WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: WA781

Title: Biodegradation of Non-Point Source Pollutants in Soap Lake, Washington

Focus Categories: Non Point Pollution, Water Quality

Keywords: Pollutants, Toxic Substances, Water Quality, Biodegradation, Arid Climates, Alkaline, Saline

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Abstract

Extremophiles are microbes that thrive in the earth's most hostile environments ranging from scalding hot springs, to high-pressure vents thousands of feet below the ocean's surface, to saline lakes and ponds at pH 10. As a result of human activities, extremophiles and the unusual environments they inhabit may be at significant risk from low-level non-point source environmental contaminants such as petroleum hydrocarbons, pesticides, and metals. Environments that harbor extremophiles are as likely to have been exposed to non-point source contamination as freshwater ecosystems. Soap Lake in eastern Washington contains 25 to 125 grams per liter total dissolved solids depending on depth, has a pH of 10, and is known to support thriving populations of extremophilic microorganisms, specifically, haloalkaliphiles (bacteria that flourish in high salt and high pH environments). Our group has data that show polynuclear aromatic hydrocarbons (PAH) from urban runoff are entering Soap Lake.

Soap Lake and other unique saline-alkaline environments of the Western U.S. may not have the degradative capacity to withstand the levels of contamination that are tolerable in many freshwater systems: a fact that seems to have been overlooked by regulatory agencies and many environmental groups. At a time when public and scientific interest in the biotechnological potential of unique microorganisms is rapidly increasing, it is important to understand and quantify the biodegradative capabilities of these unique systems to prevent toxic (and perhaps lethal) levels of contamination from accumulating in these fragile and largely undiscovered ecosystems. Scientific data on the biodegradation of contaminants in haloalkaliphilic environments are essentially not available. Currently it is unknown whether non-point source contaminants entering Soap Lake are biodegraded or are accumulating in sediments. To determine impacts of non-point source contaminants on Soap Lake and haloalkaliphilic bacteria, we propose a study that crosses disciplinary boundaries to collect water and sediment samples to analyze for PAH and pesticides, and to quantify contaminant degradation rates and toxicity parameters for selected haloalkaliphilic Soap Lake bacterial isolates. Experiments will be performed to determine rates of bio-degradation of common non-point source contaminants found in the environment. These contaminants will

include the PAH compounds phenanthrene and fluoranthene, which we have recently detected in runoff samples directly entering Soap Lake, and the pesticide, atrazine. The list of specific target contaminants may be modified if water and sediment samples indicate other contaminants should be examined.

Our results would improve the current understanding of the impacts and interactions between specific anthropogenic contaminants and the haloalkaliphilic bacteria found in Soap Lake. For the scientific community, our results will provide insight into haloalkaliphilic environments throughout the West that are potentially threatened by anthropogenic pollutants.

This study will benefit state regulators, concerned citizens, and the scientific community by providing the following deliverables:

1) Identification of non-point source contaminants present in Soap Lake water and sediments,

2) Measurements of microbial degradation rates of selected non-point source contaminants, and

3) Quantification of haloalkaliphilic microbial inhibition by non-point source contaminants. These results will shed light on the potentially negative impacts that non-point source pollutants have on extreme environments like Soap Lake and their ability to continue to support unique microbial communities.