Ripple Marks
The Story Behind the Story

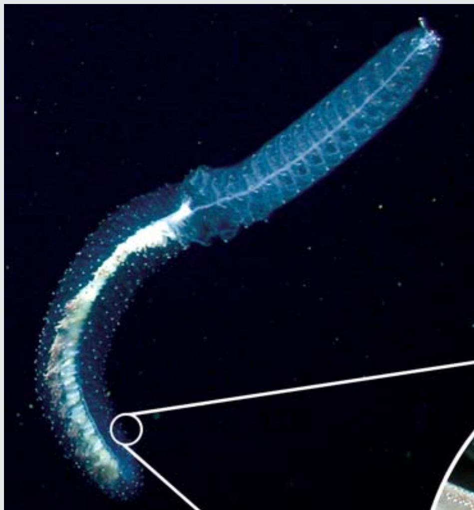
BY CHERYL LYN DYBAS

THE RED LIGHT DISTRICT

THE RED LIGHT DISTRICT IS LOCATED NOT ON A SEEDY SIDE STREET IN A MAJOR CITY, BUT, OCEANOGRAPHERS HAVE DISCOVERED, IN THE DEEP SEA. Animals that live in the sea's abyss produce and perceive red light, contrary to what was the prevailing view among marine biologists: that most deep-sea animals can't detect red light at all.

Research by Steven Haddock of the Monterey Bay Aquarium Research Institute (MBARI) and colleagues Bruce Robison and Kim Reisenbichler, as well as Edie Widder, formerly of Florida's Harbor Branch Oceanographic Institution and now of the Ocean Research and Conservation Association in Fort Pierce, Florida, shows that some deep-sea fishes not only see red light, but use it in locating prey.

As Haddock reports in a paper in the journal *Science* (July 8, 2005), siphonophores—colonial hydrozoans that can reach tens of meters long—in the genus *Erenna* are forcing scientists to take another look at red light in the deep sea. *Erenna* sports thin rod-like structures between its stinging tentacles. These "tentilla" are tipped with red, glowing beads, the better to lure in small deep-sea fish. In looking at *Erenna*'s gut contents, said Haddock, there were enough fish for the siphonophores to survive in a sparsely inhabited environment 2,000 m deep.



This newly discovered deep-sea siphonophore is about 45 cm (18 inches) long. The upper half of the colony moves it through the water. The lower half carries pale white stinging tentacles and red, glowing lures that are used to capture small deep-sea fish. Photo credit: © 2003 MBARI. Close up view of the lures and tentilla. Photo credit: Steven Haddock © 2004 MBARI.

The red lures are on stalks that move up and down, causing them to wiggle like swimming copepods, a typical food of small deep-sea fishes. *Erenna*, it appears, is mimicking copepods so the fish will swim ever closer to the siphonophore's stinging tentacles.

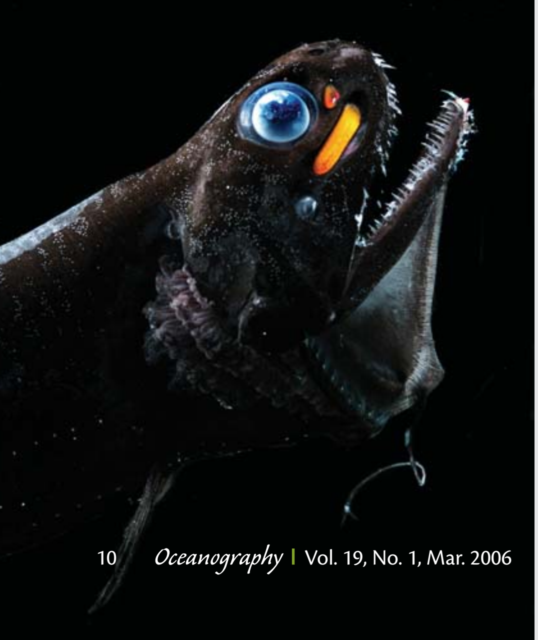
"This is at odds with the prevailing view that deep-living creatures cannot detect these wavelengths," wrote Haddock in *Science*. "However, our knowledge of deep-sea visual abilities is limited."

For *Erenna*'s ruse to work, its fish prey need to perceive red light, said Widder, who has devised a means of testing that ability. She and Robison, Reisenbichler, and Haddock published a paper in the August 2005 issue of *Deep-Sea Research* on use of a camera system called Eye-In-The-Sea (EITS). EITS uses dim red light to study life in the deep sea, including fishes like those *Erenna* catches.

"Our primary means of viewing animals in the deep ocean has required the use of bright incandescent lamps disruptive to the life processes of animals that live there," said Widder. "Animals capable of swimming often flee from the lamps or swarm around them." Sedentary animals shrink back, stopping their normal activities, and animals with sensitive eyes may be permanently blinded.

"To really understand life in the oceans," she believes, "we must find ways to study oceanic communities and populations without modifying their habitat and frightening them with intrusive, artificial lights." On land, this is done with infrared illumination, which is invisible to animals being observed, but visible to infrared cameras recording their behavior. In the ocean, explains Widder, infrared light is attenuated so quickly that observations usually are restricted to distances of less than a few meters.

Pachystomias microdon: one of the very rare dragonfish which were, until recently, the only known marine organisms to produce red luminescence. Photo credit: Edith Widder, Ocean Research & Conservation Association.



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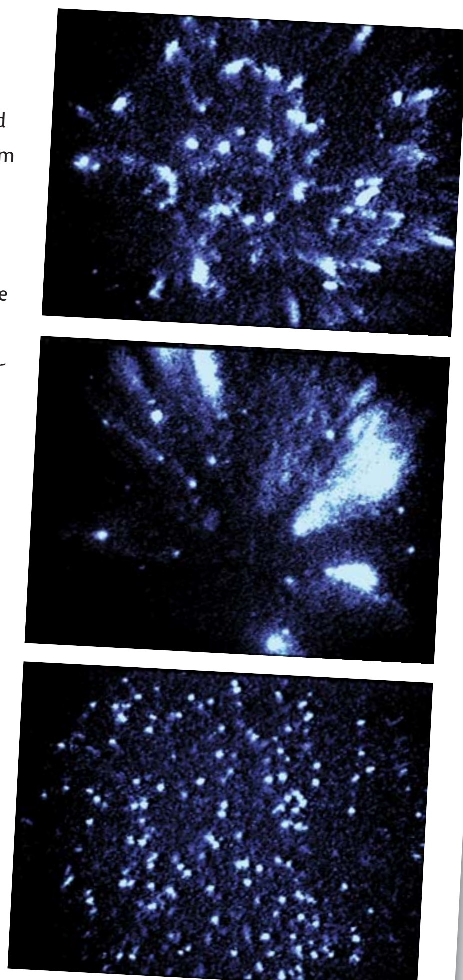
In *Deep-Sea Research*, Widder describes *in situ* observations of fish behavior viewed with far-red illumination combined with low-light-level cameras that can compensate for attenuation losses.

Widder attached a bait box to the EITS camera and lowered it to the depths of Monterey Bay aboard MBARI's remotely operated vehicle *Ventana*. "When we compared the number of 'on camera' appearances of sablefish (*Anoplopoma fimbria*) under red light to those under white light, the number was significantly greater under red light," said Widder. When red light was alternated with white light at 10-minute-intervals, she said, "the fish rushed in when red light was turned on, and then dispersed quickly when we switched over to white light."

The role of red light in marine ecology merits a much closer look, said Widder. "We should use red light," she maintains, "whenever possible to get a better view of deep-sea animals such as fishes." Lurking soundlessly in the deeps, *Erenna* would doubtless agree.



Bioluminescence has been recorded *in situ* using an intensified video camera, focused on a large-mesh transect screen mounted on a mid-water submersible. The spatial and temporal patterns of the light emissions from different organisms are distinctive enough that they can be used to identify and map plankton distribution patterns. The intensified camera records in black and white. These images have been colorized to match the spectral distribution of the luminescent emissions. In these frames, which were recorded in the Gulf of Maine, the field of view is 1 m across. In the top image, small clouds of light are produced by the copepod *Metridia lucens*, which releases its luminescent chemicals into the water to distract a predator as it escapes. A similar strategy is used by the ctenophore *Euplokamis* sp., which releases large clouds of luminescent particles into the water as seen in the middle image. Bioluminescent dinoflagellates, which are the dominant source of luminescence seen in the bottom image, are recognized by their small short flashes. In this case, based on samples collected during the submersible transect, these displays were identified as the dinoflagellate *Protoperidinium depressum*. Courtesy of Edith Widder, Ocean Research & Conservation Association.

Barnacle larvae in ice. Photo credit: Jesús Pineda, Woods Hole Oceanographic Institution.

UNEXPECTED CATCH

NEW ENGLAND INTERTIDAL ZONE SERVES UP UNEXPECTED CATCH

Q: Why did the barnacle settle on ice?

A: To establish a population where few other species could succeed. (Or might want to.)

As biological oceanographer Jesús Pineda of the Woods Hole Oceanographic Institution and his colleagues discovered, living on sea ice is no joke for barnacles of the species *Semibalanus balanoides*. Like anywhere on a crowded planet, the key to happy homeownership is location, location, location.

In the winter of 2003, Pineda's research associates Claudio DiBacco and Vicke Starczak braved the elements to take seawater samples along Rhode Island shores. In the frozen New England waters, they found unexpected life: barnacle larvae embedded in intertidal ice.

The researchers later placed the barnacle larvae in (comparatively warm) water, where the larvae revived, swam around, and eventually reproduced. "Ice was always thought to be an obstacle to any larva that didn't find its niche before winter set in," said Pineda. "As far as we were concerned, that larva was a goner. Clearly we have to do some rethinking."

Tiny drifting larvae of marine animals like barnacles hitch a ride on the ocean's currents and tides, eventually arriving somewhere they can settle down and mature into adults.

Semibalanus balanoides, an abundant and