

THINGS THAT GLOW IN THE WATER AT NIGHT

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Have you ever been out on the water at night and observed the water glowing? The glow may be shades of blues or greens and seem to occur when the water is disturbed by anything from a moving fish to a paddle swept through the water. Many people have observed this phenomena and they often wonder:

Q: What's causing this glow?

A: The glow is caused by bioluminescent producing plant and animal organisms (micro



This blackdevil angler fish, *Melanocetus johnsonii*, has a luminescent lure that she uses to attract prey and to identify herself to potential mates. Image courtesy of Edith Widder/HBOI



Bioluminescence caused by dinoflagellates. Image: University of Maryland

yes, however, macro too). Many forms of life produce bioluminescence including small single celled bacteria, dinoflagellates, diatoms, copepods and comb jellies just to name a few. Bioluminescence is the term used to describe light generated by living organisms. The glowing light is often the result of

bioluminescent dinoflagellates (a phytoplankton or drifting algae), although zooplankton (drifting animals) could also be the cause. In Florida one of the most common bioluminescent species is *Pyrodinium bahamense*, which is common throughout the Caribbean.

Q: What causes these organisms to glow, and how does it benefit them?

A: Bioluminescence was once thought to be produced by the friction of salts or by the element phosphorus in the water. Today we know that certain animals possess light producing organs called photophores and glands that emit light through a chemical reaction which involves a light producing protein called luciferin. Luciferins store energy. This energy is released in the form of photons, or light, by enzymes called luciferases.

The reasons for these bioluminescent displays are varied. Some organisms bioluminate to attract a mate as is the case in fireflies. Others bioluminate to attract prey. An example of this would be the anglerfish which dangles its glowing lure to attract potential prey.

In the case of dinoflagellates, bioluminescence is used to evade predators and acts as a

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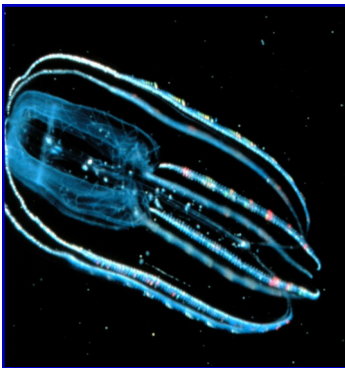
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defense mechanism. It is believed that dinoflagellates produce light when disturbed and will give a light flash lasting a fraction of a second. The flash is meant to attract a predator to the creature disturbing or trying to consume the dinoflagellates. The light flash also surprises the predator causing it to worry about other predators attacking it, making the predator less likely to prey on the dinoflagellate.

Q: Are there other phenomena that can cause similar effects? For example, what about high levels of phosphorus in the water?

A: Phosphorus in the water by itself does not produce a glowing effect; however, high concentrations of nutrients and in particular phosphorus would increase the population of dinoflagellates. Although most glows in the water are the result of bioluminescence, some organisms have the ability to fluoresce. Fluorescence is similar to bioluminescence but the trigger is changed. Instead of luciferin and luciferase, fluorescence is triggered when a pigment absorbs light from an outside source. Fluorescence is able to produce the widest spectrum of colors because the emitted color is determined by the fluorescent pigment which absorbs the incoming light. In the case of fluorescence, the emitted light is only visible while the trigger is present. Phosphorescence



Lobate ctenophores (comb jellies) are translucent and give off a bioluminescent glow. *Bolinopsis infundibulum*. Picture: OAR/National Undersea Research Program (NURP) High resolution (Credit: NOAA)

is similar to fluorescence except that the excited product is more stable, so the glow will last after the trigger has been removed. Glow in the dark stickers phosphoresce.

Q: Are there any harmful effects to other marine life, or that anglers and boaters should be concerned about? Is it OK to eat fish caught from areas where the water is glowing?

A: Luminescence does not pose a health issue, but some bioluminescent species can produce toxins, including Pyrodinium bahamense. These toxins can be bioaccumulated in the food web. The specific threat to health varies between ecosystems. It's important to note that dinoflagellates comprise a very large group of approximately 2000 different species and of these only a very small percentage are toxic. Dinoflagellates are important primary producers. They fuel food webs, providing food for zooplankton, which feed small fish and so on. It is said that phytoplankton produce most of the earth's oxygen.

Q: Why does the glow seem to be most prevalent in summer, and why is the glow sometimes very bright and intense, other times very muted?

A: You might see increases in summer months because this could correspond to when these bioluminescent organisms are reproducing (natural life cycles), or because summertime is when we have increased freshwater runoff from rains, resulting in more nutrients being flushed into the system, which in turn can lead to more blooms of these organisms. As far as intensity of the glowing, the intensity of the bioluminescence depends on the intensity of the bloom and the health of the algae in the bloom.