**Land and Food: Ocean Acidification**

"Entire ecosystems are collapsing. We are at the beginning of mass extinction, and all you can talk about is money and the fairy tales of eternal economic growth… How dare you," says Greta Thunberg, a climate activist. Greta establishes that the world is experiencing climate change, and it is contributing to significant adverse effects. Human activities are leading to the production of large amounts of carbon dioxide into the atmosphere. The carbon dioxide gases trap heat, which causes adverse effects on the lands, water bodies, and the general ecosystem. Also, climate change is causing changes in the chemistry of ocean waters. Seawater absorbs carbon dioxide from the atmosphere lowering the water pH. A lower water pH causes severe marine life effects, leading to their death, poor development, or extinction. The rising carbon dioxide concentration in the atmosphere, which occurs due to climate change, contributes to ocean acidification that causes marine species' death or makes the seas inhabitable for aquatic species.

Research and Analysis

Ocean acidification is an indicator of climate change; it is one aspect of global climate change. Human activities lead to the emission of large amounts of carbon dioxide into the atmosphere. The carbon dioxide forms a blanket around the earth and traps energy in the atmosphere causing it to warm. Typically, cold-water coral ecosystems provide a nourishment ground, vital habitat, and nursery function for several deep-water marine species, especially most commercial fishes (Guinotte & Victoria 337). However, acidified water tends to be warm, making it hard for the ocean marine species to survive in such waters.

Further, there is an increase in the ocean waters' acidity as the water bodies absorb carbon dioxide. The ocean absorbs around 30% of the carbon dioxide released into the atmosphere (National Oceanic and Atmospheric Administration 1). With high carbon dioxide levels, the oceans develop low levels of aragonite saturation levels, making it difficult for some organisms to build and maintain their shells or skeletons (Environmental Protection Agency 1). The aragonite quantity level problem is predominant in the tropical waters. Aragonite is a primary biogenically formed carbonate mineral produced by marine calcifiers. The amount of these minerals depicts the level at which marine organisms' biogenic calcium carbonate precipitation is favored. Halimeda, a green calcifying microalga, exhibits a negative calcification response when it comes into contact with a pH drop of around 0.5 (Guinotte & Victoria 334). Based on this premise, the ocean acidification phenomenon is altering water chemistry from the deep sea's darkest depths to shallow waters.

Ocean acidification is currently affecting the entire ocean, including waterways and coastal estuaries. Presently, over a billion people globally rely on food from the sea as their primary source of food (National Oceanic and Atmospheric Administration 1). Fish is their primary source of proteins, which is essential to building the body. As a result, food security and jobs rely on the shellfish and fish in our oceans. Many economies and jobs in America and worldwide rely on the shellfish and fish that live in the ocean waters (National Oceanic and Atmospheric Administration 1). If there are limited sources of fish for the people living in those surrounding and across the markets, then there will be food insecurity and impaired economies.

Furthermore, research data shows that approximately 50% of marine life is projected to be affected by ocean acidification. Based on this information, ocean acidification is highly likely to result in harmful/adverse effects. The Pacific Ocean is presently becoming very acidic and negatively impacting the cash-crabs that inhabit its coastal waters. If the crabs continue to experience injuries due to the lower pH in the seas, the coastal economies could record significant losses. There could be a mass extinction of the fishes leading to loss of food and livelihood.

Ocean acidification is fast changing the carbonate system of the global oceans. A high amount of carbonic acid in the oceans disrupts the balance of minerals in the water. This change makes it difficult for planktons, corals, and creatures to produce calcium carbonate mineral. This mineral is the crucial ingredient in their shells and hard skeletons (Environmental Protection Agency 1). With a lower pH, these animals cannot survive in the oceans. The cumulative effect is a change in the ocean's coastal ecosystems and structure, affecting the fish population and those who depend on the fish as their source of food. Shellfish such as oysters, mussels, tiny shelled organisms, and abalone cannot build their shells or reproduce in acid waters. Sea butterfly/pteropods are a critical part of several food webs as they are eaten by organisms ranging in size from whales to tiny krills. There is a significantly high pteropod shell dissolution in the Southern Ocean (Environmental Protection Agency 1). The chemistry of the ocean waters is a severe problem for the ocean ecosystem.

Additionally, the Dungeness crab key to Pacific Northwest commercial fisheries is experiencing severe damage to their sensory organs and shells dissolving due to lower pH levels in its habitat (Andrew 1). The young crabs that show signs of dissolving shells tend to have a small size than the other larvae. This feature causes developmental delays that may impair their maturation rate. Further, crabs often have tiny-hair-like structures they use to navigate their environment as they look for food. These mechanoreceptors are damaged by the acid in the water, slowing movement in the seas and making swimming difficult. Corals and crustaceans rely on carbonate ions to build their coral skeletons and shells (Van Woesik et al., 3). However, acidic waters have lower amounts of this chemical, making it hard to build their skeletons and shells, essential for their healthy functioning. If the marine organisms cannot achieve healthy growth, humans who consider them their primary food source will lack nourishment. That said, ocean acidification is a serious problem to our ocean ecosystem, impacting the population of shellfish and other marine species.

Ocean acidification affects the behavior of the non-calcifying organisms. It impacts the behavior of the predator-prey response of particular marine animals, most especially sea snails. The ability of Clownfish to detect predators is lowered in very acidic waters (National Oceanic and Atmospheric Administration 1). According to research studies, lower pH levels affect the larval clownish fish's ability to locate suitable habitat. Since these organisms are at risk of dying, the entire food web is put at risk. The ocean waters acidification often targets the young shells of the Dungeness crab larvae impairing their ability to regulate their buoyancy and ability to deter predators (Andrews 1). Even though some organisms are harmed by ocean acidification, some benefit from higher carbon dioxide in the water bodies. These species need this gas for photosynthesis like plants on land. They help control the amount of carbon dioxide gases in the water lowering the acidity. Sadly, this is not enough to reverse the hostile environment in acidified ocean waters.

Nevertheless, there is highly likely to be a mass extinction of marine species if the trend of ocean acidification continues. According to Guinotte and Victoria, some of the past mass extinctions events have been associated with ocean acidifications. Also, extinction is linked to the present rate of change in ocean water chemistry (334). It is crucial to minimize ocean waters' acidification by preventing the mass extinction of ocean organisms.

In conclusion, anything we do today to mitigate climate change will benefit the future of oceans too. Ocean acidification is an aspect of global climate change that requires the world's urgent attention. This phenomenon contributes to the shift in predator-prey behavior of marine species, death, and poor species development. Due to the changes to the ocean waters' chemistry, there is a limited number of marine species, such as crabs, planktons, oysters, and others in the ocean waters. Various relevant environmental agencies, public and private individuals have studied ocean acidification's possible effects to determine how to mitigate the problem. It is up to the relevant stakeholders to collaborate and monitor ocean acidification impacts and develop initiatives to manage this problem. As the pace of ocean acidification continues to accelerate, it is up to resource managers, scientists, and policymakers to acknowledge the importance of strengthening science as a basis for sound decision making and actions.

I have learned about my topic that relates to people, places, and the environment because an imbalance in one part of the world ecosystem affects one or the other parts. While climate change causes adverse effects on society's welfare and health, it similarly affects the oceans. Climate change causes ocean acidification, especially in the Pacific Ocean, the Southern Ocean, and other sea waters. Ocean acidification affects ecosystems and organisms, impacting ecosystem services such as food security through endangering aquaculture and fisheries. It contributes to the death of most marine species that are the primary source of food/proteins for most people across the globe. In essence, it disrupts the food web, negatively impacting all the organisms relying on the ocean. Overall, it impairs the ocean's capacity to absorb and store greenhouse gas and regulate climate change. The best way to address this problem is by reducing our carbon footprint to lower the amount of carbon dioxide absorbed by the oceans. One such way of doing this is by limiting the human activities that lead to greenhouses' production emitted to the atmosphere, such as fossil fuels.

Additionally, it is essential to teach the people and wildlife how to adapt to the changing sea waters. We may save our ocean ecosystem and guarantee food security and stable economies for present and future generations through these actions. We also protect our environment from further adverse effects. Our world is getting warmer; soon, we may not have a place to call home. As Greta Thunberg states, the entire ecosystem is collapsing while we are prioritizing profit over environmental protection. We have to start making decisions on our environment or planet based on scientific knowledge.

Works Cited

Andrew, Scottie. “The Pacific Ocean is so acidic that it's dissolving Dungeness crabs' shells.”

CNN, January 27, 2020. Retrieved from [https://edition.cnn.com/2020/01/27/us/pacific-ocean-acidification-crabs-dissolving-shells-scn-trnd/index.html Accessed on November 6](https://edition.cnn.com/2020/01/27/us/pacific-ocean-acidification-crabs-dissolving-shells-scn-trnd/index.html%20Accessed%20on%20November%206), 2020.

Guinotte, John M., and Victoria J. Fabry. "Ocean Acidification And Its Potential Effects On

Marine Ecosystems." Annals of the New York Academy of Sciences 1134.1 (2008): 320-342.

National Oceanic and Atmospheric Administration. “Ocean Acidification.” Governmental

Website, 2020. Accessed on November 6, 2020 from <https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-acidification>

United States Environmental Protection Agency. “Climate Change Indicators: Ocean Acidity.”

Governmental Website, 2020. Accessed November 6, 2020 from <https://www.epa.gov/climate-indicators/climate-change-indicators-ocean-acidity>

Van Woesik, Robert, et al. "Effects of Ocean Acidification on The Dissolution Rates of Reef-

Coral Skeletons." PeerJ 1 (2013): e208.