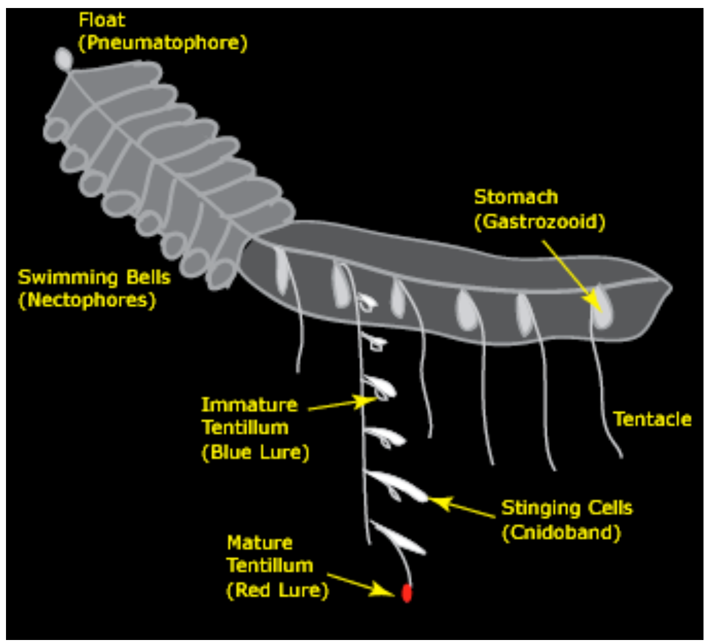
The Angler Jellyfish

Of all the luminous organisms in the sea, only a few have been known to make red light. These fishes are described on another page. Recently, a siphonophore has been discovered which uses small red "lures" to attract prey. You can read the original paper or news reports elsewhere, but this page is intended to answer some of the more confusing aspects of this discoveries and give some of the story behind the story.

So what *is* a siphonophore?

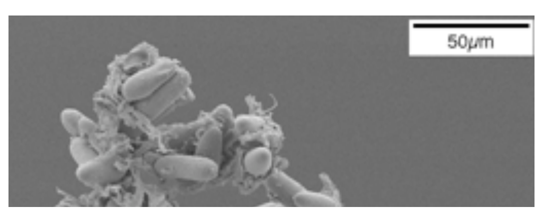
Siphonophores are in the phylum Cnidaria, which includes corals (Anthozoa), and the familiar "true" jellyfish (Scyphozoa). Siphs (as they are sometimes called) are within the Hydrozoa, which includes hydroids that grow on rocks, as well as the small and transparent jellies called hydromedusae. They are not, as some might tell you, colonies of single-celled organisms, nor do they "come together" to form a colony. There is a more thorough discussion of their coloniality at siphonophores.org, but for our purposes, it is easiest to consider them as a single "superorganism", which grows by budding off specialized polyps and medusae. (Coloniality comes in when you consider the polyps as individuals.) Each type of polyp has a special function, including feeding, buoyancy, propulsion, and reproduction.



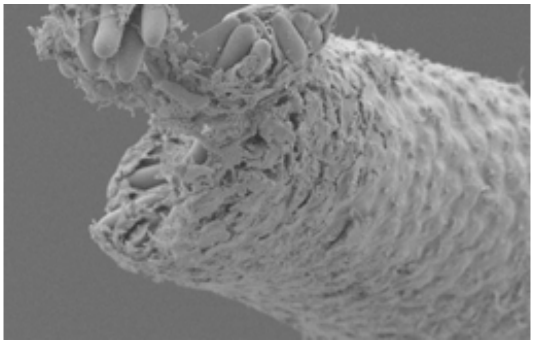
Siphonophore Feeding

Of special interest here are the feeding polyps, known as gastrozooids. In the genus *Erenna*, each gastrozooid has a tentacle which branches off of it from the base. This tentacle, in turn, has side branches called tentilla, which hold the stinging cells.

Most siphonophores catch prey by putting out their long tentacles and waiting for something to bump into their tentilla. Think of a spider web which is also laced with stingers. However, siphonophores like *Erenna,* especially the new species in



question, don't seem to follow this same mode of operation. When seen from a submersible, this one species holds its tentacles close to its body. On the face of it, this would not seem to be an efficient feeding strategy.



What makes this species more unusual is that it is known to feed only on fish, and it lives more than 1600 meters deep, where fish and other organisms are relatively scarce. So without a web, how does it catch its food?

The trap is set

A clue is found in the arrangement and "behavior" of the tentacle side branches. The side branches include a large battery of stinging cells attached to a central stalk. Several examples of these are shown at the right. At the end of the transparent stalk is a red "lure" which starts out small with a white center. The white material consists of bioluminescent material. As the small lure matures, it gets larger and the white material becomes surround by red fluorescent material.

Based on the emission and excitation spectra of this red substance, blue light emitted at the center of the lure would be expected to excite the fluor and produce orange-red light. This wavelength of light is very unusual in the ocean for two reasons. One is that it doesn't penetrate very far: meters or several centimeters rather than tens of meters. Because red light is rare, it is not surprising the the eyes of deep-sea organisms have only rarely been found to be sensitive to red light.

The lures are not just capable of producing light, but the transparent stalk also contracts rapidly to flick the lure. This behavior is eerily similar to the motion of many deep-sea copepods. Often they are seen to do a "hop and sink" behavior where they alternate between rapid jumps and slow sinking behavior. If a copepod-eating fish were able to see the motion of the lure, it would almost certainly be a tempting target!

Red menace?

For a jellyfish to have a lure is unusual enough; only anglerfish and a few squid have been suspected to use luminescence as a lure in the sea. But because so few fish see red light, there is additional resistance to the idea of a jelly using long-wavelength light in its luminous lure.

The most likely target species for this deep-living siphonophore are small (few centimeter long) bristlemouth fish in the family Gonostomatidae. Because the deep sea is so vast -- about 10x larger than the next-largest habitable volume -- the most common of these fish, *Cyclothone,* is probably the most common vertebrate on the entire planet. Despite its abundance, its visual pigments have never been measured; their eyes are extremely small and they are too fragile for many deep-sea trawling operations. If any fish were to "slip through the cracks" of our scientific knowledge and have a hidden ability to see red light, then *Cyclothone* would be a great candidate.

Even if we accept that this ability might go undetected, this still leaves the question of why a deep-sea fish would need to detect red light. One possibility is that it is using the ability to detect prey. Red fluorescent material, especially derived from plant chlorophyll, is common in the ocean, including the deep sea. Marine snow from more than 2000m deep still produces red fluorescence when illuminated with blue light. (If you don't understand the difference already, be sure to read the explanation of fluorescence vs. luminescence on the chemistry pages.) With a yellow filter in their eye, or visual pigments able to distinguish short and long wavelength light, a fish would see anything red as a conspicuous target over short distances. Light to excite fluorescence would have to come from ambient blue light (at shallower depths) or from bioluminescence itself.

Conclusions

The use of a dim red lure in the deep sea is almost impossible to observe undisturbed. Any illumination would obviously affect the visual environment, and a low-light camera would be hard pressed to find these rare siphonophores, let alone document a feeding event. Nonetheless the most conservative interpretation of the evidence seems to be that this jelly dangles red lures to attract its prey. If more specimens can be obtained, there are many avenues for further study of this special function of bioluminescence.

References and Additional Reading:

Haddock, S.H.D., C.W. Dunn, P.R. Pugh. and C.E. Schnitzler. (2005) Bioluminescent and red-fluorescent lures in a deep-sea siphonophore. *Science.* 309: 263.[PDF]

Pugh, P.R. (2001) A review of the genus *Erenna* Bedot, 1904 (Siphonophora, Physonectae). *Bull. Nat. Hist. Mus. (Zoo. Ser.)* 67: 169-182. [PDF]

Douglas, R.H., J.C. Partridge, and N.J. Marshall (1998) The eyes of deep-sea fish. I: Lens pigmentation, tapeta and visual pigments. *Prog. Ret. Eye Res.* 17: 597-636.

Douglas, R.H. and J.C. Partridge (1997) On the visual pigments of deep-sea fish. *Journal of Fish Biology* 50:68-85.