UC SANTA BARBARA

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Julie Cohen

A Living Laboratory

On May 19, 2015, near Refugio State Beach, thousands of gallons of oil leaked from a pipeline fed by offshore platforms in the Santa Barbara Channel. Within hours, UC Santa Barbara's David Valentine and volunteers from his lab were on site collecting samples. They came back twice the next day and have returned many times over the past three months.

Valentine, a professor in the Department of Earth Science, and several colleagues who have long used Refugio as a living laboratory, see the oil spill as an opportunity to understand how marine ecosystems respond to disturbance. Mark Brzezinski, director of the Marine Science Institute, suggested the researchers apply to the Simons Foundation, which awarded them a $588,000 grant to continue their study of the area for the next year.

"The discharge of heavy oil at Refugio presents a unique opportunity to discover novel metabolic, genomic and ecological feedbacks among marine microbial communities, heavy oil and ecosystem response," Valentine said. "We have the opportunity to study ecosystem changes and microbial reactions from the very early stages through an entire year. It's really rare for scientists to get day zero access to any sort of event like this."

The oil discharged at Refugio inundated marine microbes. Scientists seek to understand not only how the spill impacted microbes in the context of ecosystem disturbance but also how microbial survivors adapted to the oil and subsequently affected the oil's behavior and fate.

Capitalizing on the unique aspects of this event as well as the proximity of the site — Refugio is only 10 miles from campus — the investigators will focus on three areas involving microbial populations, each with different ecological roles. The Valentine Lab will examine metabolic and ecological feedback among oil, microbes and ecosystems.

Debora Iglesias-Rodriguez, a professor in the Department of Ecology, Evolution and Marine Biology, and Uta Passow, a research oceanographer at the campus's Marine Science Institute (MSI), will study the biophysical interactions between oil and microbes and their ecological implications.

"The Simons Award is a great opportunity to use the Santa Barbara Channel as a natural laboratory to test whether and how oil changes the fate of the planktonic community and its functional properties," Iglesias-Rodriguez said. "We will verify field observations with a number of laboratory manipulation experiments, using state-of-the-art genomic tools to investigate alterations in diversity."

Phytoplankton are also important in transferring matter to the ocean floor — for example through the formation of aggregates, a type of microbial oil-snow, which is Passow's area of expertise. "Many microbes respond to the presence of oil by producing mucus," Passow said. "This sticky mucus can cause the formation of marine snow, the dust bunnies of the ocean.

"After the spill in the Gulf of Mexico, oil-associated marine snow carried oil to the seafloor, but we have no idea if the heavy oil from the Refugio accident will cause the same biological response," she added. "This grant will allow us to analyze and expand on preliminary experiments we conducted with water samples taken from Refugio in May to evaluate if marine snow formation was an important response to this spill as well."

MSI research biologist Robert Miller, along with Valentine, will investigate the adaptation of marine invertebrate microbiomes to hydrocarbon exposure. "All animals have a community of microbes living in their gut that can be vital for digestion of food and other functions," Miller explained. "We know very little about the gut microbiome in marine animals, how it relates to their food supply and how adaptable it is to the animal's environment. These are some of the topics we will be exploring in this project."

All three projects will be able to compare information gathered post-spill to previously collected data. A variety of researchers, including members of the Santa Barbara Coastal Long Term Ecological Research network, have explored the area from a variety of perspectives.

“We’ve been studying the seepage and the hydrocarbon cycling for some time,” Valentine said. “Now we have this singular event for which we have baseline information so we’ll be able to keep track of the changes imparted by the oil spill.”

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.