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Forum: GC3 - Natural Sciences

Issue: Strategies to Assess and Counteract Coral Bleaching

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Introduction

Coral reefs, large underwater structures composed of the marine invertebrate animals named corals, make up less than 1% of Earth's undersea ecosystems. Although 1% is a small percentage, coral reefs are extremely crucial for marine life, and a decline in healthy reefs would be detrimental to all organisms, including humans. Coral reefs are home to 25% of all marine life, a quarter of the ocean's fish, including edible species that are commercially important for humans. This contribution to biodiversity translates directly to a healthier marine life, as well as food security and proper income for humans. Coral reefs also provide barriers against harsh weather conditions such as storms, hurricanes and typhoons in coastal areas. In addition to all benefits mentioned, scientists are working on ways to use coral reefs as medicine, hoping to find cures for diseases like HIV and cancer. Although their specific contribution to curing these diseases are not fully understood yet, it was proven that they have many health benefits, and research is currently going on about this topic. Thus, in addition to providing us with healthy oceans, safe sources of seafood, supported fishing industries, proper tourism and income, coral reefs may also be the source of the next medical breakthrough.

Considering all the above mentioned benefits of coral reefs, it is easy to see how essential they are in the lives of all organisms. Consequently, it should be considered that they also are in need of certain resources and a healthy environment to live in. This is provided to them by the algae that live in their tissues. Algae and corals have a very unique relationship; they depend on each other for their survival. However, corals are facing a terrible threat that forces them to expel the algae from their tissues. Once the coral is left without any algae, it loses its beautiful colors, turns white and soon dies. This process is called coral bleaching and it is becoming a more serious issue with the rise in global temperatures every year.

Thus, the issue of coral bleaching affects not only the corals, but all marine life and humans as well. Although natural causes of coral bleaching cannot be fully eliminated, it is possible to collaborate and work on solving the man-made problems like pollution and global warming that cause bleaching in oceans. If immediate action is not taken on the issue, coral bleaching will go unnoticed and the world will soon lose the beauty and health of its oceans.

Definition of Key Terms

Coral: Marine invertebrates which live in compact colonies of individual polyps



Algae: A diverse group of aquatic organisms with the ability to do photosynthesis

Symbiosis: A type of biological relationship between two organisms, where both sides benefit from their interaction. Corals comprise this unique partnership that benefits both animal and plant life in the ocean.

Coral Bleaching: The situation where changes in conditions such as temperature, light or nutrients stress the corals and cause them to expel the symbiotic algae living in their tissues, turning them completely white

Zooxanthellae: The type of photosynthetic algae that lives in the majority of corals

Mass Bleaching: Wide scale bleaching events

El Niño: An abnormal weather pattern caused by the warming of the Pacific Ocean near the equator. The warming of the water near the equator, as well as the trade winds that blow that warm water to the west causes atmospheric changes which affect weather patterns in many different parts of the world.

Background Information

The mutualistic relationship between modern corals and the algae that live in their tissues began more than 210 million years ago. The connection between algae and coral is crucial in the survival and productivity of coral reefs, which provide habitat for roughly one-fourth of all marine life. The symbiotic relationship between algae and coral is easy to understand: the coral provides the algae a safe environment to live in, as well as the resources it needs to do photosynthesis. Since corals cannot do photosynthesis themselves, the algae provides them with the products of photosynthesis: oxygen, glucose, glycerol and several amino acids required for their living. This is essential for the growth and living of coral reefs. In fact, it was found that as much as 90 percent of the organic material photosynthetically produced by the coral reef zooxanthellae is transferred to the host coral tissue (Sumich, 1996). In addition, the algae also helps the coral in removing wastes and gives its unique color.

Since algae and corals have such a close relationship, their response to the environment depends on each other as well. For instance, because algal cells require light for photosynthesis, reef corals are mostly found in clear waters to capture most light. This relationship between these two organisms and their contribution to marine life is breathtaking, but is threatened by a trend in ocean warming that causes corals to expel algae and turn white, a process called coral bleaching.

The Process of Bleaching and Its Causes

Corals get their beautiful colors, chemical supplies and resources from the algae that live in their tissues. This huge contribution of algae to coral is essential in its survival; the corals cannot survive long-term without any algae living in its tissues. Corals have very specific living conditions, and get stressed when these conditions aren't established. An example would be the limited temperature range within which they can live. If the temperature in the environment gets too hot, the corals get stressed and eject



the algae within their tissues. Once the algae are out, the corals lose their unique colors and supplies, causing them to turn white and lifeless, which is called as “bleached”.

Although coral bleaching has many different causes, the most important one is global warming and temperature changes in oceans, because of the corals’ required temperature range mentioned above. Bleaching can also occur after particularly heavy rainfall, when a sharp drop in salinity causes stress in the algae. Extra bright sunlight combined with warm seawater, disease, pollution or agricultural runoff, changes in the saltiness or salinity of seawater, destructive fishing methods, greenhouse gas emissions, ocean acidification and sedimentation from underwater activities can also cause stressing of corals.

Timeline of Major Events

Bleaching is now happening at a faster rate than ever seen in history, due to the threat of global warming and pollution. However, certain events of mass bleaching that happened in history have speeded up this process, and affected the oceans in terrible ways.

The first incidence of mass bleaching was recorded in 1980, in the Caribbean, eastern Pacific and the Great Barrier Reef (GBR). After this, there have been several mass bleachings in the GBR, and the one in 1981 drew most attention to the association between ocean temperature and coral bleaching.

The mass bleaching in 1997 was extremely widespread. Reefs in over 50 countries throughout the Pacific and Indian oceans, Red Sea and the Caribbean were affected by this event.

The greatest mass bleaching was recorded in 1998 and 2002, along the Great Barrier Reef (GBR). This was linked to the El Nino events which caused waters to become warmer than average, resulting in severe bleaching events all around the world between the years 1998-2006. In the year 2002, around 55% of corals on the Great Barrier Reef were affected by the bleaching, with the water temperature rising greatly. It had then become clear that there was a causal link between the periodicity of bleaching and changes in ocean temperature caused by El Niño cycles.

It is predicted that the water temperature along the GBR will rise 1.1-1.2 degrees Celsius by the year 2050. Scientists are investigating these bleaching events and are concerned that these episodes of mass bleaching will become more frequent and severe with the increase in water temperatures due to global warming.

Major Countries and Organizations Involved

The International Coral Reef Initiative (ICRI)

The International Coral Reef Initiative is a partnership of the United Nations, which aims to preserve marine biodiversity, protect coral reefs and related ecosystems.

UNESCO’s World Heritage Committee



The World Heritage Committee hold annual meetings and is responsible for implementing the World Heritage Convention with the representatives from 21 of the State Parties. The committee can define the usage of the World Heritage Fund, examines reports on the conservation of inscribed properties and asks State Parties to take action when necessary. The work of the World Heritage Committee concerning coral bleaching will be further explained in the following section.

Northwestern Australia, Southern Indonesia, Southeast Asia, and Western Mexico

These places are all extremely dependent on the ecosystem services provided by coral reefs. Their high levels of human coral reef dependence and carbon dioxide related issues cause them to be among the countries that are most severely affected by coral bleaching. With continued bleaching, these countries face threats regarding the safety of their fisheries and shorelines, jeopardizing their lives and economic wellbeing.

Tanzania

Tanzania is one of the countries most affected by coral bleaching, since it is highly dependent on coral related resources and activities. For instance, the El Nino related 1998 mass bleaching event caused mortalities around 80% of reefs in Tanzania. The Pemba & Mafia Islands off the coast of Tanzania were the most affected by this event; around 90% of their reefs suffered coral mortality.

Previous Attempts to Solve the Issue

UNESCO's World Heritage Committee issued its strongest decision concerning climate change in 2017, concerned that coral bleaching had serious impacts on World Heritage properties in the last two years, and that the majority of World Heritage coral reefs are expected to be seriously impacted by climate change in the future. The committee also urged the 193 signatory nations to the World Heritage Convention to address climate change under the Paris Agreement's goal of limiting global average temperature increase to 1.5°C above pre-industrial temperatures. (Day, 2017) Since this is a new event, visible outcomes have not yet been observed, but it is a big step taken in so many years.

Although it was more general and not specifically directed towards coral reefs, Paris Climate Agreement was a huge step towards the protection of the environment and natural resources. The Paris Agreement's aim is to strengthen the global response to the threat of climate change by keeping the global temperature rise low. The agreement's mission does not concern coral reefs specifically, but recent action has been taken to protect corals, in accordance with the Paris Agreement since coral bleaching is becoming a more serious threat every day.

The Coral Reef Task Force (CRTF) was established by the President of the United States in 1998, aiming to protect and conserve coral reefs by mapping and monitoring U.S. corals, researching the cause of bleaching and fighting against these causes. As a principal member of the CRTF, the National Oceanic and Atmospheric Administration (NOAA) has been working to conserve coral reef ecosystems through its Coral Reef Conservation Program (CRCP). NOAA works with scientific, private, government, and nongovernmental organizations through this program, hoping to achieve the goals of the CRTF.

Possible Solutions



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Coral bleaching has many causes. Some of them are completely out of human control, and cannot be fully eliminated with our efforts. These causes include natural events like tornados, storms, hurricanes, natural changes in seawater and heavy rainfall. However, these events only account to a small majority of coral bleaching events. The reason why the rate of coral bleaching is increasing each year can only be linked to our own actions, and the current situation we put our world in. In order to stop coral bleaching, we need to put an end to our selfish and greedy actions. Destructive fishing methods should be stopped, citizens should be more aware of how the marine products they buy are being captured. Pollution should be controlled, factories and private businesses should especially be strictly regulated and educated about how they get rid of their waste in order to protect the oceans. In addition to all these, a more general issue should be tackled: global warming. Scientists state that if coral reefs are to survive in the future, global temperature rise must be less than 1.5°C above pre-industrial levels. With the temperature increasing every year, it is impossible to stop the sea water from becoming warmer, which results in coral bleaching. In order to prevent this, awareness on global warming and individual responsibility should be emphasized. Not only this, but greenhouse gas emissions should be reduced immediately. The goals of the Paris Agreement should be tried to be met more properly and the issue should be taken more seriously. With all these possible solutions in mind, it is up to the delegates of the Natural Sciences Committee to collaborate and to determine other ways to save our corals, and therefore our oceans.

Useful Links For Further Research

The United Nations General Assembly 12 Aug. 2011 - Report of the Secretary-General on the “Protection of coral reefs for sustainable livelihoods and development” →
http://www.un.org/esa/dsd/resources/res_pdfs/ga-66/SG%20report_Coral%20Reefs.pdf

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<https://sustainabledevelopment.un.org/partnership/?p=7888>

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