



Life on the Edge: Exploring Deep Ocean Habitats

Who's Your Neighbor?

FOCUS

Benthic invertebrate groups associated with deep-sea coral reefs

GRADE LEVEL

9-12 (Life Science)

FOCUS QUESTION

What kinds of animals are found in the benthic communities associated with deep-sea corals, and how may these animals interact?

LEARNING OBJECTIVES

Students will be able to recognize and identify some of the fauna groups found in deep-sea coral reef communities.

Students will be able to describe common feeding strategies used by benthic animals in deep-sea coral reef communities.

Students will be able to discuss relationships between groups of animals in deep-sea coral reef communities.

MATERIALS

- "Data Summary Sheet," copied onto an overhead transparency or onto a marker board or flip chart
- Copies of "Fauna Associated with Live and Dead *Lophelia pertusa* Corals," one copy for each student group

AUDIO/VISUAL MATERIALS

- Chalkboard, marker board, or overhead projec-

tor with transparencies and markers for group discussion

TEACHING TIME

One 45-minute class period, plus time for student research

SEATING ARRANGEMENT

Groups of 4-6 students

MAXIMUM NUMBER OF STUDENTS

30

KEY WORDS

Continental shelf
Continental slope
Hard bottom
Lophelia pertusa
Deep-water coral
Habitat

BACKGROUND INFORMATION

For hundreds of years, thousands of fishermen have harvested U.S. coastal waters of the Atlantic Ocean and Gulf of Mexico. Yet, the marine habitats of the adjacent outer continental shelves and slopes are poorly studied and in many cases completely unknown. Until recently, most scientists assumed that these habitats did not support large or productive biological communities. Although no one had actually visited the edges of the continental shelves for a first hand look, they believed that the extensive commercial fisheries depended upon migrations from other areas and/or nutrients carried in from deeper or coastal waters. But once

they actually began exploring the area more thoroughly, scientists found many diverse and thriving benthic communities.

Between North Carolina and Florida, several unique habitats are found where the topography of the outer continental shelf is extremely rugged and swept by the powerful currents of the Gulf Stream. Hard or “live” bottom habitats support diverse biological communities that include valuable fish and invertebrate resources. On the edge of the continental shelf where depths range from 80 to 250 m, hard bottom communities provide the foundation for the food web of many commercially important species. But while scientists have studied many hard bottom communities within the range of SCUBA gear, they know very little about the ecology of these communities in deeper waters.

Even deeper, on the middle of the continental slope, the deep-sea coral *Lophelia pertusa* forms another almost-unexplored habitat. Here, in depths of 400 to 700 m, branches of living coral grow on mounds of dead coral branches that can be several meters deep and hundreds of meters long. Unlike corals that produce reefs in shallower waters, *Lophelia* does not have symbiotic algae and receives nutrition from plankton and particulate material captured by its polyps from the surrounding water. *Lophelia* mounds alter the flow of currents and provide habitats for a variety of filter feeders. Scientists suspect that many other organisms may also inhabit deep-sea coral reefs, including commercially important fishes and crustaceans. But they don’t know for sure, because most of the hard bottom and deep-sea coral habitats on the edge and slope of the continental shelf are still unexplored.

The 2003 Life on the Edge Expedition will search previously unexplored hard bottom habitats and deep coral banks on the edge and slope of the continental shelf adjacent to the coasts of North and South Carolina and define the biological communities living in these habitats. In this activity,

students will research information on the ecology of faunal groups found on a *Lophelia* reef, and make inferences about the role of these groups in the deep-sea reef community.

LEARNING PROCEDURE

1. Review the general geographic location and form of the continental shelf adjacent to the U.S. Atlantic coast. Tell students that very little is known about the ecology of the edge and slope of the shelf, but that recent explorations have found diverse and thriving benthic communities. Visit <http://oceanexplorer.noaa.gov> for more background information about the Life on the Edge Expedition, and http://oceanexplorer.noaa.gov/explorations/islands01/background/islands/sup10_lophelia.html for more background on *Lophelia* reefs.
2. Provide each student group with a copy of “Fauna Associated with Live and Dead *Lophelia pertusa* Corals.” Tell students that these data were obtained by examining 25 “blocks” of *L. pertusa* collected with a deep-water dredge near the Faroe Islands. Assign each student group one or more of the fauna groups listed in the table. Have each student group prepare a brief report on the assigned group(s) using library and/or internet resources. Each report should include (a) a description of the animal, including size range; (b) habitat; (c) food source(s) and feeding habits; (d) an illustration, if possible. The following websites contain the necessary information:
<http://library.thinkquest.org/26153/marine/animalia.htm>
<http://www.teaching-biomed.man.ac.uk/bs1999/bs146/biodiversity/metadiv.htm>
<http://tolweb.org/tree?group=Animals&contgroup=Eukaryotes>
<http://virtual.yosemite.cc.ca.us/~randerson.Marine%20Invertebrates/index.htm>
3. Have each student or group present their report to the entire class, and fill in the appropriate cells in the “Data Summary Sheet.”

4. Lead a discussion of how faunal groups associated with *L. pertusa* may interact in deep reef communities, with particular emphasis on habitat and feeding strategies. The Data Summary Sheet should reflect a variety of potential habitats including the reef surface, variously-sized spaces between living or dead coral branches, sediment, and the skeletons of dead (and sometimes living) corals.

Ask students to distinguish between motile and sessile organisms, and relate this to feeding habits. Students should realize that most of the organisms are suspension feeders like *L. pertusa*, and many of these are sessile. This implies that current flow could be important to maintaining a steady supply of food, and may explain why *L. pertusa* reefs are often found in areas with strong currents. Some groups may have several possible feeding strategies. Gastropods may be predators (some are known to feed on foraminifera) or may graze microbial films on benthic surfaces. Similarly, crustacea may also be predators, or may feed on detritus. The fact that crustaceans were three times more abundant on dead coral than live coral may suggest that food (such as sponges or sipunculids that bore into coral skeletons) was more abundant on dead coral. Polychaetes also have a variety of feeding strategies, which may at least partially account for their abundance in the samples. Bivalves are typically cavity dwellers, and were commonly found in the calices (skeleton cups) of dead corals. The obvious abundance of this habitat may account for the abundance of bivalves in the samples. Echinoderms (brittle stars) were also found in large numbers in the calices of dead coral.

Students should also realize that the primary source of food for benthic organisms is primary production that occurs in shallower waters, and that organic material and nutrients are transported out of these environments

when organisms die and settle to the bottom. Feeding activities by benthic organisms are an important process that returns some of these materials to other realms of the ocean environment. Ask students why they think there are so many different kinds of animals in these benthic communities, and why this diversity is important.

THE BRIDGE CONNECTION

www.vims.edu/BRIDGE/ – Click on “Ocean Science” in the navigation menu to the left, then “Ecology,” then “Coral” for resources on corals and coral reefs.

THE “ME” CONNECTION

Have students write a brief essay on why diverse but relatively unknown groups like those studied in this activity might be important to their own lives.

CONNECTIONS TO OTHER SUBJECTS

English/Language Arts; Earth Science

EVALUATION

Reports prepared in Step 2 provide opportunity for assessment.

EXTENSIONS

Log on to <http://oceanexplorer.noaa.gov> to keep up to date with the latest Life on the Edge Expedition discoveries, and to find out what researchers are learning about deep-water hard-bottom communities

RESOURCES

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

<http://pubs.usgs.gov/of/of01-154/index.htm> – U.S. Geological Survey Open-File Report 01-154 “Sea-Floor Photography from the Continental Margin Program”

Jensen, A. and R. Frederiksen. 1992. The fauna associated with the bank-forming deepwater

coral *Lophelia pertusa* (Scleractinia) on the Faroe Shelf. Sarsia 77:53-69 – The technical journal article upon which this activity is based

Roberts, S. and M. Hirshfield. Deep Sea Corals: Out of sight but no longer out of mind. http://www.oceana.org/uploads/oceana_coral_report.pdf

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

- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

Content Standard F: Science in Personal and Social Perspectives

- Natural resources

FOR MORE INFORMATION

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<http://oceanexplorer.noaa.gov>

Student Handout

Data Summary Sheet

	Size Range	Habitat	Food Source(s)	Feeding Habits
Porifera				
Hydrozoa				
Anthozoa				
Nemertea				
Nematoda				
Polychaeta				
Gastropoda				
Bivalvia				
Crustacea				
Sipunculida				
Bryozoa				
Echinodermata				
Ascidiacea				

Student Handout

Fauna Associated with Live and Dead *Lophelia pertusa* Corals

(adapted from Jensen and Frederiksen, 1992)

Group	Live Corals		Dead Corals	
	Number of Species	Number of Individuals	Number of Species	Number of Individuals
Porifera	8	*	13	*
Hydrozoa	22	*	26	*
Anthozoa	11	*	10	*
Nemertea	6	80	5	36
Nematoda	5	18	7	83
Polychaeta	56	710	56	757
Gastropoda	10	48	11	54
Bivalvia	13	252	13	910
Crustacea	13	104	12	208
Sipunculida	2	45	2	109
Bryozoa	35	*	38	*
Echinodermata	4	53	5	610
Ascidiacea	2	36	3	23

* not counted