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Ecology Final

Project Summary: Ocean Acidification

It is well known information by this point that our carbon emissions are negatively effecting the environment around us in a huge way. The excess CO2 has caused a greenhouse effect, warming the earth at a faster rate than ever before. However, the growing knowledge of how increased carbon dioxide is effecting our oceans has perhaps been overlooked. Oceans are slowly becoming more and more acidic, harming the delicate ecosystems beneath the surface.

In the past, during the Paleocene-Eocene Thermal Maximum (PETM), carbon dioxide levels were comparable to today. Many of the organisms in marine ecosystems were degraded, but slowly showed resilience. Today, however, with human impact included, concentration of CO2 is growing around 10 times as fast than any other time known in history. (1) This means that we can't easily predict how ecosystems will respond, but it will likely be negative. Over the past 250 years, there has been 40% increase in CO2. (2)

The ocean can absorb a certain amount of CO2, but once a certain threshold is crossed, many calcifying organisms are literally dissolved. These organisms, such as plankton, corals, coralline algae, and other invertebrates, have CaCO3 (calcium carbonate) in their shells and skeletons that help absorb CO2. (2) Research has determined that calcifying organisms show the most negative effects (not including crustaceans) while jellyfish, seagrass, and algae seem to be unaffected. (1, 3) Studies have also shown that acidification results in more bleaching and productivity loss in corals. (4) These marine ecosystems are very delicate, and are difficult or impossible to build back up once lost. Effects on more complex organisms, such as fish, have yet to be studied for effects from over acidification, but the loss will likely trickle into the rest of the ecosystem.

In my final project piece, I have illustrated a picture of a healthy coral ecosystem on one side of the image, and on the other, a barren picture of what many ocean floors could look like with increased acidification. I wanted to show the stark difference between the states. It is often difficult for people to perceive how their actions can attribute to negative impacts around the world from human activities; hopefully my project could aid a viewer in this pursuit, and encourage him or her to consider reducing their personal carbon emissions.

Bibliography

1.) *The Acid Sea,* Elizabeth Colbert, National Geographic, April 2011.
http://ngm.nationalgeographic.com/2011/04/ocean-acidification/kolbert-text/2

This source shows the effects of over-acidification (mostly from volcanic activity) on the island Castello Aragonese in the Tyrrhenian Sea and explains how this may be the future of many coral-producing areas by 2100: depletion of coral and their surrounding ecosystems leaving only jellyfish, seagrass, and algae to survive in such high CO2 rates. It is explained that carbon emissions by humans will be responsible for the loss; although there is evidence that nature has redeemed itself through periods of high CO2 concentration (Paleocene-Eocene Thermal Maximum), the earth has never experienced CO2 being released at such high rates as today.

2.) *Ocean Acidification: The Other CO2 Problem,* Scott C. Doney, Annual Review of Marine Science, Vol. 1, pgs. 169-192, January 2009.
http://www.annualreviews.org/eprint/QwPqRGcRzQM5ffhPjAdT/full/10.1146/annurev.marine.010908.163834b

This source discusses many of the effects and potential effects of the 40% increase of CO2 over the past 250 years. It explains that the oceans ability to absorb CO2 is dependant on how much CaCO3 (calcium carbonate) exists which comes from the shells and skeletons of plankton, corals, coralline algae, and other invertebrate organisms. This causes these organisms to literally dissolve when there is too much CO2, which greatly effects the surrounding marine environment.

3.) *Meta-analysis reveals negative yet variable effects of ocean acidification on marine organisms,* Kristy J. Kroeker, Ecology Letters, Vol. 13 Issue 11, 16 Aug 2010.
http://onlinelibrary.wiley.com/doi/10.1111/j.1461-0248.2010.01518.x/full

This source shows scientific data showing the variation of effects on marine life by CO2. It showed that calcifying organism by large showed more negative effects than non-calcifying organisms, not including crustaceans. It also showed that results differed among different mineral forms of CaCO3.

4.) *Ocean acidification causes bleaching and productivity loss in coral reef builders,* K. R. N.

Anthony, PNAS, Vol. 5 No. 44, 11 Nov 2008.

http://www.pnas.org/content/105/45/17442.full.pdf+html

This source shows the results of an 8-week study which compared the bleaching, productivity, and calcification of different types of coral. The data implied that acidification affected bleaching and productivity more than calcification, and that sensitive crustose coralline algae will be affected immediately, while corals response to increased CO2 will be more delayed.