mangroves

Warblers

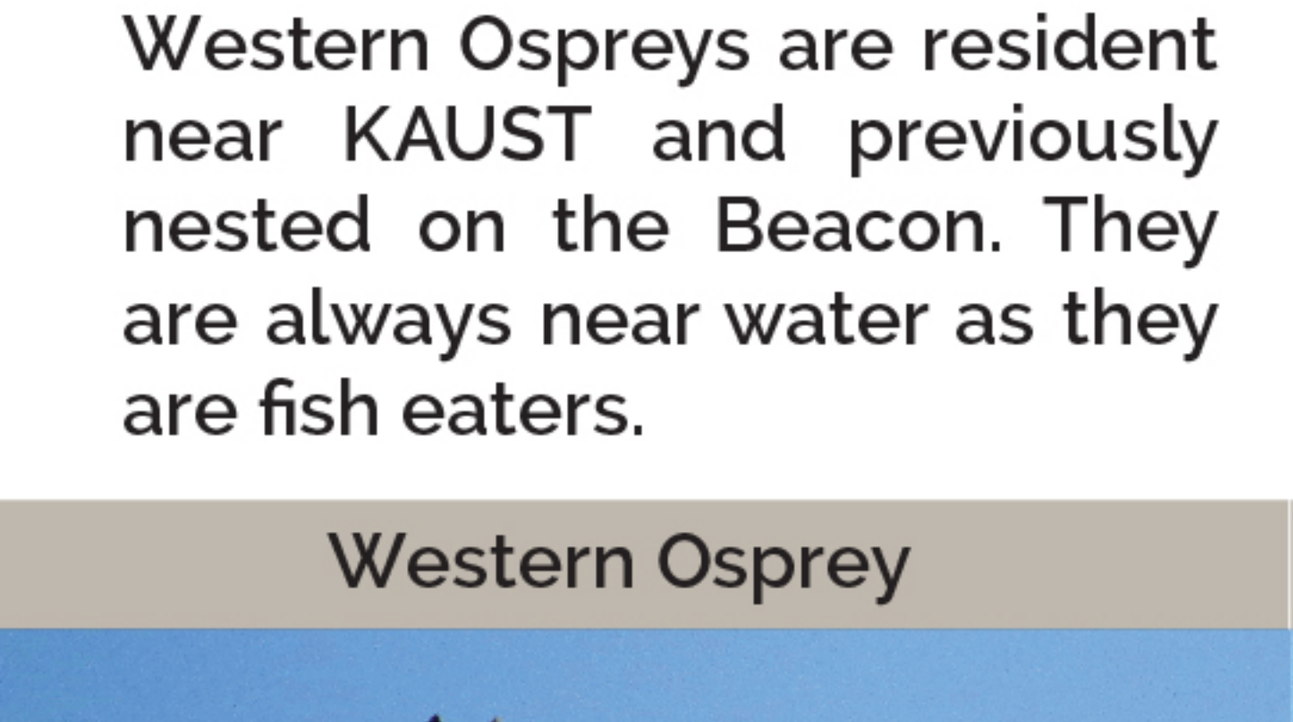
Two common species of warbler at KAUST are the Clamorous Reed Warbler (below) and the Mangrove Reed Warbler. Both are mangrove specialists. The Clamorous is large and, as its name implies, noisy. The Mangrove Reed Warbler is similar only smaller and quieter.

Birds of Prey

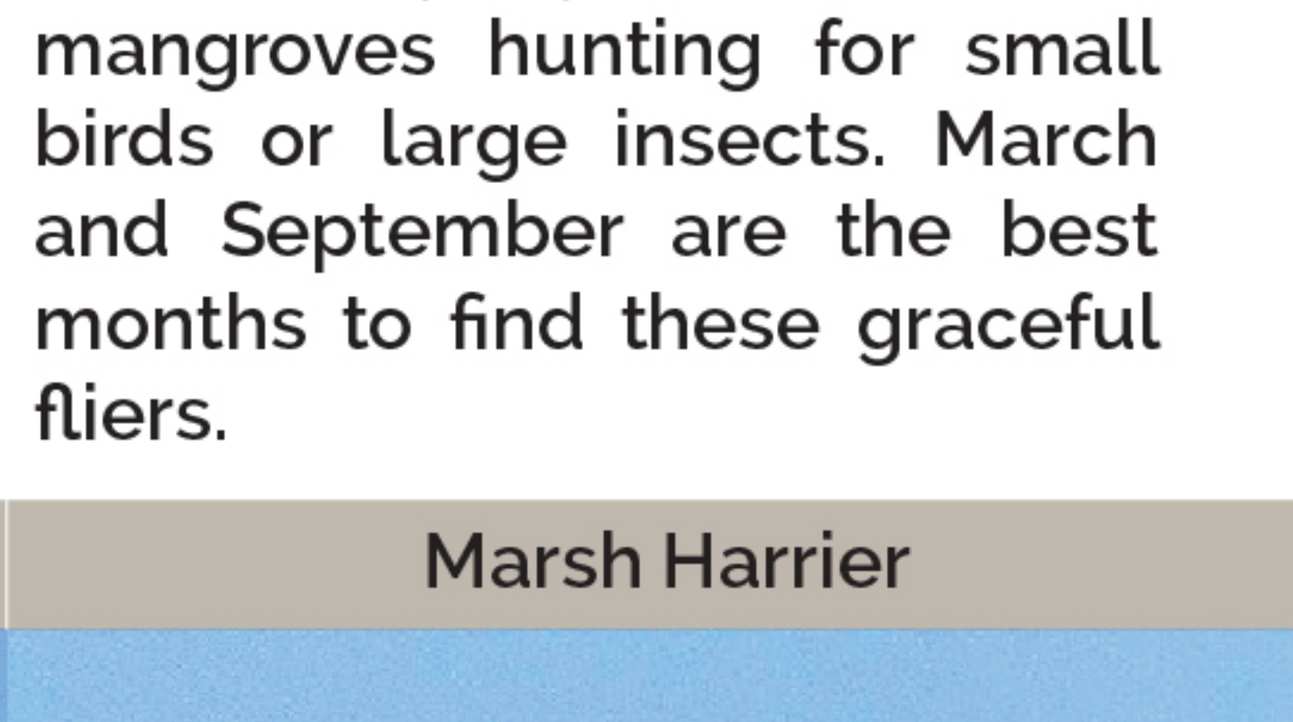
Western Ospreys are resident near KAUST and previously nested on the Beacon. They are always near water as they are fish eaters.

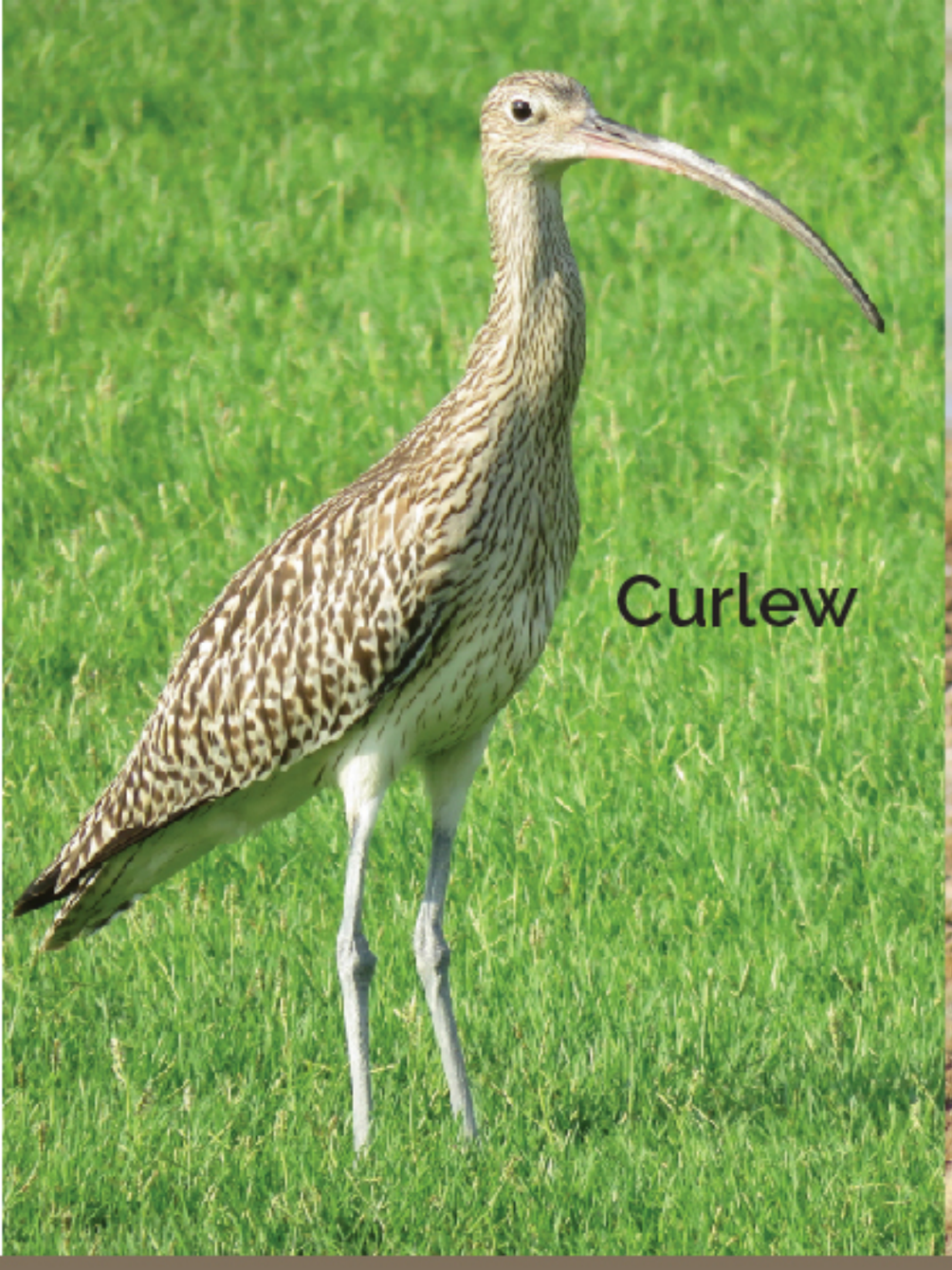
Marsh Harriers are migratory birds. They fly low over the mangroves hunting for small birds or large insects. March and September are the best months to find these graceful fliers.

Western Osprey



Marsh Harrier





Birds of the KAUST Mangroves

Waders

The mud flats surrounding the mangroves are rich in invertebrates which attracts many species of wader. The different species have a variety of beak shapes and sizes depending on the preferred food of the bird. Many have long legs enabling them to wade through the water with ease. In the summer a number of the resident species make a simple scrape on higher ground.

Gulls and Terns

Gulls and Terns are regularly seen at the mangroves or beach hunting for fish.

Saunders' Tern

Sooty Gull

Bird Migration

KAUST lies on the Red Sea, a major migratory highway for birds. They come from as far away as Siberia and the shores of the Arctic. When the cold weather comes most trees are bare, the ground is hard and any surviving insects dormant. The birds must leave their breeding grounds the birds and fly south or starve. From KAUST most will fly on into Africa where they will spend the next few months, before beginning the return journey.

The volume of birds passing is higher in autumn than in spring, as some species return down the western side. The mudflats and mangroves at KAUST are an important stopover site for these migratory species. The invertebrate rich waters allow the birds to refuel and gather strength before continuing the journey. Other birds utilise the garden areas, feeding on the abundant insect life occuring at that time.

Most smaller birds fly at night when it is cooler and there are less predators. Larger birds fly during the day utilising thermals to save energy.

How the birds find their way is poorly understood. Some follow obvious landmarks, others navigate using the stars and some seem to have an in-built magnetic compass. However, many die on the way from starvation, bad weather, exhaustion or predation. Half of all Barn Swallows perish on their first migration.

The importance of safe stop over sites is increasing. Expanding human development has resulted in many such areas being lost. At KAUST we can play a small part in helping these birds survive.