

AAAS Panel: Climate change creating major impacts on world's oceans

by Mark Floyd - OSU

BOSTON, Mass. — Climate change is rapidly transforming the world's oceans by increasing the temperature and acidity of seawater, and altering atmospheric and oceanic circulation, reported a panel of scientists this week at the American Association for the Advancement of Science (AAAS) annual meeting in Boston.

“The vastness of our oceans may have engendered a sense of complacency about potential impacts from global climate change,” said Jane Lubchenco, the Wayne and Gladys Valley Chair of Marine Biology at Oregon State University, who moderated the panel. “The world's oceans are undergoing profound physical, chemical and biological changes whose impacts are just beginning to be felt.”

Panelist Gretchen Hofmann, a molecular physiologist at the University of California, Santa Barbara, describes the situation as “multiple jeopardy.”

“Ocean ecosystems are facing new stresses and new combinations of stress,” Hofmann said. “The water is warmer, circulation patterns are changing in unpredictable ways, and oceans are becoming acidic.”

Rising greenhouse gas emissions are warming the world's oceans and providing yet a new threat to coral reefs, which already are among the most threatened of all marine ecosystems, the panelists say. Even modest warming of a degree or two above normal maximum temperatures can cause a breakdown in the relationship between corals and their symbiotic algae, zooxanthellae, said Nancy Knowlton, a marine biologist with the Smithsonian Institution.

Without zooxanthellae corals appear white, or “bleached,” and grow more slowly. They also are more susceptible to disease and may not reproduce. In 1998 there were worldwide mass bleaching events, Knowlton pointed out, affecting 80 percent of the corals in the Indian Ocean, 20 percent of which died. In 2005, severe bleaching occurred over much of the Caribbean as a result of overly warm water temperatures.

“We have already lost some 80 percent of the reef corals in the Caribbean over the last three decades, and losses in the Pacific Ocean also are widespread and severe,” Knowlton said. “Reefs are like cities, with some parts growing and some parts being destroyed, and only when net growth is positive can reefs persist. These reefs already are under threat to overfishing and local pollution and unless drastic action to reduce greenhouse gas emissions is taken soon, these reefs will cease to exist as we know them.”

These same greenhouse gas emissions also are creating dramatic buildup of atmospheric carbon dioxide,

which is rapidly making the world's oceans more acidic, said panelist Scott Doney of the Woods Hole Oceanographic Institution. Current CO₂ levels of 380 parts per million already are 30 percent higher than pre-industrial values and many scientific models predict that those rates will triple by the end of the century under "business as usual" scenarios.

While much of the scientific attention on ocean acidification has looked at the impact of coral reefs, the potential danger to other marine ecosystems is equally severe, Doney said.

"Ocean acidification harms plants and animals that form shells from calcium carbonate," he said. "Calcifying organisms include not just corals, but many plankton, pteropods (marine snails), clams and oysters, and lobsters. Many of these organisms provide critical food sources or habitats for other organisms and the impact of acidification on food webs and higher trophic levels is not well understood.

"Newly emerging evidence suggests that larval and juvenile fish may also be susceptible to changes in ocean pH levels," Doney added. "Ocean acidification is rapidly becoming a real problem."

Michael Behrenfeld, an oceanographer from Oregon State University, is studying relationships between climate and the global activity of ocean plants called phytoplankton.

"Phytoplankton are of tremendous human importance because their photosynthesis yields oxygen for us to breathe and they are the base of the ocean food webs that support our global fisheries," Behrenfeld said. "Using NASA satellites, we can track changes in phytoplankton on a global basis and what we find is that warming ocean temperatures are linked to decreasing photosynthesis. Satellites are one of the most important tools we have for understanding the link between climate and ocean biology because they provide measurements of the whole planet on a daily basis, which could never be accomplished by ship.

"Unfortunately," he added, "it is at this very time when we need satellites most that we are facing the end of NASA ocean biology satellites because of budget cutbacks or new priorities. This is a serious issue that needs to be addressed.

"Instead of facing the end of these critical missions and becoming blind to the changes occurring in our oceans," Behrenfeld said, "we should be building even better ones to see more clearly than we have in the past, and to gauge the potential consequences of climate change on ocean productivity."

The panelists also called for greater investment in ocean observing systems that would allow scientists to better measure changing in the ocean ecosystem, including large-scale circulation and coastal upwelling systems around the world. Klaus Keller of Penn State University reported on the economic costs and benefits

of effective ocean observing systems to detect changes in the north Atlantic Meridional Overturning Circulation.

Jack Barth, an oceanographer at Oregon State University, reported on the hypoxia events that have plagued the Pacific Northwest coast since 2000. These low-oxygen zones in the near-shore are unprecedented over the last five decades of scientific observation and likely linked to stronger, more persistent winds that are expected to occur with global warming. The California Current System provides a case study for similar changes in coastal upwelling zones off South America, southern Africa and northern Africa, Barth said.

“One of the things we’ve observed is how wind patterns have changed and greatly affected upwelling,” Barth said. “Two decades ago, the winds would last for three or four days, and then subside. Now they persist for 20 to 40 days before settling down. This creates significant impacts on upwelling and biological productivity, but these impacts can swing wildly from one extreme to another and have been difficult to predict.”

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