

Land-ocean connections

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The top panel shows the Pisces V submersible being deployed in Pelekunu Submarine Canyon, near Kalaupapa peninsula on Moloka'i, Hawaii. The bottom panel shows the most abundant fish in the study area, *Chlorophthalmus* sp. Credit: Top: F.C. De Leo. Bottom: Hawaii Undersea Research Laboratory.

Scientists from the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii - Manoa (UHM) and colleagues recently discovered that land-based plant material and coastal macroalgae indirectly support the increased abundances of bottom fish in submarine canyons, like those off the north shore of Moloka'i. Less than a few miles from the shore, these underwater canyons connect to deep river valleys that cut across the landscape of north Moloka'i.

The high elevation and forested landscapes along Moloka'i's north shore provide plant material, including decomposing tree trunks, leaves and tons of kukui nuts, which enter the ocean via river valleys and 'pile up' on submarine canyon floors. "In areas surrounded by very low productivity waters, this steady supply of organic matter to the

canyons supports relatively high abundances of macro-invertebrates that live associated with the seafloor (either on top or in the top layers within the sediments), such as polychaete worms (related to earth worms), tiny crustaceans (amphipods, tanaids and isopods) and mollusks (like tiny clam- and snail-like creatures). Those invertebrates in turn serve as food for many fish species that live and feed near the seafloor," says Fabio De Leo, lead author and PhD candidate at the UHM Department of Oceanography. "Areas surveyed outside the canyons showed very little contribution of plant and macroalgae material, providing support for our hypothesis that this material is really being channeled and accumulates mostly in the steep topography of the submarine canyons (i.e., a 'canyon effect')," completes De Leo.

De Leo, his PhD advisor (Dr. Craig Smith), colleagues from SOEST (Dr. Jeff Drazen), from the Hawaii Pacific University (Dr. Eric Vetter), and from the New Zealand National Institute of Water and Atmospheric Research (Dr. Ashley Rowden) used manned submersibles operated by the Hawaii Undersea Research Laboratory to perform numerous video transects in two submarine canyons off Moloka'i at depths ranging from 350 to 1,050 m (~1,000 to ~3,000 ft). Equipped with high-definition cameras and powerful light strobes the submersibles flew above the seafloor to quantitatively assess the presence of plant and macroalgae material and to count and identify all fish species (see Figure). This was among the first studies to quantitatively survey fish assemblages deeper than ~350 m around Hawaii, gathering more than 13 hours of video altogether. Among the most abundant species found were the so-called 'rattail' fishes (family Macrouridae) and the 'eel-like' fishes (synbranchids and halosaurs). Giant shark specimens were also observed but only when the submersible was stationary and not during the video transects. Therefore, that species was not included in the quantitative analysis. De Leo narrates how scary it was when he got 'face - to-face' with a 10-foot 'sixgill shark' with only the submersible's porthole separating his from the

shark's nose, as the giant approached the submersible and hit the thick glass window with its face. "Wow, it was definitely a nerve-wracking sensation. I even dropped my video camera while trying to make good footage of the beast".

The researchers also report some unexpected results. They found that this 'canyon effect' of enhancing fish abundances is obliterated at intermediate depths (around 650 m) coinciding exactly with the core of an oxygen minimum zone (OMZ) that flows around the Hawaiian archipelago around those depths. An OMZ is a layer of seawater usually at subsurface that has depleted oxygen concentrations due to several biological and chemical processes, including excess respiration by microbes. This may be indicating that the bottom fish species are somewhat sensitive to the low oxygen concentrations in the water. This result corroborates previous studies that found low abundances and diversity of deep-sea scavenger animals at similar depths around Hawaii. "The expansion of OMZs in different parts of the oceans is of great concern among oceanographers, and it is thought to be one of the main effects related to climate/ocean warming". De Leo attended the annual Ocean Sciences Meeting in Salt Lake City last week and reports that the expansion of these low oxygen ocean layers was one of the hot topics discussed at the meeting. "We should definitely keep track of near future and long term effects of expansion of low oxygen zones and how this will affect a variety of marine organisms, including fish."

In hopes of understanding what other factors lead to an increase in the number and diversity of marine animals inside these abrupt topographic features, De Leo and colleagues are analyzing data on the abundance and diversity of macro-invertebrates that live associated with the seafloor in six other submarine canyons around Hawaii. There is an increasing body of evidence that suggests that canyons are a special type of topographic feature in the seafloor no matter in what oceanographic background they are located (i.e., highly productive continental margins or in a low productivity setting, such as an island margin like Hawaii). "With the goal of protecting ecologically important habitat and preserving biodiversity, this information is crucial when

performing marine spatial planning and designing networks of Marine Protected Areas," says De Leo.

More information: Deep Sea Research Part I: Oceanographic Research Papers: The effect of submarine canyons and the oxygen minimum zone on deep-sea fish assemblages off Hawaii, dx.doi.org/10.1016/j.dsr.2012.01.014

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