Environment of the Salton Sea

Salton Sea Aquatic Primary Producers

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Abstract

"Primary producers", including bacteria, phytoplankton, and algae, play a fundamental role in sustaining the entire food web. The Salton Sea ecosystem faces significant challenges due to excessive nutrient influxes from agricultural runoff and untreated sewage, leading to heightened primary production and the formation of oxygen-depleted dead zones. These conditions lead to harmful algal blooms, dominated by dinoflagellates and cyanobacteria, which produce toxins harmful to wildlife and humans. Additionally, accumulation of agricultural chemicals and naturally occurring elements in predators poses further risks to ecosystem health. Understanding these complex interactions is crucial for devising effective conservation strategies to mitigate environmental degradation of the Salton Sea ecosystem.

Introduction

Think of the heater in your home. It takes energy from gas to then create heat for your home. Now think of trees, which combine energy from the sun with inorganic, or nonliving, materials to make organic molecules. These molecules are the fuel that powers all living things, and this special ability that trees have, along with other organisms such as algae and bacteria, earns them the title of "producers."

Primary producers, including bacteria, phytoplankton, and algae, synthesize their own energy without needing to eat. Some primary producers do this using the sun's energy, while others use chemicals in the environment. In aquatic ecosystems, primary producers include kelp, phytoplankton, algae, mosses, lichens, and bacteria.

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Primary producers in the Salton Sea include several photosynthetic and chemosynthetic organisms, ranging from wetland plants to free-floating algae and photosynthetic microorganisms in the Sea itself and its margins. These primary producers, which form the base of the Salton Sea food web, are supported by an overabundance of abiotic nutrients supplied to the Sea via agricultural runoff and untreated sewage originating from Mexico. This nutrient load results in high rates of primary production and subsequent die-off of aerobic (oxygen-dependent) organisms, such as tilapia, within oxygen-starved regions known as...

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...dead zones. These zones form when prolific primary producers die and sink into the water column, consuming oxygen during their decomposition.

When there are blooms of algae species that produce toxins, the events are called harmful algal blooms, or HABs. Harmful algal blooms are signs of polluted waters that occur from areas along California's coast to river systems to the Salton Sea. The Salton Sea's waters contain two major HAB organisms—dinoflagellates and cyanobacteria—that are toxic to organisms including humans. Dinoflagellates are microscopic single-celled organisms that can grow by photosynthesis or by taking up organic molecules dissolved in nutrient-rich water. These organisms are coated by specialized armor plates made of calcium carbonate. At certain times of their life cycles, they excrete compounds known to be neurotoxins. These toxins can accumulate in fish tissues and be passed to organisms consuming those fish, including pelicans.

Other HABs consist of species of cyanobacteria, primitive photosynthetic organisms, such as Microcystis aeruginosa that can produce toxins that cause fish and wildlife poisonings. Organisms like this not only produce toxins but also create conditions whereby their biomass causes anoxic (oxygen starved) events. In addition to toxins produced by the primary producers, agricultural chemicals and naturally occurring elements that have accumulated to potentially toxic levels in the Sea and are contained in the primary and secondary consumers can bioaccumulate in the tissues of predators such as fish and birds. For instance, selenium, DDT, and PCBs were identified in fish muscle tissue having been passed through the food web from primary producers to small invertebrates and insects and then into fish.

High rates of primary production support an array of zooplankton in the Sea, including microscopic organisms such as ciliates. The overabundance of microorganisms results in the consumption of a significant amount of oxygen, so much so that at depths too deep for mixing with the air above the Sea, the water is low in dissolved oxygen. In the absence of oxygen, microorganisms use alternate metabolic pathways, producing hydrogen sulfide (H2 S), which in addition to providing the rotten egg smell, can be toxic to animal life in high concentrations.

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