Researchers conduct first comprehensive study of NH oyster farming

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Ray Grizzle pulls a cage holding first and third-year oysters out of Great Bay. Credit: Krystin Ward/UNH

University of New Hampshire scientists have conducted the first study of oyster farming-nitrogen dynamics in New Hampshire, providing the first solid research on the state's oyster farming industry and the role oyster farms play with nitrogen removal. The research, which was funded in part by the NH Agricultural Experiment Station, contributes to a growing body of research on how oysters affect the nitrogen content of estuaries such as Great Bay.

The research was conducted by Ray Grizzle, research professor of zoology at the UNH School of Marine Science and Ocean Engineering; Krystin Ward, research assistant at the UNH Jackson Estuarine Laboratory; Chris Peter, research associate at the UNH Jackson Estuarine Laboratory; and Mark Cantwell, David Katz, and Julia Sullivan with the U.S. Environmental Protection Agency, Office of Research and Development.

"Every oyster that is harvested represents some amount of nitrogen leaving the system. We're beginning to quantify nitrogen dynamics and how the oyster farms on Great Bay affect it. Secondly, we're putting some numbers on the oyster farming industry itself," Grizzle.

Stretching 15 miles inland, Great Bay is a drowned river estuary with 144 miles of shore. According to the NH Water Resources Research Center at UNH, Great Bay has experienced a deterioration of water quality and aquatic life as a result of high nitrogen levels. A 2009 study indicated that nitrogen had increased 42 percent over the previous five years. Researchers also report that eelgrass declined by 64 percent between 1990 and 2008, and adult oyster populations have decreased from 125,000 in 1997 to 10,000 in 2009.

These are oysters harvested from a Little Bay Oyster Co. site. Credit: Krystin Ward/UNH

In this study, UNH researchers studied oysters at six sites in Great Bay over a three-year period beginning in 2010. The scientists measured the amount of nitrogen in different components of the oyster body, in different sizes of oysters, and at different farm sites.

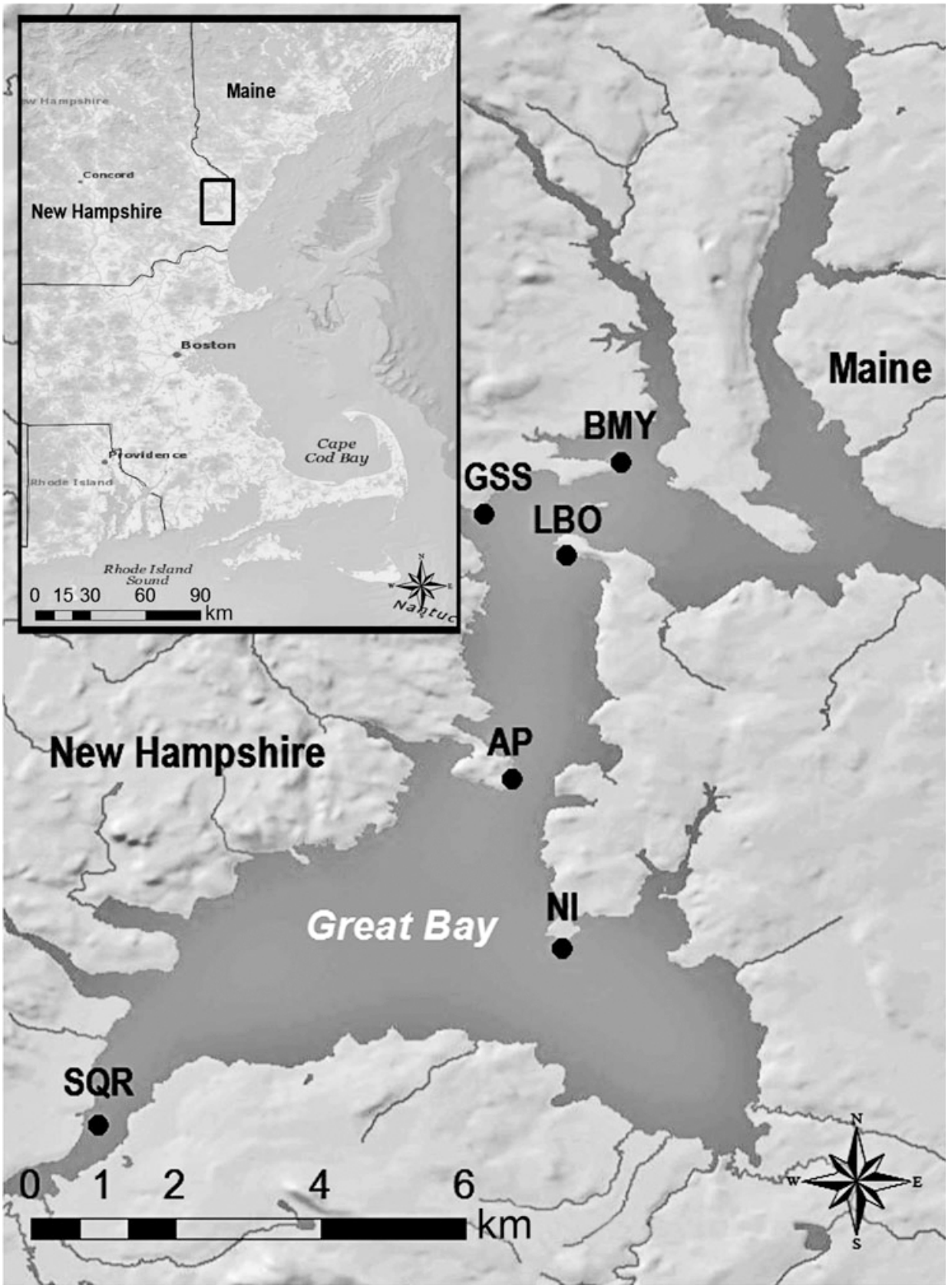
"Oysters feed on organisms that contain nitrogen, mostly phytoplankton, single-cell plants. When they feed upon these plants, they digest some of them and some go out as waste. But a significant percentage of them are incorporated into the oyster's body—the shell and soft tissue," Grizzle

said. "We wanted to see how much nitrogen is in farm-raised oysters, what factors cause nitrogen content to vary, and how oyster farming compares with other ways to remove nitrogen from the estuarine system."

Researchers found that the nitrogen in farmed oysters varied depending on size of oyster, farm site, age of oyster, seasonal variability, water quality, and time of harvest. They also found that the farmed oysters with the most nitrogen were those at sites that had the most nitrogen in the water. Overall, the average nitrogen content in the shells and soft tissue was comparable to that found in previous studies ranging from Cape Cod to the Gulf of Mexico.

Those who manage the Great Bay Estuary now are using this research to determine the amount of nitrogen that could be removed by oyster farming. "We have about 50 acres of oyster farms now. We are now modeling different levels of oyster industry size and how it would affect nitrogen removal in Great Bay," Grizzle said.

"It's never going to be a huge amount of nitrogen. I suspect it will be below 5 percent of the nitrogen that goes into the estuary, but 5 percent is 5 percent," he said.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Oysters were deployed at six sites from 2010 to 2012 for this study. Credit: UNH

According to Grizzle, the destruction of the natural oyster reefs in Great Bay likely has contributed substantially to the increase in nitrogen. Great Bay used to have many more natural oyster reefs, but in the 1990s, two oyster diseases hit the estuary. As a result, Great Bay has about 10 percent of the natural oyster reefs it had 30 years ago, and they are not in good shape.

"If we were at ten times the amount of natural reefs, the oysters would be filtering a substantial amount of water through their bodies. Some of the estimates have been upwards of 90 percent. That's the far end, but probably half would not be an exaggeration. So when they are filtering that much water, they are removing all of the particles and would have affected water quality," Grizzle said.

"However, we're getting to the point now that there may be as many oysters on farms as there are on natural reefs. We need to begin to look more carefully at how farms compare to the reefs in terms of the habitat they provide, the amount of water they filter, and the spawn they put out. We need to look at the farms in a more ecological manner," said Grizzle, who estimates Great Bay could sustain 100 acres of oyster farms.

Although Grizzle doesn't see oyster farms as being a substantial solution to reducing nitrogen in the entire Great Bay, he believes it could have a measurable impact on Little Bay. Using floating rafts may be a viable option for future oyster farming on Great Bay.

But even if oyster farming does not become a major solution to reducing

nitrogen in Great Bay, Grizzle emphasizes that oyster farming still provides valuable ecosystem services. "When the discussion focuses on one factor like nitrogen removal, people think that if it doesn't work, we shouldn't do it. Oysters provide habitat. They filter the water. They clear the water. Eel grass could expand. All of these ecosystem services come along with the farms," he said.

Going forward, Grizzle plans to research ways to increase production on oyster farms such as how to grow oysters more quickly.

Jay Baker, owner of Fat Dog Shellfish Co., said Grizzle's latest research adds to a growing body of work that demonstrates the value of farmed oysters in improving coastal water quality and mitigating human impacts to sensitive estuarine waters.

"While much of this work has focused on nutrient removal efficiencies of existing oyster populations and the results of enhancing wild stocks, Dr. Grizzle's work highlights the important role our industry can and does play in making coastal waters cleaner, and creating habitat for other valuable species," Baker said.

"Oyster aquaculture is one of few truly sustainable industries, and Ray Grizzle's great work continues to move this from abstract concept to a quantified and well documented fact. Both Dr. Grizzle and UNH have played a key role in not only improving our understanding of the value of restored and farmed oyster populations in Great Bay and the Northeast, but also in promoting shellfish aquaculture and sharing valuable knowledge and experience with new growers. The result is what has been called the 'New Hampshire Oyster Renaissance,' and we thank Dr. Grizzle and UNH for their great work," he said.

More information: Raymond E Grizzle et al. Growth, morphometrics and nutrient content of farmed eastern oysters, (Gmelin), in New

Hampshire, USA , *Aquaculture Research* (2016). DOI: 10.1111/are.12988