Title
Submarine Groundwater and Its Influence on Beach Pollution

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Submarine Groundwater and Its Influence on Beach Pollution

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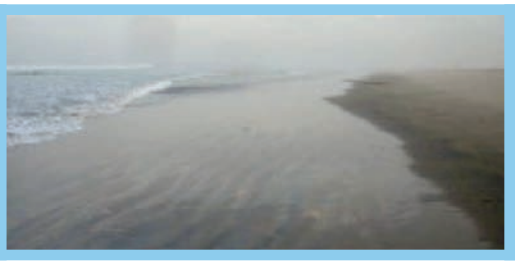

Background

Scientists believe that beach closures due to high indicator bacteria counts are linked to groundwater flowing a few feet beneath the sand. Groundwater discharging to the coast may be as important a source of coastal pollution as the more often implicated urban runoff.

Southern California's coastal water quality woes are, in part, tied to groundwater flowing a few feet beneath the sand. According to California Sea Grant scientists, submarine groundwater discharges may be as important a source of bacterial contamination as the more often implicated urban runoff.

In a series of field experiments conducted in 2003 at Huntington Beach, an area plagued by beach closures, Stanford scientists Alexandria Boehm and Adina Paytan showed that the amount of submarine groundwater flowing into the surf zone varied with the phase of the moon–in other words, the tides. Further, microbial pollution levels were linked to how much submarine ground water was flowing to the beach.

This pattern–that bacterial counts vary with lunar cycles–was documented at 50 Southern California beaches. Oddly, however, the scientists did not observe what would be expected to be true–that groundwater itself is a source of bacteria. In fact, only 1 of 26 groundwater samples tested at Huntington Beach had elevated levels of fecal indicator bacteria, the standard by which authorities evaluate beach water quality.

"Submarine groundwater" refers to the underground mix of groundwater and saltwater that ebbs and flows into coastal waters with the pull of the tides. Groundwater refers to water from rivers, water from rain, snowmelt or irrigation that seeps underground, filling pore spaces of rocks and sediments. Unless trapped, groundwater eventually flows to sea. Along the way, it may become contaminated with bacteria and nutrients from leaky sewers, septic tanks, lawn fertilizers, pet waste and the like.

Project

The central question now is to explain why bacterial counts are tied to submarine groundwater discharges if the groundwater itself is not contaminated. This California Sea Grant project will allow scientists to investigate possible cause-and-effect relationships between groundwater and bacteria levels.

A leading hypothesis, Boehm said, is that beach sand may store fecal indicator bacteria. Groundwater may "free" bacteria that would otherwise remain held in sediments.

Another possibility: Groundwater contains dissolved organic matter and nutrients–phosphate, nitrate and ammonia–that "feed" bacteria, encouraging their growth.

In their 2003 study, scientists found that nitrate concentrations were 100 times higher in submarine groundwater than in the surf zone. Nitrogen and phosphate might influence the growth of plankton and the occurrence of toxic algal blooms in some areas, Boehm said.

Another issue to be explored is the extent to which land-use patterns influence submarine groundwater and beach water quality. During their Sea Grant project, Boehm and Paytan will collect water samples from beaches in Santa Cruz, which sits within NOAA's Monterey Bay National Marine Sanctuary and Bolinas, a town north of San Francisco, within NOAA's Gulf of the Farallones National Marine Sanctuary.

These sites have different population densities and wastewater management plans. Residents of rural Bolinas are on septic tanks, which means waste is released into the ground. Santa Cruz, in contrast, is relatively urban, and the city's treated sewage is discharged at sea.

"We are the only researchers studying the connection between submarine groundwater discharges and California coastal water quality," Boehm said.

(*continued*)

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"This Sea Grant research will allow us to document how the quantity and quality of submarine groundwater affects beach water quality. There are many regulations for what is discharged from the land to the sea via runoff. Results from our work may suggest that what is discharged from land to sea via the subsurface should be regulated, too."

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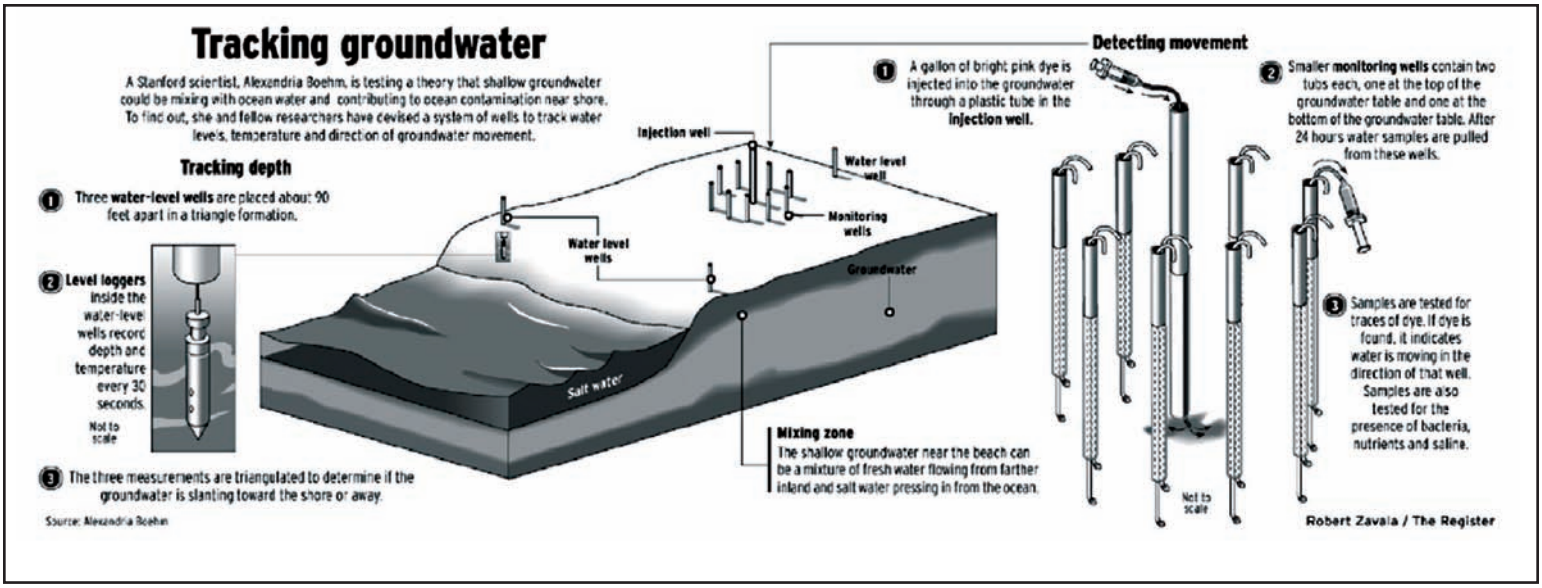
(Front) Alexandria Boehm, (Portraits) Stanford University
(Back Graphic) Orange County Register

Alexandria Boehm and Adina Payton



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