

Cold Coral Research in U.S. Waters

By Kenneth J. Sulak

To most of us, the words "coral reef" evoke thoughts of shallow, sunlit tropical seas. But massive reef-like coral communities also inhabit the cold depths of the world ocean. Deep-dwelling cold corals may grow more slowly than their tropical counterparts because they lack the energetic boost of symbiotic algae. But they are critically important to commercially valuable species of fish.

During the past decade, the fate of deep-water coral communities has gained increased scientific attention due to concerns of irreversible human impacts from bottom trawling and energy development on the seafloor.

One of the most ubiquitous reef-forming, deep-water corals is the snow-white glass coral, *Lophelia pertusa*. European marine scientists have documented a rich diversity of animal life inhabiting *Lophelia* reefs in the northeastern Atlantic.

These same reefs also provide critical living habitat for a number of economically important fish species. Unfortunately, off Scotland, Ireland and Norway, extensive areas of *Lophelia* habitat have been heavily damaged or destroyed by bottom trawling.

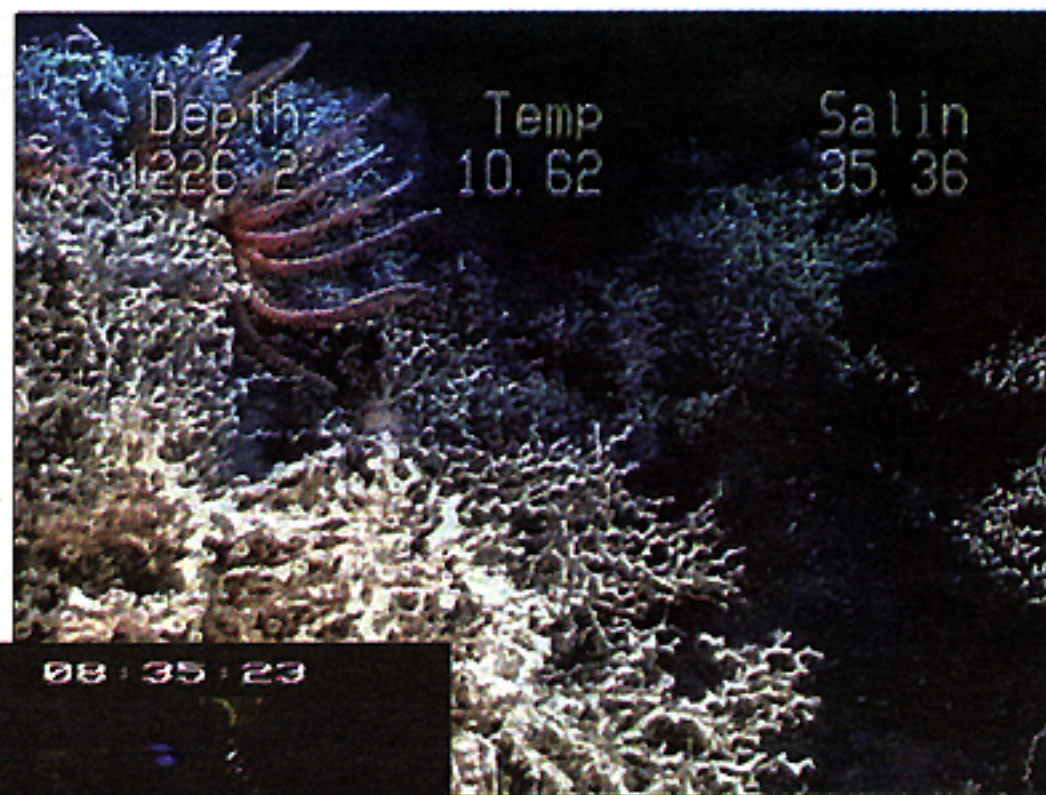
Since 1999, a multidisciplinary team of marine scientists from USGS and collaborating agencies and universities has been investigating little-known deep-water reefs on the continental slope off the southeastern United States and in the Gulf of Mexico. The effort is supported by a number of sources, including the National Undersea Research Program, NOAA Office of Ocean Exploration, USGS Outer Continental Shelf Ecosystem Studies Program, Minerals management Service, North Carolina Division of Coastal Management, and Canadian Natural Sciences and Engineering Council.

Along the East Coast, a program is carrying out fundamental research to explore cold-coral habitat and develop quantitative definitions of faunal structure and food webs for *Lophelia* reefs. The program is led by Dr. Steve Ross of the University of North Carolina-Wilmington (currently on a two-year assignment with the USGS Florida Integrated Science Center), and Dr. Kenneth J. Sulak, leader of the Coastal Ecology and Conservation Research Group at the USGS Florida Integrated Science Center in Gainesville, Fla.

Sulak also leads the USGS Gulf of Mexico *Lophelia* research program, launched in 2004. The overall research team for both programs is rounded out by a NOAA crustacean biologist, three USGS molecular geneticists, a USGS benthic biologist, a USGS microbiologist, two Canadian paleoecologists, a fish ecologist from the University of New Orleans, marine educators from the North Carolina Museum of Science, and a professional videographer.

The team has been able to get close up and personal with *Lophelia* reefs at depths of 350 to 850 meters by using the four-person research submersible *Johnson-Sea-Link* and the Navy research submersible *NR-1*. By combining manned submersible digital imaging, high-definition TV filming, and in-situ sampling, together with remote sampling of the water column and substrate from surface-research vessels, the deep-reef team has uncovered many secrets of cold corals and deep reef communities.

But, many questions remain to be answered by the team: How old are individual coral colonies (perhaps several hundred years)? How old are massive *Lophelia* reefs (also called banks) that can extend for kilometers and attain heights of tens of meters (perhaps thousands of years)? How fast do cold corals grow (do they receive an energy



A *Lophelia pertusa* coral reef, at left lives at 450-meter depth on the U.S. continental slope off North Carolina. Photo by K. Sulak, USGS, and Steve Ross, UNCW. USGS deep coral team leader Ken Sulak, below left, travels with pilot Phil Santos inside the acrylic sphere of the submersible *Johnson-Sea-Link* during a 2004 mission.



boost from symbiotic microbes, enabling rapid growth)?

How do these corals fit into the overall deep-water food web and the surface to substrate food web? Is there a distinct fauna of fishes and invertebrates that depend on, or are highly associated with, *Lophelia*? Why do *Lophelia* reefs grow in some locations but not in others with similar depths, temperatures and currents?

Answering these questions will provide natural-resource agencies like the Minerals Management Service with insights into the potential ecological importance of deep, cold coral reefs and how they can best be conserved as deep seafloor resources are increasingly

affected by human activities.

USGS and its team of collaborators have taken the lead in deep coral research in the United States, but scientists in other countries earlier recognized the importance of investigating deep coral communities.

Two international deep coral symposia have been convened, one in Canada, another in Germany. Growing concern in the United States for conservation of deep coral reefs is evident from a scientific forum held with the U.S. House of Representatives, House Ocean Caucus, in Washington, D.C., March 2003. This follows the lead of several European nations that have enacted coral protection and conservation measures.

These include listing of *Lophelia* reefs in the United Kingdom, Biodiversity Action Plan, CITES, and European Community Habitats Directive, as well as the 1998 adoption of a new coral Annex to the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic. The European Community is further considering designation of *Lophelia* reefs as a Special Area of Conservation. Already, Norway has banned trawling in a 350-square-mile area of deep coral reef habitat. Australia and New Zealand have also enacted conservation legislation.

Within the past few years, the plight of deep coral reefs has gained attention at a variety of levels, including articles in major newspapers, news service articles, natural resource agency publications, educational outreach institutions, conservation advocacy organizations, regional magazines, issue commentary articles in science digest journals and high profile scientific journals.

The third international deep coral symposium will be held in Miami, Fla., in 2005, with USGS as one major co-host, along with NOAA and the Smithsonian Institution. The USGS team launched its initial Gulf of Mexico deep coral submersible mission off Louisiana and Mississippi in July-August 2004, integrated with a contractor mission sponsored by the Minerals Management Service.

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