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Plankton and Prometheanism: A Look at Carbon Sequestration and Ocean Policy

Introduction: Global Climate Change and Ocean Fertilization

Since the Industrial Revolution, humans have significantly added large amounts of heat-trapping greenhouse gases into the atmosphere. The burning of fossil fuels, along with other human activities, have changed the composition of the atmosphere and in turn, have adversely altered temperature, precipitation patterns, sea-levels, and storm patterns (Climate Change Science 2006). While there are uncertainties associated with the projected future of climate change, the scientific community has reached a strong consensus that global climate change does in fact exist and is a serious problem (Global Warming Basics 2006). Scientists know that human activities are responsible for the atmospheric buildup of carbon dioxide and other greenhouse gases, and that the increase concentration of greenhouse gases is increasing the average global temperature (Climate Change Science 2006).

One proposed solution to global warming is carbon sequestration. Also known as carbon capture and storage, this solution would involve taking carbon dioxide from industrial and energy-related sources and depositing it into a "sink" such as forests, soils, or the ocean to isolate it from the atmosphere. There are several types of carbon sequestration, such as terrestrial or geological sequestration, and deep-ocean sequestration. One idea for oceanic sequestration is to have the carbon pumped directly into the deep water. As it can be sequestered straight from the source, this solution is most applicable to point sources of pollution such as industrial plants. Ocean fertilization, discussed later, is more feasible for sequestering carbon from diffuse sources such as air pollution from cars.

In order to counteract anthropogenic carbon dioxide emissions, some scientists have proposed artificially enhancing natural carbon sequestration in the oceans. Adding tiny particles of iron in the form of dust to ocean water is one way to do this. This iron "fertilization" would stimulate the growth of phytoplankton in areas where primary production is iron-limited. Such areas are called High Nitrate Low Chlorophyll (HNLC) areas, and are mostly in international waters in the Southern Ocean and Equatorial Pacific. The plankton would remove large amounts of carbon dioxide during photosynthesis and in the creation of calcium carbonate shells. Upon death, the plankton would then sink, bringing the carbon they uptake into deep water and ultimately bottom sediments.

There is much debate about the effectiveness of using ocean fertilization as a climate change mitigation strategy. One study found that after one hundred years of fertilizing the Southern Ocean (16% of the world's oceans by area), there would be a decrease of 90-107 ppm of carbon dioxide when accounting for anthropogenic emissions. Ocean fertilization would also be a relatively inexpensive mitigation strategy, costing just $1 to $2 per metric ton of carbon sequestered (IPCC 2005). There are many uncertainties about this strategy, however. Not much research has been done that details the full affects of this process, leading to fears that ecosystem damage, nutrient redistribution, or creation of anoxic zones could result. Additionally, massive inputs of carbon to the ocean lower the pH, making the water more acidic and stressing marine organisms, many of which have a narrow tolerance range. Another issue is one of location in the water column: only 10-20% of carbon is sequestered in deep ocean sediments, and would thus

resurface on the scale of millions of years. The rest is sequestered in deep ocean water and would thus resurface on the order of only thousands of years, leading many scientists to wonder if this strategy is worthwhile.

Meanwhile, the Federal government seems to have faith that ocean fertilization is a real and plausible solution to global climate change. The Department of Energy has several projects and initiatives looking for a "quick fix" to global warming in carbon sequestration. One example is the FutureGEN project- a one billion dollar initiative to create a coal-fired power plant that sequesters its own carbon emissions . The Carbon Sequestration Leadership Forum is an international panel that meets regularly to discuss the growing body of scientific research and emerging technologies and plan joint projects for carbon sequestration. The Carbon Sequestration Core program is part of the DOE's program to develop a portfolio of technologies that can capture and permanently store greenhouse gases.

There is clearly a disconnect between policy makers and the scientific community – the former is out for a "quick fix" to climate change, which creates a lack of objectivity for the many scientific studies of ocean fertilization funded by the DOE program. The scientific community wants to study ocean fertilization for its inherent value to understanding the physical and ecological processes as well as paleoclimate in the ocean, rather than for its potential as a solution to global warming. There needs to be an increase in communication and understanding between scientists and policy makers if a feasible mitigation strategy for climate change is to be found.

International Ocean Policy

While there is certainly a large disconnect between policy makers and the scientific community on the topic of ocean fertilization one must assume, as in so many other cases concerning science and policy, that government officials will proceed despite objections from the scientific community. Therefore, going along with the idea that ocean fertilization will one day become a reality, it is necessary to examine the relevant institutional framework that is already in place to deal with such an issue. However, in order to truly understand the relevance of these existing institutions, one must first comprehend the evolution and history of the policy concerning the world's oceans.

The first and perhaps one of the most important documents written on international ocean policy was produced by Hugo Grotius in 1609. Created mainly in an attempt to protect navigation rights of European explorers, *Mare Liberum* (commonly known as the "Freedom of the Seas" Doctrine) was produced in response to European imperialism (Jacques and Smith 105). This doctrine established the seas as a global open-pool, inexhaustible resource, which everyone has the right to use, regardless of location or affinity. This declaration ultimately set the tone in ocean policy for the next 350 years, but would eventually be contested as the worlds fisheries became not only industrialized, but a major force within the global economy (Jacques and Smith 7). While there were certainly issues that came up prior to the end of this time period (for example, the establishment of the 3 mile territorial seas in 1839), it was not until the mid 1940's to late 1950's that the standard set by *Mare Liberum* truly began to be questioned (Jacques and Smith 107).

The evolution and redefinition of ocean policy that has occurred can almost entirely by attributed to disputes within the world's fisheries. Without the dialogue created by this industry and its people, it can be reasonably argued that ocean policy never would have gotten past the standard set by the Freedom of the Seas Doctrine (which is the primary reason why the industry

got into so much trouble in the first place). The most harmful aspect of this doctrine, with respect to fisheries, specified that while the oceans could be owned be no one, its resources were available to all (Jacques and Smith 8). However, what is also important to note is that during this point in time it was not believed that human beings could have any sort of impact (positive or negative) on the ocean both for its size and abundance of its resources. For this reason no one saw any issue with exploiting these resources to their fullest extent. However, as cod fisherman would find out in the 1950's with the Cod Wars, the oceans resources were by no means infinite (Kurlansky 52).

On the other hand, indicators that people were beginning to realize that the oceans resources were, in fact, finite began popping up long before the 1950's. From the declaration of the 3 mile territorial Seas in 1839 to Britain's Sea Fisheries Act of 1889, there were many indicators that nations were slowly coming to the realization that the oceans had limits (Jacques and Smith 107-109). However it was not until September 28, 1945 that the true indicator of this recognition came when President Harry Truman declared U.S jurisdiction and control over both the continental shelf as well as all coastal fisheries (Wyman 38). What this meant to the rest of the world was that, while the U.S. could exploit other nations coastal resources to our hearts content, other nations could not do the same to our own coasts. Obviously, this hypocritical stance did not sit well with the global community and prompted a global discussion that inevitably lead to the formation of UNCLOS (United Nations Convention on the Law of the Sea), which is today's primary legal document on international ocean governance, law, and policy (Jacques and Smith 8).

UNCLOS is actually the combination of three separate meetings by the United Nations, beginning in 1958 and culminating in 1982 with a working treaty (Jacques and Smith 114-119). The key detail to note concerning the ratification of UNCLOS is that, while it is one of the most widely agreed upon international laws (now ratified by 139 UN nations), the US has yet to ratify. While we have, in actuality, signed the treaty our legislature has yet to approve the signing (Jacques and Smith 151). Perhaps the primary reason why the US legislature has yet to ratify is the fact that UNCLOS is ultimately the antithesis of *Mare Liberum*. This agreement is the first step in changing the world's perception of the sea itself. It begins by rejecting the old fragmented view of the worlds oceans fostered by the Freedom of the Seas Doctrine and attempts to promote a new inter-connected understanding. Ultimately, UNCLOS embraces the new understanding of the sea by applying the same idea to how it structures interaction among the different institutional/governmental levels of society. By promoting nations to look at the seas as common-pool resource, rather than an open-pool resource, UNCLOS encourages institutions and individuals alike to realize that international waters are not a free for all. Like any investment, the oceans must be monitored and protected in order to ensure that it continues to yield valuable returns (United Nations).

On a technical level UNCLOS has many implications for ocean fertilization. What was once a strictly two zone jurisdictional system prior to this agreement (territorial and international waters) is now a 6 zone system. It took the initial 3 mile zone of influence established back in 1839 and pushed it outwards to include up to 350 miles from the nations base coastline. Within these 350 miles (in addition to the distance on the landward side of the base coastline) are 5 of the 6 jurisdictional zones (internal waters, territorial waters, the contiguous zone, the exclusive economic zone, and the continental shelf), with the influence of the coastal nation decreasing as one gets further and further from the shoreline. Anything outside of these 5 zones is considered international waters, where, at least for the most part, *Mare Liberum* still applies. On the other

hand, the “open seas” are certainly not as open as they once were. Along with the jurisdictions set up by the UN’s regional seas programme, there are a number of environmental regulations as well as fishing restrictions in international waters (United Nations).

As for the direct implications, UNCLOS addresses ocean research in Part XIII, where, for the most part it is promoted under the one requirement given in Article 240 section (C) that it: “Shall not unjustifiably interfere with other legitimate uses…..” (United Nations). Similarly if ocean fertilization research were to occur on a large scale it would have to be proved beyond a reasonable doubt that it would not disrupt existing ocean systems to an extent that would, as is stated “unjustifiably interfere with other legitimate uses. Given that the South Pacific offers the most potential for ocean fertilization if any research were to occur it would have to meet the environmental regulations dictated by that particular jurisdictional region (in this case it would be either North-East Pacific, or Pacific jurisdictional zones) set up by the United Nations Environmental Programme’s Regional Seas Programme (Jacques and Smith 164). While conjecture concerning the research phase of ocean fertilization is fairly rooted, the schematics of what might occur, or how it might occur once it passes the research phase are much less concrete. One can only look at the patterns of the past and the current condition to predict how this might function as a viable option to combat global climate change.

Connections and Conclusions

"We all believe technology offers great promise to significantly reduce [greenhouse gas] emissions -- especially carbon capture, storage and sequestration technologies."
- President George W. Bush

Anthropogenic climate change is a growing problem unlike any this country has faced. It is global in scope, but its historical sources can be attributed largely to Western developed nations. Conversely, its effects are likely to be felt most immediately by undeveloped or developing nations. This presents an interesting policy challenge: while all parties cannot be treated equally in terms of behavioral standards and regulations, there is no precedent for assigning accountability. While the United States rose to political dominance via environmentally "unclean" methods, allowing developing nations to do the same now would have disastrous global consequences. As insinuated in the above quote, one approach to this problem favored by the United States is the "quick fix" -- in other words, a reliance on technological innovation to retroactively reverse the environmental effects of industrialization. This strategy is characteristic of a Promethean mindset as explored by Dryzek in The Politics of the Earth.

The challenge of global climate change policy is also relevant in that it is a symptom of a new paradigm of interconnectivity. This paradigm applies both to the physical and political world. Globalization, through advancements in transportation and information technologies, has woven the world's countries into a complex network of interdependencies and alliances. For example, the oil trade links the U.S. addiction to driving to the status of economies in the Middle East. The concept of the "global resource" makes international law increasingly necessary. This geographic, or "horizontal" interconnectivity is complemented by increased interaction between levels of government. This "vertical" interconnectivity is characterized by management schemes that incorporate the decisions of local, state, federal, and perhaps international governing bodies.

In the physical world, the concepts of horizontal and vertical interconnectivity are increasingly relevant. Scientists are coming to understand how local systems interact in a larger, global scheme, as well as how global natural forces affect and shape each other. Studies are

constantly finding new relationships between, for example, large scale processes occurring in the terrestrial biosphere and the atmosphere. As we come to understand these global systems as natural resources, their interconnectivity affects how we manage them. This paradigm applies especially well to the largest natural resource on the planet: the oceans. Scientists are beginning to understand the extent to which marine bodies of water on this planet are connected, and to conceptualize these bodies as comprising one global ocean. The fact that sinking cold, salty water in the North Atlantic Ocean creates a current that travels hundreds of thousands of miles to and across the Southern Ocean is representative of extreme horizontal connectivity. Vertical connectivity is demonstrated in the dynamics of marine ecosystems: the removal of a species at one trophic level can be responsible for the entire ecosystem's collapse.

As applied to the oceans, this paradigm has profound implications for policy and management. Using our case study of global fisheries, single-species management must give way to ecosystem-based management. The concept of the global ocean also renders obsolete the strategy of carving up parcels of ocean to be owned by separate foreign parties. In this sense, UNCLOS has taken the first steps towards a more comprehensive management of the oceans by dividing the ocean into international zones that deal more with functional boundaries rather than arbitrary political ones. UNCLOS has also acknowledged the failure of a typical Promethean attitude towards the world's oceans, which the grim history of marine fisheries has also debunked: although vast, marine resources are not inexhaustible. In accordance with this, they must be managed as a common-pool resource rather than an open-pool one in order to avoid a free-for-all, or a tragedy of the commons. Thus all parties involved become stakeholders, and interaction among these varied stakeholders is vital.

These policy implications must be considered when discussing quick fixes such as ocean fertilization. Because of the lack of established international ocean policy, and nation can technically proceed with such an endeavor. However, the scientific uncertainty associated with ocean fertilization, and deep ocean carbon sequestration in general, is significant. The Southern Ocean, where such a project would likely be most effective, is known by oceanographers as the "great communicator" with all of the world's oceans. An artificial adjustment of the nutrient supply on any scale could have dramatic effects on ecosystems in *any* ocean. Any party who undertook this Promethean solution could be held accountable for these repercussions across the globe. Thus, regardless of whom is ultimately responsible for anthropogenic climate change (the problem), any major technological "fix" (the solution) comes with great responsibility, as well as an obligation to understand fully the systems which are being manipulated. In order for such understanding to be possible, communication between scientists and policy makers must greatly increase.

Looking to the future of ocean policy and iron fertilization, two scenarios are considered. Keeping with current behavioral trends, the United States could choose not to ratify UNCLOS (as it has yet to do). At the same time, under both global and local pressure to act on climate change, the United States decides to adopt ocean fertilization as a technological fix to increasing atmospheric greenhouse gas levels. In the absence of international ocean policy, ocean fertilization in the U.S. is carried out like any other unregulated industry. Under the antiquated concept of *mare liberum* which UNCLOS has left behind, ocean fertilization is a free-for-all in international waters, with disastrous ecological and environmental consequences. In the other scenario, the U.S. ratification of UNCLOS leads to an organized global effort to implement and regulate ocean fertilization. Based on scientific findings, the United Nations pre-approves a certain area on international ocean water. At the same time, the U.N. allots a limited number of

permits to independent, expert fertilizing cooperatives. Integrated into the already functioning international carbon credits market, these cooperatives provide a market service to polluting industry and government groups by offsetting their carbon emissions.

Prometheanism is often criticized for its radical, futuristic faith in technological innovation. Indeed, this policy brief has criticized it for ignoring the need for regulation. However, the second scenario presented above is neither radical nor futuristic. It engages an infrastructure (the carbon credit market) that already exists as a working interaction between the market, regulation, and cooperative management. The United States can truly have the best of both worlds – a solution to global climate change and an increase in political and economic power – with a simple change of mindset. By abandoning an antiquated view of the ocean and natural resources in general and ratifying UNCLOS, the United States can take its first step towards global environmental leadership.

Sources

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