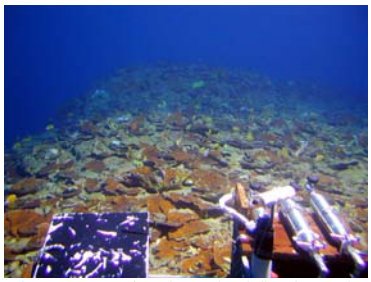
Ask A Scientist At Sea!

Seabury Hall, Makawao, Maui

Heather Spalding, Botany Dept., University of Hawai'i at Manoa

A joint project between the NSF Gk-12 program at the University of Hawai'i Manoa and NOAA's Coral Reef Ecosystem Studies program



A deep water *Leptoseris*, or plate coral, reef off Maui at ~300 ft depth. These reefs form important habitat for reef fishes.

Holly removes invertebrates from a black coral tree.

Malia, Nick, Adia: How many animals (or how many species) do you expect to find in the deep coral reef?

Ken Longenecker, *Invertebrate Zoologist/ Ichythologist,* ***Bishop Museum***

Lots! I can't even begin to think of a number. This is partly I don't know how well we'll be able to sample. On one dive, we saw at least 56 species of fish, but we know this is an underestimate because we couldn't see the very small species, and on the next day, more species were seen. For another group I'm particularly interested in (amphipods- tiny, shrimp-like animals), I expected to find several dozen species, but we've barely collected a dozen individuals. This may be due to our sampling technique; they may fall off the algae and rubble samples as they are being put into our collecting baskets by the submersible collecting arm. We may need to figure out a better way to collect the little buggers.

Dean, Justin, Riley, Sierra B.: What kind of nutrients do seaweeds live off of in deep water?

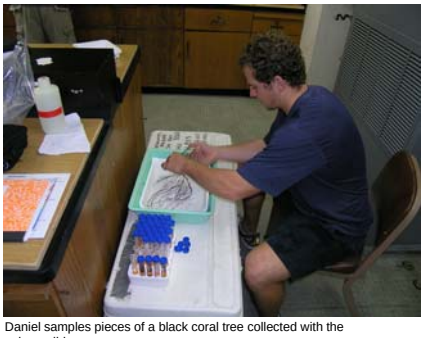
Heather Spalding*, Phycologist (graduate student),* ***University of Hawaii at Manoa, Botany***

Marine algae, or seaweed, like to absorb the same types of nutrients as plants, such as nitrates (especially ammonium) and phosphates. Deepwater algae may be absorbing nutrients from many different sources. If the algae live over soft sediments, then fast-flowing currents can "pump" nutrients out of the sediments and into the water column, thus fertilizing any surrounding algae in a burst of nutrients. There could also be currents coming from deeper water bringing up nutrients, or freshwater seeps that leak out nutrient-rich water from the land. Finding out the nutrient sources for the algae is a major objective of our research. In some areas in deep water, the bottom is COVERED with algae, while other areas only have a little. These patchy patterns of abundance may be linked to different types of nutrient sources, so we're hoping to take different types of measurements from the algae to try and figure this out.

Erik, Yacine, Blaire, Sean: Why is black coral found deep, why is it expensive and worth a lot?

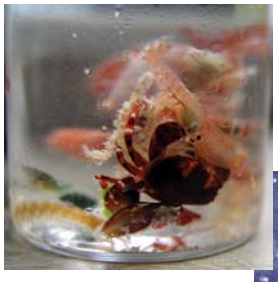
Daniel Wagner*, Oceanographer (graduate student), University of Hawaii at Manoa, Hawaii Institue of Marine Biology*

Black coral is a azooxanthellate, meaning that it does not have symbiotic algae (zooxanthellae) in its tissues. Therefore, it contains all of its nutrients by feeding on zooplankton in suspension as opposed to many other corals that have zooxanthellae and photosynthesize. Consequently, black coral does not require light. In fact, it appears that larvae of black coral move away from light and hence settle in dark areas, such as in caves, or on the deep reef where we have less light. Black coral is expensive because it is difficult and expensive to harvest due to the fact that it grows so deep (up to 125 meters, or 413 feet) in Hawaii. Operations at those depths require submersibles or technical diving, which is also expensive.



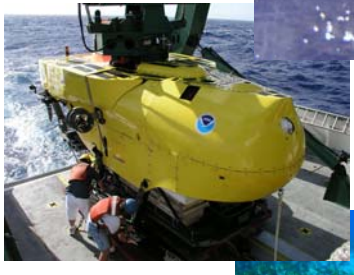
Daniel samples pieces of a black coral tree collected with the submersible.

A team of researchers from the Bishop Museum, Department of Land and Natural Resources, University of Hawai'i, and NOAA's Pacific Island Fisheries Science Center participated in six-day expedition aboard the University's research vessel, *Ka'imikai-o-Kanaloa*. This included a total of five dives using the deep diving submersibles *Pisces IV* and *Pisces V*, operated by the University's Hawaii Undersea Research Laboratory (HURL). While at sea, they participated in the Ask A Scientist At Sea program with Seabury Hall. Back row, left to right, Heather Spalding, Brian Popp, Ken Longenecker, Ray Boland, Holly Bolick, Tony Montgomery. Front row, left to right, Thierry Work, John Rooney, Rich Pyle, Daniel Wagner

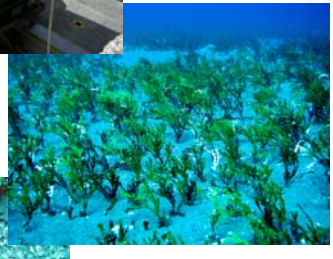


Invertebrates (crabs, polychaetes, and shrimp) collected from deep coral reefs off Maui are stored in sample jars.

A crab found on *Halimeda*, a calcified green alga, in a deep coral reef.



The *Pisces V* submersible can hold up to three people. It weighs 13 tons and has a maximum operating depth of 6,280 ft.



Halimeda kanaloana, a calcified green alga, forms meadows in the sand. It can occur from 10 to 300 ft. depths.

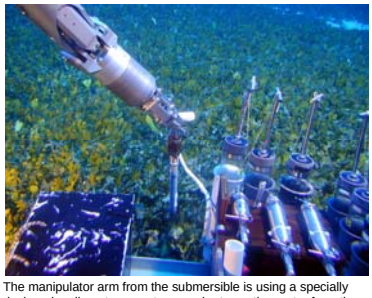
When *Halimeda* dies, it forms calcium carbonate sand. Over time, these little white *Halimeda* flakes will erode into a fine, white sand.

Dr. Kate: What is the major sediment type in the deep water around Maui? Is it terrigenous? What is its origin?

Brian Popp*, Oceanographer, University of Hawaii at Manoa, Geology*

The sediment is mostly carbonate that is formed *in situ*. That is, the sediment is derived from reef organisms. Some benthic algae, such as *Halimeda*, produce calcium carbonate and grow relatively quickly and can result in much sediment. Terrigenous fine-grained materials can also be transported offshore as the mud settles. Certain planktonic algae produce carbonate (coccolithophores) and some small zooplankton make carbonate tests (formanifera), and when they die, they settle and form carbonate sediments.

Deep water plate corals (*Leptoseris* sp.) and algae in a coral reef at ~200 ft.



The manipulator arm from the submersible is using a specially designed sediment porewater sampler to suction water from the sediment in a *Udotea* sp.meadow. *Udotea* is a type of deep water calcified green algae.

Kaipo, Vanessa, Matt: Are there more vertebrates or invertebrates at the bottom of the ocean? (2 answers!)

Holly Bolich*, Invertebrate Collection Manager,* ***Bishop Museum***

Considering total biomass, there would probably be more invertebrates such as coral, sponges, or other cryptic (hidden) species living on the substrate (ocean bottom), such as hydroids, crabs, marine worms, tunicates, etc. There are lots of invertebrates down there, and you often don't even realize it until you look a little closer or peer through a microscope.

Rich Pyle*, Ichthyologist/Database Manager,* ***Bishop Museum***

In any environment (including all parts of the sea), there are always going to be many more invertebreates than there are vertebrates. There are probably about 60,000-70,000 species of vertebreates on earth, about half of which are fishes. This sounds like a lot, but there are somewhere between 10-50 MILLION species of invertebreates! That's a LOT more! Many of these invertebrates are very small (this is particularly true of the ones that live in the sea), so you don't notice them as much. If you look at a picture of a coral reef, for example, often the first thing you notice are schools of hundreds or thousands of fishes swimming about. But even though these fishes are very conspicuous, they are just the "tip of the iceberg" of what's down there. All the corals are invertebrates, and in and among the corals are sponges, crustaceans (shrimps, crabs, lobsters, etc.), mollusks (snails and slugs), many different kinds of worms, and many, many other kinds of organisms – all of which are invertebrates. Even the sand and sediment is literally crawling with invertebrates – some that you can see, but many, many more that are microscopic.

Sierra A., Sam, Chris: What classifies coral as coral? (2 answers!)

Thierry Work*, Pathologist, United States Geological Service*

A coral is related to things like jellyfish. As you know, what makes jellyfish unique is their stinging cells (those are the parts of the animal that hurt when it touches you). Like jellyfish, corals too have stinging cells. What makes corals unique is that they make a stone-like skeleton (hence, unlike jellyfish, they don't move around much).

Tony Montgomery*, Aquatic Biologist, Department of Aquatic Resources, DLNR*

All organisms are assigned to different groups and classified based on the biology and how its biology relates to other organisms. Corals belong to the phylum Cnideria, and have a tremendous amount of variation in size and structure. Most corals are known to be colonial, meaning the corals consist of thousands to millions of individual polyps. Each polyp is an individual animal, but they are all connected. A few corals have only one polyp and are known as solitary corals. Some corals form large, hard reefs while others are soft.

Left: Heather holds a pea-sized green alga called *Codium mamillosum*. *Right:* Tony poses with a black coral tree just collected with the submersible.