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When Corals Glow: A Colorful Fight for Survival

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When diving over a dark tropical reef using a blue torch, one might witness an amazing transformation of the otherwise dreary brown corals into vibrant greens, oranges, and reds. The corals undergo fluorescence, using their unique proteins to absorb blue light and emit brighter colors. This can be protective for the algae living inside the corals by acting like a sunscreen, while in deeper waters, the corals can use this to convert limited light into the energy they need to survive. The glowing corals are actually fighting to survive in a rainbow battle. This is known as **coral fluorescence.** (Levinton, J. S., 2018). One of the most beautiful sights underwater, biologists now believe, could tell us how corals cope with stress and aid them in surviving our warming oceans.

Coral Reef

Although corals look like rocks, they are animals. To be more precise, reef building corals are made up of many small animals known as polyps. Each polyp is similar to a sea anemone and has a mouth surrounded by tentacles. They belong to the group Cnidaria, which also includes jellyfish and sea anemones (Urry et al., 2020). Underneath each polyp, a cuplike structure is made of calcium carbonate. Over time, many cups stack up to form huge limestone formations known as reefs (Castro & Huber, 2019). Most reef-building corals contain small algae inside their tissues. These algae, known as zooxanthellae, are single-celled organisms that perform photosynthesis using sunlight to produce sugar. The coral provides the algae with a safe place and some basic ingredients for photosynthesis. In return, the algae provide the coral with a large amount of food. This is a mutualistic relationship. This helps to explain why coral reefs are such busy and lively places. Despite tropical seas being clear and lacking in nutrients (like a desert), coral reefs are very diverse. Despite taking up a small area of the ocean floor, they support a massive variety of marine life (Sheppard et al., 2017). Algae is also a reason why coral often looks brown or golden brown in everyday life. The glow is something else entirely.

Coral fluorescence

Fluorescence is not like glowing fireflies. A fluorescent molecule takes light of one color (usually a short wavelength color, such as blue or ultraviolet light) and almost immediately emits light of a different color with a longer wavelength. This can be likened to a highlighter pen under ultraviolet light or white shirts glowing at parties.

Fig 1. Coral fluorescence (Source: https://stockcake.com/i/vibrant-coral-reef_1233494_849193)

This work is done by special protein present in the coral, which is closely related to the green fluorescent first found in a jellyfish. This protein became one of the most important tools used in modern biology. Scientists attach this protein to others to see live cells. This technique has won a Nobel prize in Chemistry (Urry et al., 2020). Corals produce many different types of these proteins. Some glow green, others yellow, orange and red. Different species and sometimes even parts of the same coral colony may have different combinations. A single boulder of coral can be green at its edges, orange in the middle, and dotted with red where the polyps are. No one paints the coral; it makes these brilliant colors. It looks magical, but it is a survival strategy. It helps the coral manage light and protect the tiny algae living inside it.

The Reason Coral Glows

Nature doesn't usually waste resources so most biologists believe there must be a useful purpose. There have been many suggestions for why they glow, and the debate continues.

Sunscreen for Algae: In the shallows, high intensity may harm the photosynthesis process of algae. Fluorescent proteins can act as a natural sunscreen. They absorb high-energy light and emit it as harmless long-wavelength light. Some corals also have pigments that take in light; these may work alongside fluorescent pigments (Sheppard et al., 2017).

Light Booster: There is less light, most of which is dim and blue light, deeper down. Fluorescent proteins can change blue light into other colors, such as orange and red. This means that the coral acts as a mini lighting engineer. The limited light is spread throughout the coral body so that the algae in deeper areas can still receive sufficient light. These ideas are not in conflict. Depending on the arrangement of the protein, they can provide protection in bright light and support in low light.

Repair Kit & Signaling: Some proteins may help to get rid of harmful chemicals produced when the coral is under stress. Others may act as signaling tools. Maybe to attract helpful microbes or determine which algae settles in the coral tissues. These are interesting theories however they are still being studied. This is not a settled fact just a hypothesis.

Coral Bleaching

To understand the importance of coral glowing, we need to examine the biggest threat to corals today, which is coral bleaching. The relationship between the coral and algae is very well balanced. When the temperature of the water rises by a few degrees (even one or two degrees) above the usual temperature for a few weeks, the balance of the relationship is disrupted. The algae begin to produce harmful chemicals, and the coral responds by expelling those harmful chemicals. Without the brown algae, the coral is left showing off its white limestone skeleton. The coral has "bleached" (Castro & Huber, 2019; Levinton, 2018). Bleached coral is not dead, but it is starving. The coral has lost its main source of food. If the coral is not exposed to high temperatures for too long, the algae can return, and the coral will recover. However, if the stress continues for too long, the coral will die. Once the coral has died, it quickly becomes covered by seaweed. Many fish, crabs, and other sea creatures that relied on living coral will disappear.

Fig 2. Coral bleaching Source: https://images.theconversation.com/files/336476/original/file-20200520-152327-ofiafr.jpg?ixlib=rb-4.1.1&q=30&auto=format&w=600&h=448&fit=crop&dpr=2

Coral bleaching is not a rare event. Many state that rising sea temperatures are one of the largest threats to reefs worldwide. Along with pollution, land run-off, destructive fishing and slow acidification from taking in carbon dioxide. Corals that could use to recover from heatwaves over decades are now suffering frequently. (Nybakken & Bertness, 2005; Sheppard et al., 2017). An interesting observation that has caught the attention of marine scientists is that some corals go from white to brightly colored when they are under stress. Neon pink, purple, blue and yellow. Divers referred to it as "colorful bleaching". This may look like the coral is celebrating, to a biologist it is a sign that they are struggling. When the algae are removed, the coral's own fluorescent and pigments proteins aren't blocked by the brown color anymore. The light can travel through the pale skeleton and thin tissue more easily meaning the colors look much brighter. The coral may also be glowing because they are producing more of these proteins. If these proteins are protecting the coral from damage caused by light and harmful chemicals then glowing could be a way of protecting themselves. It may be helping any remaining algae, or making it easier for new algae to return. Some studies suggest corals that produce more of these pigments may recover better.

Using Coral Glow to Save Reefs

Despite the reason for the glowing, it can be used practically.

Health Monitor: As the glow changes depending on how the coral condition is, fluorescence imaging can be used as quickly, non-invasively method to check health condition of the reef. This can be done from a camera or even drone. Early signs of stress can be picked up.

Help with Restoration: Conservation team now grow corals in nurseries and place them back onto damaged areas. If certain fluorescent characteristics are linked to higher tolerance to heat, this could help identify which corals to breed. This is still being tested; however, it can be seen as one of many tools.

Understanding Adaptation: Looking at how corals use these proteins can give scientists insight into how animals adapt to changing environments, which is a key area of biology (Urry et al., 2020).

A Battle Worth Winning

It would be nice to think the glowing corals can save themselves, Unfortunately, it isn't that simple. While the fluorescent proteins may offer some protection against the slight increase in heat and light, they can't cool down the ocean. If the water remains warm for too long, even the brightest coral will lose the fight. However, we can use science and practical steps to help. Reduction of greenhouse gas emission is the most important step. Helping to reduce the main cause of the rising temperatures. Also reducing pollution and land run-off, managing fisheries and protecting areas of reef that are naturally more heat tolerant can give the corals the chance to survive (Nybakken & Bertness, 2005; Sheppard et al., 2017).

Conclusion

Next time you see a picture of glowing coral, remember that you may be seeing an animal communicating, protecting itself and adapting to its environment. A glowing coral reminds us that there is a living relationship behind all those colorful patches of sea. Corals have been on earth for hundreds of millions of years. Whether they continue to survive may come down to what we do in the next few decades. The glowing is a call for our attention.

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