Nitrate High: What nitrate levels benefit corals without causing algae overgrowth?

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Abstract

High Tech High North County Juniors were given a research project to create a suitable living environment for coral to inhabit and thrive in. Each class was given a level of concentration (high/med/low) which was either nutrient, feeding, temperature, control or light. Every tank has been presented with a specific stressor for observation. Each group has the responsibility of conducting concise water quality tests of the contents inside of the tanks. These tests consist of: Temperature, salinity, dissolved oxygen, light, turbidity, alkalinity, pH, calcium, phosphate, nitrate, nitrite, ammonia and food availability. Each of these tests play a vital role in sustaining coral life. The team's main goal is to get the water levels and concentration of all environmental stressors to the point where it is safe for corals to inhabit the tank.

Aquarium at Birch Aquarium. (Photo taken by William Telios)

Introduction

Coral reef population is constantly declining and deteriorating which is a very serious issue for numerous reasons. Coral reefs protect our local shores and cities from storms, large waves and anything that threatens coral. These same reefs provide shelter for millions of different aquatic organisms. Sadly, coral reefs beauty can degrade at a rapid pace if conditions are rough enough. They are being threatened mainly by rising sea temperatures, increasing ocean acidity and human interaction. Coral reefs provide shelter to millions of unique species worldwide. They act as natural breaks to protect coves, and they are a massive source of revenue for the tourism industries of many coastal tropics.

Our class' responsibility is to learn all that we can about these natural wonders so that we can inform the world about the best ways to preserve them for future generations. In order to understand what we will be discussing in this paper you must know what a nutrient is. A nutrient or nitrate is a substance that provides nourishment essential for growth and the

maintenance of life. They can be found in water wherever organisms live. They are formed when the ammonia found in animal waste is broken down by bacteria into nitrites. Nitrites, unlike nitrates, are toxic to most animal life and are not wanted in most ecosystems. The nitrites are then broken down by another kind of bacteria into a form that can be used by plants; nitrates. Nitrates benefit plants by acting as a catalyst in photosynthesis so that less energy is required to complete the process. Corals benefit from nitrates because they make photosynthesis easier for the coral's zooxanthellae (an algae which lives symbiotically inside the cells of organisms such as coral). However, excessive nitrate levels can cause corals to undergo a process called coral bleaching, during which corals expel their zooxanthellae for any number of reasons; overpopulation, refusal to feed the coral, etc. Generally speaking, any environmental stressor that inhibits the zooxanthellae ability or willingness to give the coral nutrients needed for survival, will cause the coral to expel its zooxanthellae.

Adding salt into the tank. (Photo taken by William Telios)

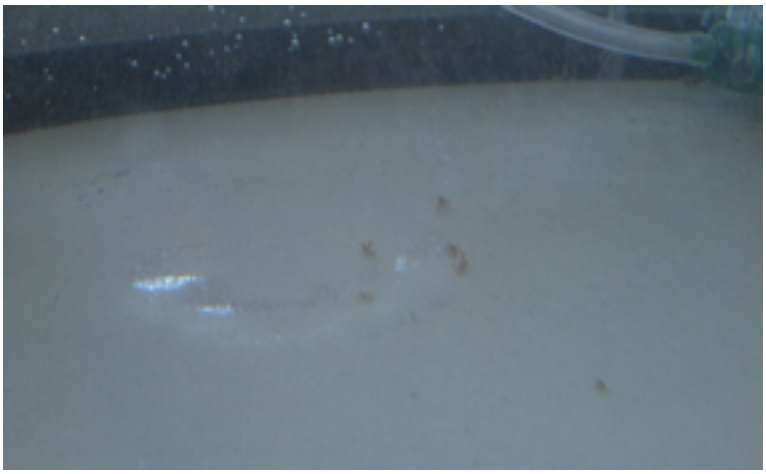
Goals/Objectives

There is clearly a fine line between insufficient nitrates for the survival of zooxanthellae, and excessive amounts that lead to coral bleaching. It is our goal to find the right amount and distribution of nitrates required for a reef to flourish. In order to accomplish this, we must first make sure that we understand exactly how nitrates interact with corals.

Our goal with this, therefore, is to first determine how coral and its symbiotic bacteria behave in unaltered water. This will give us a basis, known as a control test, so that we will have something to compare our later results to. There will be another tank built specifically to be a control test, but it will house different coral and algae.

Once a control test is established, we can move on to our real focus, which is to determine the optimal nitrate to water ratio for maintaining healthy reefs. As mentioned before, we have created a living environment for coral inside of a plexiglass tank. Over time, we will be adding nitrates to our ecosystem so that we can determine what levels best suit our coral.

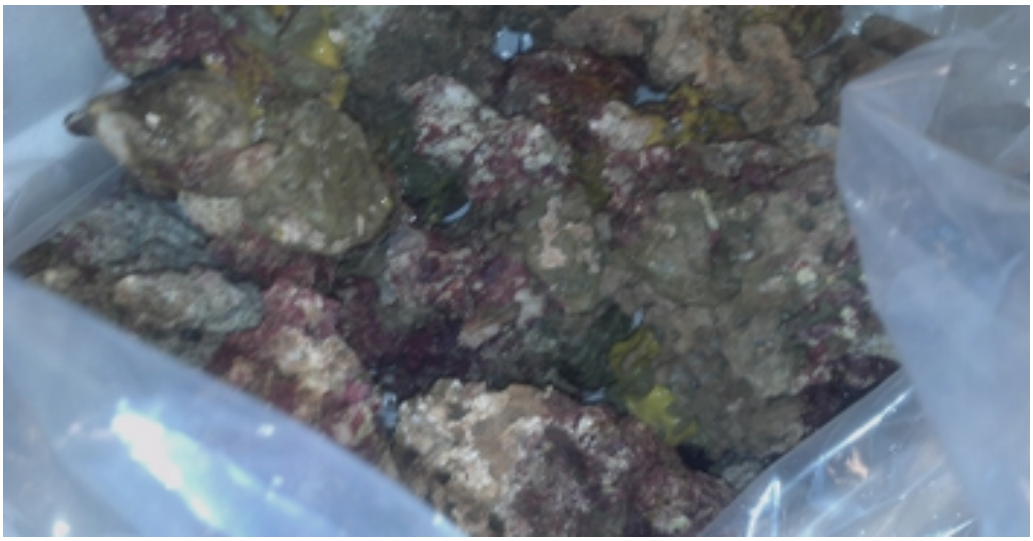
Our ultimate intention is to record everything that our experiments produce, in hopes of sharing the valuable information with coral conservationists. Hopefully, the information will be useful in future efforts surrounding coral preservation. We expect that it will be, as our work will shed light on the optimal levels of nitrates for preserving coral life.



Specimens in the bottom of a tank. (Photo taken by William Telios)

Hypothesis

There is an ideal amount of nutrients that will not cause bleaching and will bolster coral growth. The High Nutrients group will have more algae growth than the Control Group. Corals are being threatened every day by rising sea temperatures, increasing ocean acidity and human interaction. They provide shelter and food for microorganisms and larger organisms alike.



Live rock. (Photo taken by William Telios)

Materials & Methods

The first step was to create tank racks. The class began first making an image of it in Google SketchUp. Once the design was done everyone had to finalize it by gathering the materials needed for the rack. We ended up ordering steel bars for the initial rack, an acrylic tank, lights and filtration supplies. Once we had all of those materials ready we began to build it. Groups first started by welding the steel bars together. Then students had to smooth out the edges using a sanding machine. Once that was completed it had to be painted. At this point the rack was completed and ready for the tank to be placed on. Once the tank was placed on it, the groups made sure it fit and then put in the water pump, air pump, salt water, and the lights above the tank. When completed, salt water was added into the tank at the proper salinity. Now after this was done we began to run our other water quality test to make sure that the water would be ready for the coral to be placed inside. The main objective from this is to be capable of doing nitrate related tests on the water to ensure proper water quality levels.

One other test that students will be running is monitoring coral growth. First we get a container, take out the coral without exposing it to the air and putting it in the container. Then take that container and submerge it in a bucket full of water, containing a weight scale. Then simply allow the coral to rest on the scale and you will get the buoyant weight. It's important to

monitor because its mass affects its tissue and exoskeleton growth.

Another test which the groups will perform is for the algae count in the tank and on the coral. We will first get a piece of foil paper with our name on it and weigh it. Then we scrape off algae living around the coral and take it out of the water. Then we dry the algae with a paper towel and place the algae on the piece of foil paper. Next, we then wrap the algae in the piece of foil paper and place it in a dry oven to completely dry. Now once the paper is dry we will weigh it and to find the total weight of the algae, only we will subtract the weight of the foil paper from the total weight of the algae and foil combined. This is important to monitor because we can then see how the algae grows under different environments. Since the algae grows back weekly it is actually beneficial for the coral to grow more algae every week.

First steps of building our racks. (Photo taken by William Telios)

References/Literature Cited/Supporting Documentation

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