BIOLOGY

WILD AND BIZARRE MARINE LIFE

Emily Crum
NOAA Ocean Exploration

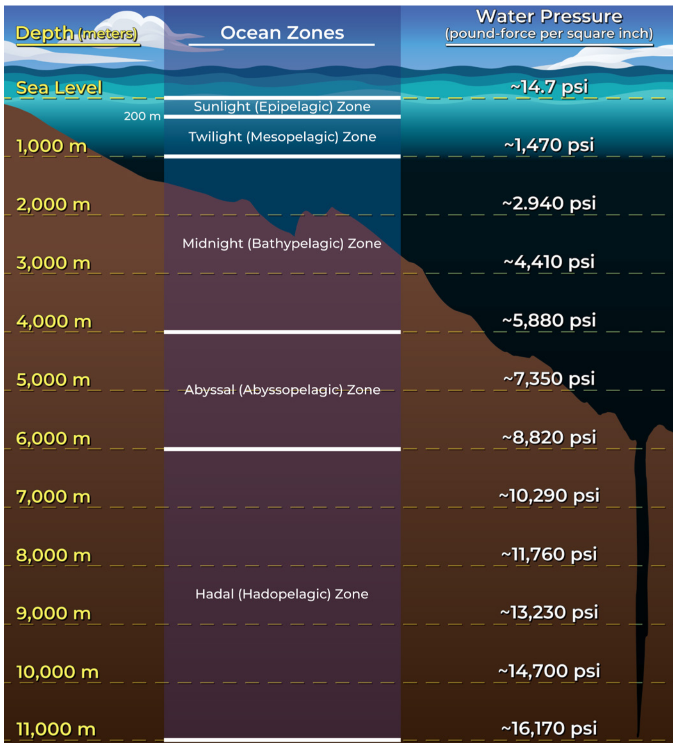
Imagine a world that is encased in darkness and freezing cold, where pressures are crushing and food is scarce. While it may sound like a different planet, these extreme conditions are what animals face in the deep ocean here on Earth.

As you travel from the surface of the ocean downward to the seafloor, the environment changes. Water pressure increases by one atmosphere (or 14 lb of force per square inch) for every 10 m (32.8 ft) of depth. At the deepest point in the ocean, located at a depth of over 11,000 m (6.8 mi) at the bottom of the Mariana Trench, the water pressure is a crushing eight tons per square inch, or about a thousand times the standard atmospheric pressure at sea level. That's a lot of pressure!

> **In the deep ocean, at depths below 200 m (656 ft), sunlight is absent and the only light comes from the organisms themselves. In a world of near complete darkness, deep-sea animals cannot rely on vision for things such as feeding, avoiding being eaten, or mating. Also, without sunlight, photosynthesis — the process by which plants make food—is not possible.**

This contributes to a general scarcity of food in the deep ocean and thus a lower overall density of animals. The lack of light at depth also means that it is very cold: below about 200 m (656 ft) depth, ocean waters have an average temperature of only 39°F. While these conditions are far too hostile for humans, consider that the deep ocean is an enormous living space, larger than any other habitable part of our planet. So perhaps what seems extreme to us is really the norm for the rest of our planet, and it shouldn't come as a surprise that animals in the deep ocean have not only found ways to survive, but also to thrive.

Let's meet some of the wild and bizarre marine life of the deep ocean.



Pressure in the ocean increases with depth. On the flip side, light decreases with depth as you travel through the zones of the ocean, with sunlight rarely penetrating beyond 200 m (656 ft), an area known as the sunlight, or euphotic, zone. By the time you reach the deepest part of the ocean, an area called the hadal or hadopelagic zone, the only light available is generated by organisms themselves.

Sea Cucumbers: Not Your Garden-Variety Ocean Animal

Despite their common name, **sea cucumbers**, also known as holothurians, are not something you'd ever find in your garden. Instead, these squishy invertebrates are found throughout the world's ocean basins, from shallows to great depths. They belong to the phylum Echinodermata, which also includes sea stars and urchins.

Sea cucumbers are particularly plentiful in the deep ocean and have developed some interesting adaptations to survive conditions at depth.

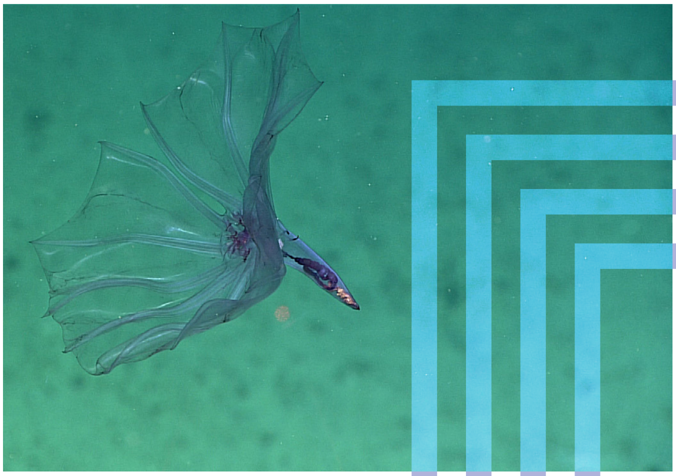
Sea cucumbers lack lungs or gas-filled spaces that would make them more susceptible to the intense pressures of the deep ocean. Instead, sea cucumbers breathe as water is pumped through two "respiratory trees" located on each side of their digestive tracts.

Speaking of digestion, as food is scarce in the deep ocean, sea cucumbers are deposit feeders, eating nutrients attached to sediments on the seafloor. They use their tube feet to "eat" seafloor mud, extracting what little nutrition remains in materials that slowly sank from the productive upper ocean, and then expelling undigested mud. For this reason, sea cucumbers are sometimes called the **"vacuum cleaners of the sea."**

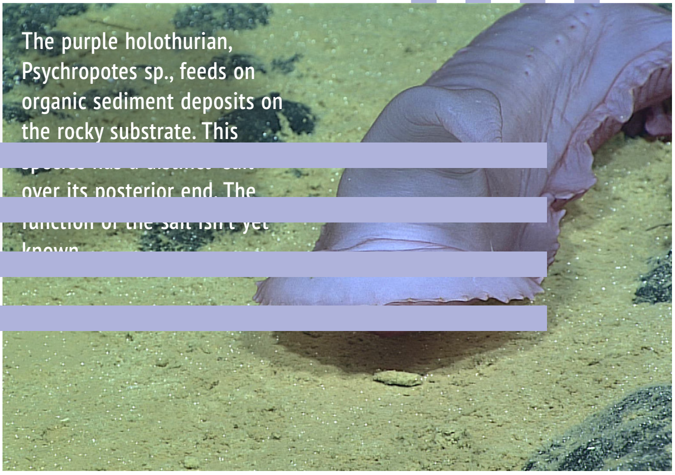
Not all sea cucumbers spend their time slowly ambling over the seafloor, eating mud. Some are able to lift themselves off the seafloor using a large, fin-like structure. They then swim through the water column with strong, rhythmic flexing motions until they reach neutral buoyancy and drift along until their next feeding trip on the bottom. Some sea cucumbers never touch the seafloor, instead spending their entire lives swimming in the water column!

V *Paroriza pallens* sea cucumbers are hermaphroditic, meaning individuals have both male and female reproductive organs. During a dive to explore in the Gulf of Mexico, we frequently encountered these sea cucumbers in pairs such as this one. The nature of the shaggy filaments hanging from the flanks of these sea cucumbers remains a mystery.

V This beautiful pelagic sea cucumber was seen swimming just above the seafloor during a NOAA Ocean Exploration expedition dive near Howland Island in the Pacific Ocean. Unlike other sea cucumbers that we sometimes see moving around on the seafloor, this particular sea cucumber spends its entire life in the water column.



The swimming sea cucumber, *Enypniastes eximia*, is sometimes referred to as the "headless chicken monster." It is a widespread species present in the abyss, encountered widely around the world with records from the Gulf of Mexico, Tropical Atlantic, East Atlantic, New Zealand, and the Southern Ocean (Antarctica). This one was seen off Puerto Rico in 2018.



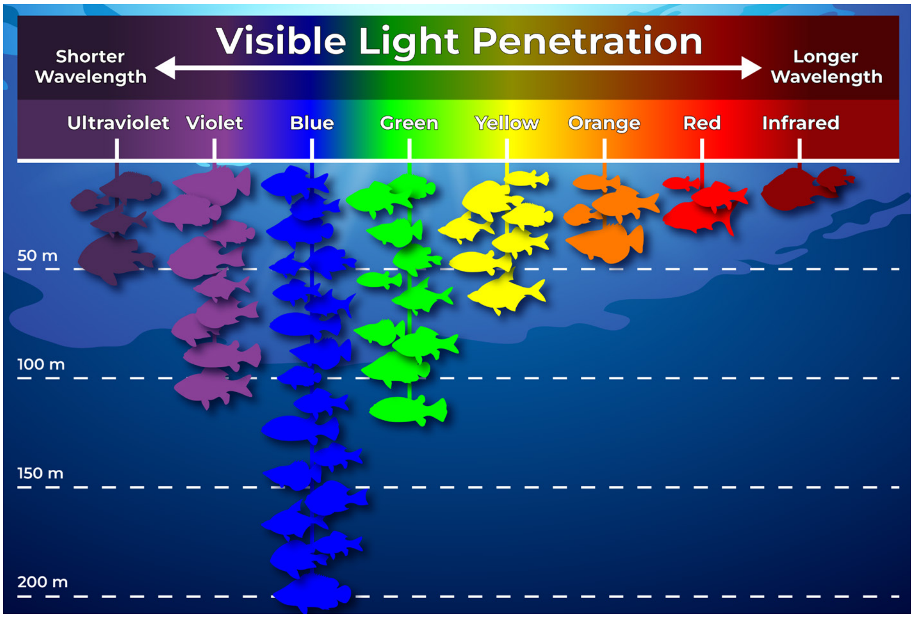
The purple holothurian, Psychropotes sp., feeds on organic sediment deposits on the rocky substrate. This species has a distinct "sail" over its posterior end. The function of the sail isn't yet known.

The Invisibility of Being Red

If you've ever looked beneath the surface of the ocean or other bodies of water, you may have noticed that water transforms light and that colors appear different. This is because water absorbs colors with longer wavelengths (such as red) at shallower depths.

Shorter wavelengths (such as blue) penetrate to a much deeper depth. Red light, with the longest wavelength in the visible spectrum, is quickly absorbed and effectively never reaches deep-ocean depths. This provides animals in the deep ocean with an interesting form of camouflage: **being red**.

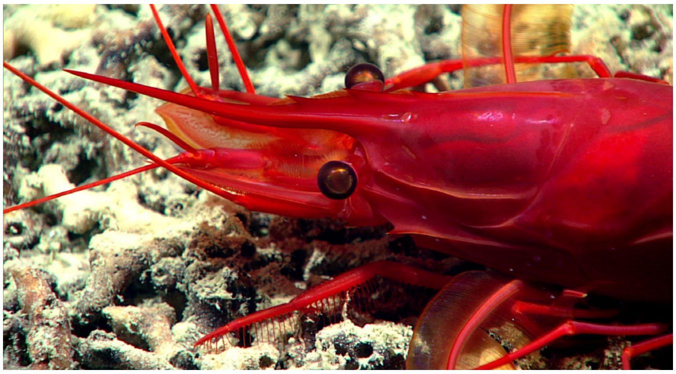
The wavelength of a color must be present in the surrounding environment in order to be seen. So, in an environment like the deep ocean where there are no red light wavelengths, a red animal appears to be lacking color and is essentially **invisible** to animals around it. When scientists exploring the deep ocean shine the artificial lights of an instrument (such as a remotely operated vehicle) on animals, we bring in all wavelengths of the rainbow and are often treated to a bright array of colors, many of which are vibrant shades of red.



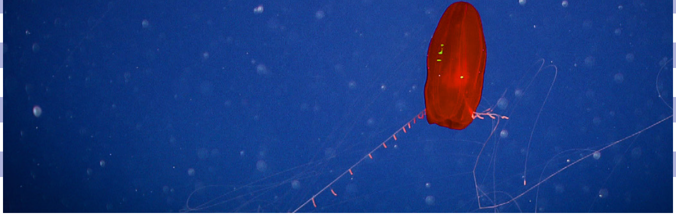
This illustration shows the approximate penetration of different wavelengths of visible light (colors) in ocean water. The actual depths of penetration will vary by location, depending on environmental conditions such as water clarity, time of day, etc.

This beautiful red jellyfish in the genus *Poralia* may be an undescribed species. It was seen while exploring the water column of Hydrographer Canyon off the coast of Rhode Island at a depth of 700 m (2,297 ft).

A close look at a beautifully colored red shrimp. The shrimp measured nearly 7.9 in long and had modified swimming legs. It was seen during a dive off the coast of South Carolina on a site dubbed "Richardson Ridge."



This potentially undescribed ctenophore was seen floating gracefully in the water column during a dive to explore north of Bear Seamount, within the Northeast Canyons and Seamounts Marine National Monument.

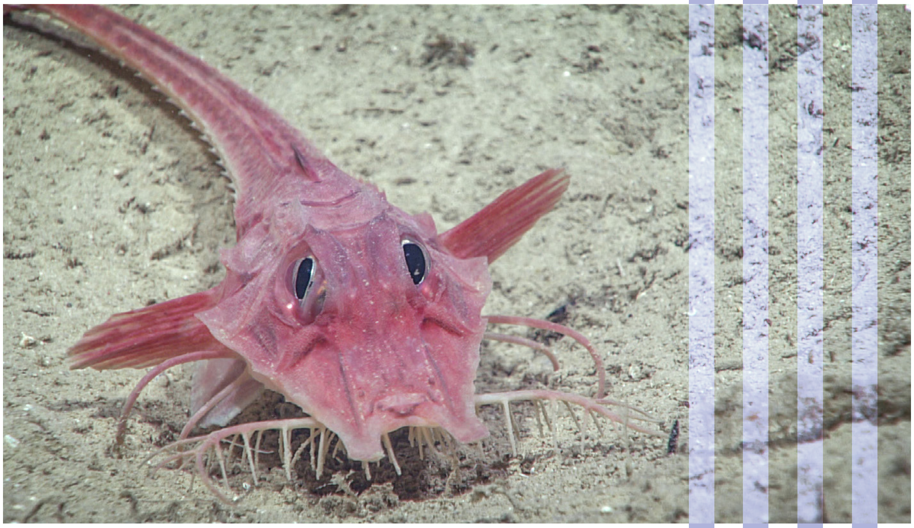


The Armored Searobin: A Fish Out for a Stroll

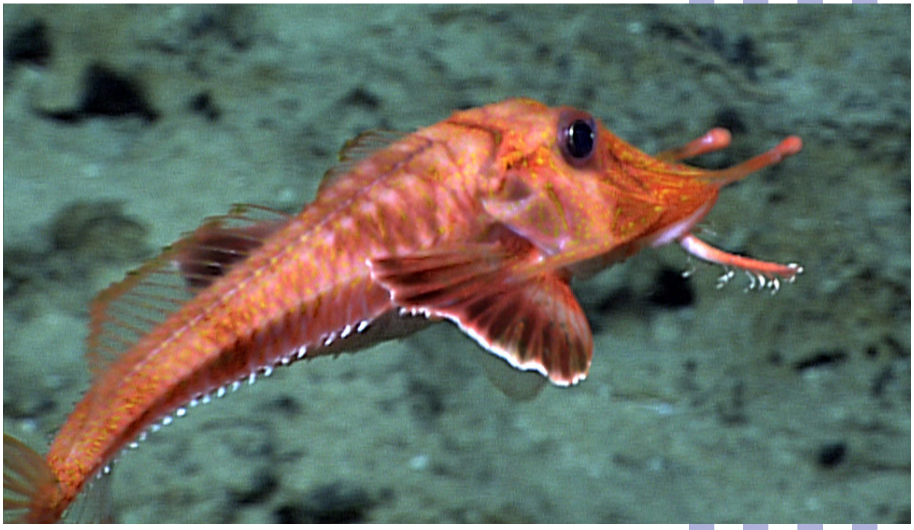
For our next dose of deep-sea weird, meet the **armored searobin**! Found only in the deep ocean, these unusual fish in the family Peristediidae can actually "walk" across the seafloor.

Like their shallow-water relatives, armored searobins have fan-like fins (**pectoral fins**) with stiffened rays on each side of their bodies behind their heads. The first few rays are free from the membranes of the rest of the fin and are very thick. The fish uses these thickened, stiff fin rays to "walk" along the bottom of the ocean. So rather than swimming, like other fishes, the usual form of locomotion for armored searobins is **walking**!

Armored searobins also have four rows of bony plates along their bodies. Each plate has a thick, curved, short spine, or "armor"—hence the fish's common name. They also have horn-like projections on each side of their snouts and branched barbels that look like whiskers on the bottom of their heads, in front of their mouths. These branched barbels have taste buds and are used to sense food on the bottom.



This armored searobin was seen moving across the seafloor during exploration of an area south of the Florida Keys in the Straits of Florida.



Although we most often see armored searobins using their modified fins to walk across the seafloor, sometimes we do catch them swimming. This one was seen during a dive off Keahole Point, several miles north of the Kona Coast of Hawaii.

Seeing two deep-sea animals interacting with each other is rare. What is even rarer is when they behave the opposite of how we expect them to. During a dive off Puerto Rico, scientists observed this brittle star climb on top of the mouth of an armored searobin. They assumed that the fish would try to eat the brittle star, but as it turns out, the fish just wanted to dislodge the extra baggage.

Chemosynthesis: Life Finds a Way

Animals have to eat in order to stay alive. The majority of life on Earth is based on a food chain that revolves around sunlight, whereby plants use energy from the Sun to make food. But what about environments like the deep ocean, which are completely dark and devoid of sunlight? In these areas, marine snow, which consists of dead plants, animals, plankton, and other material that sinks down from the upper reaches of the ocean to the seafloor, is the primary source of food. But some animals have found a different way to survive: through a process called **chemosynthesis**.

Chemosynthesis occurs when bacteria and other organisms use chemical energy from sulfides, methane, and other inorganic compounds to produce food. Some of these bacteria are free-living colonies that are eaten by other animals. Many other chemosynthetic bacteria fuel life by forming symbiotic relationships with larger animals, living directly in the tissues of these animals. Together, these bacteria form the basis of the food chain for life at places on the seafloor around hydrothermal vents, cold seeps, whale carcasses, and even sunken ships.

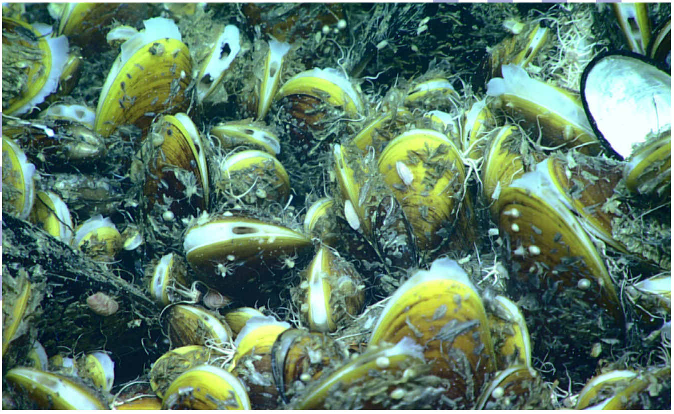
The animals that make up these chemosynthetic communities are truly unique—not found anywhere else on Earth. They are key components of the ocean ecosystem, yet our knowledge of them is relatively new. The first chemosynthetic communities were discovered in 1977, when ocean explorers observed a vent on the deep ocean floor and found a thriving community where there was no light. Since then, chemosynthetic communities have been found in ocean basins all over the world.

No one had ever thought to look for them, but these communities were there all along. And now we know that together photosynthesis and chemosynthesis fuel all life on Earth.

Look closely. These are shrimp! These Rimicaris sp. shrimp were seen clustered around an area of diffuse fluid flow at the Von Damm vent site, located in the Caribbean Sea's Mid-Cayman Rise. These shrimp are about four inches long and eat chemosynthetic bacteria that grow on their bodies.

The anterior end of a chemosynthetic siboglinid tubeworm, *Lamellibrachia* sp., protrudes from its tube. The red "feathers" are respiratory tentacles filled with hemoglobin-containing "blood." The white structure is called an obturaculum and functions as a trapdoor that protects the opening when the worm withdraws into its tube.

These hairy "snails" are almost always associated with seafloor hydrothermal activity in the Mariana region of the Pacific Ocean. These snails graze upon bacteria that produce food via chemosynthesis.



Bathymodiolus mussels are common members of chemosynthetic communities. These mussels have a symbiotic relationship with chemosynthetic bacteria living in their tissues. In turn, beds of *Bathymodiolus* mussels often support a huge variety of invertebrates, including sea stars, scaleworms, and limpets.

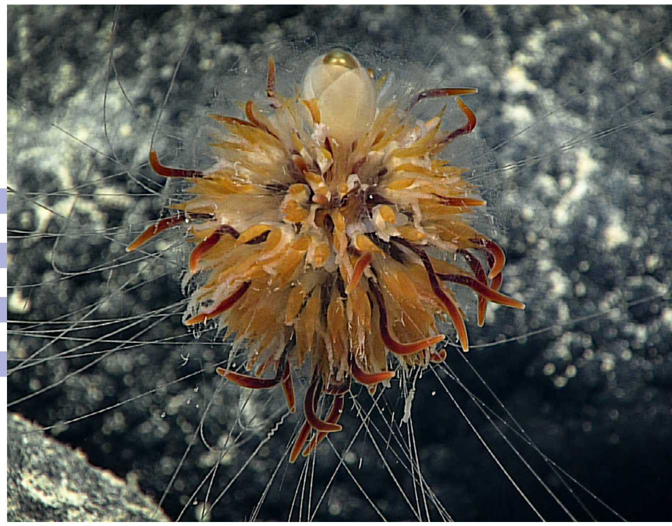
Siphonophores are commonly observed in the water column. This individual was seen at a depth of approximately 400 m (1,310 feet) in the Gulf of Mexico.

Siphonophores: In This Together

Siphonophores belong to the phylum Cnidaria, which also includes corals, sea anemones, and jellyfish. There are approximately 175 described species of siphonophores, and they are all marine, found in ocean basins around the world. The familiar Portuguese man o' war is the only species of siphonophore that lives in surface waters. The rest are found at greater depths and are often encountered while exploring the deep ocean.

Siphonophores are a **colonial** type of hydrozoan. When looking at a siphonophore, you may think that these marine invertebrates are single organisms, but a siphonophore is actually a colony of many individual hydrozoans (called **zooids**) working together. Each individual zooid is specialized for different functions such as swimming, feeding, reproduction, or defense. They are similar to other solitary animals, but the individuals are all attached to each other instead of living independently. Siphonophores are considered to be some of the most complex colonial animals.

Most siphonophores are long and almost rope-like in appearance, with individual zooids arranged on a long "stem." This siphonophore, observed while exploring the Winslow Reef Complex in the Pacific Ocean, has a pinkish internal system visible through clear external tissues. It was largely intact and in good shape, which is unusual as these animals are so delicate that we often observe them in pieces.



The majority of siphonophores are active swimmers, living in the water column of the open ocean. An exception is the so-called "dandelion siphonophore." Belonging to the family Rhodaliidae, these animals tether themselves to the seafloor using their tentacles. This siphonophore, which is a potentially new species, was seen using its tentacles to attach to iron-manganese encrusted rocks on the deep slopes of Rose Atoll.

Scientists estimate there may be between 700,000 and 1 million species of organisms living in the ocean (excluding most microorganisms, of which there are millions). By volume, the deep ocean is the largest living space on Earth, so it's not surprising that it's home to such a large number of organisms. Even more surprisingly, roughly two-thirds of the species in the ocean (possibly more!) have yet to be discovered or officially described. Each year, almost 2,000 new species are accepted by the scientific community—but that still leaves a lot left to discover! And with each new mission to explore the deep, we make new discoveries that increase our understanding of one of the largest, but least explored, living spaces on our planet.

Our discoveries aren't just limited to bizarre and wild marine life. Join us next month as we take a deep dive into the world of maritime heritage and learn how glimpses of the past help us understand history, connect us to our cultural heritage, and teach us lessons on how the environment and human error can impact each other.