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Ocean Acidification in the Great Barrier Reef

The Great Barrier Reef has faced many challenges since it was first discovered. The Great Barrier Reef is a large section of coral reef that spans over 1,000 miles long on the northeast coasts of Australia. This reef maintains thousands of species and holds some of the highest densities of wildlife in the world. However, the Great Barrier Reef is under attack. The Great Barrier Reef has suffered for many years as ocean acidification ravages the coral ecosystems and renders them empty husks of what they once were. This paper will analyze and provide solutions to combat this problem and the steps already being taken today.

First, some background knowledge of ocean acidification is required. Carbon dioxide is held in such high atmospheric concentrations that it readily dissolves in water. This combination of H_2O and CO_2 causes one of three separate substances to form carbonic acid (H_2CO_3), bicarbonate (HCO_3^-), and carbonate (CO_3^{2-}) (Uthicke et al., 2014). The creation of these acids through this acidification process increases the pH of the water, which causes corals to suffer since it inhibits their ability to create their hard exoskeletons (Guo et al., 2020). This rise in acidification, however, does not only affect the corals. The increase in the acidification of the ocean damages and inhibits almost all marine life. When looking at the Great Barrier Reef, we see that the entire ridge is made of coral. This specific effect on corals is called coral bleaching. When examining the Great Barrier Reef, we see many locations where the coral has turned pure white due to the loss of the little marine animals called polyps that live in the coral and give it its color. This killing of the corals strips these areas of most of their marine life and creates an underwater graveyard.

Not only this, but the ocean's acidification has also been increasing its temperature and salinity. When looking at multiple areas over the course of 5 years, a study showed a net increase of 0.1 degrees Celsius in the Great Barrier Reef area. While this is seemingly insignificant to us, this temperature increase has terrible effects on the marine life living in the Great Barrier Reef. There is also the problem of increasing salinity. Salinity is the “saltiness” of the ocean, or, more accurately, its concentration of salt ions (van Oppen & Lough, 2018). These salt ions are not the typical table salt that one might think of. These salts are elements such as potassium and magnesium. The increased salinity of the water makes the living conditions increasingly harsh for all marine life. These two elements, paired with the ocean acidification of the water, devastate marine life. As discussed earlier, coral is the most susceptible to these changes since they are stationary. The death of these corals leads to even more problems. Coral filters out a large amount of the calcium in the water (Uthicke et al., 2014). They use this calcium to create their hard exoskeletons. If there is no more coral, they are no longer extracting calcium from the water, which leads to what is called calcification (Mongin et al., 2016). Calcification is essentially just an excess of calcium ions in the water. The reason that this is a problem is because calcification decreases the possibility of photosynthesis. This decreased photosynthesis stunts and harms plant life. The decrease in plant life affects animal life, and the chain continues. In summary, the acidification of the ocean leads to a road of destruction for the ocean.

While there is a lot of doom and gloom around this topic, efforts are being taken to counteract and possibly completely reverse this issue. The UNFCCC, the United Nations Framework Convention on Climate Change, has made multiple plans and proposals to correct the significant problem of ocean acidification (Dobush et al., 2022). Most notably, the climate change convention has two big pushes that they are making. The first of these is to massively reduce pollution in our oceans. Regarding the ocean acidification process, the atmospheric air makes acidification possible. Therefore, if there is reduced carbon dioxide in the atmosphere, this will be enacted with harsher pollution limits, mainly applied to larger corporations that shell out millions of tons of carbon dioxide every year. The other is more direct, as it will monitor the pH levels directly in certain areas and will use alkalinity injection to counter the rising pH levels in those areas. It will target bad spots along the Great Barrier Reef that have suffered from ocean acidification (Mongin et al., 2021). These target locations would be where there is the most marine life to protect. While the second is just a proposal, it still holds much potential for truly reversing the effects of ocean acidification. It uses dissolved silicate, which contains an important mineral called olivine (Mongin et al., 2021). This mineral acts as a sponge to decrease acidification, almost like the corals; it collects calcium and creates tiny deposits that reduce the amount of saturated water in the ocean.

While there is some hope for this bleak problem, it remains an ever-mounting threat to the Great Barrier Reef. Even more so, it has been discovered that any level of ocean acidification will destroy certain species because ocean acidification at any level still affects corals down to their core. This rising problem continues to demand everyone's attention to fix and restore the Great Barrier Reef to the blossoming reef it once was.

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