

Wonderful Water

An Environmental Education Programme

A Watery World

Mangrove Ecosystems in TCI

4. Threats to Mangrove Ecosystems

Teachers' Guide



TCI
Education Department



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Target Age Group - 9 - 11 years

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. 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.

As a possible model to assist environmental education in other areas of the Caribbean (especially UK Overseas Territories) these materials will be made available to a wider audience.

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Introduction

In devising these teaching materials, reference was made to the TCI Science Curriculum for Grade 5 and 6, and the science teaching materials currently being used in primary schools in TCI.

A curriculum framework has been developed, which links the Wonderful Water themes to curriculum requirements. As part of the curriculum framework, expected levels of achievement for a particular stage in a students' education have been developed into statements of competency which can be used to assess the levels students have reached. The purpose of these statements of competency is to support teachers in their review of students' progress. The objectives given in the pupils' materials relate to these statements of competency.

Assessment criteria / Statements of competency

These level statements relate to levels of attainment given in the Science National Curriculum for England, but are compatible with such statements about expected attainment in many other curricula.

This table gives the level (L) a child is expected to achieve at a particular stage in their schooling:

End of grade:	Expected attainment related to curriculum levels (from National Curriculum for England)		
	Slower progress	Most pupils	Faster progress
4	L2	L3	L3/4
5	L2/3	L3/4	L4/5
6	L3	L4	L5

4 - Threats to Mangrove Ecosystems: statements of competency

The assessment criteria / statements of competency, which relate to the unit on Feeding Relationships in a Mangrove Ecosystem are given below. These can be used to guide progression.

Threats to the mangrove ecosystem

The effect of human activity on the mangrove ecosystem

L2: Know that it human activities can damage the environment.

L3: Explain 2 ways in which human activities damage the environment.

L4: Give examples of how human activities cause environmental effects, using terms such as pollution, reclamation, drainage, erosion.

L5: Understand the ways by which human activity (such as draining or polluting a wetland) can change the environment and affect the plants and animals living there.

The effect of pollution on the ecosystem

- L2:** Name a source of pollution which could affect a wetland.
- L3:** Explain how pollutants can harm plants and animals.
- L4:** Describe how plants and animals in a food chain can be affected by pollutants.
- L5:** Describe how the abundance and distribution of organisms may be affected by pollutants and relate this to food webs

Invasive species

- L2:** Know what an invasive species is.
- L3:** Give one reason why invasive species are a threat to ecosystems.
- L4:** Know that a lack of resources and / or increased predation affects numbers of plants and animals.
- L5:** Know that an invasive species can seriously affect an ecosystem by excessive predation and / or removal of resources.

The pupils' text provides key information for pupils.

The teachers' guide contains further information and resources for teachers, suggested activities for pupils, and example pupil worksheets.

The illustration in this guide, and those in the pupil text, will be provided as powerpoint pdfs.

The suggested pupil activities and worksheets can be carried out by individuals, pairs or small groups.

These materials are a working draft, and any suggestions for further activities, amendments and improvements are welcome.

Any comments / suggestions should be sent to the UKOTCF Environmental Education Co-ordinator, Ann Pienkowski. Email apienkowski@ukotcf.org

Background information on issues threatening mangroves

Rapid development in Providenciales

In 1966, in exchange for 4,000 acres, a company called Provident Limited began the development of Providenciales. Provident constructed an airstrip, built roads that linked three settlements together and built a 10-room hotel called the Third Turtle. The first car arrived on island that same year. Barclays Bank opened a full service branch on Providenciales in 1981 and in 1984 Club Med Turquoise opened. Cable television came in 1985 and in 1989/90 Ocean Club became the first condominium project on the Island.

The expansion of the tourism industry, with associated building development, has resulted in a rapid population increase in Providenciales: There were 26 persons per square mile in 1980 to 347 in 2001. There has been a greater increase since.

It was recognised in 2006 that planning for the sustainable development of the Tourism sector, in particular, and the TCI, in general, required (amongst other things): consideration of the environmental impact (direct and indirect) on the fragile coastal and marine environment.

An assessment of development issues in TCI was carried out, and a report issued - National Socio-economic Development Strategy : National Socio-economic Development Framework, 2008-2017. This report can be accessed online at:

www.caribbeanelections.com/eDocs/strategy/tc_strategy/tc_National_Socioeconomic_Development_Strategy_2007.pdf

The “Protecting our Environment” section, 3G, starts at page 111. Since 2006 there have been many tourism-related developments and development proposals, throughout TCI. Students could be asked what they think about this.

Shrimp Farming Issues

The Turks and Caicos Islands do not currently have any shrimp farms, but proposals for shrimp farms could happen in the future. Students therefore need to be aware of the issues relating to shrimp farms.

Below is some background information which may be of use in informing discussions.

Traditional shrimp (or prawn) farming is sustainable: In traditional shrimp farming, a small shrimp pond is created in the mangrove with bunds or a wall of mud and earth. A sluice gate controls the water flowing in and out of the pond. At first, the sluice gate is kept closed so that little prawns that naturally occur in the water can develop within the pond. After some time, the sluice gate is opened and the water is let out of the pond, but a net is placed at the sluice gate to catch any prawns that move out with the water

Large-scale shrimp farming is destructive: The large shrimp or prawns that we eat often come

from shrimp farms or are harvested from the wild by trawling or traps. While traditional farming and harvesting methods are sustainable, large-scale commercial shrimp farms and shrimp trawling are more destructive and unsustainable.

These are some of the ways in which commercial shrimp farms can impact the environment:

- Destruction of large tracks of mangroves and other intertidal habitats to create the farms;
- Harvesting egg-bearing adults from the wild to provide stock for the farms;
- Introducing non-native shrimp or prawns, which could upset the natural balance if they escape;
- Feeding shrimp with wild caught fish, depleting the natural fish stocks and impacting local fisheries;
- Treating ponds with antibiotics, pesticides and water additives to prevent diseases or boost growth. These chemicals are very damaging to the natural environment.
- Polluting surrounding environment with water from these farms, laden with shrimp waste and chemicals.
- Creating antibiotic resistance to diseases, which can then not only affect the shrimps in the shrimp farm, but also the natural marine wildlife.

There are varying estimates of the amount of mangrove ecosystems which have been lost. One report (UN Environment Programme) states “Roughly 50% of the global mangrove area has been lost since 1900 and 35% has been lost in the past two decades.”

Of course, mangrove loss due to shrimp farming accounts for only part of this.

Globally, some estimates put the loss of mangroves linked to shrimp farming at as much as 38%. Others would say that the figure is much lower. For example, the Global Aquaculture Alliance (an international, non-profit trade association “dedicated to advancing environmentally and socially responsible aquaculture) states that less than 5% of mangrove loss has been due to shrimp farming.

Locally in some areas of the world, a large percentage of mangroves have been destroyed for shrimp farming, in places such as Thailand and Ecuador. In one part of Ecuador (the Muisne region) approximately 90% of the mangrove forests have been lost.

Mangroves are an important part of the spectrum of marine ecosystems that extend to reefs. Many commercially important fish and other seafood spend their younger days in the shelter of mangroves. The impact of shrimp farms on mangroves will also impact on the wider marine ecosystems.

Mangroves protect the land from events such as tsunamis, hurricanes and high waves. The destruction of mangroves for shrimp farming is believed to have aggravated the impact of the Indian Ocean Tsunami of December 2004.

However, the practice of aquaculture (which includes shrimp farms) is not going to be abandoned, especially in a world where increasing food resources are needed. So it is important to try to make sure that new developments are sustainable, and do not affect vital natural resources.

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There are some enterprises which are trying to establish sustainable shrimp farms. A documentary about Linda Thornton: *Seeking Sustainability, One Shrimp at a Time*, - explores the life of a resilient, pioneering aquaculture entrepreneur as she pushes the frontiers of sustainable shrimp farming in Belize. The link is:

<http://www.youtube.com/watch?v=5haEZ2OFbrY>

This video might provide an interesting focus for discussion.

Pollution

Large hotels and resorts

The majority of the large tourism-related developments are in Providenciales, but in recent years such developments are also taking place, or have been planned for the sister islands.

The National Socio-economic Development Framework (2008-2017) report, referenced on page 6, considered issues of development.

A relevant extract from the report is reproduced in the text box below.

Rapid built development of residential and hotel accommodation has not been matched by the appropriate infrastructure to manage waste, and run-off. The leaching of coral is already evident on Grace Bay. It is a moot point whether this is the result of the early impact of global warming or instead the result of the run-off and of effluent escaping from the built development in the area contiguous to the Bay.

Oil Pollution

Oil pollution is chronic throughout the marine environment. However, the explosion on the Deepwater Horizon oil drilling rig in the Gulf of Mexico in April 2010 really brought this issue to public attention. Eleven people were killed during this catastrophe at sea on April 20, 2010. The explosion and later sinking of the Deepwater Horizon caused the Macondo well to leak for 86 days, making it the world's largest accidental release of oil into the ocean. The oil pollution from this event threatened the whole area, including Turks and Caicos.

Following on this terrible event, National Geographic have produced some excellent teaching resources. They can be accessed from the following link:

<https://www.nationalgeographic.org/education/oil-spills/>


The website introduces these online resources as follows:

The 2010 Gulf of Mexico oil spill is a tragedy of enormous proportions that will impact communities and be studied by scientists for many years. Use the resources on this page to help your students better understand oil drilling and the impacts of oil spills.

Each activity features film clips, maps, and photography from National Geographic's collection of online articles and visuals about the Gulf of Mexico oil spill.


Some example resources from the website

2010 Resources



Layers of Life Diagram


An illustration supplement from the September 2010 issue of *National Geographic* magazine depicting coastal and marine ecosystems in the Gulf of Mexico. The illustration addresses damage to ecosystems and dangers to organisms from the 2010 *Deepwater Horizon* oil spill.



Geography of Offshore Oil Map

A downloadable map supplement from the September 2010 issue of *National Geographic* magazine showing the extensive network of oil and gas wells, pipelines, and platforms found in the Gulf of Mexico.


Read About It



Gulf Oil Spill


Read the October 2010 *National Geographic* magazine article that asks the question: Is another Deepwater disaster inevitable?

Learn More



2010 Gulf Oil Spill


Find photos and articles on the worst oil spill in U.S. history to date.



Pictures of Disaster


View photos from the aftermath of the 2010 *Deepwater Horizon* oil spill.

Activities for preK-3



Birds, Feathers, and Oil


How does oil affect feathers?




Sorting the Gulf Ecosystem

What are the different types of plants and animals living in the Gulf of Mexico ecosystem?


Activities for Grades 4-8




Sea Turtles and the Gulf of Mexico Oil Spill




Oil and Bird Populations



Oil's Impact on Black Mangrove Trees




Geography of Oil Drilling in the Gulf of Mexico



Gulf Oil Spill—One Year Later

After the worst oil spill in U.S. history, nature has shown surprising strength—but the long-term damage remains to be seen.

Related Videos



- Gulf Turtle Eggs Relocated
- Gulf Spill Still Threatens Millions of Migrating Birds

Invasive Species

Lionfish (*Pterois volitans*)

The lionfish is native to coral reefs in the sub-tropical and tropical regions of the South Pacific, Indian Ocean and the Red Sea. Outside its native range, the lionfish is a voracious predator with venomous spines. It is devastating Caribbean fish populations, especially native coral reef and mangrove species, shrimp and crabs. Because of their venomous spines, lionfish have no natural predators in their invaded range and this helps their populations to continue spreading

It is likely that the Lionfish were introduced into the Caribbean and southern Atlantic from releases from aquaria. Their devastating effect on coral reefs has been well documented. However, Lionfish have also been found in mangrove ecosystems in the Bahamas and Turks and Caicos. The latter are critically important as nursery grounds for a variety of marine life.

Research on lionfish in the Bahamas has shown a reduction in the recruitment of native reef fish which may significantly affect fisheries. A single small lionfish can reduce the number of small fish on a small reef by about 80 per cent in just a few weeks. Additionally, the loss of herbivorous fish can allow excessive seaweed growth on coral reefs, which smothers the coral. If the coral reefs are already under stress from other factors such as pollution, coral bleaching and increased storm frequency, then it is possible that the reef will suffer serious, and possibly irreversible, degradation. The value of healthy coral reefs to the tourism industry as well as to local fisheries is very high. So the impact of Lionfish on coral reefs is of great concern.

Control methods for lionfish currently consist of harvesting by divers, although the poisonous barbs can make this a difficult task. Nonetheless, local harvesting and other monitoring efforts may allow for early detection and rapid response to contain the further spread of the lionfish invasion, particularly into sites of ecological or socioeconomic value. Currently, eradication is unlikely given the ability of the lionfish to quickly spread and establish.

A possible control of lionfish by Groupers is currently being investigated. Lionfish have been recorded in the stomachs of large Caribbean groupers. Whether grouper predation of lionfish is sufficient to act as a biocontrol of the invasive species is unknown, but pest biocontrol by predatory fishes has been reported in other ecosystems. Groupers were surveyed along a chain of Bahamian reefs, including one of the region's most successful marine reserves, which supports very large groupers. Here, the Lionfish biomass was reduced. However, findings so far show that only very large groupers predate on lionfish. These large grouper are uncommon in grouper populations which are fished extensively for food. Smaller grouper do not seem to eat lionfish.

Two videos available on YouTube show groupers learning to eat lionfish:

Teaching Grouper to eat lionfish YouTube video

<http://www.youtube.com/watch?v=JGNGAIXZnKY>

Grouper "Mini Me" learning to eat Lionfish - Little Cayman, Cayman Islands

<http://www.youtube.com/watch?v=0BJ-pcL2ZVY>

Language Activities to consolidate learning

Survey on what people think about mangroves

Not everyone realises how important mangroves are, or that they are threatened. Students could find out what people know about threats to mangrove by developing a questionnaire, asking people they know (family members, neighbours, etc.), and writing a report about what their survey shows.

Alternatives outputs from such a survey could be a poster, oral presentations, letter (eg to Department of Environment, local newspaper).

Discussion / Debate

Several issues regarding threats to mangroves lend themselves to discussion or debate, which could be organised informally in small groups, with students then presenting a summary of their discussions to the rest of the class.

Topics for discussion could be:

- What are the threats to mangroves in TCI?
- Are the threats to the mangrove ecosystem in TCI serious?
- How to make people more aware of the threats to mangroves?
- Is it necessary to change people's attitude to mangroves? If so, how could this be done?
- Think about the connections (pp. 8-9 of pupils' text).S

Students will probably generate other ideas for discussion.

Reading and comprehension

Activities based on the text in the Pupils' Text book. Some examples are provided at the end of this guide.

Question and Answer Quiz

Ask each student to come up with a question and write it on a piece of paper, with the answer on the back. Put all the papers into a box. Draw them out one by one and read to class to answer (teacher can do this, or students can take in turn.) Answers can be given by individuals, or teams - with points awarded if conducted as a team game. If more appropriate, the teacher can make up the questions.

Identify missing words

Create a missing word passage, based on the text in the Pupils' book. An example is given in the Example Activity Sheets section.

Learning Key Vocabulary

Suggested key words and phrases: aquaculture, chemicals, clearance, destruction, development, golf course, human activities, invasive species, lionfish, marinas, nutrient waste, oil, pesticides, pollution, shrimp farm

Use these key words to create:

Wordsearches

Crosswords

Scrambled word puzzles

Websites which can create such puzzles for free are:

<http://puzzlemaker.discoveryeducation.com/>

<http://www.teachers-direct.co.uk/resources/wordsearches/>

Some examples of these are provided in the Activity Sheets section

Students can also be asked to produce a key words glossary, where they explain in their own words what key vocabulary words mean.

Wondrous West Indian Wetlands Teacher Resource Book - Relevant Activities

Some of the examples in this teaching resource may not be applicable to TCI, as it covers situations throughout the Caribbean. However, there is lots of useful, relevant background information, and the activities can be adapted to suit the situation in TCI.

Activities relevant to threats to mangrove ecosystems are to be found in Chapter 4 - Going, Going Gone. What is happening to our wetlands? pp 109 - 184.

Information and activities include:

- Causes of wetland loss and degradation
- Undervalued wetlands
- Loss of habitat
- Threatened and endangered species
- Sustainable use
- Pollution

If you, or your school, do not have a copy of this resource, copies should be available from DECRA or the Education Department. If you are unable to find a copy, please contact apienkowski@ukotcf.org.

Example Activity sheets follow on the next pages.

Threats to Mangroves - Missing Words

Mangroves are _____ for developments, like _____,
_____ courses and _____ farms.

They are damaged by _____. If the water running
into the mangroves contains _____ this can _____ the
mangrove roots and _____ them

_____ species like the _____ damage the
mangrove ecosystem by _____ many of the small
animals which the marine food _____ depends on.

Fill in the gaps using these words:

chain, cleared, clog, eating, golf, invasive, lionfish, marinas, oil,
pollution, shrimp, suffocate

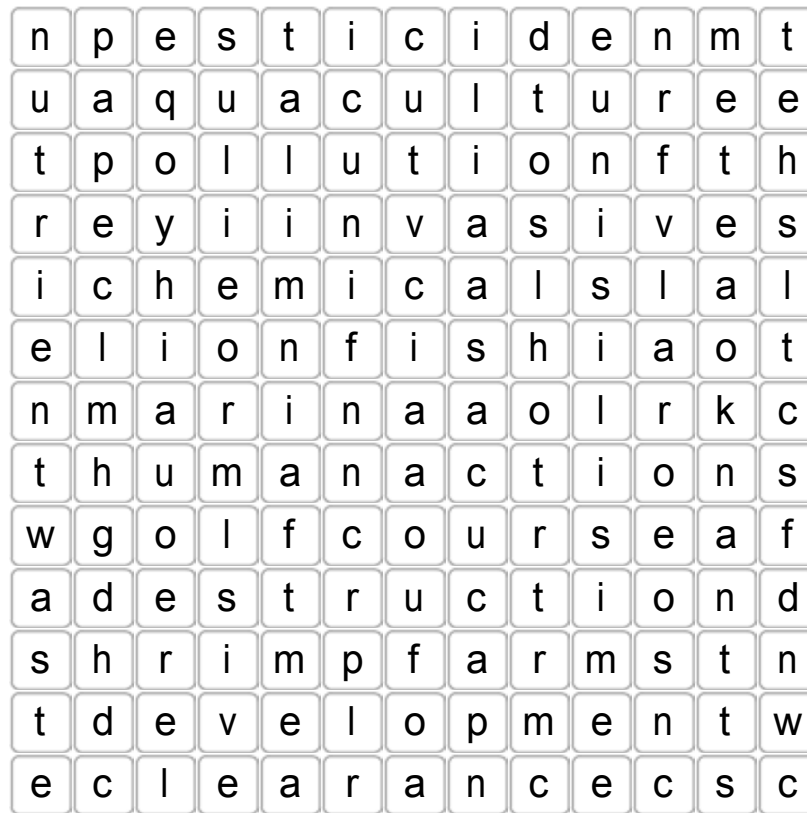
What do you know about threats to mangrove ecosystems?

Answer these questions, in complete sentences if you can. Use the information in the pupils' book to help you.

1. Give three reasons why mangroves are threatened.
2. Why is oil pollution a threat to mangroves?
3. Where might oil pollution come from?
4. Explain how tourism developments could be a threat to mangroves.
5. Why are lionfish a problem in mangroves?
6. What do you think is the biggest threat to mangroves in TCI?

Threats to Mangroves - Wordsearch

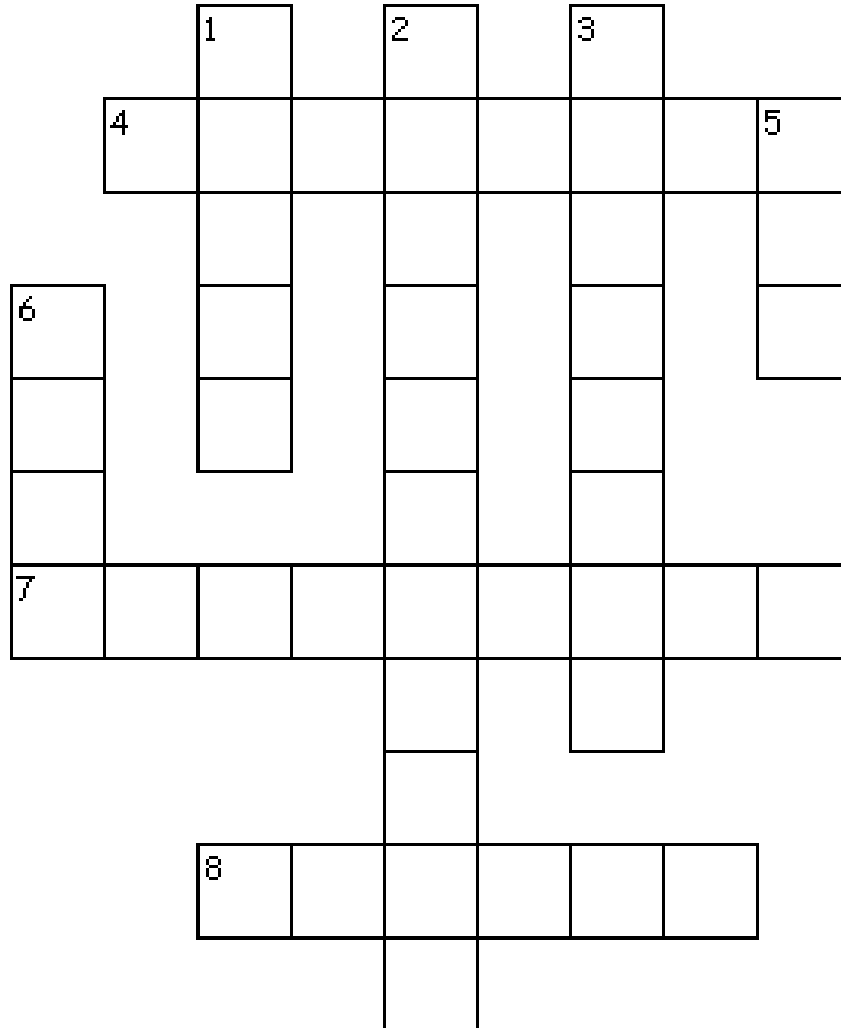
Threats to Mangroves



Words to find:

aquaculture, chemicals, clearance, destruction, development, golf course, human actions, invasives, lionfish, marina, nutrient waste, oil, pesticide, pollution, shrimp farm.

Threats to Mangroves Crossword Puzzle



Across

4. Mangroves are mistakenly blamed for large numbers of this insect.
7. Used in gardens to make plants grow.
8. Mangroves can be destroyed to make this place for boats to anchor.

Down

1. A place where tourists stay which can be a cause of chemical pollution.
2. Marine farming, like shrimp farms.
3. An invasive fish.
5. A fuel which causes pollution.
6. Mangroves are destroyed so that courses can be made for this popular game.