# The Impact
## of Climate Change on Our Oceans

written by Susanna Pilny '16

The impact of climate change on our oceans — rising sea levels, fluctuating temperatures, intensified storm patterns, and altered biogechemical cycles — promises an uncertain future in and out of the water.

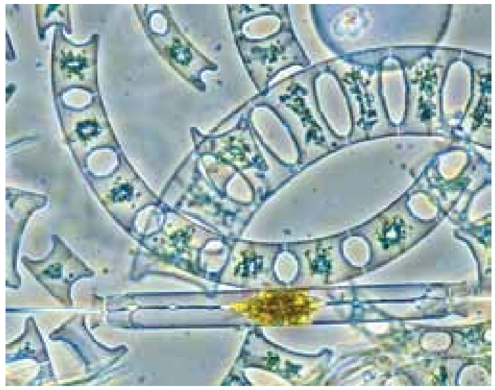
At the University of Rhode Island (URI) Graduate School of Oceanography, Associate Professor Tatiana Rynearson hopes to bring a better understanding of the unknown through her research on diatoms, a species of photosynthetic plankton that drift with the ocean's tides and currents. Covered in beautiful, delicate glass houses, these microscopic organisms are much more than a pretty shell.

"Diatoms are comprised of thousands of species and generate about 20 percent of all photosynthesis on Earth — more than all of the world's tropical rainforests," says Rynearson. "They generate the oxygen in every fifth breath of air that we breathe, so they have a large impact on the composition of our atmosphere. In addition, they supply about 40 percent of all the energy and food to form the base of the marine food web."

This critical role in the food chain means that any changes to the productivity of diatoms results in astounding repercussions. And yet, the impact of climate change on this keystone species is not yet fully known.

"The balance of prey like diatoms with their predators can significantly influence how much food is available for commercially important marine life, like fish and shellfish," says Rynearson. "We are really at the beginning of trying to understand how climate change affects diatom populations genetically."

Tatiana Rynearson
Associate Professor
Oceanography



Field sample of diatoms from Narragansett Bay shows the diversity of species found in just one drop of water.

To better gauge what will happen to the ocean and its inhabitants as water temperatures warm and alters nutrient levels, Rynearson collaborates with colleagues across the Ocean State as part of the statewide Rhode Island NSF Experimental Program to Stimulate Competitive Research (EPSCoR) grant. In many cases, her work cuts across disciplines and campuses, earning seed funding from the state for catalytic projects that hold promise of follow-on funding.

From 2012-2015, Rynearson participated on five different teams that earned RI Science and Technology Advisory Council (STAC) grants and served as lead investigator on two of the four. The STAC grants, which provide a year's worth of funding, are the state's match to the EPSCoR grant. Rynearson's most recent STAC involvement came in two 2015 grants:

- Diatom Community Composition as an Indicator of Coastal Ecosystem Change studied the regional biogeochemical responses to climate change and sought to develop novel tools for monitoring such changes. This work was done in collaboration with researchers at URI and Brown University.
- Canaries in Narragansett Bay: Untangling the Ecological Response of a Key Diatom Genus to Environmental Change researched how environmental changes affect the base of the food web in Narragansett Bay. This work was done in collaboration with the U.S. EPA.

"One of our recent studies showed that diatoms subjected to a few months of projected ocean acidification underwent rapid evolutionary change," Rynearson says. "In essence, there was a change in their genetic composition and this led to a change in their growth rates in response to ocean acidification."

In that project, diatom growth rates increased by 30 percent in response to ocean acidity — a change that can upset the delicate balance of marine ecosystems. In other instances, diatom populations have seen decreases as a result of climate change stressors. Often, Rynearson says, it is difficult to tell which way the population will go.

"That's the challenge of climate change research — it's ultimately a multi-stressor event and that is very hard to simulate in the lab under controlled conditions," she explains.

Rynearson and her colleagues aim to make such changes easier to anticipate, trying to understand the predictability of the evolutionary response and whether that can be incorporated into models of environmental change.

Her research also takes her beyond Narragansett Bay to look at the effects of climate change on a global scale through work to design a national network to monitor marine diversity. In April 2013, Rynearson published an article in the journal BioScience, where she and colleagues called for a national network to monitor the diversity of marine life as a means to assess ocean health.

In response to her call, the National Oceanographic Partnership Program made $17 million available for regional test networks in the Florida Keys, the California coast and the Arctic Ocean. After this test period of five years, the goal is to create a national network. Such a network, Rynearson explains, would track marine diversity at all levels of the food chain — be it microbes or whales — and link changes in diversity to physical changes in ocean ecosystems, such as a rise in water acidity.

Her future research will include studying the effects of climate change on plankton in the Southern Ocean and creating new tools to aid in understanding complex organisms and food webs. She and her colleagues, including URI Associate Professor Bethany Jenkins, have developed and are applying a metabolic fingerprinting technique, which requires cutting edge genomics and bioinformatics methods, to look inside the plankton and ask questions about their health, especially in response to stress.

Rynearson says, "This will give us new insights into what influences the engine that ultimately keeps marine food webs running."

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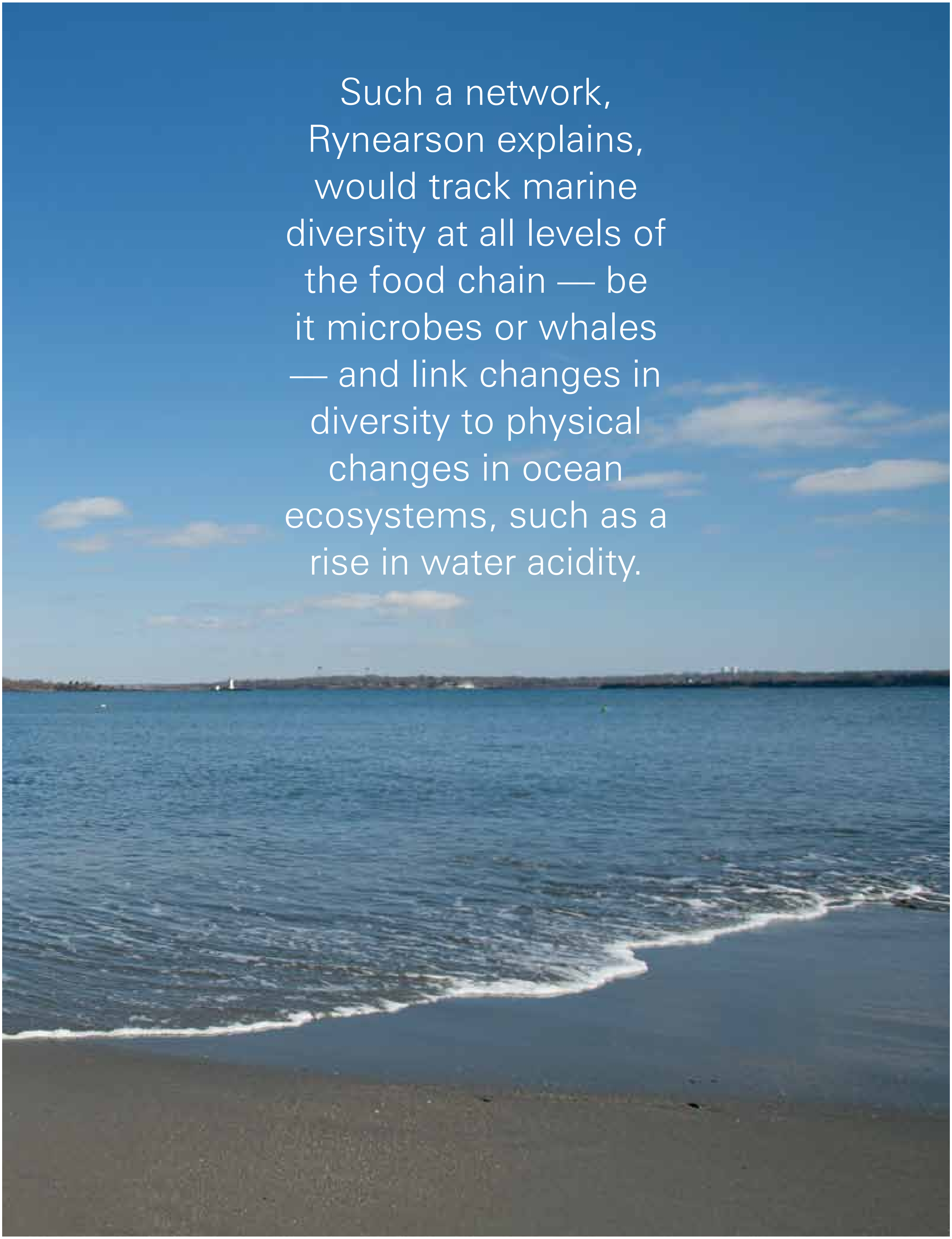

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