[Coral Reef Wall Hotspots]

Warteye stargazer (*Gillellus uranidea*) –

The warteye stargazer spends most of its time hiding in the reef or under the sand. By fluorescing red light that predators can’t see, fishes like the warteye stargazer can potentially send secret messages to each other without attracting the wrong kind of attention.

Atlantic blue tang (*Acanthurus coeruleus*) –

As the name implies, adult Atlantic blue tangs are blue—but the larval fish are actually yellow. The green glow of the larvae matches the color of water as seen by predatory fishes, so larval forms of fishes like the Atlantic blue tang could use their fluorescence to hide against the ocean background.

Atlantic lizardfish (*Synodus saurus*) –

The Atlantic lizardfish looks almost identical to other species of lizardfish living in the Caribbean. However, each species has a distinctive fluorescent pattern, so it’s possible that the fish use the glowing patterns to recognize potential mates.

Spotted scorpionfish (*Scorpaena plumieri*) –

A fierce predator, the spotted scorpionfish has a green glow around its eyes that may help it catch even more prey. Many fishes find glowing lights very attractive, so the spotted scorpionfish may use its green glow as a fishing lure to draw in unsuspecting victims.

Mountainous star coral (*Montastraea faveolata*) –

The mountainous star coral serves as a home for microscopic dinoflagellates, which provide the coral with nutrients in exchange for a place to live. Unfortunately, these dinoflagellates produce poisonous oxygen molecules as a waste product. Fluorescent pigments could process the poisonous oxygen waste, providing a benefit to the dinoflagellates.

Massive starlet coral (*Siderastraea siderea*) –

The massive starlet coral shelters microscopic organisms that provide nutrients in return for a place to stay. In their juvenile phase, the microscopic organisms swim around, looking for a coral to call home. The coral’s fluorescence could advertise a particular coral to microorganisms seeking shelter.

Caribbean ricordea rock (*Ricordea florida*) –
The Caribbean ricordea rock is a popular anemone for home aquariums because it grows easily under different conditions. In the wild, the organism is exposed to dangerous ultraviolet (UV) light. By absorbing and defusing the UV light, the fluorescent pigments in this anemone may protect it from damage.

Spotted soapfish (*Rypticus subbifrenatus*) –

Camouflage helps the spotted soapfish avoid predators, but that invisibility becomes a problem when the fish want to be seen. Fluorescence could potentially counteract that camouflage when the fish need to advertise their location, like during the full-moon nights when they mate.

The spotted soapfish get its name from the poisonous mucus the fish secrete when threatened. Throughout nature, colorful patterns often advertise the presence of poison, telling would-be predators that an animal won't make a tasty meal—and might even be harmful. The spotted soapfish's fluorescent display could serve to warn away predators.

False moray (*Kaupichthys hyoproroides*) -

Before accidentally wandering into photos taken for this exhibit, no one knew that false moray eels fluoresced. Even more surprising, every part of the eel, from the skin to the muscles to the organs, glows green. Upon further investigation, Museum scientists John Sparks and David Gruber discovered that eels are the only fishes known to fluoresce inside and out.

Yellow stingray (*Urolophus jamaicensis*) –

American Museum of Natural History (AMNH) scientists made a number of discoveries while working on this exhibit. When photographing a yellow stingray for Creatures of Light, researchers recorded the first example of fluorescence in rays.

Harlequin bass (*Serranus tigrinus*) -

Camouflage helps the harlequin bass avoid predators, but that invisibility becomes a problem when the fish want to be seen. Fluorescence could potentially counteract that camouflage when fishes need to advertise their location, like during the full-moon nights when many species mate.

Pink burrowing sea anemone (*Phyllactis praetexta*) –

The pink burrowing sea anemone glows different colors on different parts of its body. Although no one knows for sure why the anemone glows in this pattern, the similarity to patterns seen in flowers and insects means the fluorescent coloration might provide visual cues to other creatures on the reef.
Lamark’s sheet coral (*Agaricia lamarcki*) –

Sheet coral gets its name from its very thin structure. A delicate coral, sheet coral has a limited ability to deal with high temperatures and other kinds of stress. As the warm periods of Caribbean water get longer, these corals face a serious environmental challenge.

Lettuce coral (*Agaricia agaricites*) –

Like many other corals, lettuce coral use microscopic organisms to produce nutrients. Unlike other corals, those microorganisms only live in one area in the coral. That happens to also be the only part of the lettuce coral that glows, with the fluorescence protecting the microbes, attracting them or both.

**[WHAT IS FLUORESCENCE SLIDE]**

**WHAT IS FLUORESCENCE**

Bioluminescence is not the only way to glow; some creatures use fluorescence instead.

While bioluminescent creatures make light through a chemical reaction, fluorescence involves special pigments that make low-energy light out of high energy light.

Oxygen

Luciferin

Luciferase

In fluorescence, pigments become excited when they absorb high-energy light, such as ultra violet light.

UV Light

Pigment

When the pigments calm down, they release the left over energy as low energy light.

UV Light

Low energy light

Pigment
Since light fuels fluorescence, fluorescent pigments only glow when they are under high energy radiation-like ultraviolet light.

Rather than emitting the new light right away, some pigments store the energy, and release the lower energy light slowly. This kind of glowing is called phosphorescence.

[Reef Slide Text]
THE REEF

What you see here.

About the reef
Coral reefs are the tropical rain forests of the sea; they contain a greater variety of life than anywhere else in the ocean. American Museum of Natural History scientists focus their attention a particular reef called Bloody Bay Wall, a small section of which is highlighted in this exhibit (see picture above for highlighted section). Due to its unique setting and isolation from tourists, Bloody Bay Wall sports even more diversity than most Caribbean reefs.

Located near the Cayman Islands, Bloody Bay Wall snakes uninterrupted through a mile (1.6 km) of crystal clear water (see map to the left). For scientists this coral wall provides a continuous stream of important, and often unexpected, discoveries in the fields of ecology, biodiversity and medical science.

Research
About 18 feet (5.5 m) underwater, the reef takes a sharp plunge over a sheer cliff, creating a vertical wall of coral that ends in darkness deep below. Bloody Bay Wall’s rare combination of changing depth and extreme diversity allows scientists to perform unique experiments, such as studying how the effects of depth and decreases in light affect life on the coral reef. Additionally, scientists hope they can discover new fluorescent chemicals in the reef’s many glowing creatures for use in medical and biological science.

Meet the Scientists
John Sparks, an associate curator at the American Museum of Natural History, originally came to Bloody Bay Wall to study fluorescence in coral. However, to the surprise of Sparks, he and his colleague David Gruber discovered that a whole range of fish display previously undiscovered fluorescent patterns. Some fish glow very little, whereas others glow from head to tail (and even on the inside). The function of fluorescence in these fishes remains a mystery, and is a major focus of Sparks’ ongoing research.
David Gruber, an assistant professor of biology and environmental science at Baruch College, aims to fill in the gap in scientific knowledge about reef life below 100 feet (30 m) down. By studying coral at such depths, Gruber and his team hope to learn how the form and function of fluorescence varies among corals that receive differing amounts of sunlight because they live at different depths, and how the variation in light level affects the algae that live in the coral.

For Vincent Pieribone, a Yale University neuroscientist, the coral wall is a vast, untapped library of potential medicines. Not only have the creatures on the coral wall evolved solutions to unique biomedical challenges, but their fluorescent chemicals could provide new tools to researchers. Scientists use fluorescent chemicals as markers in many different areas of biology, and Pieribone believes Bloody Bay Wall’s fluorescent creatures could provide an array of similarly important glowing proteins.

**Shooting the Wall**

**Hellemn Bio**

In 1998, photographer Jim Hellemn set out to photograph an entire coral reef wall at a resolution high enough to produce life-sized re-creations. Producing such a large, sharp picture would require assembling many different photos, all with the same lighting and angle, into a giant mosaic. Hellemn couldn’t find any existing equipment that would maintain the same conditions for each picture, so he built a special underwater camera rig himself. The custom mount Hellemn designed at home worked perfectly, allowing him to produce unique photos full of so much detail that even scientists began to take notice.

**How They Shot It**

To capture the hidden fluorescence of Bloody Bay Wall, American Museum of Natural History researchers combined special lights and filters with Hellemn’s custom camera mount. The lights illuminated the reef with the specific kind of blue light needed to produce fluorescence from the creatures on the reef. Then, filters on the camera lens block out the blue light, so the camera captures only the fluorescent light.

**Pieribone Research**

Vincent Pieribone’s laboratory uses the fluorescent proteins found in these corals to invent new sensors that translate the electrical chatter of individual brain cells into tiny flashes of fluorescent light. Visualizing the activity of brain cells lets scientists see how the human brain works at its most fundamental scale, providing insight on the workings of diseases like epilepsy depression and Alzheimer’s disease.

[What Fish See Text]

**WHAT FISH SEE**

[First Slide]
HUMAN VIEW
The colorful reef seen by humans looks totally different to fishes. They can see some things we can’t, and are blind to colors and patterns that stand out to us.

[Second Slide]

PREDATOR VIEW
To predator fishes, many colors appear grey, blue fishes disappear into the background of the sea and red fishes camouflage into the reef.

[Third Slide]

REEF FISH VIEW
Unlike humans, many fishes can see UV light, but cannot see certain patterns. The fishes also see fluorescent patterns that humans can only view with the aid of special lights.

[Help Text]
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Toggle Languages

Touch icons to learn more

Touch & drag

TOUCH & DRAG SCREEN TO EXPLORE

View additional content here

Touch here to toggle between natural and fluorescent views

Click the “Learn” button to access additional content.

Click on the additional content titles to learn more about fluorescence, fish vision and Bloody Bay wall.

Click here to toggle between natural and fluorescent images.

Click on these icons to learn about why different species glow.

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FLUORESCENCE on a Coral Reef