Deep-sea crabs grab grub using UV vision

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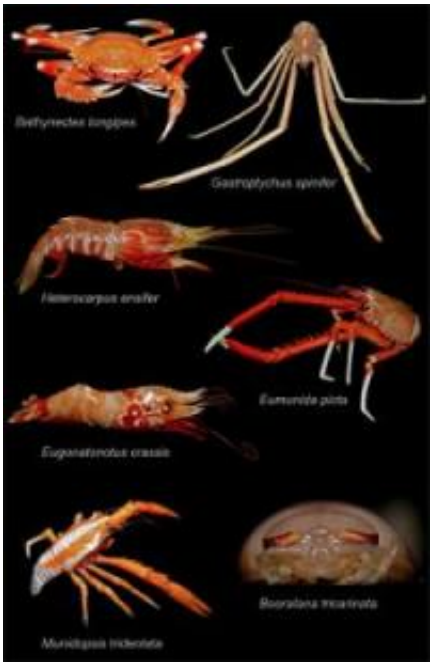

A montage of the deep-sea crustaceans tested for UV vision. Image courtesy of: Sönke Johnsen, Duke

(Phys.org)—Crabs living half-a-mile down in the ocean, beyond the reach of sunlight, have a sort of color vision combining sensitivity to blue and ultraviolet light. Their detection of shorter wavelengths may give the crabs a way to ensure they grab food, not poison.

"Call it color-coding your food," said Duke biologist Sönke Johnsen. He explained that the animals might be using their ultraviolet and blue-light sensitivity to "sort out the likely toxic corals they're sitting on, which

glow, or bioluminesce, blue-green and green, from the plankton they eat, which glow blue."

The discovery explains what some deep-sea animals use their eyes for and how their sensitivity to light shapes their interactions with their environment. "Sometimes these discoveries can also lead to novel and useful innovations years later," like an X-ray telescope which was based on lobster eyes, said Tamara Frank, a biologist at Nova Southeastern University. She and her collaborators report their findings online Sept. 6 in the Journal of Experimental Biology.

Frank, who led the study, has previously shown that certain deep-sea creatures can see ultraviolet wavelengths, despite living at lightless depths. Experiments to test deep-sea creatures' sensitivity to light have only been done on animals that live in the water column at these depths. The new study is one of the first to test how bottom-dwelling animals respond to light.

The scientists studied three ocean-bottom sites near the Bahamas. They took video and images of the regions, recording how crustaceans ate and the wavelengths of light, or color, at which neighboring animals glowed by bioluminescence. The scientists also captured and examined the eyes of eight crustaceans found at the sites and several other sites on earlier cruises.

To capture the crustaceans, the team used the Johnson-Sea-Link submersible. During the dive, crustaceans were gently suctioned into light-tight, temperature-insulated containers. They were brought to the surface, where Frank placed them in holders in her shipboard lab and attached a microelectrode to each of their eyes.

She then flashed different colors and intensities of light at the crustaceans and recorded their eye response with the electrode. From the

tests, she discovered that all of the species were extremely sensitive to blue light and two of them were extremely sensitive to both blue and ultraviolet light. The two species sensitive to blue and UV light also used two separate light-sensing channels to make the distinction between the different colors. It's the separate channels that would allow the animals to have a form of color vision, Johnsen said.

During a sub dive, he used a small, digital camera to capture one of the first true-color images of the bioluminescence of the coral and plankton at the sites. In this "remarkable" image, the coral glows greenish, and the plankton, which is blurred because it's drifting by as it hits the coral, glows blue, Frank said.

That "one-in-a-million shot" from the sub "looks a little funky," Johnsen noted. But what it and a video show is crabs placidly sitting on a sea pen, and periodically picking something off and putting it in their mouths. That behavior, plus the data showing the crabs' sensitivity to blue and UV light, suggests that they have a basic color code for their food. The idea is "still very much in the hypothesis stage, but it's a good idea," Johnsen said.

To further test the hypothesis, the scientists need to collect more crabs and test the animals' sensitivity to even shorter wavelengths of light. That might be possible, but the team will have to use a different sub, since the Johnson-Sea-Link is no longer available.

Another challenge is to know whether the way the crabs are acting in the video is natural. "Our subs, nets and ROVs greatly disturb the animals, and we're likely mostly getting video footage of stark terror," Johnsen said. "So we're stuck with what I call forensic biology. We collect information about the animals and the environment and then try to piece together the most likely story of what happened."

Here, the story looks like the crabs are color-coding their food, he said.

More information: Light and vision in the deep-sea benthos I: Vision in Deep-sea Crustaceans. Frank, T., Johnsen, S. and Cronin, T. (2012). *Journal of Experimental Biology*. DOI: 10.1242/jeb.072033

Light and vision in the deep-sea benthos II: Bioluminescence at 500-1000 m depth in the Bahamian Islands. Johnsen, S., et. al. (2012). *Journal of Experimental Biology*. DOI: 10.1242/jeb.072009

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