Executive Summary

Latitude 41 UNDER SIEGE

IMPACT OF NUTRIENT POLLUTION AND OCEAN ACIDIFICATION ON COASTAL WATERS, AND ESTUARIES OF SOUTHERN NEW ENGLAND

This summary provides an overview of scientific information presented at a symposium organized by The Prospect Hill Foundation on February 12, 2015. The full report discusses emerging and successful collaborations that bring together diverse communities in common cause around coastal issues. In addition, the report reviews the top 10 actions that symposium participants recommended should take place to address these critical environmental challenges, out of the more than 70 individual recommendations proposed at the symposium. The report is intended to encapsulate the symposium's dialogue around nutrient pollution and ocean acidification, and provide information on these critically important topics to a broader audience. Action is needed by citizens, organizations and officials to address the threats to the coast, and to better protect, conserve and restore the bays, estuaries and ocean waters from Long Island to Cape Cod.

Nutrient Pollution

In 2000, the National Academy of Science recognized that nutrient pollution was a common thread of many problems plaguing U.S. waters. The main nutrients of concern are nitrogen and phosphorus. Fertilizers running off farm fields and lawns, sewage discharges from sewage treatment plants, stormwater runoff from city streets, and septic systems all contribute nitrogen to bays and coastal waters. The nitrogen sparks harmful algal blooms (HABs) that destroy native plants like eelgrass and other important habitat. The mats of algae consume oxygen, resulting in shellfish bed closures and fish die-offs in the hypoxic (oxygen-deficient) water conditions.

Hypoxia has occurred from Long Island Sound to Cape Cod:

- **Long Island Sound.** Long Island Sound is the nation's third largest estuary, and portions of it are plagued with HABs. Red tide blooms that cause paralytic shellfish poisoning have led to an increasing number of shellfish bed closures, rising from 2,000 closures in 2005 to nearly 14,000 shellfish bed closures in 2012. Brown tide blooms also occur in parts of the Sound. About two-thirds of the nitrogen loading into Long Island Sound comes from wastewater, which feeds the algal blooms. The entire scallop fishery in New York was lost because of HABs.
- **Narragansett Bay.** A low oxygen event driven by inputs of nitrogen from wastewater, along with wind, rain and tides, combined to create conditions that triggered a massive fish kill of roughly one million juvenile menhaden and other fish in Narragansett Bay in August 2003. More than half of the nitrogen inputs into Narragansett Bay come from the 35 publicly owned wastewater treatment facilities that discharge into it, 19 of which are located within Rhode Island with another 16 in Massachusetts in the Bay's watershed.
- **Cape Cod.** Many of Cape Cod's watersheds have impaired water quality and ecological damage due to nitrogen loading. Nitrogen from septic systems accounts for about 80% of the watershed load, with stormwater and fertilizers accounting for the remainder of non-atmospherically deposited nitrogen. Frequent violations of water quality standards and diminished shellfisheries have been linked to HABs caused by excessive nitrogen.

Harmful algal blooms also create conditions that further imperil coastal waters. For example, carbon dioxide can encourage the growth of brown tide blooms, which themselves produce carbon dioxide during their life cycle. The higher carbon dioxide levels lead to acidification in which the pH of waters declines. Native grasses and fish species can therefore be hit with a double whammy of increasingly acidic water with less dissolved oxygen, creating a hostile environment and causing die-offs. This feedback loop of HABs growing in carbon dioxide-rich waters and, in turn, producing more carbon dioxide that further acidifies the water is occurring against a larger backdrop of ocean acidification caused by the absorption of carbon dioxide from the atmosphere.

Ocean Acidification

The ocean has already absorbed around 25 percent of human-caused carbon dioxide emissions. When carbon dioxide dissolves in ocean water, it produces carbonic acid which, in large enough quantities, can change the pH of ocean water, moving it from a less acidic state to a more acidic state. Because of ocean absorption of carbon dioxide, there's been an increase of about 30 percent in ocean acidity since pre-industrial times. It is projected that by 2100, ocean acidity will have increased by 150 percent since pre-industrial times.

Reduced pH in ocean water can impact marine life in a number of ways. Some clownfish have shown an impaired ability to smell predators, which may suggest that neurological pathways can be interfered with by lowering the pH of ocean water. There may also be reduced respiratory efficiency in animals such as squid.

Executive Summary (cont'd)

One of the most devastating impacts of ocean acidification can be seen on coral reefs and shellfish. When carbon dioxide dissolves in ocean water, the hydrogen ions from the carbonic acid bind with the carbonate, displacing the calcium. There are two principal kinds of calcium carbonate: aragonite and calcite. When carbonic acid binds with carbonate, it can reduce the amount of aragonite available for shell-bearing sea life to build shells with. For example, larvae of bivalves depend on drawing calcium carbonate out of the water to build their shells. As Elizabeth Kolbert put it in a 2006 New Yorker article, "the supply of material available for shell formation shrinks. Imagine trying to build a house when someone keeps stealing your bricks." Seawater moves from having levels of aragonite that are healthy for shell-bearing marine animals, to seawater that's undersaturated with aragonite. This can effect shell-bearing organisms not only in the shell formation period but also after the shell is formed.

Impacts have already been observed on some economically important shellfisheries. The National Oceanic and Atmospheric Administration (NOAA) reports that in 2009, U.S. shellfish represented about half the total seafood revenue estimated at $3.9 billion. Molluscs, including oysters, have been shown to be affected by ocean acidification, according to NOAA, threatening not only marine ecosystems but local economies dependent on shellfish harvesting.

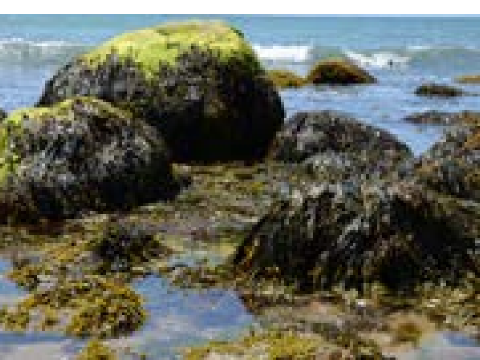
In addition to shellfish, coral reefs also depend on healthy levels of aragonite saturation in ocean waters to build healthy reefs. Losing coral reefs to ocean acidification has potentially severe repercussions not only for marine life, but for human communities that depend on coral reefs. NOAA estimates that coral reefs provide habitat for roughly one million species, and offer food, income, and coastal protection for about 500 million people globally. NOAA has identified ocean acidification as a contributing threat to coral reefs that are already suffering from unsustainable fishing, warming seas and pollution.

> It is clear that the threats from nutrient pollution and ocean acidification are entwined, and that their combined effects may be greater than additive; there may also be synergistic effects. Action is needed to address these threats through a variety of approaches. The region's economy is directly linked to healthy, vibrant coastal and ocean ecosystems. Commercially important shellfisheries and fisheries, recreation and tourism industries, abundant wildlife and diverse habitat all depend on healthy marine waters.

Steps to Protect and Restore Coastal and Ocean Resources

The Symposium identified a suite of actions that need to take place to address the problems posed by nutrient pollution and ocean acidification (see "Recommended Actions" on pp. 16-18 of this report.) There are three broad focal areas in which a number of actions should take place:

- **Conducting more scientific research and data collection, and deploying information to support needed actions.** More scientific research and data collection is needed to support management decisions and inform the public and policy-makers, in clear and compelling ways, about key marine threats and solutions to them. As part of this enhanced data collection, **a regional information repository should be created that includes water quality research and information, practices and policies.** This research should include climate change impacts relating to nutrient pollution and ocean acidification, while ways to better integrate ocean acidification into nutrient monitoring should be thoroughly researched and developed.
- **Leveraging laws and policies to address nutrient pollution and ocean acidification.** The nation's premier water protection law, the Clean Water Act, should be leveraged to address critical coastal and estuarine pollution and habitat issues. **Using provisions of the Clean Water Act, local and regional water quality planning should be done** to address nutrient pollution from septic systems and cesspools, sewage treatment plants, and runoff. **Nutrient criteria should be developed through the Act,** and provisions of the Act and other policies should be fully implemented to promote wetland restoration to help address nutrient pollution.
- **Enhancing engagement by the public, policy makers and elected officials.** Building stronger ties between Members of Congress from the Southern New England and mid-Atlantic region would help unite the region's elected officials and bring a collective voice to calls for funding and action on nutrient reduction and ocean acidification. **To better inform the public and other key leaders, a regional four-state summit on nitrogen pollution and ocean/coastal acidification could be convened to showcase best practices and produce an action plan,** and further solidify regional support for action.



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February 12, 2015
Symposium

organized by

The Prospect Hill Foundation