Colors of Corals: Light, Chlorophyll, and Other Pigments

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Introduction

There are many environmental reasons why corals may change in coloration, but the most common and dramatic changes are due to the qualities of light that the corals receive. These qualities of light include intensity, spectrum, and amount of UV light. In response to light, the number of cells within a coral that are responsible for utilizing light, as well as the pigments that provide protection for the corals, may vary. As a result, a balance is achieved such that the number of cells and amount of pigment match the corals' needs for both nutrition and protection.

Color change due to light intensity

A coral has the ability to adapt to different intensities of light. A coral contains symbiotic chlorophyll-containing cells called zooxanthellae cells. The coral provides these cells with protection, and in turn, these cells provide the coral with nutrients as a result of photosynthesis. The numbers of zooxanthellae cells and amount of chlorophyll vary in response to light intensity so that the coral continues to receive the necessary nutrients.

If the lighting is more intense than the coral is accustomed to, either some zooxanthellae cells will be expelled from the coral, or the amount of chlorophyll within those cells will be reduced. Having an excess number of these cells in a brightly lit situation can be dangerous to a coral because the zooxanthellae cells can produce too much oxygen. Oxygen at high concentrations can become toxic to the coral.

On the other hand, if the intensity of light is lower than what the coral usually receives, the zooxanthellae cells will not be able to provide the necessary nutrients through photosynthesis. In this case, the number of zooxanthellae cells will increase as well as the amount of chlorophyll within those cells.

The resulting color change of a coral in response to different light intensities is due to the concentration of both the zooxanthellae cells and the amount of chlorophyll present within those cells. The color of these cells ranges from a golden-yellow to brown. The higher the concentration of these cells within the coral, the more the coral will take on a brown appearance. In other words, if the lighting is less intense than the coral is accustomed to, it will take on a darker brown appearance. On the other hand, when the same coral is placed under intense lighting, some of the zooxanthellae cells will be expelled and the amount of chlorophyll reduced, giving the coral a lighter appearance.

Color change due to light spectrum

The spectrum of light that corals receive will alter their appearance in the aquarium. Certain colors, such as fluorescent red or orange, that are not visible in daylight become very apparent under actinic lighting. Mixes of bulbs with different spectrums, along with different lighting systems, will produce varying effects on the colors of the same or similar corals. A typical lighting system for a reef aquarium will provide lighting that contains a mixture of approximately 50% white and 50% blue actinic lighting. This mixture of lighting provides the wavelengths of light that will bring out the fluorescent colors, as well as the spectrum that makes the aquarium appear natural in color.

Color change due to UV light

Ultraviolet light is made up of three components; UV-A, UV-B, and UV-C. UV-C is not a factor in either the home aquarium or in nature, since these light waves are not created by artificial lighting nor do they penetrate the earth's atmosphere. UV-A and UV-B light waves do penetrate the water's surface and are filtered out as the light travels through the water. Both UV-A and UV-B light waves have been found to cause destruction of the DNA and RNA within the coral's tissues. In response, many corals have made adaptations in reducing the effects of these harmful rays. Corals have developed protective pigments that are often blue, purple, or pink in color. Most corals that contain these pigments come from shallow waters where the amount of UV-A and UV-B light is higher than in deeper areas of the reef.

In an aquarium, we use glass over metal halide lighting to reflect any UV light before it enters the water. This is important to protect any corals that do not contain these pigments, and to protect the shallow water corals that may have lost their pigments in transportation. It is common for corals with these bright colors to adapt to the lower UV-A and UV-B conditions within the aquarium by losing their colorful pigmentation. This is not a sign of an unhealthy coral; it is simply the adaptation of the coral to its new environment.

Conclusion

It is a common misconception among many hobbyists that when a newly received coral changes color in the home aquarium, the coral is not healthy. Many times the color change is merely due to the coral's adaptation to the new lighting intensity, spectrum, and change in UV light. With this in mind, it is important to consider the color of newly received corals and research their lighting requirements when placing corals in the aquarium.