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Climate Change Research

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The Coral Curtain Call

I. Abstract

The purpose of this paper is to analyze the degradation of the Great Barrier Reef located off the coast of Australia. The highly diverse marine community of reefs offers an array of ecosystem services and should be conserved. Research will include information about factors which are thought to be the primary cause(s) of coral bleaching: ocean acidification as a result of carbon dioxide emissions produced by human activity. Methods involved in the formation of this paper include research within online databases, as well as background information derived from the entry-level Pearson textbook *Environment: The Science Behind the Stories*. In addition, this paper will present first-hand experience of interaction with the Great Barrier Reef. Results indicate that increased ocean acidification, caused by carbon dioxide emissions, is the primary reason for the observed death of coral reefs. To cease the ongoing demise of the Great Barrier Reef, human carbon dioxide emissions need be drastically reduced. The implementation of integrated monitoring is a valuable approach to further expand the knowledge of the current state of the coral reefs, and will illuminate necessary changes humankind should make in order to safeguard the remaining coral communities. These changes include possible successes, limits, and consequences which may arise as a result of advanced monitoring.

II. Introduction

The Great Barrier Reef is a 2,000-km-long community of an estimated 2,800 coral reefs off the northern coast of Australia, reaching as far as the Coral Sea (Schiller). The reef is deemed a World Heritage Site, which means that it is recognized as possessing significant international importance and therefore deserves special protection. Despite this highly esteemed classification, this ecosystem faces a possible irreversible eradication. A coral reef is defined as “a mass of calcium carbonate composed of the skeletons of tiny marine animals known as corals” that hosts a tremendous amount of biodiversity (Withgott 431).

The reef is a cornerstone of Australian heritage, and it also generates a vast amount of economic benefits through ecotourism, recreational activities, commercial fishing, and more. A “2007 report by Access Economics for the Great Barrier Reef Marine Park Authority found that the total economic contributions to Australia from tourism, commercial fishing, and recreational activities in the [Great Barrier Reef] totaled more than \$AUS 5.7 billion (approximately \$US 5.9 billion) from [2005 to 2006]. The report also found that these activities accounted for a direct and indirect national contribution of 66,000 full-time equivalent jobs” (Schiller). Despite the widely held belief that the Great Barrier Reef is the seventh wonder of the world and should be conserved, it is in a rapid state of decline. Threats to the livelihood of the reefs stem from ocean acidification, pollution, climate change, overfishing, and coastal development. Many of these issues are correlated with the emission of carbon dioxide. Human activities also cause the other factors, such as overfishing and coastal development.

The purpose of this article is to examine the variables causing peril to the reef, and to further discuss a possible method of conservation that can be taken to safeguard the coral communities.

This method will elaborate on mediums by which integrated monitoring operates, specifically in regards to coral reef observation. An introductory Environmental Science course and readings from an overview-level textbook motivated the advanced research presented in this study. Definitions will be provided which are relevant to the issue at hand. Peer-reviewed articles were used to extend research to ensure the credibility, reliability and timeliness of the information gathered. It should be noted that any and all articles cited in this study are esteemed and scholarly-reviewed. I will present descriptions about the reefs from my first-hand experiences while in Australia and relate them back to the gathered data. An analysis of the negative human impacts on the reef will be conducted with the primary goal to identify the most severe influence. Analysis of currently implemented methods to protect the reefs are not within the scope of this paper. Current attempts to protect the reefs are too vast and intricate to address within this study. This research is limited to academic texts at this time.

III. Results

The Great Barrier Reef Marine Park Authority is responsible for ensuring the conservation and protection of the reef, but despite being a marine protected area, the reef has suffered from a “50 [percent] loss in coral cover between 1985 and 2012...” and from 2015 to 2016, also fell victim to “the worst mass bleaching event on record, in which 93 [percent] of the 911 surveyed reefs experienced bleaching” (Albright). Increased ocean acidification subsequently leads to other factors, all of which contribute to the degradation of the Great Barrier Reef. Ocean acidification is the process whereby the ocean absorbs carbon dioxide which subsequently leads to a decrease in pH and the concentration of dissolved carbonate ions (Albright). Calcification is the process in which marine creatures build calcium carbonate shells,

and “as the availability of carbonate ions in the water declines, it gets more difficult to build” these shells, and as “acid....ions become more common in the water...shells of marine creatures like corals even begin dissolving” (Withgott 428-429). The world’s oceans have absorbed 30 percent of carbon dioxide emissions produced by human activities (Albright). The causes of these emissions range from combustion of fossil fuels to global warming, which is a human impact. It is apparent that human activity, most notably the increased emissions of carbon dioxide, has led to the increased acidification of oceans, therefore degrading the Great Barrier Reef.

As a result of the research conducted, it has been verified that the Great Barrier Reef is at an increased risk of ultimate degradation. Changes in environmental conditions and major human impacts have led to this tragic environmental loss. The primary cause of the decline of the reefs is ocean acidification, which has wide-reaching impacts within a marine ecosystem. This has been verified, as “chemistry tests in the lab show that coral shells begin to erode faster once the carbonate ion concentration falls below 200 micromoles/kg of seawater” (Withgott 429). Field researchers have confirmed this by proving “reefs are growing only in waters with greater than 200 micromoles/kg of carbonate ion availability,” which is significantly decreased due to ocean acidification (Withgott 429).

The current state of knowledge on this topic is that the Great Barrier Reef is still in decline, and there is no feasible way to restore the reefs that are already dead. Studies have shown that the concentration of carbonate ions described above “is what we would expect to result from an atmospheric [carbon dioxide] concentration of 480 parts per million (ppm). Earth’s natural (‘preindustrial’) level was 280 ppm, and today we have raised it above 380 ppm”

(Withgott 429). This data asserts that we are slightly over the halfway mark at which coral reefs will “begin to dissolve in most of the areas they now exist” (Withgott 429). Ultimately, these statistics provide the understanding that atmospheric carbon dioxide concentrations have increased dramatically since the preindustrial era; ocean waters are falling victim to this increase, as they reflect carbon dioxide concentrations well above normal levels—higher than what is actually present in the atmosphere today. The facts are clear: the oceans are becoming more acidic, and as a result, the demise of the reefs is inevitable unless drastic actions are taken and successfully implemented.

IV. Discussion and Conclusions

My personal experience in Australia deeply impacted me, and I completely fell in love with the country and its culture; it is a tragedy that such a major characteristic of the land is being lost. I had the opportunity to snorkel within several locations of the Great Barrier Reef, and I was shocked at what I saw. I am an avid swimmer, so I ventured further than my peers; I was curious to see for myself the state of the reefs. The primary spot in which I was snorkeling was absolutely beautiful; it hosted a large amount of biodiversity. I saw fish of all kinds, sea turtles, vivid corals, and more. However, as I ventured further towards the outskirts of the main reef, I was heartbroken to view dismantled reefs. The surrounding reefs were entirely bleached, entirely lifeless; there was very minimal marine life surrounding them. I am personally very saddened by the knowledge I have gained. Although I was very disheartened by viewing the status of much of the reef, I was and still am grateful that I was able to experience it for myself, rather than simply accepting what I have been told. I was then able to form my own opinion and understanding of the Great Barrier Reef. It is an issue I have become passionate about since returning from

Australia. Keeping in mind my memories of the reef, I feel as though the data and research I have gathered validate my perception.

Coral reefs provide many essential ecosystem services, and without “living and growing...reefs, the rich communities of reef-dependent animals will likely collapse. For human society, fisheries will decline, tourism will wither, and coasts will lose protection against storm surges” (Withgott 249). Ultimately, the demise of the Great Barrier Reef has (and will have) far-reaching effects, those of which are not immune to impacting humans.

It is important to know from this point how/what could be changed to minimize the negative impacts on the reef. These change will need to take place on the human-level, as “results [have] predicted that as atmospheric [carbon dioxide] levels rise, coral reefs will shrink in distribution, diversity, and density” (Withgott 429). These results have forced humankind to adapt particular methods by which they may be able to secure the remaining reefs. Greater knowledge entails greater work to be done, and the Great Barrier Reef is no exception.

Only by analyzing the current state of the reef, ocean, and marine life can the impacts of the current changes be known and used to plan effective interventions. This entails taking on an adaptive-management approach, in which “monitoring is used to update system models with data and management responses in a process of continuous improvement” (Hedge). This type of monitoring is deemed integrated monitoring, which is “described as ‘the systematic, consistent, and simultaneous measurement of physical, chemical, biological and socio-economic variables of different ecosystem compartments, over time and specified locations’” (Hedge). Utilization of integrated monitoring will allow researchers to gather a great deal of data about various reefs within the entirety of the Great Barrier Reef; this will further allow them to analyze why

particular areas are more affected than others, and thus understand how to better minimize the impacts on the reefs. This approach has the capacity to be guide efforts to conserve the remaining reefs if it is planned and operated efficiently; in this case, there are two major benefits expected as a result: “firstly, a better understanding of the cause-and-effect relationships within coupled socio-economic and ecological systems, and the response of these systems to management actions...secondly, the cost-effective use of available resources for monitoring priority values” (Hedge). If humankind is to make the effort to truly conserve the remaining coral reefs, “ultimately the only effective solution is to reduce our carbon emissions, and soon” (Withgott 429). A drastic reduction of these emissions is required if humans are to continue reaping the benefits and services that the Great Barrier Reef provides.

As a fellow earthly species, we harbor a responsibility of sorts to protect and conserve all forms of life, and such a beautiful wonder of the world is a great place to start. Although there is no possible way to give life back to the reefs that have already been bleached, there is still hope for the remaining ones. The World Heritage Site that is the Great Barrier Reef should be treated as such; the loss of such a wonder of the world means a loss of the world heritage it represents. Humans have the choice to make a change for the greater good of the health of the reefs and for the conservation of a cornerstone of Australian and international culture. Hope is what can and should drive the powers of integrated monitoring. This underwater mecca is well deserving of human attempts to salvage the reefs left in the wreckage of our own doing. Adaptation, implementation, conservation: the perfect storm to cease the one ongoing in the Great Barrier Reef.

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