

**CLIMATE CHANGE NEWS****NATIONAL RESEARCH COUNCIL STUDY FINDS THAT GREENHOUSE GAS EMISSIONS HAVE CAUSED OCEAN ACIDIFICATION**

The average pH of the oceans has fallen and continues to fall because of human-generated greenhouse gas (GHG) emissions says a recent congressionally requested report by the U.S. National Research Council. Unless nations significantly curb carbon dioxide (CO<sub>2</sub>) emissions, or atmospheric CO<sub>2</sub> is controlled by some other means, the average pH of the ocean will continue to fall. The long-term consequences of ocean acidification on marine life are unknown, but many ecosystem changes are expected to result.

**The National Research Council Report**

In the middle of 2008, Congress tasked the National Research Council (NRC) of the National Academy of Sciences to generate a study examining the anticipated consequences of ocean acidification due to rising atmospheric carbon dioxide levels on fisheries, protected species, coral reefs, and other natural resources in the United States and internationally. National Oceanic and Atmospheric Administration, NASA, the U.S. Geological Survey, and the National Science Foundation funded the study.

NRC then assembled a panel of scientists with expertise in a variety of relevant fields including chemical and biological oceanography, marine ecology, physiology, ocean-climate modeling, paleoceanography, and resource management and economics. The group then set forth to analyze current information on ocean acidification, covering past, present, and anticipated future effects on ocean ecosystems; identifying the critical uncertainties and key science questions regarding the progression and impacts of ocean acidification, and the new information needed to facilitate research and decision-making for potential mitigation and adaptation options; and, ultimately, to recommend a strategy of research, monitoring, and assessment for federal agencies, the scientific community, and other partners. On April 22, the NRC committee announced the report, titled:

“Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean.” (Available at: <http://www.nap.edu>)

**Impacts on Natural Resources**

According to the authors, the oceans have absorbed a significant portion of CO<sub>2</sub> emissions from human activities, about one-third of the total emissions for the past 200 years from fossil fuel combustion, cement production and land use change. While having the oceans act as a carbon sink benefits society by moderating the rate of climate change, it also decreases the pH of the water leading to a suite of chemical changes collectively known as ocean acidification.

The report notes that since the beginning of the industrial revolution, the average pH of ocean surface waters has decreased approximately 0.1 unit—from about 8.2 to 8.1—making them more acidic. Models project an additional 0.2 to 0.3 unit drop by the end of the century if GHG emissions are not curbed.

According to the report, studies on a number of marine organisms have shown that lowering the pH of the oceans with CO<sub>2</sub> affects biological processes, such as photosynthesis, nutrient acquisition, growth, reproduction, and individual survival depending upon the amount of acidification and the species tested. The most concrete example provided involves experiments on organisms with calcium carbonate shells and skeletons. The results of those experiments demonstrated decreases in shell and skeletal growth in a range of marine organisms, including reef-building corals, commercially important mollusks such as oysters and mussels, and several types of plankton at the base of marine food webs. The authors are careful, however, to note that the available scientific data is too scarce to properly predict the impacts on natural resources due to changing ocean chemistry related to GHG emissions.

Similarly, the report acknowledges that it is unknown whether various marine organisms will be

capable of acclimating or adapting to ocean acidification. Nevertheless, the authors indicate that existing data does suggest that there will be shifts in the composition and functioning of many marine ecosystems. Such ecosystem changes could threaten coral reefs, fisheries, protected species, and other natural resources. Although changes in ocean chemistry caused by increasing atmospheric CO<sub>2</sub> can be determined, not enough information exists to assess the social or economic effects of ocean acidification, much less develop plans to mitigate or adapt to them, the committee noted.

### Report Recommendations

The committee recommended six key elements of a successful National Ocean Acidification Program [The federal government has developed the National Ocean Acidification Program, which is the program likely to implement these recommendations]: (1) An integrated ocean acidification network that includes development of new tools, methods, and techniques to improve measurements; (2) research to fill critical information gaps; (3) identifying stakeholder concerns and a process to provide relevant information for decision support; (4) a data management office that would ensure data quality, access, and archiving, plus an information exchange that would provide research results, syntheses, and assessments to managers, policymakers, and the general public; (5) facilities to support high-quality research and training of ocean acidification researchers; and (6) an effective ten-year

strategic plan for the program that will identify key goals, set priorities, and allow for community input, in addition to a detailed implementation plan.

The committee found that legislation has laid the foundation for a program that will advance our understanding and improve our response to ocean acidification.

### Conclusion and Implications

The authors' findings in the report lend credence to the voices arguing for fast reaction to the potential risks related to ocean acidification. At an April 22 hearing held by the Senate Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard, Subcommittee Chair Maria Cantwell (D-WA) and Ranking Member Olympia Snowe (R-ME) both spoke about the potential environmental and socioeconomic impacts of ocean acidification. Senator Snowe commented that "if current trends in ocean acidification continue, by the end of this century vast areas of the sea could very well become inhospitable to many species which form the foundation of the marine food web," and that we "simply cannot leave the future of our oceans and their valuable resources to chance." Presently, however, the government has not provided any indication of whether it will proceed with the recommendations from the report.

The federal government's National Ocean Acidification Program, currently in development, is a positive move toward coordinating efforts to understand and respond to the problem, said the study committee. (B. Flanagan)