

FSEM: Sustainable Energy Choices

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Coral Reefs vs. Extinction

The Earth is made up of three-quarters of water. The ocean waters are home to millions of species of animals and plants. From single-celled organisms to more complex animals, water life thrives in the ocean surviving off the abundance that the waters provide. The ocean is home to many ecosystems that depend on each other to survive. Ecosystems are communities of living organisms interacting with each other and their environment. One of the most important ecosystems of the ocean is the coral reef ecosystem. This community is home to hundreds of species of animals and inhabits algae that protect it. Without this ecological system, numerous species will no longer exist, and a natural domino effect will occur. The end of one ecosystem would be detrimental to other surrounding ecosystems in the ocean. Extinction is a concern due to the rise of environmental change and anthropogenic pollution. Before tackling the concerns regarding coral reef ecosystems and the potential solutions to these problems, one must understand what a coral reef ecosystem is, and its importance to the planet and the people that inhabit the planet.

Background

Coral Reefs are benthic organisms that dwell in shallow, warm waters in the photic zone. They are made up of colonies of corals that are minute invertebrates. The coral colonies are made up of individual animals called polyps. Two types of coral exist: stony and soft. Stony corals have six tentacles while soft corals have eight (Harris, 2021). The limestone structure of the reef is made up of secretions of calcium from the polyps to surround itself and protect it from

harsh water conditions. Depending on the conditions of the water currents, the structures of the reefs vary for ultimate protection.

The color of coral reefs is given by the algae that surround the surface of the coral structure. The colonies are covered with “single-celled dinoflagellates” called zooxanthellae (Harris, 2021). Coral and algae share a mutually symbiotic relationship. They benefit each other in many different ways. The algae provide another layer of protection to the colonies while the coral provides the algae with shelter and essential nutrients. While the algae go through the process of photosynthesis, it produces sugar as a byproduct which is then transferred to the coral as another source of food. This exchange provides some coral species with “more than 90% of their nutrition on sunny days.” Alongside the nutrition given by the algae, they also consume their usual planktonic organisms (Harris, 2021). The algae also supply oxygen, from photosynthetic processes, to the coral reef (Allemand and Osborn, 2019). This symbiotic relationship is very crucial for the survival of coral reef ecosystems.

Coral reefs are found in warmer areas that have access to large amounts of sunlight. Coral reefs are mainly distributed around 30° N and 30° S in the tropical and subtropical zones around the equatorial belt (Allemand and Osborn, 2019). Allemand and Osborn point out how Spalding in the article, “World Atlas of Coral Reefs”, says that the distribution of corals depends mainly on the light and temperature of the water (2001). Corals are often found in water with low nutrient concentrations. The Darwin Paradox explains how even though tropical waters have low amounts of nutrients, this is the best environment for the growth of these reefs (Allemand and Osborn, 2019) The movement of water and its continuous flow supply the corals and algae with the necessary nutrients, even if it is a poor amount, and gets rid of the waste that is excreted by the invertebrates (Harris, 2021). Many coral reefs are found in oceans surrounding the Australian

continent. Mainly Australia and Indonesia. Coral reefs are extremely abundant in life and are estimated to be “400 times richer in species diversity than other ocean areas” (Allemand and Osborn, 2019). Coral reefs are the hotels/apartments of the ocean. Biologically, their importance is greater than most might imagine.

The importance of coral reefs socioeconomically is as important as the biological. People all around the world travel to these islands to witness the beauty of these structures. To see for themselves the complexity of their being and how different they are from their imagination. As a result, the locals turned this exchange into revenue. Tourism is the major source of income. Coral reefs provide ecosystem services that create conditions for “human communities to settle and thrive in areas adjacent to the reefs” (Allemand and Osborn, 2019). Reef tourism brings in billions of dollars globally, an estimated amount of about 3 to 375 billion dollars annually (Allemand and Osborn, 2019). Ecosystem services are essentially how the existence of a particular ecosystem benefits its surroundings or humans. The services that the reefs provide are tourism, protection, food, and biodiversity. The reefs attract people from all over the world, bringing in revenue to those regions. Reefs provide an added layer of protection for the coast against strong wave currents that could potentially speed the rate of erosion. Reefs reign in hundreds of different types of fish that the locals can consume. Globally, “half a billion people depend on the reefs for food” (Allemand and Osborn, 2019). The locals can also choose promising fish to be exported to other places for revenue. Reef fisheries, globally, bring in around 5 billion dollars annually (Allemand and Osborn, 2019). Having these different outlets, reefs also provide jobs for the locals in the fishery industry and the hospitality industry. These beautiful sculptures of art offer the world so much. Now that light has been shed on the

importance of these structures, the focus should now shift to unroot the reasons as to why these life forms are in danger.

Threats to Coral Reef Ecosystems

The threats that these life forms face are anthropogenic pollution and environmental changes. Anthropogenic pollution is pollution that originates from human activities. A big example of this would be water pollution from runoff. Agricultural facilities would use fertilizers and pesticides on their crops, when it rains these chemicals would collect in water and make their way down to the ocean. Other anthropogenic issues would include “unsustainable tourism, overfishing, and development of coastal infrastructures” (Allemand and Osborn, 2019). When people come to scuba dive in the ocean to see marine life and coral, often the environment gets accidentally disturbed. Coral can be damaged easily due to its fragility.

The number one pollutant that humans have introduced into the natural world is plastic. Plastic pollution continues to harm marine ecosystems. “Trash such as plastic bags, bottles and discarded fish gear that makes its way into the sea can snag on corals and block the sunlight needed for photosynthesis” (Environmental Protection Agency). Plastic is dangerous due to how it never fully biodegrades. Instead, they break down into very small pieces that end up in the stomachs of marine life. Even the coral can ingest these harmful microplastics that can block their digestive tracts and introduce toxins (Environmental Protection Agency).

An interesting activity that peoples participate in is coral harvesting. Coral harvesting is when people take pieces of coral for their personal use. Whether that is for jewelry or just a new décor piece for their home aquariums. Harvesting can lead to reef destruction and reduced

biodiversity (Environmental Protection Agency). Humans must do better to lessen their imprint in the natural world.

Corals are very susceptible to environmental changes. A global threat that corals are in danger of is global warming. The smallest temperature change can have very strong effects on marine life. “An increase of as little as 1°C above the normal summer sea surface temperature” can interfere with the interaction between the algae and coral (Allemand and Osborn, 2019). The increase in temperature causes the zooxanthellae to break down, this causes the coral to lose its color and protection while revealing its white skeleton. This process is called coral bleaching (Allemand and Osborn, 2019). Coral bleaching is a problem because it perpetuates the disruption of the symbiotic relationship that the coral and algae have. If the algae die off, then the coral is left with fending for itself when it comes to finding additional food sources. Since the water that they inhabit does not supply enough nutrients, ultimately, they will die. The first recorded event of bleaching was in the 1980s. The events of bleaching usually last up to a few weeks or a few months (Spalding and Brown, 2015). An interesting point made by the Intergovernmental Panel on Climate Change is that, if temperatures rise 1.5°C, the expected coral reef loss is to be 90% but certainly 100% if it reaches 2 °C (2018). This should be alarming to many, especially to those in power. When any species is in the grip of extinction, attention should be redirected, and concern should be met with action.

Another environmental challenge the coral ecosystem must face is the effects of ocean acidification. Ocean acidification is a process by which carbon dioxide dissolves in the water resulting in the pH decreasing. This increase in acidity is not healthy for coral reef ecosystems. “Ocean acidification threatens coral reef futures by reducing the concentration of carbonate ions that corals need to construct their skeletons” (Mollica et al., 2018). When there is a reduction in

the material that makes the structure, it may cause the structure to not be stable. The skeletal density of the reef structures is very sensitive to changes in the water. Ocean acidification directly affects the density but not the linear extension of the reefs (Mollica et al., 2018). This results in the structure becoming more fragile. This dissolution of carbon will continue to rise while the emission of greenhouse gases continues. The water cycle will continue to cycle, causing the gases in the atmosphere to find their way into the oceans.

Solutions

Now that the concerns have been voiced, discussions should be made about the potential solutions and actions that should be taken to prevent the loss of coral reefs. Allemand and Osborn made a point that the only long-term solution is to control the carbon dioxide emissions in the atmosphere, resulting in the reduction of global warming (2019). If the emissions continue to be distributed into the atmosphere, they will continue to make their way to the ocean through the water cycle. Subsequently, ocean acidification will continue to be a recurring problem in the ecosystems. Finding alternative energy sources, to power the world's needs, will be necessary to reduce the use of fossil fuels. Fossil fuels are the main cause of greenhouse gas emissions in the atmosphere. This then results in global warming causing sea temperatures to rise.

Action needs to be taken sooner. It will take longer to get the emission issue under control so instead focus should be shifted elsewhere. There are different ways to go about acting. Allemand and Osborn adapted the diagram of Gattuso et al. (2015), based on the four clusters of action against climate change, to exhibit the solutions for coral reefs (2019). These divisions are called Mitigation, Protection, Adaption, and Repair (2019). Mitigation is the process of removing something that is causing severe harm to something. In this case, mitigation would be removing the main source of harm which would be carbon dioxide/greenhouse emissions. Controlling

human-made pollution would also fall under this category. Protection is the category that would be about making laws and regulations that create limitations. Some examples of protection would be the creation of marine protected areas, developing mooring buoys, and promoting marine conservations (Allemand and Osborn, 2019). Protection can range from guaranteeing consequences for negligence to finding ways to ensure the survival of the resilient species of corals. Adaption entails what they can do to ensure the survival of the coral going through these events. What measures should be taken to guarantee their survival through these current events? To help the coral adapt people can promote blue economies that embody sustainable principles (Allemand and Osborn, 2019). The blue economy is where money is made through environmentally conscious outlets, such as sustainable fishing or tourism. The last method is through repair. This category is centered around repairing and restoring the already damaged coral ecosystems (Allemand and Osborn, 2019). There are a couple of ways that this restoration can happen. Colonies can be taken from areas that are resilient to change and replant them on rocks and let them regrow or breed the resilient corals to produce corals with resilient phenotypes that can be reintroduced in the benthic communities that are struggling the most (Allemand and Osborn, 2019). Repair and restoration can lead to positive outcomes if the focus is sufficient. Government officials need to either follow suggested actions or actively make their own to ensure the safety of the environment. The natural world is being critically imprinted on by humans and it is time that the planet wakes up and is made aware of its negative actions.

As individuals, some simple lifestyle changes can be made to reduce anthropogenic waste. People who like to visit coral reefs can practice safe diving and snorkeling techniques. This includes avoiding touching the reefs. Fishermen or people that own boats should resist placing their anchors on reef structures. They might look like they are strong and sturdy, but the

reality is that they're very fragile. In the day to day, people can practice recycling and properly disposing of their trash. This can minimize the amount of trash that enters the ocean. The Environmental Protection Agency even suggests reducing the amount of fertilizer use and using environmentally friendly modes of transportation as conscious ways to lessen the threats against coral reef ecosystems. To get people involved in such a cause information needs to reach the public. Many forms of media can be manipulated to voice the concerns of the people.

In summation, the coral reef ecosystem is in a battle against extinction, and it is up to the people to be aware of the threats and solve them. Coral reefs are living things that are extremely fragile to change. They depend on a symbiotic relationship with an alga called zooxanthellae that provides it with additional sources of food and oxygen. They are very comfortable in warm water with access to large amounts of light. They are important for biological and socioeconomic reasons. Reefs provide economic resources that help people thrive and settle into coastal communities. They are threatened by anthropogenic pollution and environmental change. With the effects of coral bleaching and ocean acidification, extinction continues to have the upper hand. If an ecosystem dies, it will cause a mass domino effect through the ocean. This will affect all surrounding ecosystems. One's comfort should not come at the expense of another being's life. Everyone should have a sense of awareness to ensure the safety of all the planets' inhabitants. There are four different ways to act which include the methods of mitigation, protection, adaptation, and repair. The planet needs words to be met with action. Now is the time to stop the clock and knock extinction out of the ring for good.

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