Red, Green, or Black: What Color is Your Lagoon?

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Ever wonder why people assume a red or purple color means a lagoon is healthy?

Reddish color indicates the presence of purple sulfur or purple non-sulfur bacteria in the lagoon. The designation sulfur and non-sulfur is confusing. Both types of organisms do the same thing: absorb sulfides and volatile acids, greatly reducing odor emissions from the lagoon.

But purple is not the sole indicator of lagoon health.

Lagoons are complex biological systems made up of many communities of microorganisms. The communities exist in layers, more or less along the lines shown in Figure 1. The names given to the layers arise because of two distinctions: aerobic versus anaerobic and phototrophic versus heterotrophic.

Aerobic organisms require oxygen to live. Anaerobic organisms do not require oxygen, and many anaerobes cannot survive in the presence of oxygen. Most lagoon microorganisms are facultative, meaning they can survive in either aerobic or anaerobic environments.

Phototrophic organisms use light for energy. Trees are phototrophs that use sunlight to build organic matter through photosynthesis. Heterotrophic organisms digest organic matter to survive. You and I digest food for growth and energy.

A lagoon's color is determined by the type of organisms dominating the layer closest to the surface.

Phototrophic organisms are brightly colored. They use pigments to capture light. Green generally indicates aerobic conditions; red and purple indicate anaerobic conditions. Aerobic organisms absorb red light; therefore, they reflect green. Anaerobic phototrophs absorb light from the middle and the blue ends of the spectrum, so they appear red or purple.

Heterotrophic organisms tend to be drab in color, because they absorb light across the entire spectrum. Anaerobic heterotrophs dress in basic black.

All livestock lagoons contain a black, anaerobic layer.

The presence of other layers is a function of organic loading, available sunlight, temperature, and mixing. Reducing the organic load on a purely anaerobic heterotrophic lagoon increases the likelihood that the lagoon will develop a red layer. If you further decrease organic loading and increase the surface area, the lagoon may develop an aerobic layer and appear green.

What if your lagoon is red in summer, but black in winter?

Less sunlight falls on the lagoon in winter. Also, microbial activity decreases with colder temperatures, so organic matter accumulates in the lagoon, further blocking light penetration. The phototrophic anaerobic organisms, so vigorous in the summer, lose out to heterotrophs in the winter.

How do you explain a brown lagoon?

Look closely. The brown color may be a combination of green algae and red bacteria (Figure 2). Algae and anaerobic phototropic bacteria always coexist in lagoons. They gather light from opposite ends of the spectrum, remember. The lagoon is green when algae dominate. Phototrophic bacteria have the upper hand in red lagoons. If algae and bacteria are equal, the upper layer is brown.

I once studied a lagoon in Tennessee that looked brown from a distance, but close up you could see tiger stripes of green algae undulating on top of watermelon pink liquid. It was like Mother Nature's psychedelic light show.

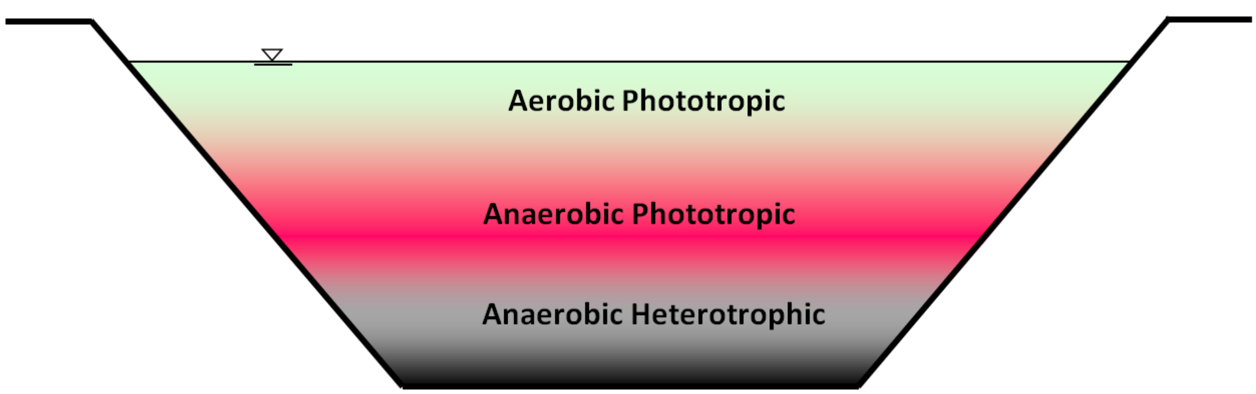

Figure 1. Biological community layers in lagoons.

Figure 2. Mats of algae pushed by the wind to the banks of an otherwise completely purple lagoon.