Ocean Acidification:
Managing the Marine Impacts of Climate Change

Environmental Law Institute, Washington DC

Co-Sponsored by the Environmental Law Institute
& DC Bar Ocean and Marine Resources Committee

June 23, 2010

Seminar Summary

Climate change is affecting the biogeochemistry of the ocean. The ocean serves as a sink for large quantities of atmospheric carbon dioxide, but this ecosystem service comes at a price: the dissolution of carbon dioxide acidifies seawater, which affects the ability of marine organisms to form calcareous shells and skeletons. Efforts to manage both the causes and effects of acidification are beginning. For example, the Center for Biological Diversity and Environmental Protection Agency recently reached a settlement on using the Clean Water Act to address ocean acidification. This is one of the tools that may help ocean and coastal managers respond to the potentially devastating impacts of climate change on the marine environment. Panelists representing the scientific, nongovernmental, federal, and regulated communities addressed the litigation, legislation, and research being undertaken and developed to address these changing ocean conditions.

Speakers

- Dr. Nancy Knowlton, *Roger Sant Chair for Marine Biology, Museum of Natural History, Smithsonian Institution*
- Dr. Susan Roberts, *Director*, *Ocean Studies Board, National Research Council*
- William J. Snape III, *Senior Counsel, Center for Biological Diversity*
- Christine Ruf, *Senior Policy Analyst, Watershed Branch, U.S. Environmental Protection Agency*

Moderator

- James Walpole, *Chair, District of Columbia Bar, Ocean and Marine Resources Committee*

Dr. Nancy Knowlton provided a primer on current scientific knowledge about the process of ocean acidification, explaining the biogeochemical process and its effects on marine ecosystems. She discussed the documented correlation between levels of atmospheric carbon dioxide (CO_2) and the pH of the world's oceans. When atmospheric CO_2 dissolves in water, the concentration of hydrogen ions in the water increases and causes the water to become more acidic. About 30% of atmospheric CO_2 is dissolved into the world's waters, so as levels of atmospheric CO_2 rise the oceans become more acidic. In the last twenty years, between 1989 and 2009, the concentration of hydrogen ions in the world's oceans rose by 30%. If industry continues to produce atmospheric CO_2 at its current rate, hydrogen ions in the ocean will increase by 150% by 2100. Dr. Knowlton stressed that while previous geologic events have resulted in drastic decreases in ocean pH due to growing amounts of atmospheric CO_2, the current rates of acidification are occurring 10 to 30 times faster than has ever been seen before.

Dr. Knowlton explained that one of the ways one can measure the effects of acidification is by monitoring levels of aragonite, which marine organisms use to form their shells and skeletons but that dissolves in more acidic waters. In 1765, most tropical ocean waters contained optimal aragonite levels – but by 2100, as ocean waters become more acidic, the entire ocean will have low or extremely low levels of aragonite. Dr. Knowlton discussed the severe effects ocean acidification may have on coral reefs. Studies have demonstrated that in more acidic waters corals do not form their calcareous skeletons, but rather exist solely as polyps. This is a critical ecosystem problem, since thousands of marine species depend on corals and other ecosystem engineer species to build three-dimensional structures like reefs. Dr. Knowlton explained that coral reefs cannot survive if atmospheric CO_2 reaches 500 parts per million (ppm). Yet if industry continues at present-day levels, atmospheric CO_2 levels will be at 650 ppm by 2100. Atmospheric CO_2 lasts for centuries, so commitments and decisions now will affect generations far into the future.

Dr. Knowlton stressed that the effects of ocean acidification on marine species are complex and varied. Some shelled species (e.g. oysters) will get smaller under more acidic conditions, while other species (e.g. lobster) will grow larger. The physiological changes that occur in acidified water are not completely understood, but for most species and ecosystems they will be negative. Dr. Knowlton concluded by noting that as significant as ocean acidification is, it is but one strand in a complex web of factors affecting the ocean. While people continue removing fish and mammals at increasing rates, the ocean is being flooded with CO_2, nutrients, toxins, sediments, and alien species.

Dr. Susan Roberts discussed a two-year study on ocean acidification completed by the National Research Council (NRC). When Congress reauthorized the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act in 2006 (see Section 701 of H.R. 5946[1]) it directed the NRC to conduct a study on ocean acidification and its effects on the United States. Co-sponsors of the study included the National Oceanic and Atmospheric Administration, National Science Foundation, National Aeronautics and Space Administration, and the US Geological Survey. NRC's statement of task called for a review of the topic, identification of questions and uncertainties, recommendations for future research and assessment, and strategies for the establishment of an interagency program to address anticipated ocean acidification needs. The Federal Ocean Acidification Research and Monitoring (FOARAM) Act[2] which was originally proposed in 2007 but not passed until 2009, called for an interagency committee to develop a US ocean acidification program.

Dr. Roberts highlighted several key findings from the recently completed NRC study. The study found that the current rate and magnitude of change to the ocean's chemistry is unprecedented, and that

[1] For full text of H.R. 5946, see here.

[2] The FOARAM Act was originally proposed in 2007, in S. 1581, but did not pass. Two years later, President Obama signed H.R. 146, an omnibus bill which included the FOARAM Act of 2009.

these changes are a result of anthropogenic CO_2 emissions. Scientists are not sure about how marine organisms will acclimate or adapt to these new conditions. At the current rate of acidification, the oceans' average pH will be 7.8 by 2100, significantly less than present-day levels and dramatically less than pre-industrial levels. Dr. Roberts also outlined the study's recommendations for a national program to study ocean acidification. The program should focus on, among other things: supporting a robust observing network, developing research and needs assessments, managing data, and providing relevant information to decision-makers. There are many research needs, but researchers are still determining how to prioritize them.

Dr. Roberts stated that in addition to looking at the chemical and biological impacts of ocean acidification, researchers are also examining its socioeconomic impacts. The study identified fisheries, aquaculture, and tropical coral reef systems as the most vulnerable business sectors as well as the areas that have attracted the most public concern. The combined value of these sectors is about $4.3 billion, but Dr. Roberts cautioned against judging these financial figures as relatively small, since local impacts can be much greater than what the data would reveal. Researchers are looking into two strategies, mitigation and adaptation, as ways to deal with acidifying oceans. Dr. Roberts noted that researchers are also engaged in predicting what could be the oceans of the future, looking at areas near natural underwater CO_2 vents. Plant life appears to flourish in acidified water, while animal life does not.

Mr. William J. Snape, III provided an overview of how our legal and regulatory frameworks can address ocean acidification. He noted that while there are several new legal tools being proposed to deal with climate crises like ocean acidification, existing laws, such as the Clean Water Act[3] and the Clean Air Act[4], should not be overlooked. He called for stringent science-based regulations to come out of these science-based statutes. Mr. Snape stressed that while the previous two panelists noted the uncertainties associated with ocean acidification, it is important to remember that there is radical change occurring in the ocean and its impact is mostly negative.

Mr. Snape described how Sections 303(d) and 304 of the Clean Water Act can be used to address ocean acidification. Section 303 governs water quality standards and their implementation. In Section 303(d), the centerpiece of recent litigation between the Center for Biological Diversity (CBD) and the Environmental Protection Agency (EPA), states are called on to identify impaired waters, i.e. those bodies where water quality standards are not being met. The state and the EPA must identify pollutant limits for such impaired water bodies, called a total maximum daily load (TMDL). Section 304 delineates the criteria by which water quality standards are articulated, and requires that they are in line with current scientific knowledge.

Mr. Snape discussed the process that led to a lawsuit between CBD and EPA. CBD identified CO_2 as a pollutant and saw it impacting water quality in coastal states. Yet the state of Washington's list of impaired waters did not include any waters impaired by CO_2. CBD then challenged EPA's approval of Washington's list of impaired waters, first with a petition and later a lawsuit. Mr. Snape noted that CBD and EPA ultimately reached a settlement in the lawsuit, which has spurred EPA to examine how Section 303(d) can be used to gather information about and mount efforts against ocean acidification.

Mr. Snape identified two challenges to implementing strategies to manage ocean acidification under the Clean Water Act. First, because atmospheric CO_2 pollution is not only national but global in scope, EPA

[3] EPA Summary of the Clean Water Act. For full text of 33 U.S.C. §1251 et seq. (1972), see here.
[4] EPA Summary of the Clean Air Act. For full text of 42 U.S.C. §7401 et seq. (1970), see here.

will find it difficult to establish pollution limits and targets. Second, EPA has never before used the Clean Water Act to issue water quality permits based on an air pollutant. Mr. Snape cautioned that while these are legitimate issues, they are manageable and should not preclude the EPA from defining standards by next year. He expressed optimism that the crisis of ocean acidification will be used as a galvanizing force to motivate swift action on dealing with climate change, pointing to recent international and domestic efforts as hopeful signs. He stressed, however, that even under optimistic scenarios, the oceans will be radically changed by the end of this century.

Ms. Christine Ruf discussed how EPA has engaged in addressing ocean acidification. She provided background on the Section 303(d) program and associated regulations, noting that 44,000 waters nationwide have been listed as impaired – but that few of the listed bodies are coastal waters, and non are listed for marine pH levels. Following the impaired waters designations, states must develop TMDLs, a “pollutant budget” which establishes the maximum amount of a pollutant that a water body can receive to meet water quality standards. To date, 42,000 TMDLs have been developed.

Ms. Ruf also expanded upon Mr. Snape’s discussion of the recent CBD and EPA settlement. She noted that EPA’s approval of Washington’s 2008 list of impaired waters did not comply with the antidegradation portion of EPA’s water quality standards. The EPA posted a Federal Register Notice and allowed for a period of public comment on questions dealing with, among other things: specific elements of monitoring and assessment, states’ and EPA’s role in monitoring ocean acidification and its impacts, and issues in addressing TMDL development for waters impaired by ocean acidification. Following the conclusion of the public comment period, EPA began formulating a plan to develop TMDLs for ocean waters. Ms. Ruf noted that they are looking at the EPA’s mercury program for guidance in going forward. She stressed that since monitoring carbon dioxide emissions falls under EPA’s air program rather than water, regulations involving ocean acidification will not affect carbon caps.

Question & Answer

Since ocean acidification is not just domestic but international in scope, do any of the panelists see any movement in international law to deal with the issue?

Mr. Snape said that the Convention on Biological Diversity, to which the United States is not a party, has begun working on developing frameworks to deal with ocean acidification. The Convention, however, is more hortatory than regulatory in nature. In addition, Mr. Snape noted that international climate regulation negotiations could deal with ocean acidification, but he does not know of the issue being on the agenda for the upcoming negotiations in Cancun. He said that domestic efforts do not have to rely on international agreements, but that it would be helpful.

An audience member affiliated with the International Union for Conservation of Nature noted that the United Nations Environmental Programme and the United Nations Framework Convention on Climate Change have begun a movement to develop research dialog on the issue. The parties involved with this research dialog are now aiming to translate their discussions into practical political changes.

Does the Clean Water Act apply to marine and coastal waters, or does it only apply to freshwater?

Mr. Snape said that the Clean Water Act applies to marine waters up to three miles offshore, but lawyers continue to look at how the Act can be applied to federal waters between three[5] and two hundred miles offshore.

Is there an existing law that will apply to federal waters between three and two hundred miles offshore?

Mr. Snape stated that the Clean Water Act applies to those waters.

Were the gradual declines in historical marine pH displayed in Dr. Roberts' presentation associated with mass extinctions? Do scientists know what caused the pH to rise after the declines?

Dr. Roberts explained that natural processes involving sediments and minerals affect the pH of the ocean. Over hundreds of thousands of years, the pH of the oceans can rise because of these processes.

Dr. Knowlton stated that the best analog to present-day ocean acidification is the acidification that occurred 55 million years ago, which was accompanied by mass extinctions of all species that built skeletons. That process took significantly longer than what is occurring now.

Is there any United States legislation that declares CO_2 *to be a pollutant?*

Mr. Snape said that the Clean Air Act, under the Supreme Court holding in *Massachusetts v. US EPA* and subsequent endangerment findings by the EPA, has already led to the conclusion that CO_2 is a pollutant. EPA has independently moved ahead to regulate CO_2 from motor vehicles and stationary sources.

Mercury is a pollutant that can be measured from a baseline. How can we measure CO_2 *as a pollutant if its levels vary based on many different factors?*

Ms. Ruf said that developing methods to measure CO_2 pollution levels is one of the challenges in listing waters and identifying TMDLs. In addition, the EPA's water program does not regulate atmospheric CO_2; the air program does. She expressed optimism that EPA will come to a solution for this issue.

Why did it take litigation to make EPA look at ocean acidification? Are there cultural changes that could occur within the EPA to prevent such delays?

Ms. Ruf said that EPA has a lot of responsibilities and not enough resources. Litigation is an expensive and resource-intensive process, and EPA wants to avoid having a court determine program direction – therefore pending litigation does sometimes drive an issue to the top of program priorities. Ms. Ruf noted that recent political changes in the legislative and executive branches of the government have allowed the EPA to move forward on many programs.

Dr. Knowlton noted that the science of ocean acidification is new, and scientists have only recently begun to look at its effects. Political agendas often follow scientific advances, with some delay.

The 2010 Ocean Seminar Series is made possible by generous support from the Naomi and Nehemiah Cohen Foundation.

[5] Off of Texas and western Florida, state waters extend to nine miles offshore.