UC SANTA BARBARA

THE Current

December 19, 2002
Gail Gallessich

# A Drop of Ocean Water Tells a Story

Scientists are still learning what's in a drop of ocean water, according to this week's Nature Magazine. And the answers have implications for the whole planet, says co-author Craig Carlson, an oceanographer at the University of California, Santa Barbara. Carlson is an assistant professor in the Department of Ecology, Evolution and Marine Biology.

About ten thousand bacterioplankton of the type SAR 11 are found in every drop of seawater. And yet, as explained in the article, which gives the first accurate quantitative assessment of SAR 11, scientists are only beginning to understand what these organisms do.

The article is the result of a collaborative effort between Craig Carlson, and his lab, and Stephen Giovannoni of Oregon State University (OSU) and his lab, including first author Robert Morris. They are attempting to better understand the role of microbes in natural systems.

The work was conducted under the Oceanic Microbial Observatory project, a joint effort between UCSB, OSU and the Bermuda Biological Station for Research that was initiated in 1999 by the National Science Foundation.

"Microbes like bacterioplankton are important biogeochemical agents," explained Carlson. "Over geologic time, they have played an important role in altering the chemical nature of the earths's environment, allowing for the evolution of plants and animals. Without them, we would have no oxygen to breathe, organic matter would

not be degraded, and the cycling of life's essential nutrients would cease."

In a world that appears to be dominated by large organisms (i.e.things we can see), some might ask why we care about microbes -- don't they just make us sick? The fact is that only a small percentage of microbes are pathogenic; most are beneficial to life on earth, according to Carlson. The living biomass and processes that drive the earth's biosphere are really in the hands of the microbes.

For decades marine scientists have been able to enumerate bacterioplankton and scientists have known that they are important to the cycling of nutrients in the ocean. They have also known that there are many types (species, strains) of bacterioplankton in the oceans. But, until recently, the ability to distinguish one species from another in a quantitative manner was very limited. As a result, most oceanographers treat the bacterioplankton as a 'black box.' "However, we know that all bacterial species do not function the same way, so the 'black box' approach grossly oversimplifies microbial contributions," said Carlson. "One of the objectives of this study was to 'open up' the 'black box' and assess quantitatively how a specific group of bacterioplankton, called SAR 11, contribute to the total bacterial pool in the open ocean."

SAR 11, were first identified in the early 1990s by Steve Giovannoni from samples collected in the Sargasso Sea. They were identified qualitatively via gene cloning as a major group of uncultured bacterioplankton. Until now scientists haven't had good quantitative information about how this specific group of bacteria contributed to the total oceanic bacterial pool. The use of molecular techniques in combination with microscopy now allows for the identification of certain bacteria types. The scientists found that the bacterioplankton SAR 11 comprises as much as 50 percent of the total surface microbial community (from zero to 140 meters below the surface) and 25 percent of the rest of the water column down to the bottom of the sea.

They were able to do this using a technique called "FISH," short for fluorescence in situ hybridization. The SAR 11 FISH probes, developed in

Giovannoni's lab, are short DNA sequences that have a fluorescent tag on them. Water drops containing one hundred thousand to millions of many different types of bacteria are concentrated onto a filter. Under special laboratory conditions the fluorescent DNA probe sticks to the targeted SAR 11 bacterial sequence and lights up like a Christmas tree bulb when exposed to a certain wavelength of light, and

thus the SAR 11 can be counted.

Carlson said that "FISH" probe allows scientists to gain qualitative and quantitative information from a mixed bag of bacteria. "We can tell who they are and how many there are," said Carlson.

"By sheer numbers, SAR 11 is important," said Carlson. "They are one of the most successful groups of bacteria in the ocean. The next step is to learn what they do. Identification is a first big step that allows us to assess their particular role in nature."

---

## 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.