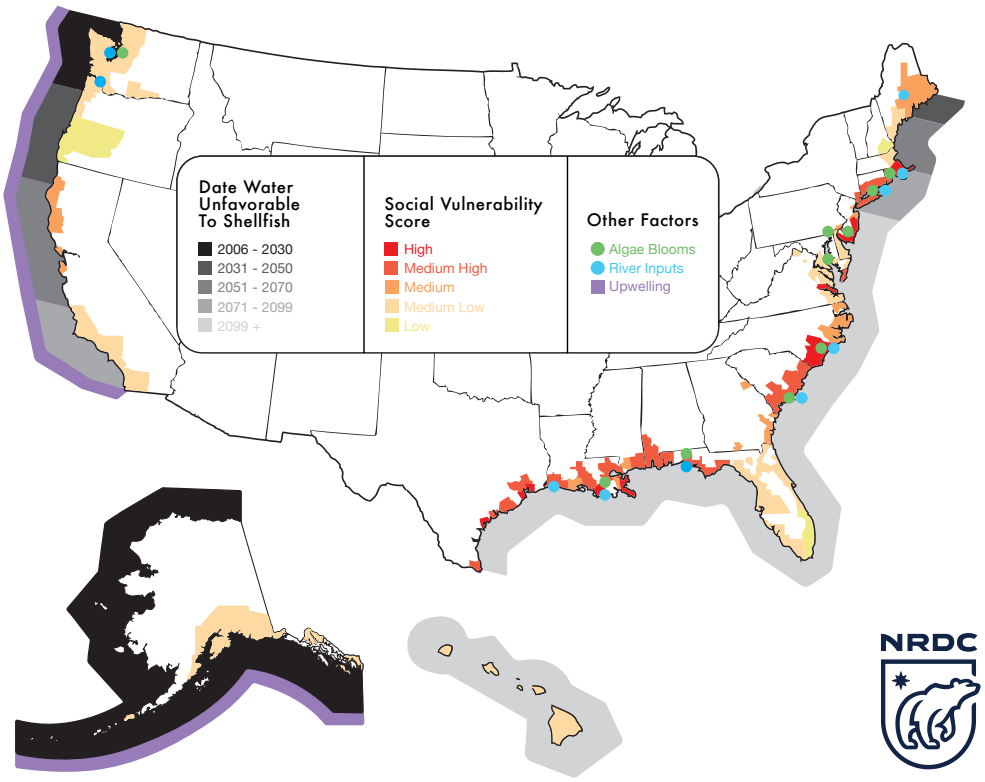
MASSACHUSETTS IS HIGHLY VULNERABLE TO OCEAN ACIDIFICATION ACCORDING TO A NEW STUDY



According to a new assessment of the U.S. communities most vulnerable to ocean acidification, Massachusetts at high risk. Communities and governments can still take action, researchers say.

MAP LEFT: The long-term economic impacts of ocean acidification are expected to be most severe in regions where ocean areas are acidifying soonest (black) and where the residents rely most on local shellfish for their livelihood (red). Local factors such as algae blooms from nutrient pollution, local upwelling currents, and poorly buffered rivers (green, purple, blue) can amplify acidification locally.

adapted by NRDC from Ekstrom *et al.*, 2015

WHY ARE THE SOUTHERN COUNTIES OF MASSACHUSETTS A HOTSPOT?

ECONOMIC DEPENDENCE

Southern Massachusetts (Bristol and Plymouth counties, Cape Cod, and the Islands) is highly vulnerable to ocean acidification because it's more economically dependent on shelled mollusks than any other U.S. region—and it lies adjacent to the rapidly acidifying waters of New England.

A SALTY GOLDMINE. Southern Massachusetts makes more money from shelled mollusks than any other U.S. region. These three counties alone bring in approximately $300,000,000 worth of shelled mollusks (landed value) a year. Indeed, the prized sea scallop has helped make New Bedford America's most profitable fishing port for the last 14 years.

JOBS, JOBS, JOBS. Southern Massachusetts supports a high number of shelled mollusk fishermen, with an average of 1,350 commercial fishing licenses per year to harvest bivalves (clams, oysters, mussels, scallops).

SMALL, DELICIOUS—AND IMPORTANT. As fish stocks have declined, shellfish are more important than ever to those who depend on the sea for their livelihood. Over the past decade, 72 percent of fisheries, revenues in Southern Massachusetts come from shelled mollusks, on average.

OCEAN VULNERABILITY

But ocean acidification will increasingly put the thumbscrews on the commercial harvests. Why? The very assets that make southern Massachusetts so great for harvesting clams, oysters, and scallops—cold water and sheltered bays—are increasing its risk from ocean acidification.

COLD WATERS SPELL TROUBLE. As we continue to burn fossil fuels worldwide, CO_2 is absorbed into the oceans—and it's especially absorbed by cold waters such those off the Massachusetts coast.

RIVERS MATTER. Dozens of rivers flow into the Gulf of Maine's coastal waters—with relatively acidicfresh water. This further reduces the pH level and availability of carbonate minerals that shellfish use to build shells. (see sidebar)

POLLUTION HELPS SOUR THE WATERS. In some inlets and bays, farms, lawns, and leaky sewage systems pour excess nutrients such as nitrogen into waterways. This pollution spurs excess algae growth. When the uneaten algae die, they decompose, releasing additional CO_2 acidifying the waters even more.

And yet, amazingly, despite the importance of shellfish to this region, little to no research and monitoring are being conducted. The sensitivity of sea scallops to acidification remains unknown.

PHOTO CAPTION: Massachusetts scallop boat.
PHOTO CREDIT: Coonamessett Farm Foundation Inc.

WHAT CAN WE DO?

Alaska fishermen send urgent message to save the oceans from ocean acidification. | PHOTO: Lou Dematteis/Spectral Q

THE MOST EFFECTIVE STEP toward healthier oceans is to stop pumping carbon dioxide into the sea from cars, factories, and power plants. But Massachusetts policymakers—and residents—don't need to wait for global coordination, researchers say. They can make a difference now:

HELP NATURE CULTIVATE ocean acidification-resistant bivalves by selecting strains that are naturally more resistant to the ocean changes.

REDUCE the amount of pollution from nutrients such as nitrogen that flows into waterways through smarter farming and development techniques and by installing upgraded sewage treatment.

INVEST in shellfish aquaculture techniques to help protect mollusks from corrosive waters during their sensitive larval phase.

INCREASE funding for targeted research and monitoring programs that help protect the shellfish industry, such as the National Oceanic and Atmospheric Administration's Sea Grant program and the Federal Ocean Acidification Research and Monitoring program.

ESTABLISH AN OCEAN ACIDIFICATION TASK FORCE. States such as Maine, Maryland, and Washington have taken an important step toward reducing their vulnerability to ocean acidification by assembling an expert commission to evaluate the risk of economic and ecological harm and to identify measures to mitigate them.

ABOUT THE STUDY

THE FINDINGS ABOUT MASSACHUSETTS ARE contained in a new paper, "Vulnerability and Adaptation of U.S. Shellfisheries to Ocean Acidification," published today in *Nature Climate Change*. The study breaks new ground by identifying the communities along our nation's shores that will most likely suffer long-term economic harm from ocean acidification, revealing a mosaic of vulnerability.

Coastal communities in 15 states are at high economic risk from ocean acidification due to their dependence on U.S. shelled mollusk fisheries, which brings in $1 billion annually. The researchers urge policymakers to take action now to protect these regions.

Researchers studied harvests from shelled mollusks such as oysters, clams, and scallops, which will likely be the first U.S. fisheries harmed by ocean acidification. They mapped locations in the ocean experiencing the most rapid changes from rising CO_2 in the atmosphere. They identified places where local factors such as algae blooms contribute to acidification, and mapped coastal communities that would be most vulnerable to declining harvests. Finally, they identified places where all these variables overlapped.

This work was supported by the National Socio-Environmental Synthesis Center under funding received from the National Science Foundation DBI-1052875.

WHAT IS OCEAN ACIDIFICATION?

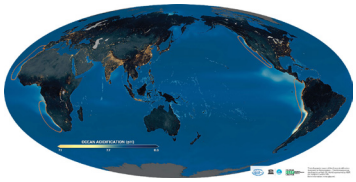
THE OCEANS NATURALLY absorb carbon dioxide from our atmosphere. Now, however, we've tinkered with that equation, dramatically increasing the amount of carbon dioxide entering the ocean through more than a century of burning fossil fuels.

When carbon dioxide dissolves into the ocean, it triggers chemical reactions that reduce the pH (increasing its acidity) while also reducing the availability of compounds such as carbonate. Carbonate is crucial because many shellfish and corals need it to build their skeletons and shells. With less of it, organisms expend more energy on shell-building and less on eating and basic survival. This can harm the organism and reduce populations.

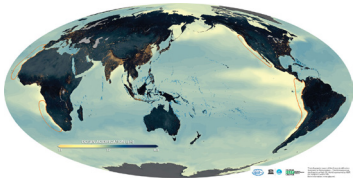
As ocean acidification accelerates, it now poses a serious threat to the web of life underwater.

RAPID DECLINE IN:
OCEAN pH

OCEAN pH IN 1860



PROJECTED OCEAN pH IN 2100



INFOGRAPHIC: This infographic is part of the *Ocean Acidification Summary for Policy Makers – Third Symposium in an Ocean in a High CO_2 World* sponsored by IGBP, IOC-UNESCO, and SCOR for more information www.igbp.net.