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Gulf of Mexico Deep-Sea Coral Ecosystem Studies, 2008–2011

Most people are familiar with tropical coral reefs, located in warm, well-illuminated, shallow waters. However, corals also exist hundreds and even thousands of meters below the ocean surface, where it is cold and completely dark (fig. 1). These deep-sea corals, also known as cold-water corals, have become a topic of interest due to conservation concerns over the impacts of trawling, exploration for oil and gas, and climate change. Although the existence of these corals has been known since the 1800s, our understanding of their distribution, ecology, and biology is limited due to the technical difficulties of conducting deep-sea research.

DISCOVRE (DIversity, Systematics, and COnnectivity of Vulnerable Reef Ecosystems) is a new U.S. Geological Survey (USGS) program focused on deep-water coral ecosystems in the Gulf of Mexico. This integrated, multidisciplinary, international effort investigates a variety of topics related to unique and fragile deep-sea coral ecosystems from the microscopic level to the ecosystem level, including components of microbiology, population genetics, paleoecology, food webs, taxonomy, community ecology, physical oceanography, and mapping (fig. 2).

The deep-water coral *Lophelia pertusa* (fig. 3) is globally distributed but is most common in the Atlantic Ocean. In the Gulf of Mexico, *Lophelia* reefs are scattered along the continental shelf break and upper continental slope (300–500 meters in depth). This hard, branching coral forms bushes or thickets that provide important complex habitat for a wide variety of fishes, crustaceans, and other invertebrates. Determining the habitat and ecological relations of *Lophelia* and other deep-sea corals is a focal point for DISCOVRE studies.

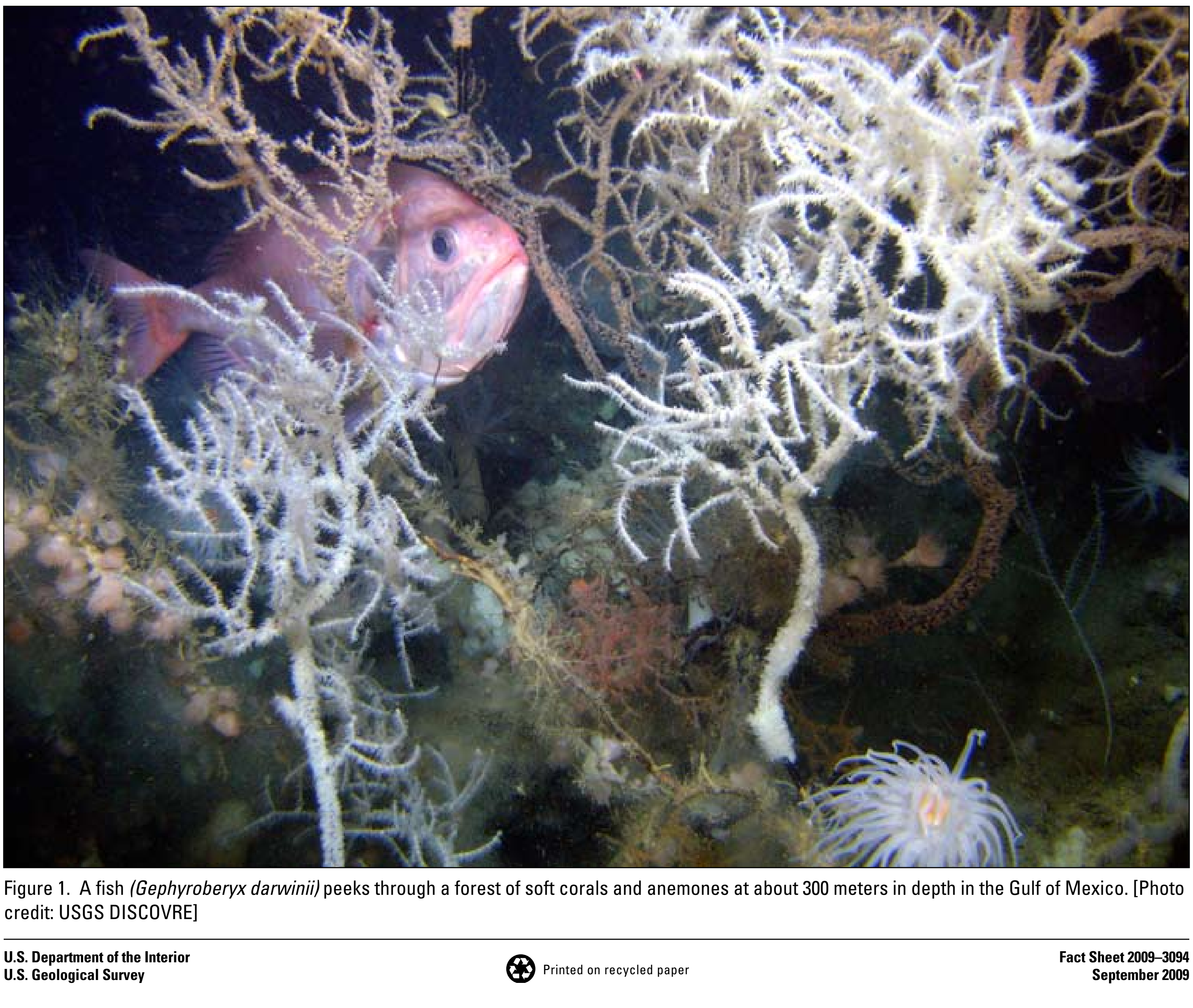

Figure 1. A fish *(Gephyroberyx darwinii)* peeks through a forest of soft corals and anemones at about 300 meters in depth in the Gulf of Mexico. [Photo credit: USGS DISCOVRE]

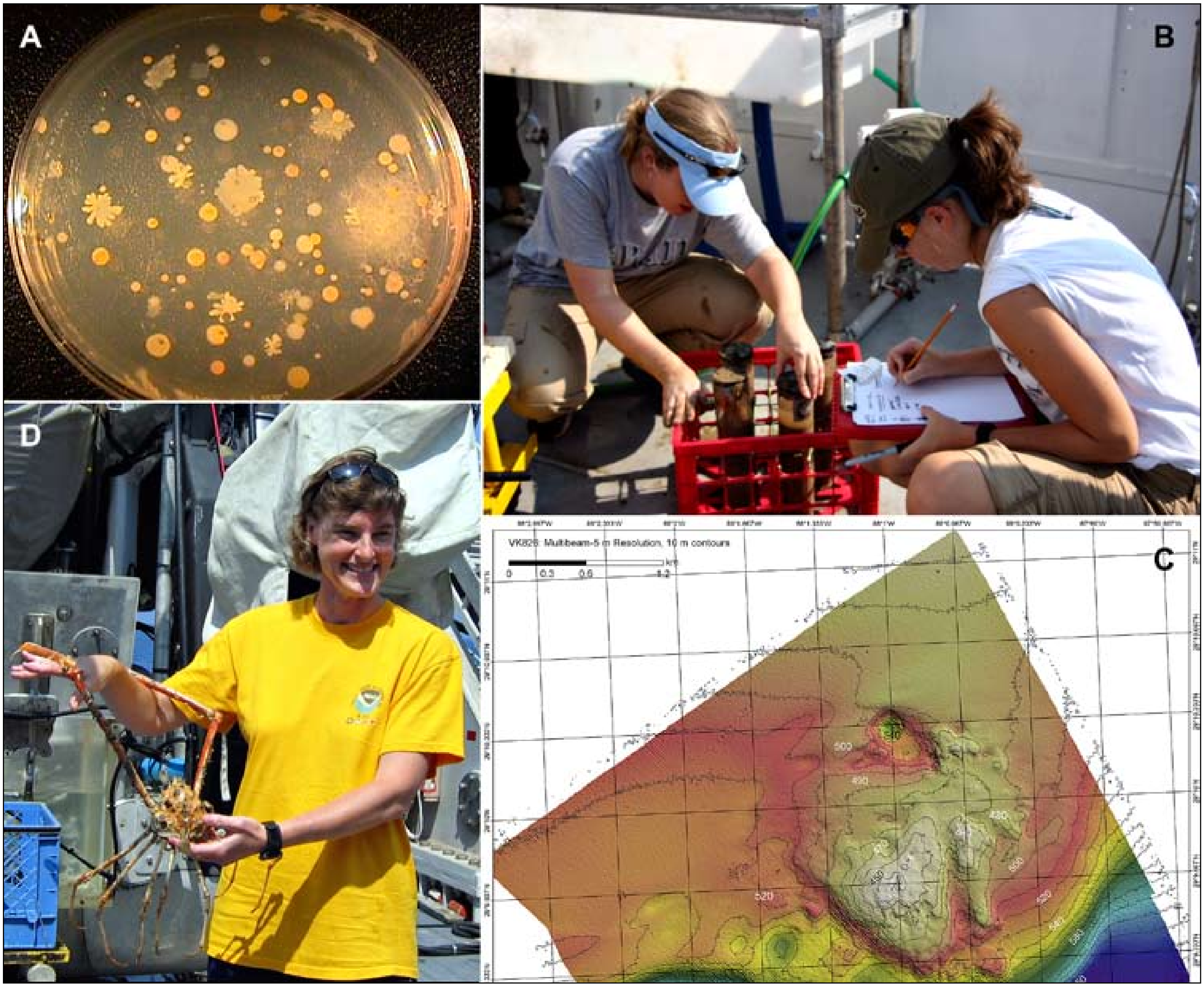

Figure 2. Data collection comes in many shapes, sizes, and colors! Clockwise from upper left: **A:** Bacteria growing on a Petri dish. Characterization of coral-associated microbes is fundamental to understanding coral health and biology. [Photo credit: Christina Kellogg, USGS] **B:** Sediment cores are collected to characterize tiny animals like worms and shrimps that are important components of benthic food webs. Understanding who is eating whom is a key part of determining the energy and carbon flow in these environments. [Photo credit: A. Roa-Varon, USGS] **C:** Multibeam sonar allows scientists to map the bottom in three-dimensional views. Colors represent different depth contours, with warmer colors being shallower. Peaks and ridges can indicate new areas of deep-sea corals. [Photo credit: Erik Cordes and Andrea Quattrini, Lophelia II Expedition] **D:** Invertebrates like this inflated spiny crab (*Rochinia crassa*) are collected for taxonomy and population genetics. New species continue to be discovered in deep-coral habitats. [Photo credit: Christina Kellogg, USGS]

The USGS has partnered with the Minerals Management Service, National Oceanic and Atmospheric Administration, University of North Carolina at Wilmington (UNC-W), University of South Florida, Netherlands Institute for Sea Research, and the Scottish Association for Marine Science. This collaboration aims to map the habitats and characterize the biology and ecology of the deep-sea coral ecosystems in the Gulf of Mexico, to compare these ecosystems with other areas, and to provide the information necessary for effective management and protection of this resource. These corals may live thousands of years, but their slow growth makes these deep habitats vulnerable to long-lasting damage. Submersibles (fig. 4), remotely operated vehicles, and benthic landers (fig. 5) are used to collect samples and environmental data at depths down to 800 meters. USGS scientists are determining the relationship between *Lophelia* and the reef microbial flora; *Lophelia's* genetics, growth, metabolism, and reproduction; and community ecology and food-web relations of reef-associated organisms through the analysis of stable isotopes and diet (stomach contents). Since the DISCOVRE team already has established collaborations with colleagues from several countries (including the Netherlands, United Kingdom, and Norway), this project is well positioned to be an important part of the TRans-Atlantic Coral Ecosystem Study (TRACES)—an international research effort focused on cold-water coral environments across the Atlantic Basin.

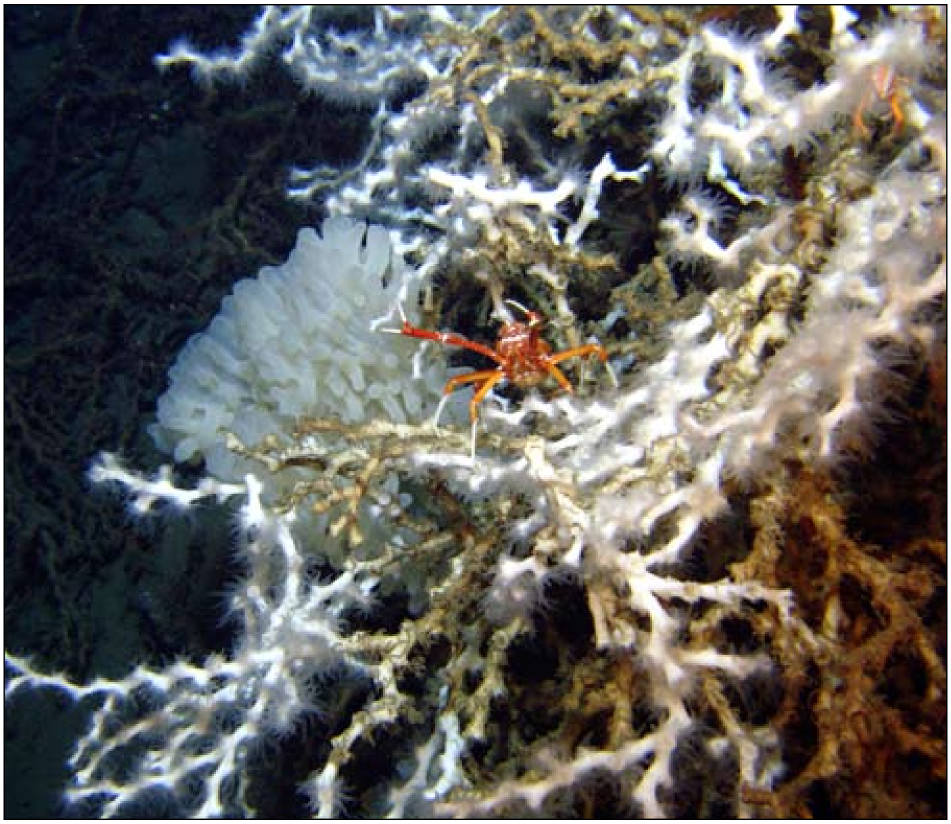

Figure 3. Live *Lophelia pertusa* is white because the calcium carbonate skeleton shows through the nonpigmented coral tissue. Dead coral is soon covered in a brown biofilm. The red-orange squat lobster *(Eumunida picta)* in the center of the photo is prepared to catch its dinner. [Photo credit: USGS DISCOVRE]

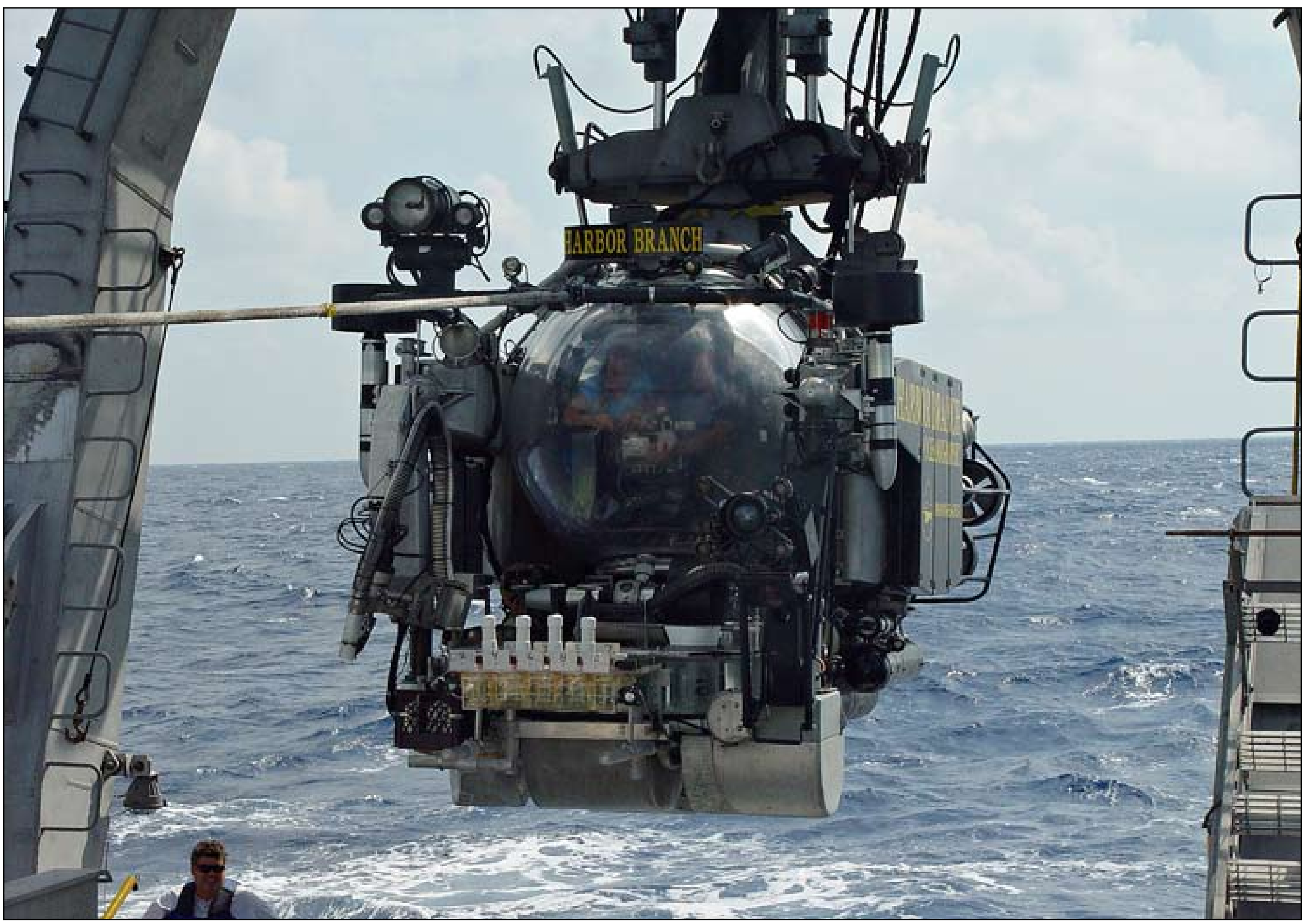

Figure 4. A USGS scientist begins her dive in the *Johnson-Sea-Link* submersible. The submersible can reach depths of 900 meters and has a manipulator arm and suction tool for collecting samples. [Photo credit: Cheryl Morrison, USGS]

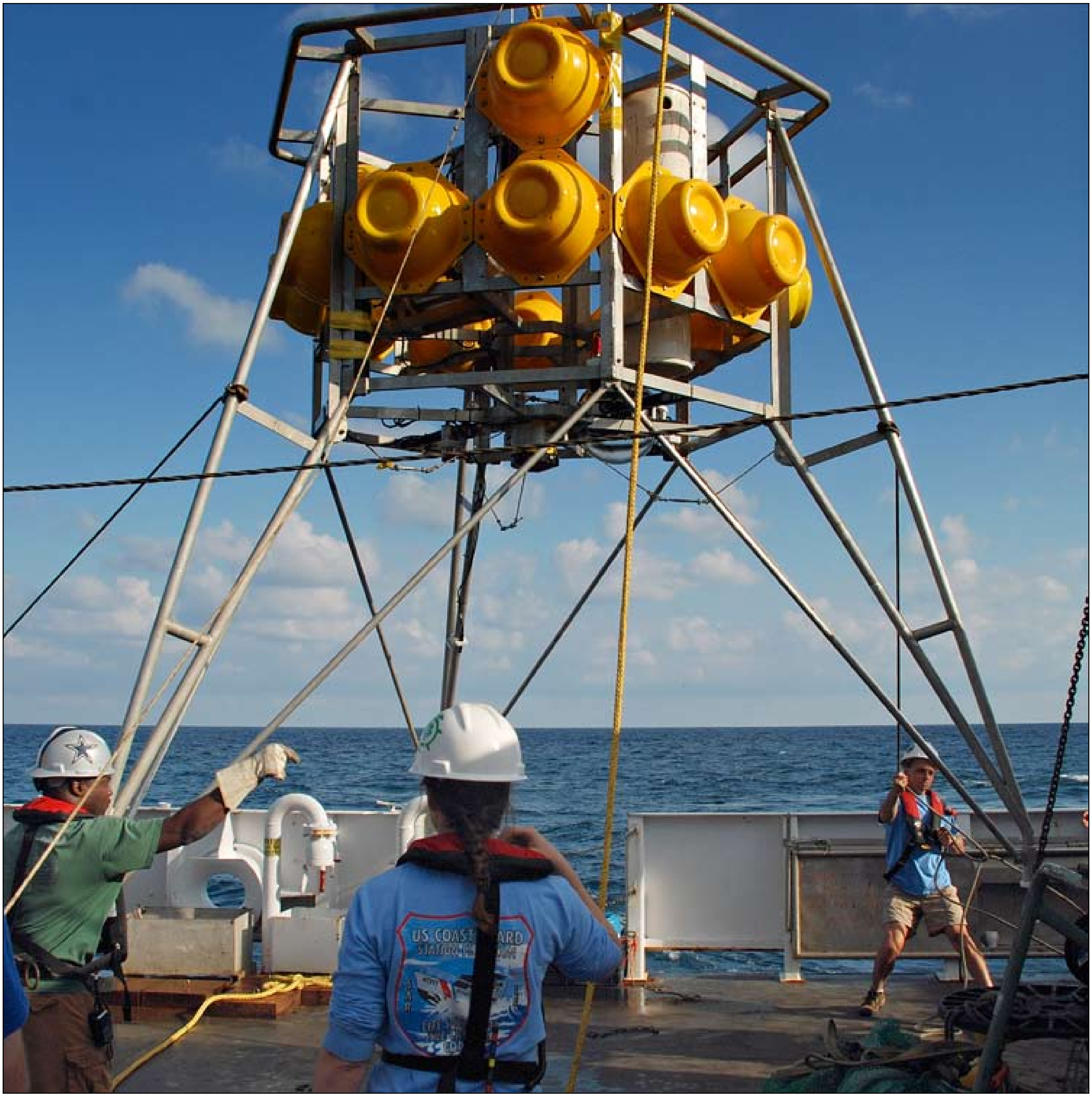

Figure 5. A benthic lander, being deployed. Scientists visit deep-coral ecosystems for only a week or two during a research cruise and capture snapshots of data with each sample. The benthic lander is designed to record what is happening on the ocean floor for much longer periods of time. The metal frame protects instruments in the center that measure and record current speed, water temperature, turbidity, and sediment flux. The lander is placed on the bottom in a deep-sea coral ecosystem and recovered a year later. [Photo credit: Steve Ross, UNC-W]

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http://fl.biology.usgs.gov/DISCOVRE/index.html