TINY THINGS BIG IMPACT

Varela against a backdrop of diatoms. UVIC PHOTO SERVICES

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Phytoplankton are helping us better understand past, present and future global ocean change

by Vimala Jeevanandam

Every spring, as the rest of us are admiring the daffodils, Dr. Diana Varela has her eye on a different type of bloom. The University of Victoria biological oceanographer is studying the marine diatoms of Saanich Inlet, just north of campus. As the days lengthen and the sun gets brighter, the diatoms burst into algal blooms, nourished by the abundant nutrients that have built up over the past winter.

These unicellular life forms are the crux of ecosystems both aquatic and terrestrial. Part of a larger group of microscopic algae known as phytoplankton, diatoms drift across the top layer of oceans, seas and lakes.

Phytoplankton as a whole produce about half of Earth's oxygen and cycle elements such as carbon, silicon and nitrogen throughout the ocean, all while providing a primary food source for marine animals. And like plants, phytoplankton trap atmospheric carbon dioxide, making them a powerful influence in global climate change.

"Because they're rarely seen with the naked eye, it's easy to overlook phytoplankton. But they're fundamental to so much of life," says Varela, who is a scientist and professor in UVic's Department of Biology and School of Earth and Ocean Sciences.

Phytoplankton have been the focus of Varela's research for the past 20 years, where she couples field studies with laboratory experimentation. In her search to clarify the complex relationship between phytoplankton and their environment, she's gone on expeditions to some of the planet's most extreme climates—from the Arctic Ocean to Antarctic marine waters.

There, she's examined the dramatic seasonal effects of polar conditions, as well as the burgeoning impact of climate and habitat change on the productivity of sensitive planktonic communities.

Closer to home, Varela has been examining the role of diatoms in Saanich Inlet.

Each year, after the diatoms bloom, they die off in large numbers as part of their bloom-and-bust cycle. As they die, they fall toward the inlet's ocean floor. Here, in the depths of the inlet, the intensity of the diatom seasonal die-off causes low oxygen levels, creating a natural seasonal dead zone.

"The inlet is a unique habitat—dynamic and constantly changing," says Varela. The variations it experiences over a year make it an excellent place to study the role of diatoms on carbon capture, oxygen content and the overall marine ecosystem.

As the global climate changes, there's been an increase in the number and size of low- or no-oxygen areas, dramatic increases in phytoplankton productivity in some regions, and a decrease in others. The information that Varela's team gathers on phytoplankton processes can be extrapolated to explain and predict changes that are happening in marine ecosystems throughout the world.

Phytoplankton can help us better understand the present and future, but they also help us look deep into the past. Made of silica—a form of natural glass—diatoms can remain at the bottom of the ocean for millions of years.

The composition of diatoms changes depending on nutrient and other marine conditions at the time when they were growing. When we better understand the connection between diatoms and their environment, we can build a more precise record of past ocean conditions, says Varela.

"Understanding what influences phytoplankton and, in turn, their impact on their environment, is essential for understanding our planet as a whole."

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Phytoplankton come in many shapes and sizes. The largest look like tiny specks floating in the water. But most are so small they appear as coloured water, including red, green and brown. Under a microscope, you'll see many beautiful and intricate forms—such as opalescent ovals, pill-box-like chains with protruding spines, and plated "spaceships" with flickering flagella.

Over geological time scales of settling to the bottom of the ocean, phytoplankton become the oil we extract from the oceans to use as fuel.

Researchers aboard the C3 Expedition—a 150-day journey through Canada's northwest passage commemorating the 150th anniversary of Confederation—collected about 100 samples for Varela in the Arctic and sub-Arctic. She's using these samples to further develop a pan-Canadian Arctic perspective on the production of organic matter in Arctic waters and the presence of diatoms.

Varela's research is conveyed to students in her undergraduate courses on biological oceanography and the biology of algae, as well as a graduate course on the ecophysiology of phytoplankton.

Varela collaborates with researchers from the US, France and Argentina. Her research is funded by the Natural Sciences and Engineering Research Council.

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