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UC Berkeley, U.S.G.S. Scientists Discover Microscopic Invader Of San Francisco Bay, The First Known Marine Microbe Invader Of U.S. Waters

Denver -- While there are many known cases of exotic creatures invading the country's rivers and estuaries, scientists have for the first time documented the invasion into U. S. coastal waters of a type of marine microorganism.

In a talk to be given on Thursday, Oct. 31, at the annual meeting of the Geological Society of America in Denver, Doris Sloan and Andrew N. Cohen of the University of California at Berkeley, and Mary McGann of the U.S. Geological Survey in Menlo Park, Calif., report the introduction of a single-celled amoeba-like organism, the foraminifer *Trochammina hadai*.

Foraminifera or forams, microscopic marine creatures with shells of calcium carbonate, are best known from their abundant fossils, which are found in such profusion and diversity they are used to date sedimentary rocks going back as far as half a billion years.

The organism apparently arrived within the past 10 years from Japan, probably hitching a ride in the ballast tanks of a ship that took on water in a Japanese port and emptied its tanks into western U.S. waters, the scientists say. This exotic foraminifer is a common inhabitant of estuaries and bays in Japan, where it lives in the mud in shallow water.

Alarmingly, the new resident in San Francisco Bay has spread widely

throughout the bay and is now found in large numbers at many sampling sites.

The introduction of an exotic organism that spreads as rapidly as *T. hadai* is a matter of considerable concern, Sloan says. In particular this invasion raises questions about the extent to which other microorganisms are invading the world's ports and estuaries.

It is too early to tell what the impact of this introduction will be on the ecosystem, Sloan says, but at the population levels currently found, it is likely to have a large impact on the native species of foraminifer.

The introduction of exotic species to the estuaries and inland waters of the United States is now a well known problem. Invaders such as mussels, clams, crabs and other invertebrates crowd out native species, and if they have no natural predators, can cause major damage to our harbors and waterways. A prime example is the zebra mussel which has clogged water pipes in the Great Lakes region, causing millions of dollars of damage.

Cohen, who works with the Energy and Resources Group at UC Berkeley, has previously reported the introduction of more than 200 exotic macroscopic species, both plants and animals, to San Francisco Bay in the past 150 years, suggesting that the bay is the most invaded estuary in the world.

T. hadai's presence in San Francisco Bay is probably not the first time one of these tiny organisms has traveled around the world, the scientists say. It is likely that there are a number of introduced microorganisms in the world's estuaries that just haven't been noticed yet.

Some of the species previously reported as natives might in fact have been introduced before studies of shallow-water foraminifers became common in the 1950s. Cohen thinks that they could have arrived in the bay as hitch-hikers on ship hulls during the Gold Rush, in shipments of oysters from the Atlantic seaboard, in ballast water or by other mechanisms.

T. hadai was first found in San Francisco Bay sediment by McGann in 1995 while examining samples taken near the San Francisco airport. She recognized that this organism was not one of the common native species of foraminifers that lives in the bottom of the bay.

At about the same time Sloan, a geologist and lecturer emerita in environmental sciences at UC Berkeley, also found it in samples taken further north in Marin County waters. Sloan and McGann then

looked at many sediment samples collected in earlier years from the bay, to see if they could determine when it first arrived.

While they did not find it in any sediment samples which had been collected between 1964 and 1981, they did find it in samples collected from the bottom of the bay in 1987. Evidently this organism was introduced to the bay sometime between 1981 and 1987, though no samples from this period are yet available to date its arrival more closely, Sloan says.

Since they first found it, the scientists have sampled bay sediments twice a year and have now found that *T. hadai* has spread throughout the entire bay ecosystem. At many sampling sites it makes up over 50 percent of the foraminifer population and in one case over 90 percent.

The mud and water found in ballast tanks of ocean-going ships is probably one of the most common current mechanisms by which species travel from port to port today, Cohen says. Over 68 million gallons of ballast water are released by ships in San Francisco Bay annually, yet there currently is no regulation of such dumping to prevent invasions by exotic species.

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