



2005 Florida Coast Deep Corals Treasures in Jeopardy

FOCUS

Conservation of deep-sea coral reefs

GRADE LEVEL

7-8 (Life Science)

FOCUS QUESTION

How can deep-sea coral reefs be protected from damage by human activities?

LEARNING OBJECTIVES

Students will be able to compare and contrast deep-sea coral reefs with their shallow-water counterparts.

Students will be able to explain at least three benefits associated with deep-sea coral reefs.

Students will be able to describe human activities that threaten deep-sea coral reefs.

Students will be able to describe actions that should be taken to protect deep-sea coral reef resources.

MATERIALS

- Access to the internet, or copies of materials cited in "Learning Procedure"

AUDIO/VISUAL MATERIALS

None

TEACHING TIME

One or two 45-minute class periods, plus time for student research

SEATING ARRANGEMENT

Groups of two to four students

MAXIMUM NUMBER OF STUDENTS

30

KEY WORDS

Deep-sea coral
Conservation
Pharmaceuticals
Lophelia
Oculina

BACKGROUND INFORMATION

Coral reefs are one of the most species-rich ecosystems on Earth. Shallow-water coral reefs have been widely studied and well-publicized, in contrast to reefs formed by deep-water corals. Recent studies suggest that deep-water reef ecosystems may have a diversity of species comparable to that of coral reefs in shallow waters, and have found deep-water coral species on continental margins worldwide. One of the most conspicuous differences between shallow- and deep-water corals is that most shallow-water species have symbiotic algae (zooxanthellae) living inside the coral tissue, and these algae play an important part in reef-building and biological productivity. Deep-water corals do not contain symbiotic algae (so these corals are termed "azooxanthellate"). Yet, there are just as many species of deepwater corals (slightly more, in fact) as there are species of shallow-water corals.

Deep-water coral reefs were discovered in the

Gulf of Mexico nearly 50 years ago, but very little is known about the ecology of these communities or the basic biology of the corals that produce them. The major structure-building corals in the deep sea belong to the genus *Lophelia*, which has been intensively studied on deep-water coral reefs near the coasts of Europe. Most reports of *Lophelia* reefs in the Gulf of Mexico are the result of investigations directed toward hydrocarbon seepage and/or chemosynthetic communities. Scientists studying deep-water reefs on the Norwegian continental shelf have found that many large *Lophelia* banks occur at sites where there are relatively high levels of light hydrocarbons present in the sediments. The reason for this correlation is not known, nor is it known whether a similar correlation exists in the hydrocarbon-rich Gulf of Mexico.

While *Lophelia* corals are capable of building substantial reefs, they are also quite fragile, and there is increasing concern that these reefs and their associated resources may be in serious danger. Many investigations have reported large-scale damage due to commercial fishing trawlers, and there is also concern about damage that might result from exploration and extraction of fossil fuels. The objectives of the 2005 Florida Coast Deep Corals Expedition are to:

- Map selected deep-water, high-relief coral ecosystems on southwestern and eastern regions of the Florida shelf;
- Describe biological communities associated with these reefs;
- Identify dominant fish species associated with these coral communities; and
- Describe the geologic and hydrographic features of each site.

According to scientists involved with the expedition, deep-water reef systems are at a disadvantage in gaining public empathy because most people will never see them. Consequently, a key part of efforts to protect deep-sea coral reefs involves educating the public about these valu-

able resources. In this lesson, students will develop materials that can be used as part of this kind of education activity.

LEARNING PROCEDURE

1. To prepare for this lesson, read the introductory essays for the 2005 Florida Coast Deep Corals expedition at <http://oceanexplorer.noaa.gov/explorations/05deepcorals/welcome.html>
2. If your students are not familiar with the Cnidaria, briefly review the basic biology and classification of this phylum (for an easy introduction, check out <http://www.ucmp.berkeley.edu/cnidaria/cnidaria.html>; for a suggested list of points to be reviewed, see the “Deep Gardens” lesson at <http://oceanexplorer.noaa.gov/explorations/05deepcorals/background/edu/edu.html>).

Briefly review deep-water coral reefs, and contrast these reefs with the more familiar shallow-water reefs. Tell students that deep-water reefs are important in a variety of ways, but are significantly jeopardized by human activity (keep the discussion very general at this point, since students will be researching details as part of their assignment). Say that because of their location, deep-water reefs and their associated benefits and problems are largely unknown to the general public. Consequently, there is an urgent need for public education as a first step toward protecting these valuable resources.

3. Tell students that their assignment is to develop a poster that could be used as part of efforts to educate the general public about the importance of deep-water coral reefs and the need to protect them. Each poster should address the following questions (students may want to use these questions as headings on their poster):
 - What are deep-water coral reefs?
 - Where are they found?
 - How are deep-water coral reefs different from coral reefs in shallow water?
 - Why are deep-water coral reefs important?

- What is the problem?
- What needs to be done?

Encourage students to use images of deep-sea corals and coral reefs as part of their poster.

You may want to direct students to the July 2005 issue of *Current: the Journal of Marine Education* which is a special issue on deep-sea corals (available online at http://www.mcbi.org/Current_Magazine/Current_Magazine.htm), or allow them to discover this (and other resources) on their own.

4. Lead a group discussion of students' posters.

Each poster should include the following points:

- Deep-water coral habitats occur at depths of 70 to greater than 1000 m.
 - Deep-sea corals are known from all the world's oceans.
 - Deep-water corals often lack symbiotic algae (zooxanthellae) that are typical of shallow-water corals.
 - Typical deep-water corals include *Lophelia pertusa*, *Oculina varicosa*, hydrocorals (family Stylasteridae), black corals (order Antipatharia), bamboo corals (family Isididae), and sea fans (order Gorgonacea) [note that images of all these are readily available on the internet].
 - *Oculina* and *Lophelia* dominate deep reefs off the southeastern coast of the United States.
 - Coral is an important habitat-provider on *Oculina* and *Lophelia* reefs.
 - *Lophelia* reef systems in the northeast Atlantic include more than 1,300 species of fish and invertebrates.
 - Only a small percentage of deepwater reefs have been mapped or have had their biological resources characterized.
- Very little is known about deep-sea coral distribution, population dynamics, ecology, or about how these corals function in providing habitat for other species.
 - Many new species of deep-sea corals have been discovered on seamounts.
 - Many seamount species are endemic (they do not occur anywhere else) and are therefore exceptionally vulnerable to extinction.
 - Some deep-sea sponges and corals are sources of new pharmaceuticals that can be extremely valuable in treating human diseases. Examples include:
 - **Discodermolide**: isolated from the sponge *Discodermia dissolute*; may treat cancers which are resistant to other drugs
 - **E7389**: isolated from the sponge *Lissodendoryx* sp.; in clinical trials for the treatment of lung cancer and other cancers
 - **Dictyostatin-1**: isolated from a sponge from the order Lithistida; may be more effective than Taxol as an anti-cancer drug
 - **Topsentin**: isolated from the sponge *Spongopories ruetzleri*, shows promise as an anti-inflammatory agent to treat arthritis and skin irritations, as well as for the treatment of Alzheimer's disease and to prevent colon cancer
 - **Bone Grafts**: shallow tropical corals have been used as bone grafts for more than 10 years, but deep-sea species have not been used though recent research shows that bamboo corals (family Isididae) have a skeletal structure and dimensions that are almost identical to bone
 - **Collagen**: Gorgonin, found in bamboo corals, closely resembles collagen, an important component of bone that also can be used for controlled release of medicines, and as a foundation for tissue rebuilding.

- Deep-sea corals usually inhabit places where natural disturbance is rare.
- Many deep-sea corals are slow-growing and may require decades or even centuries to regenerate if they are damaged; but it really isn't known whether these species are capable of repopulating a given area at all if they are destroyed.
- Deep reefs worldwide are being impacted by destructive fishing methods, such as trawling, which destroys the delicate corals.
- Damage from bottom trawling is a global threat to deep-water coral reefs.
- In addition to bottom-trawl fishing, oil and gas production, cable laying, mining, and coral harvest may also negatively impact deep-water coral reefs.
- Protecting the benefit offered by deep-sea coral reefs depends upon measures like the Deep Sea Coral Protection Act (DSCPA) which was introduced in the U.S. House and Senate in 2003-2004. Provisions of the Act include:
 - Freezing the footprint of bottom trawls in all fishery management regions;
 - Preventing trawling from expanding into previously untrawled regions until deep-sea corals in those regions are surveyed and mapped; and
 - Implementing a comprehensive research plan to collect information on deep-sea coral locations and life history.

5. Brainstorm ways that information included in students' posters could be communicated to larger audiences. If possible, display some of the posters at events where they might be seen by other students, parents, and members of the general public.

THE BRIDGE CONNECTION

<http://www.vims.edu/bridge/> – In the "Site Navigation" menu on the left, click on "Ocean Science Topics," then "Biology," then "Invertebrates," then "Other Inverts" for links to more information about Cnidaria.

THE "ME" CONNECTION

Have students write an "op-ed" style essay in which they explain why deep-water coral reefs are personally important and what steps individuals can take to help ensure their protection.

CONNECTIONS TO OTHER SUBJECTS

English/Language Arts, Earth Science

EVALUATION

Posters and group discussions provide opportunities for assessment.

EXTENSIONS

1. Have students visit <http://oceanexplorer.noaa.gov> to keep up to date with the latest discoveries by the 2005 Florida Coast Deep Corals Expedition.
2. Visit the Marine Conservation Biology Institute Web site (<http://www.mcbi.org>) for more information about deepsea corals and strategies for their protection.
3. Visit http://oceanservice.noaa.gov/education/kits/corals/supp_coral_lessons.html for more activities on coral reefs and how they may be protected.

RESOURCES

<http://oceanexplorer.noaa.gov> – Web site for NOAA's Ocean Exploration program

Pickrell, J. 2004. Trawlers Destroying Deep-Sea Reefs, Scientists Say. National Geographic News. http://news.nationalgeographic.com/news/2004/02/0219_040219_seacorals.html

http://www.mcbi.org/Current_Magazine/Current_Magazine.htm – A special issue of Current: the Journal of Marine Education on deep-sea corals.

Morgan, L. E. 2005. What are deep-sea corals? Current 21(4):2-4; available online at http://www.mcbi.org/Current_Magazine/What_are_DSC.pdf

Reed, J. K. and S. W. Ross. 2005. Deep-water reefs off the southeastern U.S.: Recent discoveries and research. Current 21(4): 33-37; available online at http://www.mcbi.org/Current_Magazine/Southeastern_US.pdf

Frame, C. and H. Gillelan. 2005. Threats to deep-sea corals and their conservation in U.S. waters. Current 21(4):46-47; available online at http://www.mcbi.org/Current_Magazine/Threats_Conservation.pdf

Roberts, S. and M. Hirshfield. Deep Sea Corals: Out of sight but no longer out of mind. http://www.oceana.org/fileadmin/oceana/uploads/reports/oceana_coral_report_final.pdf — Background on deep-water coral reefs

<http://www.oceanicresearch.org/> – The Oceanic Research Group Web site; lots of photos, but note that they are very explicit about their copyrights; check out “Cnidarians: Simple but Deadly Animals!” by Jonathan Bird, which provides an easy introduction designed for classroom use

<http://www.mesa.edu.au/friends/seashores/index.html> – “Life on Australian Seashores” by Keith Davey on the Marine Education Society of Australasia Web site, with an easy introduction to Cnidaria, including their method of reproduction

<http://www-biol.paisley.ac.uk/courses/Tatner/biomed/units/cnid1.htm> – Phylum Cnidaria on Biomed of the Glasgow University Zoological Museum on the Biological Sciences, University of

Paisley, Scotland Web site; includes explanations of the major classes, a glossary of terms and diagrams and photos

<http://www.calacademy.org/research/izg/calwildfall2000.pdf> – Article from California Wild: “Stinging Seas - Tread Softly In Tropical Waters” by Gary C. Williams; an introduction to the venomous nature of tropical cnidarians, why and how they do it

http://oceanexplorer.noaa.gov/gallery/livingocean/livingocean_coral.html – Ocean Explorer photograph gallery

<http://oceanica.cofc.edu/activities.htm> – Project Oceanica Web site, with a variety of resources on ocean exploration topics

NATIONAL SCIENCE EDUCATION STANDARDS

Content Standard A: Science As Inquiry

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard C: Life Science

- Populations and ecosystems
- Diversity and adaptations of organisms

Content Standard F: Science in Personal and Social Perspectives

- Populations, resources, and environments
- Science and technology in society

Content Standard G: History and Nature of Science

- Nature of science

FOR MORE INFORMATION

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