

EXPLORATION NOTES Bioluminescence



Lights in the Dark: New Tools in the Search for Bioluminescence

Expedition: [Galapagos Platform](#)

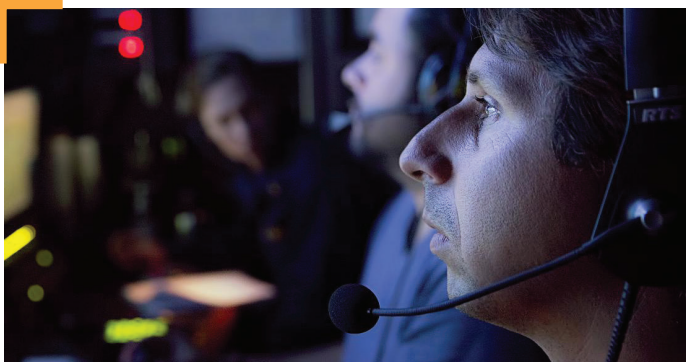


By [Ariel Zych](#) and the Ocean Exploration Trust team

Complete blackness greeted the viewers of *Nautilus Live* for a time during an Ocean Exploration Trust [Galapagos Expedition](#). All the lights on the remotely operated vehicles (ROVs) *Hercules* and *Argus* were turned off. Members of the exploration team searched the ocean with a new tool: a low-light camera capable of detecting bioluminescence. After sending two brief, bright flashes into the darkness, one of these filming sessions returned [exciting footage of bioluminescence in a marine worm](#).

ROVs *Hercules* and *Argus* both had multiple cameras aboard, but they were not sensitive enough to detect the ocean's dimmest light sources. "I'm interested in looking at everything, and this camera is the truest way that we can measure low light in the ocean," said researcher [Brennan Phillips](#). Phillips worked with Vincent Pieribone at the J.B. Pierce Laboratory at Yale University to adapt the camera for use with ROVs hoping to find new, unique examples of bioluminescent organisms.

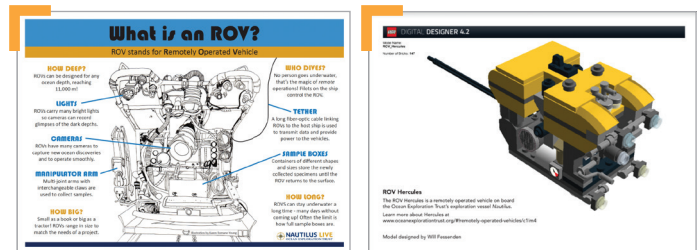
Bioluminescence is light created and emitted by living organisms. The light emitted by organisms is created by a chemical reaction involving a special molecule called luciferin. The reaction results in the emission of photons (light energy). Bioluminescent organisms can be easily observed at the surface of the ocean and researchers have found them at depths of over 2,500 meters. However, little is known about the diversity of bioluminescent organisms and the wavelengths of light they produce.



Phillips, exploring the deep with specialized technology. *Image courtesy of Ocean Exploration Trust - Nautilus Live.*



With ROV *Hercules*, Ocean Exploration Trust has surveyed ancient shipwrecks, discovered hydrothermal vents, and helped to identify new marine species. *Image and video courtesy of Ocean Exploration Trust - Nautilus Live.*



ROV explainer graphic and LEGO Brick ROV *Hercules* Design Challenge. *Images courtesy of Ocean Exploration Trust - Nautilus Live.*



Bioluminescence in Monterey Bay

The shores of Monterey Bay illuminated by a bioluminescent plankton bloom that ignited the waves with blue flashes of brilliance. *Video courtesy of Monterey Bay Aquarium.*



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Lights in the Dark

Pieribone and Phillips have explored different regions of the ocean searching for bioluminescence at different wavelengths and intensities for possible future biomedical uses. For example, the proteins that cause bioluminescence can be used to visualize gene expression in living tissues.

Scientists are now working to identify a broader range of bioluminescent (and fluorescent) proteins to advance the field of gene expression visualization. "Different wavelengths allow for different tissues to be visualized. Finding new frequencies, or colors, of bioluminescence will give biomedical researchers more tools to work with," says Phillips. "If we can find proteins that have other wavelengths, these researchers could create non-invasive imaging tools that could be embedded in a person – we could create signaling proteins deep within a person's body." This could be a powerful diagnostic tool, and possibly reduce the need for some surgeries or procedures currently used to examine the inside of the body.

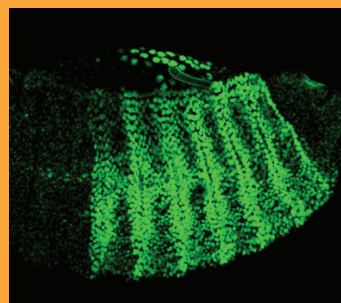
The first step to finding these new frequencies is to search diverse ocean habitats for bioluminescent organisms and measure the wavelengths of light they produce. Phillips has taken the low-light camera on several different cruises to look for new organisms including the waters off New England and the Solomon Islands.

The hydrothermal vents near the [Galapagos Islands](#) also piqued his interest because vent bacteria have been found to have genetic sequences that code for luminescing protein. But a question was, do they actually produce light? After a few dives, Phillips was still unsure. The camera observed a single bright dot at a vent chimney, which was encouraging. "I'm not trying to collect the animals, I'm more interested in demonstrating that the camera can accurately measure levels of light," Phillips said. "I was hoping to match light measurements from the actual vent with images of the bioluminescent animals that might be there. This is very hard to do, since you have to turn off all of the lights to see bioluminescence, but very often you can't see the whole animal that's making the light. We're still figuring out the right way to do this," Phillips said.

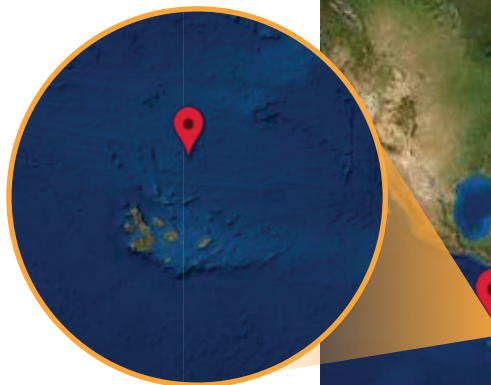
For more, [take a look behind the scenes](#) as Dr. Brennan Phillips describes how low-light cameras are tested to capture the light of bioluminescent animals.

LEARN MORE

A green fluorescent protein is already used for visualizing gene expression in living tissues. The protein was first found in the jellyfish *Aequorea victoria*. The protein is so often used that its discoverers, Roger Tsien, Osamu Shimomura, and Martin Chalfie, earned a Nobel Prize.



Green fluorescent protein, used for visualizing gene expression in living tissues. This image is of a fruitfly embryo. Image courtesy of Ocean Exploration Trust - Nautilus Live.



The Galapagos Islands, off the coast of Ecuador, was the site of this expedition. In 1835 Charles Darwin visited the islands aboard the HMS *Beagle*. Image courtesy of Ocean Exploration Trust - Nautilus Live.



Original blog: <https://nautiluslive.org/blog/2015/07/21/lights-dark-new-tools-search-bioluminescence>

Expedition: <https://nautiluslive.org/cruise/na064>

Explorer (bio): <https://nautiluslive.org/people/ariel-zych>

Bioluminescence in a marine worm (video on webpage): <https://nautiluslive.org/blog/2015/07/21/lights-dark-new-tools-search-bioluminescence>

ROV *Hercules* (image): https://nautiluslive.org/sites/default/files/styles/responsive_image_xl/public/images/2019-04/rov_herc_on_crane.jpg?itok=A8Y6uWUjv

ROV Explainer Graphic (poster): <https://nautiluslive.org/resource/rov-explainer-graphic-poster>

LEGO Brick ROV *Hercules*: <https://nautiluslive.org/resource/lego-brick-rov-hercules>

Brennan Phillips (image): https://nautiluslive.org/sites/default/files/styles/responsive_image_xl/public/images/2015-07/brennan_phillips.jpg?itok=0jABdJc9

Bioluminescence (video): <https://www.youtube.com/watch?v=HKsG94ZxmGM>

Green fluorescent protein (photo): https://nautiluslive.org/sites/default/files/styles/responsive_image_xl/public/images/2015-07/stage-14_drosophila_embryo_expressing_abda_and_exd_both_fused_to_one_half_of_the_fluorescent_protein_venus_-_journal.pbio.1001349.g001.png?itok=tVfNl5fv

Galapagos Islands cruise (map): <https://nautiluslive.org/cruise/NA064>

Low Light Camera Captures Bioluminescent Animals (video): <https://nautiluslive.org/video/2018/01/23/low-light-camera-captures-bioluminescent-animals>