Teachers Factsheet

Food Webs and Warming Oceans

SCIENCE KS3

CLIMATE LAB

Introduction

In August 2003, a 15 year old girl saw what she believed was a Great White Shark feeding off the Cornwall coast. She reported her sighting to the National Marine Aquarium, which, using the description she had given, agreed that, although unlikely, it could have been a Great White, which usually only inhabits seas in warm climates.

The question everybody wanted answered was, what could bring such a huge predator to our seas?

This project looks at the way climate change will force organisms to adapt and shift range because of changes to physical conditions, habitats and food webs.

NB: The BBC put together a documentary about Great Whites in British waters which was screened in July 2006. There is also an article in BBC Wildlife magazine (July 2006).

http://www.bbcwildlifemagazine.com/viewIssue.asp?id=592

http://news.bbc.co.uk/cbbcnews/hi/newsid_5220000/newsid_5223700/5223788.stm

http://news.bbc.co.uk/1/hi/england/cornwall/5223142.stm

Links to the curriculum

This project is rooted in the 'living things and their environment' scheme of work.

It is designed to help you teach the following:

- About ways in which living things and the environment can be protected, and the importance of sustainable development
- That habitats support a diversity of plants and animals that are interdependent
- How some organisms are adapted to survive daily and seasonal changes in their habitats
- How predation and competition for resources affect the size of populations (for example, bacteria, growth of vegetation)
- Feeding relationships
- About food webs composed of several food chains, and how food chains can be quantified using pyramids of numbers

Warming Oceans – The Facts

At the core of this project is the fact that our oceans are warming up. This will have a chain reaction effect on food webs, habitats and the living creatures which depend upon them.

Quick Facts:

- Our oceans are warming up. Ocean surface temperatures worldwide have risen on average 0.5˚C, and ocean waters in many tropical regions have risen by almost 1˚C over the past century. This is 30 times the amount of heat that has been added to the atmosphere, a significant amount even though the ocean has a lot more mass than the atmosphere.
- Warming causes thermic expansion, making sea levels rise and causing flooding.
- It also contributes to the bleaching of coral reefs

More information about the warming of the oceans and how this affects habitat:

http://www.oceansalive.org/explore.cfm?subnav=article&contentID=4704

http://news.bbc.co.uk/2/hi/science/nature/4275729.stm

http://192.171.163.165/Climate%20Encyclopaedia/oceanwarming.html

Teaching this project

- Show this video, which features Doug Herdson of the NMA speaking about the appearance of 'foreign' species in our waters.

http://www.bbc.co.uk/bbcfour/documentaries/features/climate-shorts.shtml

- Read and discuss the article about the great white shark, to be found on the students' fact sheet. Encourage students to consider what might force species of fish to swim into waters where they would not usually go. Guide them to think about changes in habitat and food chains. Ask them to think about what they believe may cause these changes.

- Lead them from this discussion to the practical experiment below. This was devised as a way to show students how energy transfers up the food chain, and by extension how less energy in the first place equals less energy in the entire food chain.

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Practical: Arctic Food Chains

National Marine Aquarium scientist Paul Cox visited Spitsberg in the Arctic to join a Norwegian Research team looking at the the effects of climate change on plankton and food webs. Below he describes the background to his trip. This also appears on the students' fact sheet and they should read it before beginning the practical.

More detail on the trip – and a short film – can be found at www.eur-oceans.info

Arctic Food Chains

"Despite being dark and ice covered for large parts of the year, the Arctic is a region of huge productivity. The spring and summer bring together plentiful amounts of light and water born nutrients - the vital ingredients for a massive bloom of phytoplankton. This phytoplankton supports a food chain that provides nutrition for residents like polar bears and seals but also draws huge populations of seasonally migrating birds and marine mammals to these rich waters.

The vital link between the enormous quantities of primary production and the large animals at the upper levels of the food chain is provided by zooplankton – tiny grazers that capture and store the food energy that has been generated by the tiny plants. The survival of massive whales and the breeding success of millions of birds depends upon the ability of these microscopic cows of the sea to provide them their nutritional needs and it is upon these creatures that the focus of much climate research is directed."

Food Chain Practical

The research team from the Norwegian Polar Institute have measured shifts in the relative abundance of different varieties of zooplankton. They link these changes to water temperature to allow predictions to be made about future scenarios.

They focus upon three types of plankton:
Calanus glacialis,Calanus finmarchicus and Calanus hyperboreus

The key to this experiment is remembering that: Calanus glacialis has 10 times more energy than Calanus finmarchicus and Calanus hyperboreus has 25 times more energy than Calanus finmarchicus.

This practical shows how the changes in the prevalance of types of plankton, because of warming oceans, could have a profound effect on creatures in the foodchain, in this case, the Little Auk. A marked shift in Zooplankton composition has been observed between warm and cold years (depending on water currents). In warm years Calanus finmarchicus, the plankton with the lowest energy value of the three, dominates whereas in cold years Calanus glacialis is dominant Little Auks must work much harder in warm years to collect enough energy to breed and nurture their young.

You need:

- A flat basin filled with water
- A pair of tweezers (the larger the better - science tweezers, not the cosmetic type)
- Sesame seeds
- Pumpkin seeds or sun flower seeds.
- Hazelnuts

The idea of this practical is that students, working in pairs, see how many sesame seeds (Calanus finmarchicus) pumpkin seeds (calanus glacialis) and hazelnuts (calanus Hyperboreus) they can pick up in 30 seconds. They should then add up the energy values of the different food they have collected.

For the sake of this practical, we will say that a sesame seed contains 1kJ of energy, a pumpkin seed contains 10 kJ of energy and a hazelnut contains 25 kJ of energy.

Adult Little Auks need 131 grams of food a day to successfully rear chicks, using much of their energy to fly and collect food. This is the equivalent of 694 kJ.

In 30 seconds, how many kJ of energy have been collected?

Say that in 30 seconds, 10 sesame seeds (Calanus finmarchicus) had been collected. This would be the equivalent of 10kJ of energy. So if that took 30 seconds, how long would it take the little auk to collect enough food to meet its quote of 694 kJ?

Ask students to do the same calculation for the pumpkin seeds (calanus glacialis) and hazelnuts (calanus Hyperboreus) you have collected and then write up their results and draw a graph showing how long it takes to collect 694kJ of each type of plankton.

NB: It is important to note that, in addition to each individual of the larger species having more energy, they are bigger and easier to catch – these birds are not filter feeders so they must pick their food from that water while diving.

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What will happen if Little Auk populations decrease, move, or die out all together?

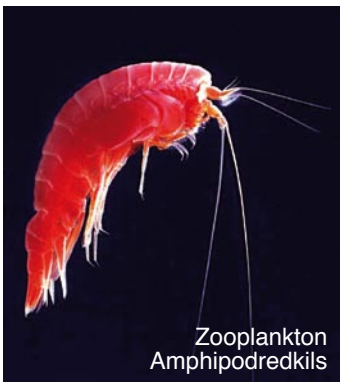
Little Auks are part of a larger foodchain. As well has feeding on plankton, they feed on crustacea and small fish. They are also fed on - by arctic foxes, glaucus gulls and even sometimes polar bears, which eat their eggs.

Using the pictures supplied, ask students to cut out and stick together a food web showing where Little Auks fit into the food chain. Discuss what would happen if they were to die out or relocate their breeding grounds.

Little Auks

Zooplankton Ctenophora

Zooplankton Hyperia



Zooplankton Amphipodredkils

Arctic Fox

Crustacean

Glaucous Gull

Polar Bear

A Fish out of Water?

Activity One:

Read and discuss the following article in class.

"Great White" Sighting Puts U.K. on Shark Alert
James Owen in England
for National Geographic News
August 12, 2003

Usually it's only jellyfish and skin-pinching crabs that swimmers worry about along the beaches of southwest England. But this summer they have something else on their minds—the ocean's awesome predator, the great white shark.

The perceived threat, however slim, follows reports of a large, unidentified shark feeding 20 yards (18 meters) off the west coast of Devon. Experts disagree on whether it was a great white, which can easily be confused with another species of shark commonly found in these waters.

However, the publicity given to the sighting has raised a number of interesting questions. Why, for example, do great white sharks not ordinarily venture into this part of the ocean? And if it was a great white spotted off Devon, could this be the first of many following their traditional food source? For some years now, many species that are also the great white shark's prey have been observed migrating farther north—possibly because the sea around the U.K. is getting warmer. Is it not inevitable that the great whites will follow in their wake?

The shark thought to be a great white was recently spotted by Chaynee Hodgetts while on vacation. The teenager, who wants to become a marine biologist, watched the shark from cliffs for ten minutes as it attacked a shoal of fish. Using binoculars, she judged its length at 12 feet (3.66 meters) by comparing it with common dolphins chasing the same shoal.

Having seen detailed notes taken by the 15-year-old, experts say her description closely matches that of a great white (Carcharodon carcharias)—a species never before recorded in U.K. waters. She reported her sighting to Rolf Williams, a shark expert at the National Marine Aquarium in Plymouth, England.

"It's tantalizing and we're taking it seriously," he said: "We scrutinized Chaynee very thoroughly to get the best information we could. We'll never know for certain, but some of her observations strongly suggest a great white."

Williams says there are just two other sharks found off southwest England that could be mistaken for this super-predator.

The basking shark, which can grow to 36 feet (11 meters) in length, is certainly big enough, but Williams rules it out as the species is a plankton-eater that wouldn't attack shoals of fish.

Discuss the following questions:

- Why would a Great White Shark come to the UK?
- Is it normal to find one in our waters?
- If not, why do you think one would come here?
- The world's oceans are warming up. What potential effect could this could have on habitats and food chains?

Activity two: Arctic Food Chains

Read and discuss before completing food chain practical

"Despite being dark and ice covered for large parts of the year, the Arctic is a region of huge productivity. The spring and summer bring together plentiful amounts of light and water born nutrients - the vital ingredients for a massive bloom of phytoplankton. This phytoplankton supports a food chain that provides nutrition for residents like polar bears and seals but also draws huge populations of seasonally migrating birds and marine mammals to these rich waters.

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- Paul Cox, National Marine Aquarium

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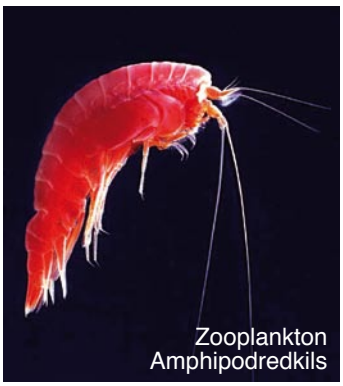
Zooplankton Amphipodredkils


Arctic Fox


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