Underwater noise and marine mammals - Teacher Notes

AIM:

To introduce the effects on marine species of noise associated with building and operating wind farms, with specific reference to marine mammals and to illustrate key concepts such as noise, how sound travels underwater and disturbance.

LEARNING OBJECTIVES

- What are the 5 senses?
- How does sound travel underwater?
- How are marine animals adapted to live underwater?
- What are the implications of noise on the marine environment?
- What animals might be affected by wind turbines?

LEARNING OUTCOMES

After the lesson the class should be able to:

- Name the 5 senses
- Understand how marine mammals use sound underwater
- Define noise pollution and its impacts on marine mammals
- Identify sources of noise in the marine environment
- Explain the implications of building windfarms in the sea.

CURRICULAR LINKS

England
Science
Sc 1 Scientific enquiry
Sc 2 Life processes and living things
Unit 1. Life processes (KS1+2)
Uni 2. Humans and other animals (KS1)
Unit 5. living things in their environment (KS1+2)
Sc 4 Physical processes
Unit 3 e, g. light and sound

Scotland
Science
Biodiversity and interdependence
SCN 0-01a
SCN 2-02ab
Vibrations and waves
SCN 2-11a
Body systems and cells
SCN1-12b
Topical Science
SCN 1-20a
SCN 2-20ab

Wales
Science
Interdependence of Organisms. 6,7
How Things Work. 4

Lesson Plan

This lesson is designed to complement the lesson on species found on and around offshore windfarms and the Life Around the Turbines workshop. It can however be used on its own.

Begin the lesson with a brief introduction/recap of senses. *What are the 5 senses?* Write the terms on the board. Discuss what each sense is used for. Ask the students if one of the senses is needed more. *Can you give a reason for this? Why do we have senses? What will happen if a person loses one of their senses?* You could mention that some fish such as sharks have a 6th sense, the ability to detect electricity!

Talk about the sense of hearing, get the children to close their eyes and listen to the general noises around them.

Discuss that the underwater environment is different and that it is often a lot harder to see underwater. Marine animals develop their hearing to allow them to complete basic tasks such as locating food and other animals in the marine environment.

There are lots of natural noises in the ocean, (listen to a recording of underwater noise if you have one) can the students pick out some of the sounds (dolphins, waves, etc). Explain that some animals such as dolphins and porpoises are very sensitive to sound. They emit noises and interpret the echo to locate their prey and navigate their way around obstacles. This is called 'echo location'. Talk about echolocation, and the use of sonar clicks.

The Dolphin game:

Blindfold one person (the dolphin) and sit them on a chair in the middle of the class, everyone else sits in a circle around them. Teacher to point at one person (the fish). The 'dolphin' makes a noise of their choosing (maybe a click or squeak to mimic a dolphin). The 'fish' then repeats this noise. The dolphin is then to point in the direction of the sound. If they are correct, that person is out. If they are wrong, the person who made the sound becomes the dolphin. The person to catch the most fish in a row at the end of the game is the winner.

Dolphin Game 2:

This is the same game as before however we are adding a background noise the class should realised that it is a lot harder to locate the source of the sound. As a class, think of some loud noises in the sea that could prevent marine mammals from hearing.

Back ground noise can be in the form of drums, or recordings of underwater noise or noises made by other children in the class to replicate the types of underwater noise they have identified.

Class discussion.

Ask the class how they felt not being able to hear properly. Go on to discuss the noises that prevent animals from hearing. Explain that scientists have developed hydrophones to allow them to hear the underwater environment.

Background information

Sound travels great distances underwater, five times faster than in air. Humans find it hard to detect where a sound is coming from underwater, however marine mammals have developed their hearing and use of sounds to allow effective hunting, navigation and communication skills.

Why is sound important for marine mammals?

Many marine mammals rely heavily on sound to sense the ocean around them. They use sounds to:

- Forage and hunt for food
- Communicate
- For social behaviour- reproduction, parental care
- Avoid predators
- navigation

Echolocation

Echolocation allows animals to determine the distance of objects (food and predators) and the location of underwater objects for navigational purposes.

Marine mammals such as dolphins produce sounds, known as sonar clicks. They are reflected back to the animal when they strike an object. The further away an object is, the longer the click will take to return. Dolphins can work out how far away an object is from the time it takes the click to return to them (the echo). If clicks are produced continuously and the dolphin can use the echoes to determine the distance and movement of an object. For example, they can follow the speed and direction of movement of prey animals. If the dolphin is far from the target it will produce clicks at a slow rate. As the dolphin gets closer to the object, the faster the clicks will bounce back, and the dolphin will increase the amount of clicks.

Echolocation makes it possible for marine mammals to feed and navigate in limited visability, either at night or in dark and murky water. A dolphin can detect an object the size of a golf ball which is placed almost a football field away.

Communication

Sounds are also used by marine mammals to communicate with each other. Sound travels very well in water, allowing some animals can communicate over great distances.

Dolphins have a well developed sense of hearing, they can respond to tones within the frequency range of 1 to 150 kHz. For humans the average hearing range is about 0.2 t0 17 kHz. Dolphins can sense higher frequency sounds than humans and hear best in the range of 40 to 1200 kHz. The shape of the dolphin's ear, probably allows it to localize sounds underwater effectively, something that is difficult for humans. The middle ear cavity of a dolphin has a huge blood supply, allowing it to adjust pressure efficiently when it dives. The melon is an organ on the forehead, which is believed to be used by toothed whales (including dolphins) for echolocation.

Impact of noise on marine mammals

The ocean is a very noisy environment. Sounds range from from natural noises, from ocean dwellers and rain on the surface to man-made sounds such as offshore drilling, fishing activities building and sonar, which all add to background sounds in the ocean. Background noises can have an effect on the hearing of marine mammals. When noises interact with an animal's sense of hearing it is known as masking.

Offshore windfarms emit noise from various sources into the sea. Construction, operation and decommissioning all produce noise. Noise emissions from hydraulic hammers used to drive and fix the steel piles to the sea floor during construction, are strong enough to impact the hearing of marine animals. The noise from off shore pilling can be heard against background noise over large distances.

During operation, noise emissions come from the turbines and from ships servicing the wind farms. The noise emissions from windfarms are low in frequency and intensity and probably cannot be heard by marine mammals over distances over more than a few tens of meters. This is because the hearing abilities of these animals are best at higher frequencies. Noise trauma can reduce the hearing abilities of marine mammals. The level of damage depends on the frequency and duration of the noise and in extreme cases may cause hearing loss.

Reduced ability to hear high frequencies is the first stage of hearing loss that may occur. The loss of hearing in mammals could potentially cause them to lose the ability to locate and detect food. Behavioral responses of marine mammals to noise vary greatly from very subtle reactions (startle=small changes in swimming direction) to strong avoidance behaviour (swimming away from the noise source and avoiding a large area).

The offshore windpower industry has commissioned work to assess the potential impacts the construction of wind turbines could have on marine mammals and where possible take steps to minimize the potential impact of noise pollution.

Other web pages:

http://www.underwaternoise.org.uk/effects/index.shtml

References

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Thomsen, F., Lüdemann, K., Kafemann, R. and Piper, W. (2006) Effects of offshore wind farm noise on marine mammals and fish biota, Hamburg, Germany, on behalf of COWRIE Ltd., available at www.offshore wind.co.uk

