Wonderful Water

A Watery Environment

Wetland Ecosystems in the Turks and Caicos Islands Part 2:

including:
What is an ecosystem?
Biodiversity
Population Size
Invasive Species

Pupils' Text

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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. 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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Ecosystems and Biodiversity

Introduction

It is fairly obvious to anyone visiting, living in and travelling around the Turks and Caicos Islands that the land area is small, but that there are large areas of shallow seas, coral reefs, tidal flats, and other wetlands, varying from very salty, through brackish to freshwater.

There are two shallow submerged banks, the Turk Island Bank (254 sq km) and the Caicos Bank (5,334 sq km). The dry land area of the Turks and Caicos Islands is 500 sq km, but over half of that (266 sq km) is made up of inter-tidal sand banks and mud flats.

This map shows the shallow sea areas of the Caicos and Turks Banks.

Freshwater is scarce. Grand Turk has a mean annual rainfall of about 24 inches (61 cm) per year, compared with 51 inches (130 cm) per year in Jamaica. There are no rivers or estuaries. Instead there are relatively large areas of shallow marine banks and inter-tidal creeks, lagoons and flats. Inland water bodies are made up of salinas and salt ponds, with relatively few freshwater wetland areas such as marshes and sinkholes.

All these wetland ecosystems are incredibly important for wildlife, and for the future health and prosperity of the Turks and Caicos islands.

These intertidal wetlands are in North Caicos.

Objectives

This unit will help you to learn more about the variety of wetland ecosystems in TCI, the variety of plants and animals which rely on them, and why they are important.

You will:

- learn that an ecosystem is made of up of both living and non-living parts, and that they are all important
- that a healthy ecosystem has a wide variety of different kinds of living things
- that a healthy ecosystem is balanced, it sustains itself (it keeps going by itself)
- about biodiversity, and why it is important.

What is an ecosystem?

Eco comes from a Greek word (oikos) meaning house or surroundings. It has come to mean "living things". So ecology is the part of science that studies how living things react with each other, and with their environment. A system is something that has different parts, that all work together. So an ecosystem is a system of living things, together with the non-living things in their environment.

This freshwater well on Salt Cay is a small ecosystem.

These flats and marshes on North Caicos make a large ecosystem.

In an ecosystem, the living and non living things interact with each other and depend on each other. Every part of an ecosystem has an important role, which might not be obvious, but however small the role might seem, it is needed to keep the ecosystem healthy and balanced.

An ecosystem can be very small, like a tiny puddle, or much larger, like a large area of marsh. The water in both will be used by plants, and the plants will also need sunlight, air, and minerals to keep them alive. The plants will be eaten by animals, some of these animals will be eaten by other animals. When a plant or animal dies, it decays, and the materials released by microbes can be used again. This recycling is what keeps the ecosystem going. The relationships between all the parts of an ecosystem can be quite complicated. In our work on **A Watery Environment** we will study some of the different parts of ecosystems separately, but always remember that everything is connected. By the end, you should have a good idea of how everything fits together, like a 3-dimensional jig-saw.

What makes an ecosystem?

There is no easy answer to this question. But there are key features which all ecosystems must have.

All ecosystems must have living and non-living things, which are connected. The living parts of an ecosystem are sometimes called the **biotic** parts, and the non-living things the **abiotic** parts. The **a** in **abiotic** means not, so the word abiotic just means not living.

This White Top Palm plant is a producer.

The biotic parts are:

The **producers**. These are the green plants which use water, sunlight and minerals to make sugars and starches.

The **consumers**. These are the different types of animals that eat plants, or other animals. There are different types of consumers, depending on what they eat:

The Rock Iguana, like all animals is a consumer.

Herbivores eat plants.
Carnivores eat other animals
Predators kill other animals to eat.
Prey are the animals killed by the predators.
Omnivores eat plants and animals.
Detrivores feed on plants and animals that are already dead.
Decomposers cause dead plants and animals to decay, so that their nutrients can be recycled.

This green heron is eating a mouse.
Which is the predator and which is the prey?
Is the heron a herbivore or a carnivore?
Is the mouse a producer or a consumer?

You will learn more about these feeding relationships in other Units.

Each living thing within an ecosystem has its particular role. This is called its niche. Within an ecosystem there will be populations of living things. Population means a group of the same type of living thing in the same place at the same time. All the populations that live in an ecosystem are called the community.

The **abiotic** parts are the water, air, minerals (like salt and rocks) and the sunlight.

A healthy ecosystem is balanced. There will be limiting factors which stop a population from getting any larger. These limiting factors can be living or non-living parts of the ecosystem. An example of a non-living (abiotic) limiting factor would be water in a dry climate. Predators will be a limiting factor on the number of prey there are in the ecosystem.

Which biotic and abiotic parts of the ecosystem can you see in the photographs of the well and the flats, on page 5?

All ecosystems have inputs and outputs. An input is anything coming into the ecosystem, like energy from the sun, animals migrating in, water from the sea or rain. An output is something leaving the ecosystem. Animals can move out of the area, water can be evaporated by the sun, the sea leaves an inter-tidal area at low tide, people remove plants and animals for food.

These crops are outputs in this human-modified ecosystem. At harvest time, they will be removed from the ecosystem.

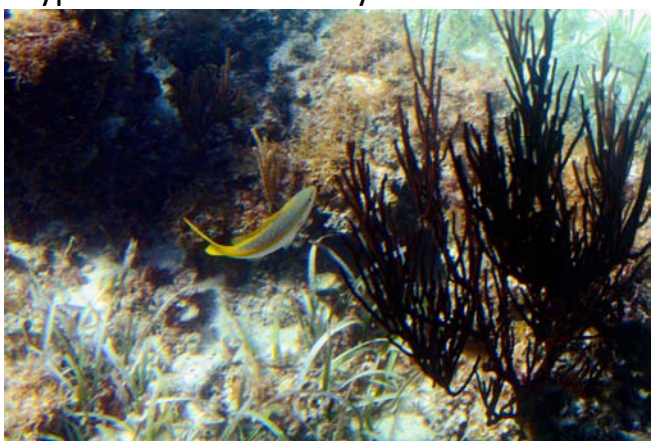
Different ecosystems are frequently linked through these inputs and outputs. For example, turtles lay their eggs in the sand. The heat from the sun hatches the eggs. The young turtles move into the sea where they feed in the shallow waters. As adults the turtles migrate huge distances, and eventually return to the place where they were born to produce more eggs. Think about the inputs and outputs of this example, and how different ecosystems are connected.

The biggest ecosystem of all is our earth. This is called the biosphere.

Different Types of Wetland Ecosystems in TCI

Considering that so much of the area of TCI is covered by water, then it is not surprising that there are several different types of wetland ecosystems in TCI.

The **submerged sand banks** cover vast areas on the southern side of the island group. Much of this is less than 6 feet (2 metres) deep. In this area there are many seagrass beds and shallow water corals and reef fish. These are important feeding grounds for young green turtles and different kinds of fish.



The submerged banks are a rich ecosystem with seagrass beds, shallow-water corals, and fish.

These intertidal flats are in Middle Caicos

Intertidal sand and mud flats also make up another large area. These areas are regularly flooded by high tides, or covered during periods of heavy rain or wind-blown seas. This flooding brings more nutrients into the area. Salt marsh plants such as glasswort, marsh grass and stunted mangroves can be found here. These flats are important feeding areas for birds during low tides, and fish during high tides.

Lagoons are protected inlets which are tidal, and open to the sea at least at very high tides. Lagoons are closely connected with **mangrove swamps**. Often the water in these lagoons and mangrove swamps is less salty than the sea. Red, black and button mangroves grow in these areas. The bottom of the lagoon or swamp is a thick soft mud containing lots of invertebrates, which provide important food for birds and young fish.

Red Mangroves on the edge of a protected lagoon in Providenciales.

Flamingo Pond on North Caicos is an amazing salt pond ecosystem.

Salt ponds occur inland, and are probably only connected to the sea during storms. The water is saltier than the sea, due to evaporation of the water, leaving the salts behind. However, many small invertebrates live in the mud, and fish live in the water, despite it being extra salty. So the shallow water is a good feeding place for many birds.

Marsh plants can grow along the edges, including Nash's Pepperwort Fern which is endemic to the Southern Bahamas and TCI. Endemic means it is found nowhere else in the world. The silver button wood also grows here. These plants provide shelter and food for others, like insects, reptiles and birds.

Salinas are rather like the salt ponds. They were created (mainly from natural salt-ponds) for the production of salt. Since that industry finished, they have become an extremely important wetland ecosystem. They are more salty than the sea. The shallow open water often dries out and salt crystallizes along the edges. Like the salt ponds, small invertebrates and fish live in this extra-salty water, and salt tolerant plants grow around the edges. A small shrimp, called a brine shrimp, is important food for flamingos. Many birds rely on this ecosystem.

These Salinas are on South Caicos.

Marshland ecosystems can be quite varied. Marshlands contain lots of different kinds of plants, and usually have water in them. However, the water can range from fresh to salty, and the water level frequently changes, depending on the amount of rain, and

Marshland on Grand Turk.

other factors. The plants include grasses, sedges, and rushes. They provide rich feeding grounds for resident and migrant waders, herons and ducks, including the threatened West Indian whistling duck

This sinkhole is on Middle Caicos.

Sinkholes are usually circular holes in the limestone rock holding fresh to brackish water. Brackish means that it is less salty than the sea. They are often fairly deep, and they provide important permanent freshwater habitat which supports submerged plants and a wide variety of invertebrates. There are often connections between the sinkholes and the underground cave systems. Some very unusual crustacean (shrimp-like creatures) can be found in these cave pools. The sinkholes are very important feeding and nesting habitat for water birds such as the Least Grebe.

Most of the wetlands in TCI range from saltier than the sea, to brackish. True freshwater areas are uncommon. The sinkholes are one of these very precious freshwater sources. Like many plants and animals, people need freshwater to stay alive, for example for drinking and for watering crops and animals. **Freshwater wells** were developed in many places in the Turks and Caicos Islands, tapping into the underground freshwater systems. Many of these places are no longer in use, but they provide a very important freshwater ecosystem. Good examples of these can be found at North and South Wells on Grand Turk.

North Wells, Grand Turk, is a rare freshwater ecosystem.

Biodiversity

What is biodiversity?

Biodiversity is short for Biological Diversity, and means the variety of living things. Our earth contains an amazing number of different kinds of living things. So far, scientists have found more than 1,700,000 (1.7 million) species. These include:

950,000 species of insects
270,000 species of plants
19,000 species of fish
10,500 species of reptiles and amphibians
9,000 species of birds
4,000 species of mammals

The rest are molluscs, spiders, fungi, algae and micro-organisms.

Some examples of the wonderful biodiversity of TCI. Can you recognise a plant, insect, fish, reptile, bird, mammal?

More new species are still being found. Over the last 10 years 39 new mammal species were found in the Amazon. Who knows what else is still to be discovered?

Biodiversity also includes **genetic biodiversity**. Genes are what give individuals their particular characteristics. This genetic biodiversity can be seen with domestic dogs. All kinds of domestic dogs are just one species. The fact that there are so many different kinds of dogs is caused by their genetic biodiversity. In populations of wild animals, you cannot always see the genetic biodiversity from the look of the animal. However, it is there, and is very important. Genetic diversity allows species to cope with changing conditions, and keeps the population healthy. If the genetic diversity is low, then animals are more likely to suffer from disease or disability. Genetic biodiversity is very important with small populations of endemic species – species which are found only in one place on the earth. In the Turks and Caicos Islands, the Rock Iguana is an endemic sub species.

Wetland ecosystems are amongst the most diverse in the world. For example a single coral reef can support more than 3000 species of fish and invertebrates The wetland ecosystems in the Turks and Caicos Islands make a great contribution to the biological diversity of TCI. They are rich in species diversity and genetic diversity.

It is worth mentioning that, as well as species and gene biodiversity, **ecosystem biodiversity** is also important. In some parts of the world, very important ecosystems do not have many species. For example, in cold areas on the tops of mountains, or in the arctic or antarctic regions, the number of species are limited by the low temperatures. They do not have many species. But they are still very important to the world's biodiversity.

Healthy coral reefs are very diverse.

Why is biodiversity important?

A straightforward answer to this question is that the quality of our lives depends on it.

Clearly, without plants there would be no animals. Plants produce oxygen for animals to breathe, and food for animals to eat. But all plants do this, so why is it important to have a wide variety of plants? Different plants have different roles in a community (their niche) so the ecosystems would collapse if plants were lost. Different plants grow in different conditions, to provide food for animals, including people, all over the world. Plants slow down the drainage of water after rain, letting the water go into the underground chambers rather than just run off into the sea, or evaporate. Almost all commercial medicines are derived from plants, and there are probably many more waiting to be discovered. Many people in TCI know the value of bush medicine.

Different animals have different roles in a community – bees, butterflies, birds and bats pollinate flowers. Without these the ecosystem would collapse. And we need pollination for crop production.

A typical example of biodiversity in TCI - a butterly feeding on, and at the same time pollinating heather - the national flower of the TCI and an endemic species. This flower is found only in TCI.

Tourists like to visit places with a lot of biodiversity. This is especially important for places like the Turks and Caicos Islands, where tourism is a major part of the economy. Botanists (people who study plants), divers and birdwatchers come to the Turks and Caicos Islands because of the amazing biodiversity.

Scientists and economists have been looking at how much money all the things which an ecosystem provides for people (called ecosystem services) would cost. They put a value on these ecosystem services of at least $33 trillion per year. This is double the value of all human produced goods and services.

There is also the strongly held belief that we should preserve biodiversity not solely from a financial point of view, but because it exists, and the natural world should be respected and protected.

Ecosystems and population sizes

You have learnt something already about the complicated nature of ecosystems. Working out what affects the sizes of populations within an ecosystem community is important for scientists to find out. This information is needed for a number of reasons, including working out what is likely to happen if something changes.

In this section you will:

- learn more about the relationship between predators and their prey
- learn that, in a healthy ecosystem there is enough food and water for the plants and animals to live and reproduce successfully
- learn that a lack of resources, and predation changes, affect the numbers of plants and animals
- find out about introduced alien invasive species, and how they can seriously affect an ecosystem

When there are lots of flamingos, you can be sure that there are lots of small animals in the mud under the water for the flamingos to feed on. Lots of prey means that there can be lots of predators.

Limiting Factors

In a healthy ecosystem, although the numbers of plants and animals can change, with the seasons and with the weather, throughout the year there is a balance of populations and numbers in the community. So something must be causing this balance, limiting the numbers in a population. These are called limiting factors. They can include living and non-living parts, such as the numbers of predators or the amount of water.

Water is a limiting resource - when there is lots of water, there will be lots of animals and plants. If the water dries up, the plants die and the animals leave or die.

A simple example of a predator being a limiting factor is with herons feeding on fish in the salinas. If there are lots of herons, they will be eating lots of fish, so the fish numbers will go down. When the fish numbers go down, it is more difficult for the herons to find fish, so the herons go elsewhere to feed. Now that there are not so many herons eating the fish, the fish numbers go up. And so it goes on.

The effect of a limited resource could be seen after Hurricane Ike, in September 2008. After Hurricane Ike there were no flowers. The small hummingbird, the Bahama Woodstar, which feeds on the nectar in flowers, had nothing to eat, and it disappeared. Even though the flowers returned within a few months, it was 2 years before the hummingbirds started to be seen again.

The large egret is chasing the small egret away from a good feeding spot.

Animals, like some people, will always try to get the best spot. This is where competition for resources is working on population sizes. If you watch the birds feeding on the salinas, you will often see them chasing other birds to keep them away from the best feeding spots.

You might think that plants do not compete with each other, but they do. Plants compete for resources, such as water or sunlight. If you look at where the plants are growing in an ecosystem, you will probably see that

there are some larger plants, which do not have small plants growing near them. The shade under the larger plants prevents small plants from getting the sunshine they need, and the roots of the larger plants take all the water in the ground, so young plants have difficulty surviving.

Invasive species

Invasive species introduced accidentally or deliberately by people are very disruptive to an ecosystem, because they out-compete native species for resources, and are often aggressive predators. Unfortunately, TCI has several human introduced invasive species which are causing a lot of problems.

Many of the wetland areas have large trees, which are liked for their shade, but are dreadful invaders, and are very bad for the natural ecosystem. These are the **Australian Pines, Casuarinas**, which people planted before they knew that they would damage the natural environment. They are successful competitors for water and sunlight. They also have another nasty trick. The needles that they drop onto the ground poison the ground, so that native vegetation cannot grow near them. Unlike native TCI trees, they have shallow roots, so blow over easily during hurricanes, which allows soil erosion. So they are actively destroying natural TCI ecosystems.

These young Casuarinas will grow very quickly, and the native plants underneath will die out.

One of the most invasive species affecting the coral reefs in the Caribbean, including TCI, is the **Lionfish**. This species is native to the Pacific Ocean. It is an attractive fish, and was popular for aquariums. Somehow, perhaps from

aquarium escapes, it got into the Atlantic Ocean and then to the Caribbean. It is a great threat to the coral reef ecosystem. It is a voracious predator and is eating large numbers of native coral reef fish. As it has no natural enemies, its numbers are increasing rapidly so the predation on the reef fish is getting worse. Another problem is that it has huge poisonous spines, which can give divers a very nasty sting. The TCI Department of Environment and Coastal Resources is working very hard to keep the lionfish under control, and are encouraging fishermen to hunt it. Once the poisonous spines are removed, the fish is very good to cook and eat. DECR would like people to eat lots more lionfish!

The **Pineyards** are a very special ecosystem on Middle, and North Caicos, bordering the tidal flats, and on Pine Cay. The **Caicos Pine** is the national tree of TCI, and is found only in this area, and some parts of the Bahamas. Nearly 90% of these trees have been killed by an invasive insect, probably introduced on Christmas trees imported from North America. If the pine trees are killed, then the other plants and animals which depend on this ecosystem will also die, or have to leave the area. DECR, the Turks and Caicos National Trust, with the support of international conservationists, like the Royal Botanic Gardens, Kew, London and UK Overseas Territories Conservation Forum, are co-operating on a project to save the Caicos Pine. Seedlings have been collected, and are being grown in the plant nursery on North Caicos. The trees can then be replanted in the wild, once the invasive insect is exterminated. Ecologists are now working out how to get rid of the insect, in the wild, to try to save the remaining living pine trees.

The dead Caicos Pine trees in the Pineyards have been killed by an invasive insect species.

These example show how important it is not to let any non-native species into an ecosystem, and to act quickly to get rid of an invasive species before it gets too numerous. The introductions are due to human activity, so we have a responsibility to solve the problems caused by them.