Ocean Explorers Probe Gulf of Mexico

The Gulf of Mexico may be a source of food, fuel, and fun for millions of Americans, but vast reaches of it have never been mapped or examined in detail. In the spring of 2012, Tim Shank, a biologist at Woods Hole Oceanographic Institution (WHOI), led a science team aboard the *Okeanos Explorer* on a mission to explore seafloor sites in the northern and eastern Gulf of Mexico.

They used the remotely operated vehicle *Little Hercules to* investigate natural hydrocarbon seeps, diverse deep-sea coral ecosystems, three wooden and iron-hulled shipwrecks, and evidence of areas where sperm whales hunted prey.

During their three-week cruise, they visited part of the continental shelf called the West Florida Escarpment, several canyons in the escarpment and elsewhere, and sites within a few miles of the Deepwater Horizon oil rig.

—Cherie Winner

A shrimp casts a wary, bulging eye on the camera.

Intensity reigns in the ship's control room as WHOI biologist Tim Shank (left) and ROV Team Coordinator Dave Lovalvo view images sent back from the seafloor by the ROV *Little Hercules*. The headphones let Shank draw on the expertise of researchers around the world who were viewing the same images in real time via the ship's "telepresence" system.

Joe Biscotti, NOAA

Deep-sea Corals Felt Impacts of Deepwater Horizon Spill

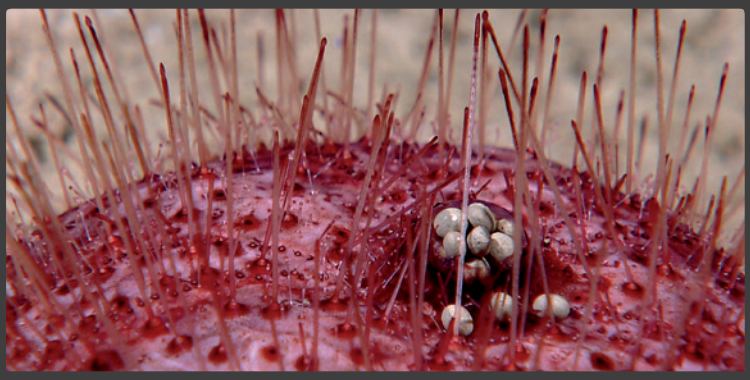
Scientists from Woods Hole Oceanographic Institution (WHOI) helped find strong evidence that the Deepwater Horizon oil spill had impacts on deep-sea coral communities in the Gulf of Mexico.

The study, published in March 2012 in *Proceedings of the National Academy of Sciences,* used all of the deep-sea robotic vehicles of the WHOI-operated National Deep Submergence Facility—the three-person submersible *Alvin*, the remotely operated vehicle *Jason,* and the autonomous underwater vehicle *Sentry*—to investigate corals near the ruptured Macondo well.

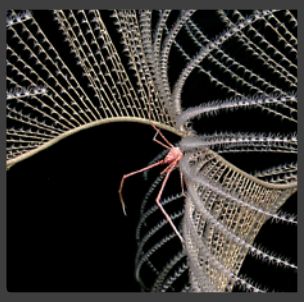
"These corals exhibited varying levels of stress, including bare skeletons, tissue loss, and excess mucus production—all associated with a covering of brown flocculent material," said WHOI biologist Tim Shank.

The study's lead author, Helen White, a geochemist at Haverford College, worked with WHOI marine chemist Christopher Reddy and WHOI researcher Robert Nelson to identify oil found in the coral communities and surrounding sediments. They provided evidence that its source was the Macondo well, using an advanced technique, pioneered at WHOI by Reddy and Nelson, called comprehensive two-dimensional gas chromatography. Pen-Yuan Hsing, a graduate student at Pennsylvania State University (PSU), compiled further evidence by analyzing 69 images of 43 individual corals taken with cameras on undersea vehicles.

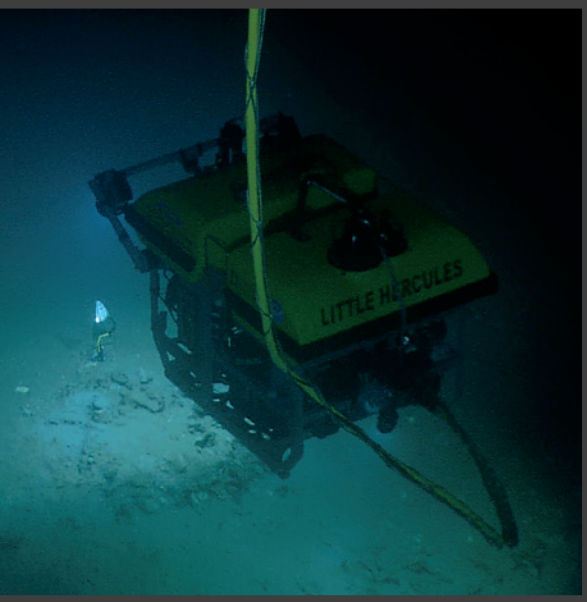
The study grew out of a research cruise to the Gulf led by PSU biologist Chuck Fisher in late October 2010, six months after the Deepwater Horizon oil spill. This expedition was part of an ongoing study of deep-sea life in the Gulf funded by the Bureau of Ocean Energy Management and the National Oceanic and Atmospheric Administration (NOAA). Using *Jason*, the team discovered numerous distressed and flocculent-covered coral communities 6.8 miles from the Macondo well.



Eggs emerge from the gonopore of a sea urchin. Fertilization occurs in the seawater; the male releases sperm and then the female releases eggs.

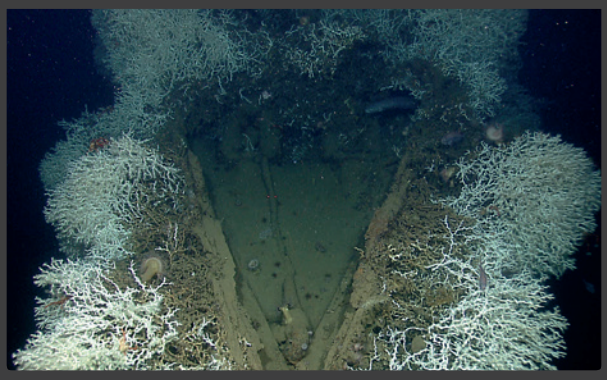


At the edge of a steep cliff nearly 2,000 meters (1.25 miles) below the surface, a slender-legged chirostylid crab haunts the delicate spiral branches of an iridogorgid coral.



Little Hercules explores the bottom of the Gulf of Mexico in early spring 2012. The shiny triangle on a bent stalk is a marker placed there by the *Little Herc*'s manipulator arm. Scientists leave such markers at places of interest for future visits.

The bow of an old shipwreck is thickly crusted with *Lophelia* corals. A few anemones and fish can also be seen. The expedition examined two shipwreck sites that had been spotted in seafloor sonar surveys by the oil and gas industry and also discovered a third shipwreck.



All underwater images courtesy of the NOAA *Okeanos Explorer* Program, Gulf of Mexico Expedition

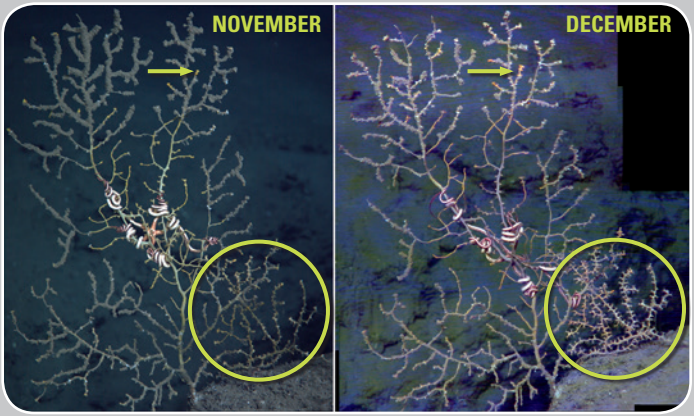
Despite the corals' proximity to the well, the visible damage could not be directly linked to the Deepwater Horizon spill. The research team, again headed by Fisher and augmented by White, returned a month later, funded by the National Science Foundation's rapid response research grant program.

"It is easy to see the impact of oil on surface waters, coastlines, and marine life, but this was the first time we were diving to the seafloor to examine the effects on deep-sea ecosystems," White said. The team employed *Sentry* to map and photograph the ocean floor and *Alvin* to get a better look at the distressed corals.

"We don't know the long-term impacts on these corals," Shank said. "Beyond that, the corals serve as hosts to other animals—crabs, shrimp, and brittle stars—that may be affected by the loss of their habitat. We hope our continued monitoring of this site will give us insight into whether they will recover." In March, he returned to the site aboard the NOAA ship *Okeanos Explorer* (see story above) to continue monitoring impacts on coral communities over the long term.

—Eils Lotozo and Stephanie Murphy

Several months after the Deepwater Horizon oil spill, scientists twice visited deep-sea corals in the Gulf of Mexico. Many corals were covered with brown material and had suffered tissue loss. One coral, shown below, had one branch (circled) showing signs of recovery on the second visit, and some branch tips (arrows) were alive at both times.



Lophelia II 2010, BOEM & NOAA OER; copyright WHOI Dr. Charles R. Fisher; copyright WHOI