Wonderful Water

An Environmental Education Programme

A Watery World

Mangrove Ecosystems in TCI

2. Adaptations of Mangrove Species

Pupils' Text

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This environmental education programme has been produced by the UK Overseas Territories Conservation Forum (UKOTCF) and the Turks and Caicos Department of Education.

It was part-funded by the Overseas Territories Environment Programme (OTEP) of the UK Department for International Development and the Foreign and Commonwealth Office.

The project was developed from an original idea by Mr Edgar Howell, Director of Education, Turks and Caicos Islands, and these materials developed by a team co-ordinated by Ann Pienkowski, Environmental Education Co-ordinator, UKOTCF. In particular, thanks to Bryan Naqqi Manco for his input to this unit.

It is hoped that through the teaching materials developed for this project, students in TCI will gain a greater understanding of the importance of the water ecosystems in TCI, and the need to conserve these.

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Photo © Mike Pienkowski

The upside-down jellyfish is found in the shallow waters in the Mangroves. They lie on their backs, so their stinging tentacles are on top, to deter predators. Algae live amongst their tentacles. These photoshynthisise and make sugar. The jellyfish benefits by getting some of this sugar.

Introduction

To survive, living organisms must collect or capture food and other nutrients, get oxygen, obtain freshwater, hide or avoid predators, and, for animals, maintain a body temperature which is not too hot or too cold and reproduce. The harsh environment between the land and the sea, where it can be very hot, very dry, very salty, and where water levels change according to the tide or the rain means that animals and plants need special adaptations to live there. So the animals and plants living in the mangrove ecosystem show many adaptations to cope with this difficult environment.

Objectives

These materials will help you to understand what some of these adaptations are, and how they help the organisms' survival.

You will:

- Find out what is meant by adaptation
- Describe how some animals and plants are adapted to living in the mangrove ecosystem
- Be able to give some examples of animal behaviour that helps survival in the mangrove ecosystem.

What is an Adaptation?

All living things have adaptations. An adaptation can be a body part or structure, or a behaviour that enables an animal or plant to survive in its environment.

Photo © Mike Pienkowski

Why do you think the Fiddler Crab lives in a burrow?

Adaptations of plants in the mangrove zone

Let's look at the plants which grow in the mangroves, and their adaptations

Mangroves live in an environment where the water is very salty, water levels are constantly changing, and oxygen levels are low. Most plants would die under these conditions. However, mangroves live very well. They have adaptations to survive in these harsh conditions.

Red, Black and White Mangroves have different adaptations to live in different areas along the coastline. Red Mangroves are better at growing in the sea, Black and White Mangroves in drier saltier soils further inland, Buttonwoods in the driest areas. Each species has special adaptations to cope with these different harsh conditions.

Why do you think different mangrove species grow in different zones in the mangrove ecosystem?

Red Mangroves

The prop roots of the Red Mangroves keep most of the tree out of the salt water, so the leaves are protected. As the tree is on stilts, it does not suffer from being in the water most of the time. The prop roots also keep the salt out – they act like the TCI water companies' desalination plants, so the roots take in fresh water and leave the salt behind.


Photo © Mike Pienkowski

Red Mangrove prop roots keep the leaves out of the salty water and take in fresh water, leaving the salt behind.

Black Mangroves


Photo © Mike Pienkowski

The Black Mangroves grow in the drier, intertidal, saltier areas, where the oxygen level is low. The oxygen level is low because the decaying plants and animals in the soil use the oxygen up. The roots of the Black Mangroves cannot get enough oxygen from the soil. So Black Mangroves have adaptations to cope with these two harsh conditions.

Black Mangrove pneumatophores get oxygen to the roots.

The Black Mangrove gets oxygen into its roots from the air above ground! It has special roots called pneumatophores. These sprout up from the ground around the base of the tree. They look like little black straws or snorkel tubes sticking up in the air, and these suck in oxygen for the plant roots.

The Black Mangroves get rid of the excess salt through their leaves. They have special pores in the underside of their leaves, which get rid of the salt. If you lick the bottom of a black mangrove leaf it will taste salty!

White Mangroves and Buttonwoods

Both of these species get rid of salt before it reaches their leaves. At the bottom of each leaf there are two salt glands, which remove the salt.

The Silver Buttonwood has leaf hairs which are a natural sunscreen to protect the leaf from intense light. They also protect the leaf from heating up too much, so reducing water loss through the leaves.

The hairs on the Silver Buttonwood leaf, which give it the silvery sheen, act as a natural sunscreen.


Photo © Mike Pienkowski

Leaves

Mangroves get the fresh water they need from the seawater, but this takes a great deal of energy. So the leaves of the Mangroves are well adapted for water conservation. They are very tough and have a waxy covering. This waxy covering stops too much water being lost from the leaves.

Look for the waxy covering on mangrove leaves which slows down water loss from the leaves.

Seed Production

Red Mangrove propagules (sea pencils) on the tree

To survive, all plants have to reproduce, and like many plants, mangroves produce seeds. If the seeds just dropped into the salty water or soil, they would die. So mangroves have a special adaptation for seed production, called **viviparity**. Instead of releasing seeds, which would soon get soaked with salt and die, the seeds of mangroves germinate while still attached to the tree.

The fully developed seedlings are then dropped from the trees. These baby mangroves float root side down in the water until they reach the shallows near shore and take root. These long seeds are called propagules and they can float quite a long way in search of somewhere suitable to grow. White Mangrove propagules can float for about a month, Black Mangrove propagules for several months and Red Mangroves propagules for up to a year!

The seeds of the Red Mangrove are sometimes called sea pencils, and these are fun to grow. Ask your teacher how to do this.

Why do you think that mangrove seedlings are adapted to float in the water for a long time?

Adaptations of animals in the mangrove ecosystem

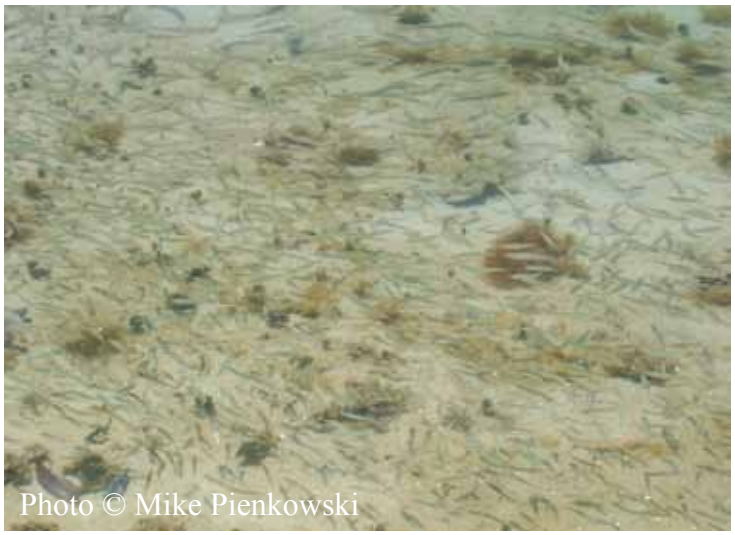
The mangrove ecosystem supports a large variety of different animals, all of whom have adaptations so that they can live there. Like all living things, to survive they need to:

- collect or capture food and other nutrients,
- get oxygen
- obtain freshwater
- reproduce
- maintain a body temperature which is not too hot or too cold
- hide or avoid predators

The animals that live in the mangrove ecosystem will have adaptations that enable them to do all these things. Some of these adaptations are body parts, and some are behavioural.

Silverside fish

The Silversides feed on tiny animals floating in the water, called zooplankton. The Silversides need to avoid being eaten by larger fish. They have adaptations to help them do this.



Silversides keep in large groups, Their translucence makes them less visible, so they are camouflaged

Body Adaptations

The silvery colour helps them merge with their background so makes it more difficult for predators to pick them out. This ability to blend in to their surroundings is called camouflage. The Silverside is a small fish, and the long narrow shape reduces water resistance. So the fish can move through the water more quickly and easily. The forked tail and fins help it change direction quickly.

Behavioural Adaptations

They live in large shoals, or schools. By keeping together as a group, they make it more difficult for a predator to pick one individual out. Also, if they are in a large group, the chances that one individual will be caught are smaller than if they were one of a small group. One in a group of 4 has more chance of being picked out by a predator than one in a group of 40 or even 400!

The shoal moves together as if it were one unit, to confuse predators. The shoal moves and changes direction quickly, to get out of the way of predators.

Needlefish

The Needlefish eats other, smaller fish, like the Silverside so it is a predator. The Needlefish has to overcome the adaptations which the smaller fish have to avoid being eaten!

Body Adaptations

The Needlefish has a streamlined shape for low water resistance and mobility, and very sharp teeth in a narrow mouth. The name is a good description of its shape. It is a pale-coloured translucent fish, so not very visible to its prey. Its shape means it can move quickly and easily through the water, and its sharp teeth hold the prey once it catches it.

Behavioural Adaptations

They swim near the surface where the surface ripples help hide them from their prey. They catch their prey with a sideways sweep of the head, so they are able to take their prey by surprise.

Both their translucent colour and their behaviour of swimming near the surface camouflages them

Aquatic Blue Crab and Blue Land Crab

Although one of these lives in the water, and the other mainly on the land, many of their adaptations are similar. However, all crabs get their oxygen through their gills, which have to be kept moist. And all crabs need to lay their eggs in the sea. So the Blue Land Crab has special adaptations to cope with this. The Blue Land Crabs live in burrows deep enough to allow water to seep in for moisture. The adult females carries the eggs beneath her body before migrating to the ocean and releasing the eggs into shallow inshore waters.

Blue Land Crab

Body Adaptations

One of the most obvious adaptations is the hard shell (exoskeleton) which protects the soft inner body. Another obvious feature is the pincers, for feeding and defence against enemies. Crab's eyes are on protruding eyestalks (antennae), so that the crab can see front, back and sideways. This is very useful for spotting danger. The crab's antennae can sense vibrations, smell and taste chemicals in the water to help detect prey or predators. The land crab's antennae detect smells in the air.

Behaviour Adaptations

The Aquatic Blue Crabs are lie-and-wait predators. They hide buried in the sand, then reach up at passing fish lightening fast. You wouldn't think a crab would be able to move that fast, but they can. The Blue Land Crab can also move fast to grab prey as it goes by its burrow.

The land crabs live in deep burrows, which protect them from predators, keep them hidden from their prey, and help keep their gills moist.

Yellow-crowned Night Heron


Photo © Mike Pienkowski

Despite its name the Yellow-crowned Night Heron is active during the day, as well as during the night. They are seen quite often in the Turks and Caicos Islands throughout the year. One family lives in an overgrown patch next to the Turks and Caicos National Museum in Grand Turk. However, the mangroves are one of its favourite places to live.

Yellow-crowned Night Heron amongst Black Mangroves

Body Adaptations


Photo © Mike Pienkowski

This bird has a strong, heavy bill to cope with eating crabs, which are one of its main food items. If the crab is small, they may swallow it whole, but they can also use their strong bill to crush it. They have large eyes, so that they can see well. This means that they can hunt at night, as well as during the day. Their long legs enable them to wade in water. Like the majority of birds, they can fly. They might fly to escape danger, or to go to another place which offers better food, or a good nesting or roosting site.

Behavioural Adaptations

The Yellow-crowned Night Heron often stands motionless and waits (sometimes for several minutes), until food (like crabs) appears, then it lunges quickly to seize the prey in its bill. Another technique it uses is to wade slowly in the water, stalking its prey, then lunge. They hunt on their own, away from other birds. This means that they have a greater chance of finding food.