These Bugs Aren't Pests

Bugs – from macroscopic beetles to microscopic bacteria – are helping improve water quantity and quality by attacking invasive saltcedars in the West, producing power from grease in California wastewater treatment plants, and "breathing" arsenic in salt pans of the Mojave Desert.

Beetles Partial to Saltcedar

Saltcedar, or tamarisk, is an unwelcome species in much of the West because it crowds out native vegetation and consumes large amounts of water. In August, the Colorado Department of Agriculture (CDA) announced that about 60,000 saltcedar leaf beetles (*Diorhabda elongata deserticola Chen*) were to be released in seven western states to help control saltcedar. In Colorado, beetles were released at river-bottom sites in three counties. Other releases this year are scheduled in Wyoming, South Dakota, Montana, Oregon, Kansas, and Idaho. The Colorado Department of Agriculture Insectary in Palasade, Colorado, is coordinating the project, which also includes collaborators from the U.S. Department of Agriculture and Colorado State University.

According to CDA, saltcedar leaf beetles come from central Asia where they live and feed on the plant. The beetles are only effective in northern states with climates similar to their native northwestern China, thus they will not help in Arizona, New Mexico, or Texas, states that also are battling saltcedar invasion. Since the first biocontrol beetles were brought to the United States in the early nineties by the U.S. Department of Agriculture, they have been extensively studied and tested, particularly to ensure that they feed only on saltcedar.

Dan Bean, state biocontrol specialist at CDA, noted that "It's important to remember that while the beetles are expected to suppress large infestations of saltcedar, they will not eradicate the plant. Like all biocontrol programs, this one is designed to bring plant density down to a manageable and economically insignificant level."

In 1991, 1,300 beetles were released at a site in Nevada, reported the *Delta County* [Colorado] *Independent*, and two years later, 400 acres of saltcedar had been defoliated. The newspaper pointed out that management of saltcedar with beetles is expected to cost less than $10 per acre, compared to manual removal at $1,500 to $3,000 per acre.

Bacteria Transform Grease to Power

Disposal of grease can be a significant expense for restaurants, and it clogs storm drains and sewer manholes when it is illegally dumped. But, according to the *Riverside* [California] *Press-Enterprise*, in Riverside, grease added to sewage sludge helps feed bacteria, which produce methane gas that is captured for use in a cogeneration power plant, and in turn used to power the treatment plant.

Test programs begun in April showed that adding grease wastewater to the sewage increased methane production from one digester by 66 percent, said the article. Only a relatively small amount of grease wastewater is needed to achieve an effect – 5,000 to 10,000 gallons a day into a digester with 150,000 gallons of sludge. But, reported the paper, a spike in methane output has been observed after grease is added. Sugars typically present with restaurant grease are expected to further fortify the bacteria.

Riverside's wastewater treatment plant received a $16,000 grant from Riverside Public Utilities to run the trial program, wrote the *Press-Enterprise*. Regan Bailey, a wastewater resources analyst for the utility, told the paper they hope to produce enough methane to operate the treatment plant entirely with the methane produced onsite, saving the city nearly $1 million annually.

The city of Oxnard and the East Bay Municipal Utility District are also using grease for energy production, but not on the scale of Riverside, said the article.

Arsenic-Breathing Microbes

U.S. Geological Survey biochemist Ron Oremland and his colleagues have discovered microbes living in extreme environmental conditions at Searles Lake in the Mohave Desert of southeastern California. These microorganisms derive their energy for growth by metabolizing arsenic. Although the phenomenon had been previously observed, the discovery that such a process occurs under the harsh conditions of Searles Lake was a novel finding.

"This is a water body that is poised at salt saturation, about ten times saltier than seawater, but also with the added factor of being quite alkaline and thereby very caustic," Oremland said. "The pH of Searles Lakes is 9.8 and is therefore about seventyfold more alkaline than seawater. If you add in the unusually high concentrations of toxic arsenic in the water (about 300 milligrams per liter) along with other harsh elements like boron, this is an environment that is definitely hostile to most forms of life. It's a place where very few organisms can live. Sulfate-reduction and methane production do not occur in the anoxic sediments. What we discovered is that these microbes can exploit the dissolved arsenic in the lakewater in order to 'breathe'."

The research may have applications for arsenic remediation in other water sources. "Now that we've identified and isolated these bacteria, it will be interesting to see what analogous species with the same type of arsenic biochemistry are capable of doing in less extreme environments, such as freshwaters and drinking water aquifers," Oremland said.

Visit www.ag.state.co.us and www.pe.com. Oremland's findings were featured in the May 27, 2005 issue of Science. *Visit www.usgs.gov/homepage/science_features/arsenic.asp.*

SW Hydrogeologic Areas, Flow Systems Classified

A new report from the U.S. Geological Survey describes a study in which the hydrogeology of the Basin and Range Physiographic Province was classified at basin and larger scales in parts of Arizona, California, New Mexico, Utah, and most of Nevada.

David Anning, lead author of the report, said that results of this study will not only help water resource managers and decision makers transfer much-needed information across similar hydrogeologic areas, but will provide them with a synthesis of results from many previous hydrologic investigations. Anning and his colleagues developed a conceptual model for the hierarchy of the hydrogeology, by scale, for the Basin and Range Province that consists, in order of increasing size, of hydrogeologic components, hydrogeologic areas, hydrogeologic flow systems, and hydrogeologic regions. This hierarchy formed a framework for hydrogeologic classification.

Hydrogeologic areas were classified into 19 groups through an analysis of eight characteristics of each area's hydrologic system. Six characteristics represented the inflows and outflows of water through the hydrogeologic components and can be used to determine the area's position in a hydrogeologic flow system. The remaining two characteristics are indexes that represent recharge and discharge processes in each specific area.

Hydrogeologic flow systems consist of either a single isolated hydrogeologic area or a series of multiple areas that are hydraulically connected. A total of 54 hydrogeologic flow systems were identified and classified into 9 groups on the basis of the types of inflow/outflow between areas, the mechanisms for water loss in each area, and the predominant hydrogeologic component—soils and streams, basin fill, or consolidated rocks—that hydraulically connects each specific area into hydrogeologic flow systems.

The report "Classification of hydrogeologic areas and hydrogeologic flow systems in the Basin and Range Physiographic Province, Southwestern United States," by D.W. Anning and A.D. Konieczki, is U.S. Geological Survey Professional Paper 1702, available at water.usgs.gov/pubs/.

EPA Seeks Data for 26 Drinking Water Contaminants

Twenty-six unregulated contaminants will be monitored by numerous U.S. drinking water suppliers under a new rule proposed by the U.S. Environmental Protection Agency. This second cycle of the Unregulated Contaminant Monitoring Rule (UCMR 2) also proposes the use of nine analytical methods to detect the contaminants.

The data collected will help EPA determine the occurrence of the contaminants in drinking water, the potential population exposed to each, the levels of exposure, and whether to regulate them. The contaminants include pesticides, herbicides, explosive agents, flame retardants, and several nitrosamines.

EPA currently has regulations for more than 90 contaminants. The Safe Drinking Water Act requires EPA to identify up to 30 contaminants for monitoring every five years. The first cycle, UCMR 1, published in 1999, covered 25 chemicals and one microorganism.

The contaminants are divided into two lists: assessment monitoring and screening surveys. EPA has information from some public water systems on 11 contaminants chosen for assessment monitoring but lacks a national estimate of how widely they occur. EPA needs to collect more data on the 15 selected for screening surveys because analytical methods have been only recently developed.

All public water systems serving more than 10,000 people and a sample of 800 systems serving 10,000 people or fewer will monitor those contaminants on the assessment list for 12 months from July 2007 through June 2010. Additionally, 322 systems serving more than 100,000 people and 800 serving 100,000 or fewer will conduct the screening surveys during a 12-month period from July 2007 through June 2009.

The substances were chosen through a process that included a review of an existing list of "reserved" contaminants for which no analytical methods were yet available, and EPA's Contaminant Candidate List, which contains priority

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contaminants that are researched to make decisions about whether regulations are needed.

The contaminants on the list are known or anticipated to occur in public water systems. However, they are currently unregulated by existing national drinking water regulations.

Costs for the five-year UCMR 2 will total approximately $42.1 million. EPA will conduct and pay for monitoring of those water systems serving 10,000 people or fewer, at a cost of $8.05 million.

For the list of contaminants and additional information, visit www.epa.gov/safewater/ucmr/ucmr2.

Reclaimed Wastewater Shows Promise for Irrigation

From the TAMU-AgNews, Aug. 9, 2005

As water becomes increasingly scarce, irrigating crops with wastewater may be a safe option if done correctly, researchers at the Texas Agricultural Experiment Station (TEAS) in El Paso say.

"Managing reclaimed water by pretreating before using it to irrigate, monitoring for viruses, choosing correct crops and periodically leaching the soils should be successful and safe," said George Di Giovanni, an environmental microbiologist at TEAS.

Di Giovanni and his colleagues studied the movement of viruses carried in water through sandy and clay soils in which spinach was planted. They wanted to find out how long viruses in the water remain in the soil, how they move through the soil, and whether they could harm humans or livestock. Their findings have been accepted for an article in *Agriculture Ecosystems and Environment*.

"No bacteriophage (virus) was found on the spinach leaves, regardless of the type of soil they grew in," Di Giovanni said.

The tests were done in a greenhouse in soil collected from the region. Two types of water were tested: a blend of reclaimed water, and filtered wastewater laced with bacteriophage, which is a type of virus that infects only bacteria. The water was dripped under the soil surface in plastic columns built for the test.

The research found that bacteriophage could be found on the crusty surfaces of both soil types and remained in the clay soil for about a month after irrigation ended.

"That suggests that human viruses could also linger in the soil," Di Giovanni said. "Reclaimed water must be effectively treated to remove or kill pathogens before use, regardless of irrigation method."

The researchers said their use of a closed system, using underground pipes to apply water to the crop, limited exposure to the soil surface and edible parts of

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the crop. While their study showed the use of wastewater was feasible, the researchers said similar trials would need to be conducted at each site to assess soil conditions prior to initiating a new system.

Visit agresearch.tamu.edu.Contact George Di Giovanni at gdigiovanni@ag.tamu.edu.

UCLA Forms Water Technology Research Center

UCLA's Henry Samueli School of Engineering and Applied Science has formed a new Water Technology Research (WaTeR) Center to develop new desalination technologies, minimize environmental impacts associated with desalination, and lower the cost of desalination by integrating it with innovative energy generation.

The center will be led by chemical engineering professor and desalination expert Yoram Cohen, and will enlist multidisciplinary project teams involving researchers from other institutions, including University of California campuses at Los Angeles, Davis, and Riverside, the University of Southern California, and Universitat Rovira i Virgili in Spain. The endeavor already has been awarded a $1 million grant from the state of California and $1.6 million from other donors.

According to Cohen, "the UCLA Water Technology Research Center will look at new ways to enhance water recovery, as well as methods to increase membrane efficiency and decrease membrane fouling. As just one example, we will explore how to create a membrane surface that is less prone to fouling and scaling guided by modern tools to evaluate surface adhesion at the nanoscale."

The center also plans to initiate research on the integration of renewable energy, energy recovery, and solar energy to power desalination plants and to enhance the production of desalted water.

Visit www.desalination.ucla.edu/.

CLIMAS Update Now Electronic

The *CLIMAS Update*, a bi-annual newsletter about the research and outreach activites of the NOAA-funded Climate Assessment for the Southwest, has moved to an electronic-only format. Beginning with the Fall 2005 issue, the *Update* will be offered in PDF format through the CLIMAS Web site at www.ispe.arizona.edu/climas/pubs.html#newsletter.

To receive an e-mail notice when new issues are released and monthly notices for the CLIMAS-Arizona Cooperative Extension's Southwest Climate Outlook, sign up at www.ispe.arizona.edu/climas/subscribe.html

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