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Currents

A Newsletter of the UC Center for Water Resources

In This Issue

Perchlorate in Water: Determining Health Risks

By Andrew Chang

Perchlorate (ClO_4^-) has contaminated the soil and groundwater at many military installations and rocket propellant testing facilities across the country where the expired solid missiles / rocket fuels were routinely disposed. While the military is the most significant source of perchlorate, the chemical also is used in road safety flares, fireworks and other explosives. The production of these items and their use also may pose environmental hazards.

As a state prominent in the aerospace and defense industries, the drinking water in California is impacted by the presence of perchlorate in groundwater. The California Department of Health Sciences (CDHS) reported perchlorate detection in 350 of the state's approximately 6,700 reported drinking water sources. The overwhelming majority of those were linked to contaminated groundwater. Others were all related to water imported to southern California from the Colorado River. In 249 of the 350 water

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The UC Center for Water Resources is a multicampus research unit and special program within the University of California's Division of Agriculture and Natural Resources. The Center is charged with stimulating and coordinating research and information dissemination on a wide variety of issues related to California's water resources.

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Director's Message

by John Letey

Several months have passed since the last issue of *Currents* was published. The decision to not publish more issues was driven by budgetary considerations. The University of California budget reductions in 2003-04 were very severe and had a major impact on the Center for Water Resources. Indeed, there was some consideration of disbanding all statewide special projects and programs within the Division of Agriculture and Natural Resources, including the Center for Water Resources, as early as Jan. 1, 2004. The Center has remained intact but the Water Resources Center suffered a 19.5 percent budget cut and the Salinity/Drainage Program a 45 percent cut for the 2003-04 fiscal year. For planning purposes, the Center for Water Resources was advised to assume that the 2004-05 budget would be comparable.

On a personal note, I retired July 1, 2003; however, I have maintained a part-time appointment as Interim Director to the Center. The appointment was initially through Dec. 31, 2003, later extended through June 30, 2004, and finally through September 2004, which will complete my slightly more than 11 years of administrative responsibility to the UC Center for Water Resources. The Division of Agriculture and Natural Resources requested a proposal from the appropriate deans on the Berkeley, Davis and Riverside campuses to host the Center for Water Resources for a five-year period beginning Oct. 1, 2004.

My tenure with the Center has been a very rewarding and enjoyable experience. At the top of my positive list are the numerous individuals with whom I have become acquainted and interacted with in the quest to address the present and future issues associated with water resources management in California. I particularly acknowledge and thank the numerous individuals who have served on technical and advisory committees serving the Center for Water Resources. Their service and contributions have been extremely valuable and made my assignment much easier.

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The UC Center for Water Resources has a new phone number

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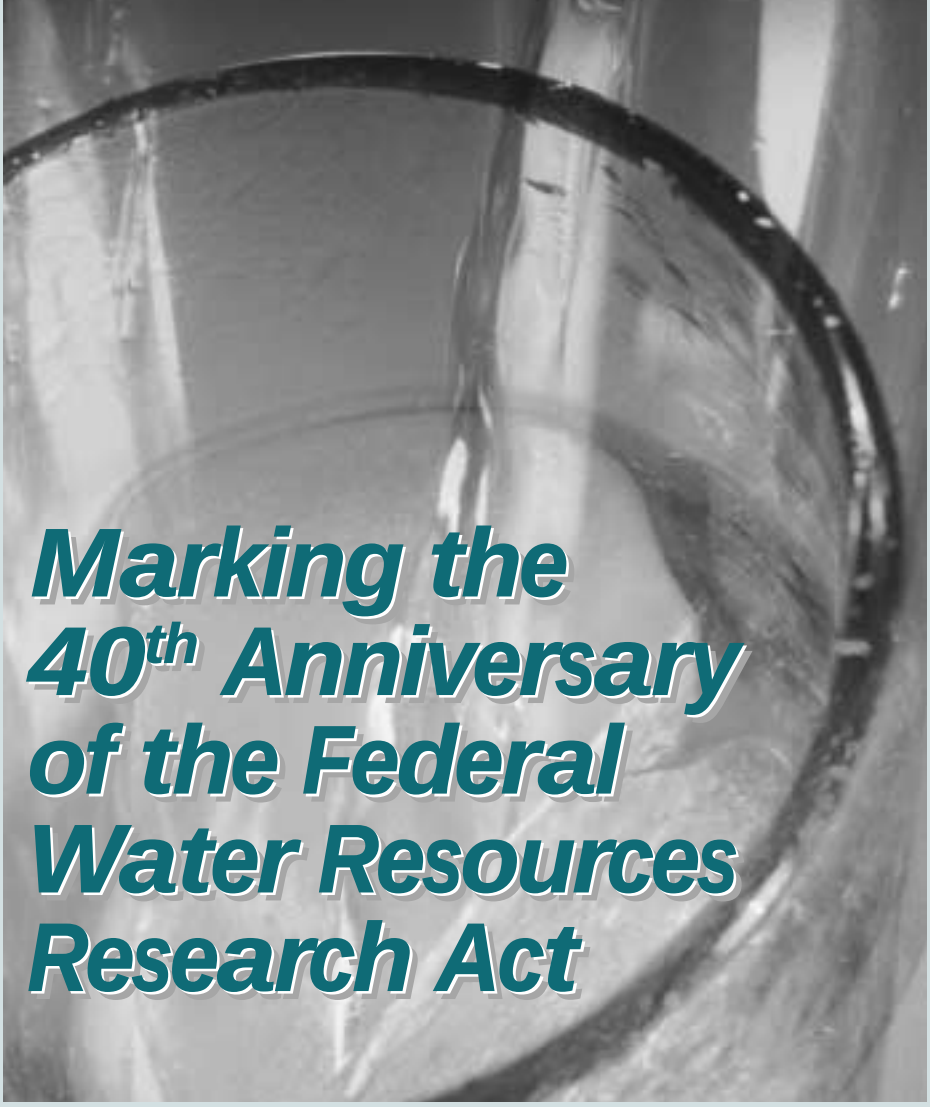


Marking the 40th Anniversary of the Federal Water Resources Research Act

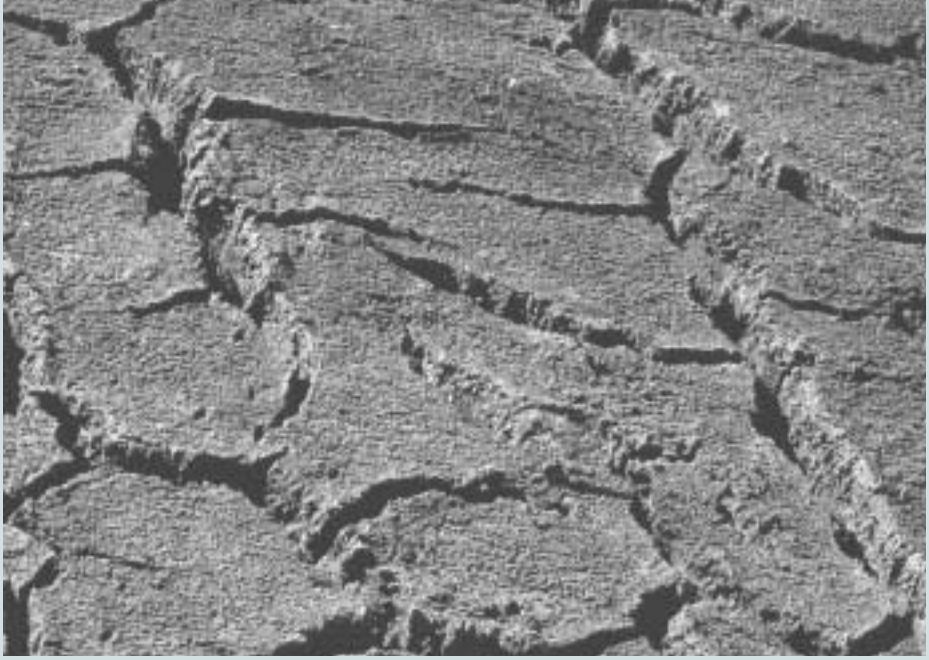
Recognizing the importance of water, President Lyndon B. Johnson signed the Water Resources Research Act on July 17, 1964, establishing a Water Institute in each state. "Abundant good water is essential to continued economic growth and progress," Johnson said when he signed the Act. "The Congress has found that we have entered a period in which acute water shortages are hampering our industries, our agriculture, our recreation, and our individual health and happiness.

"Assuming a continuation of current practices by the year 2000 there will not be enough usable water to meet the water requirements of parts of the states of Arizona, California, Colorado…," the president continued, "This legislation will help us solve this problem. It will create local centers of water research. It will enlist the intellectual power of universities and research institutes in a nationwide effort to conserve and utilize our water resources for the common benefit… The bill contemplates a high degree of interstate cooperation, and I urge that this be encouraged."

The University of California Water Resources Center, established in 1958 by the State Legislature, was selected as California's institute under the federal Water Resources Research Act, which has been amended and reauthorized eight times since 1964. The Act is subject to reauthorization in 2006. During those eight reauthorization processes, questions have been raised related to the content and intent of the original Act.

One of the most major issues is the intended duration of federal support for the water institutes. In very recent years, including the present, the administration has zeroed out the support budget for the institutes. Recognizing the critical nature of water issues and the cost effectiveness of these national water institutes, federal lawmakers have restored funding to support the institutes each year. The University of California's national institute budget has fluctuated over the years, reaching a low of $20,000 in 1994, and the federal budget is small in comparison to the California state budget assigned to the Water Resources Center.

Nevertheless, being a member of the National Institutes of Water Resources is of considerable benefit. Beyond providing an annual "base" budget, the Act has been of significant value to UC scientists. The 104G section of the Act authorizes monies to be distributed for water related research on a national competitive basis. UC scientists have been very successful in this highly competitive program in which only about 10 percent of the proposals are funded (see page 5). Furthermore provisions of the Act allow the US Geological Service to fund research activities to a state institute on a noncompetitive basis. This provision has allowed the USGS to support a multimillion-dollar project lead by Joel Michaelsen at UC Santa Barbara (see page 4).



UC Santa Barbara Scientists Participate in International Famine Early Warning System

Research being conducted at the University of California, Santa Barbara, is helping federal and international officials' efforts to resolve famine in Africa. In the late 1990s, UC Santa Barbara and the US Geological Survey signed a series of cooperative agreements for research related to food security in Africa. These agreements provided support for several graduate students, including one African national who obtained his master's degree in Geography at UC Santa Barbara and is now the field scientist for USGS' Famine Early Warning System Network (FEWS NET).

Background

The famine warning system was established in the mid-1980s in response to Africa's large-scale famines in the 1970s and early 1980s. These famines shocked the world and pointed up the tragic lack of timely information that might have served to significantly reduce the human suffering. In response, Congress called on the U.S. Agency for International Development (USAID) to create the famine early warning system.

Over the years, FEWS NET has developed a strong emphasis on local African-based analyses. Regional scientists with expertise in drought monitoring, hydrology, remote sensing and geographic information systems have been recruited for West Africa, the Greater Horn of Africa and Southern Africa. They work closely with FEWS NET food security analysts and network partners to interpret the nature of drought and flood threats to livelihood systems (especially subsistence agriculture).

Continuing Research

In 2003, UC Santa Barbara's Climate Hazards Group (CHG) was funded by USGS through the UC Center for Water Resources to collaborate with and coordinate the efforts of the USGS-affiliated field scientists in Niger, Harare, Nairobi and Guatemala, and a coordinating scientist in Washington (Saud Amer). Leading the CHG's five-scientist team are Professor Joel Michaelsen and Professional Research Scientist Chris Funk. The project's specific goals involve working closely with the International Program at the USGS/EROS Data Center to develop and apply improved flood and drought monitoring tools.

Funding for this program was made possible by the special relationship between the Center for Water Resources and USGS through the USGS State Water Resources Research Institute Program, which provided about $850,000 for the 2003-04 fiscal year, and a three-year renewal proposal for about $1 million per year has been approved.

A major CHG activity in 2003-04 involved assessing risks associated with poor rains in the first half of the growing season in Southern Africa. These results were incorporated in reports produced by the Regional Remote Sensing Unit in Harare, Zimbabwe, and distributed to decision makers in Africa, the United States and Europe. The low early rainfall heightened food security concerns in Southern Africa. Over 5 million people received food donated by charitable sources in Zimbabwe alone because of the drought the two previous years. Subsequently, UC Santa Barbara researchers, working with partners at NOAA's Climate Prediction Center and the International Research Institute for Climate Prediction, forecast a return to above normal rainfall in the second

half of the season that would bring relief to subsistence agriculture. This forecast proved to be correct and the food security outlook in the region improved substantially.

UC Santa Barbara researchers also are working with Central American climatologists to develop historical monthly precipitation time-series, forecast interpretations and daily rainfall databases and estimation procedures. In Asia, Saud Amer, a FEWS NET expert on Afghanistan, has helped track and interpret the agricultural impacts of the anomalously warm spring and early snowmelt experienced there this year. He has also become involved with a new USGS resources and hazards project in Afghanistan, playing a role in water resources assessment and the improvement of geospatial data infrastructure.

UC Researchers Successful in NIWR/USGS National Competitive Research Grants

Each year, the National Institutes for Water Resources and U.S. Geological Survey National Competitive Grants Program selects six to eight new research projects for funding. Such projects are selected on a nationwide basis and UC researches have proven to be very successful at securing funding from this highly competitive program:

- A molecular, community-based approach for tracking bacteria through coastal watersheds (Patricia Holden, UC Santa Barbara, 1999-2000)
- Bioavailability of particle-associated pesticides in Northern San Francisco Bay (Donald Weston, UC Berkeley, 1999-2002)
- Dynamic chemical loads as a function of land use changes on a watershed (Arthur Keller, UC Santa Barbara, 2000-2003)
- Dynamics of point and nonpoint source fecal pollution from an urban watershed in Southern California (Stanley Grant, UC Irvine, 2003-2006)
- Distribution and toxicity of sediment-associated pesticides in the Sacramento river watershed (Donald Weston, UC Berkeley, 2003-2005)
- Institutional re-arrangements: forging "smart use" water policy coalitions at the intersection of geo-technical engineering with urban open space (Helen Ingram, UC Irvine, 2004-2006)

Information on National Institutes for Water Resources may be found at http://wrri.nmsu.edu/niwr/ and on National Competitive Grants Program may be found at http://water.usgs.gov/wrri/. For submittal information, please contact the UC Center for Water Resources.

Director's Message

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Although there are many "doomsayers" about the present and future water quantity and quality issues in California, I maintain a positive attitude. My optimism is based on my observation that there is a broad based commitment to meet the challenge. Numerous options, including conservation, storage, treatment, conjunctive use, water exchange, water marketing, etc., are available and all are being pursued. The least expensive options are initially adopted, followed by the more expensive options as they become necessary. Future water demands will be met, but in most cases, at a higher price.

The demand for water tends to be categorized into environmental, urban and agricultural needs and these groups are considered to be competitors for water. Progress toward the efficient management of water resources will not be achieved by competition but rather by a cooperative approach among the three groups. The focus must be redirected from self-service to management plans to best serve the needs of all entities. Numerous mutually beneficial water management schemes are possible and these must be pursued with an open cooperative attitude.

I will give one parting comment for the reader to consider. The human population is increasing on a global scale. The great majority of population increase resides in the urban setting. One might consider

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WRC Research Highlights

These research highlights represent significant findings from a few of the projects funded by Water Resources Center.

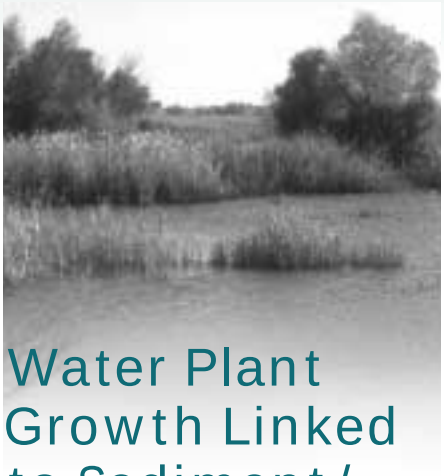
Progress reports on all funded projects will be included in the 2003-2004 Water Resources Center Annual Report. Free copies can be downloaded via our website www.waterresources.ucr.edu or requested by calling us at (951) 827-4327.

Measuring Salmon Abundance

Michael Johnson

Historical changes in salmon abundance in a stream can be estimated using the nitrogen isotope composition of annual growth rings of trees growing at the edge of the stream. Using this unique technology, Dr. Michael Johnson of UC Davis determined that salmon returns to the West Branch Mill Creek generally declined from the 1940s to the lowest values in the 1980s and then increased to the 1940s amounts during the last three years.

West Branch Mill Creek, a tributary of the Smith River in northern California, was selected for the study because continuous salmon records have been maintained since 1980, providing 23 years of continuous data for analyses. Tree ring samples from Douglas fir trees were analyzed for annual changes in stable nitrogen isotopes, percent of nitrogen content and tree growth. His study showed that annual tree growth, percent of nitrogen content of the wood and salmon-derived nitrogen were all positively related to the number of salmon returning to spawn the previous year. The resulting model was validated for years of known salmon returns, 1980-2003, and used to reconstruct returns for 1946-1979. By using Dr. Johnson's model, researchers can estimate historic salmon populations in other streams and rivers.



Water Plant Growth Linked to Sediment/ Erosion

Nina Maggi Kelly and Kristen Byrd

Soil erosion on landscapes contributes a sediment load on water bodies. Human activity such as cultivated agriculture can cause an increase in erosion and subsequently greater deposition of sediments in water. A study was initiated by Dr. Nina Maggi Kelly and Kristen Byrd at UC Berkeley to investigate the impact of agriculture on Elkhorn Slough, one of the largest coastal marshes in California.

Aerial photos taken in 1971, 1980, 1992 and 2001 at Elkhorn Slough were used to create a decadal record of wetland vegetation changes on sediment fans in the slough. Sediments associated with erosion from farmlands have been deposited in the marsh creating a plant succession of pickleweed to salt grass to

arroyo willow in some portions of Elkhorn Slough, resulting in a reduction in salt marsh and an increase in arroyo willow coverage within the study area.

After analyzing field data at the site showing a change in soil type and salinity, the researchers' initial results suggest that the extent of wetland change may be more dependent on the slope of the upland farm plus the topography and area of land between the farm and the wetland, than on the total area of farmland draining into the wetland.

Climate Change and Snow

Slawek Tulaczyk

California's water supply system is largely dependent on seasonal melt of Mt. Shasta's glaciers, and deterioration of those glaciers could have a significant practical impact on the water supply. With the latest climate models predicting that northern California will warm by several of degrees Celsius over the next century, the health of the Mt. Shasta glacier system could be endangered.

Dr. Slawek Tulaczyk at UC Santa Cruz examined the photogrammetric record of fluctuations in the size of Mount Shasta's glaciers over the years. The analysis of five glaciers since 1951 revealed that each had increased in area throughout the time period, excluding a brief contraction in the late 1980s. He surmised that while there has been an increase in winter temperature, resulting in a thinner spring snow pack at low elevations, the high elevations of the glaciers are insensitive to this warming, remaining below the freezing level for most of the winter.

Such a trend is significant because it presents a scenario in which climate warming may result in increased spring snow accumulation at high elevations and glacier growth. This would have far reaching implications for the assessment of the impact of climate change on California's snow reservoir.

Disease Killing Yellow-Legged Frogs

Cheryl Briggs

In portions of California's Sierra Nevada, the disease chytridiomycosis is causing rapid die-off of mountain yellow-legged frogs; whereas the frogs appear to be persisting with the disease in other areas of the Sierra Nevada. A study was initiated to investigate why the disease is having different outcomes on frog populations in different California watersheds.

Dr. Cheryl J. Briggs at UC Berkeley determined that frog die-offs due to the disease in the Sierra Nevada are occurring mainly in areas consisting of deep lakes surrounded by granite bedrock, where the adult frogs spend the majority of their time in the lakes. The sites at which the frogs are persisting with the disease include extensive marsh and stream areas with emergent vegetation, in addition to lakes.

When uninfected tadpoles raised from eggs in the laboratory were inoculated with a known amount of a fungal strain from either a die-off site or a persistent site, the researchers found no differences between the fungal strains in transmission, virulence, infectivity, or tadpole survival. Researchers found no evidence that differences in fungal strains are responsible for the different population-level impacts of the disease at different sites. Dr. Briggs is now investigating other potential factors.

WRC Funded Research Projects • Initiated October 1, 2003

Each year, the Water Resources Center reviews research proposals to determine which to award. These projects provide critical information on issues related to some of California's most difficult water issues. Seven projects were selected for funding effective Oct. 1, 2003 with another 11 selected for funding effective July 1, 2004.

October 2003 Projects

TITLE	PRINCIPAL INVESTIGATOR	CAMPUS
Hydrological Regimes, Pond Morphology, and Predation: Using Complex Interactions to Control an Aquatic Invasive Species	Cheryl Briggs	UC Berkeley
Using Marine Derived Nitrogen in Tree Rings to Assess Nutrient Flux and Salmon Escapement	Michael Johnson	UC Davis
Feasibility of Snow pack Characterization Using Remote Sensing and Advanced Data Assimilation Techniques	Steven Margulis	UC Los Angeles
Kinetics of Inorganic Arsenic Contamination in Surface and Ground Waters	Michael McKibben	UC Riverside
Development of a Quantitative Detection Method for Enumeration Host-Specific Fecal Bacteria Based on Real-Time, Quantitative Polymerase Chain Reaction	Kara Nelson	UC Berkeley
Future Regional Climate Change in the Ten Hydrologic Regions of California: A Climate Modeling Investigation	Lisa Sloan	UC Santa Cruz
Modeling and Optimization of Seawater Intrusion Barriers in Southern California Coastal Plain	William Yeh	UC Los Angeles

July 2004 Projects

TITLE	PRINCIPAL INVESTIGATOR	CAMPUS
An Economic Analysis of Groundwater Nitrate Pollution Control in Dairy-Intensive Watersheds	Kenneth Baerenklau	UC Riverside
Development of Biosensors for Real Time Analysis of Perchlorate in Water	William Frankenberger	UC Riverside
Understanding the Spatial and Temporal patterns of Wetland Evapotranspiration, Primary Production, and Nutrient Cycling	Michael Goulden	UC Irvine
Non-Native Fish in Mountain Lakes: Effects on a Declining Amphibian and Ecosystem Subsidy	Sharon Lawler	UC Davis
Nutrient Deposition and Alteration of Food Web Structure in High Sierra Lakes: Response by Microbial Communities	John Melack	UC Santa Barbara
Do Constructed Flow-Through Wetlands Improve Water Quality in the San Joaquin River?	Anthony O'Geen	UC Davis
Simultaneous Detection of Fecal Waste Sources and a Major Pathogen Associated with Waste, E. coli 0157:H7 in Irrigation and Recreational Waters using a Low-Density Microarray	Betty Olson	UC Irvine
Estuarine Landscape Modeling of Suisun Bay	David Schoellhamer	UC Davis
Imperial Valley Agriculture and Water: A Regional Economic Analysis	Kurt Schwabe	UC Riverside
California-2100: Assessing Future Water Resources Over California	Bryan Weare	UC Davis
Futures Markets for Water in California: Effective Management of Supply-Side Risk	Jeffrey Williams	UC Davis

Perchlorate in Water: Determining Health Risks

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sources in which perchlorate was detected, at least one was above the PHG of 6 µg per liter and 76 percent of those were located in Los Angeles, San Bernardino, Riverside and Orange Counties. The distribution of the contaminated sources may be viewed at the CDHS website, (http://www.dhs.ca.gov/ps/ddwem/chemicals/perchl/perchlindex.htm)

Health Effects

Perchlorate is known to interfere with the normal function of the thyroid gland by blocking sites where iodide is absorbed. As a result, the synthesis of thyroid hormones may be inhibited. For healthy individuals with normal levels of iodine reserve, there is little evidence of cumulative long-term effects due to chronic exposure to small amounts of perchlorate in food and/or drinking water as the chemical is rapidly excreted through the kidney. The pursuant toxic effects are more apparent in pregnant women, fetuses and infants at the early postnatal stage as they may have little or low iodine reserve. Newborns are at much higher risk of experiencing developmental problems if the thyroid hormone plasma T4 of the expecting mother is low at the 12th week of the gestation.

What is Safe?

The safe level of perchlorate remains an unsettled issue. In 2003, the U.S. Environmental Protection Agency proposed 1 µg per liter (ppb) as the maximum contaminate level goal (MCLG) for perchlorate in drinking water based on the abnormality observed on the brain morphometry of exposed animals (http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=24002).

The California Office of Environmental Health Hazards Assessment Office (OEHHA) established the public health goal for perchlorate in drinking water at 6 µg per liter based on levels possibly causing interference on thyroidal iodide uptake, (http://www.oehha.org/water/phg/pdf/finalperchlorate31204.pdf).

The UC Irvine Urban Water Research Center convened a scholars committee to review the science and policy of regulating perchlorate in drinking water and released its report in June 2004 (http://www.urbanwater.uci.edu/UCI-UWRC_Perchlorate_wCorrection061404.pdf). This panel concluded that perchlorate should not be harmful to normal individuals if its concentration in drinking water does not exceed 100 µg per liter.

Because of uncertainties in the current toxicological database, the above-cited concentration of 100 µg per liter may not be entirely protective for pregnant women and the normal development of their offspring. Several other states have established guidelines/action levels in the vicinity of either 4 to 6 µg per liter or 14 to 18 µg per liter. The final resolution on the adopted safe level of perchlorate in drinking water will have significant implications not only on public health but also on costs of remediating the contaminations.

Until CDHS adopts a MCL for perchlorate in drinking water, the public health goal is the reference point for judging the suitability of drinking water. When the perchlorate concentration of the source water exceeds the goal, the source must be either shut down or treated to lower the perchlorate level below 6 µg per liter.

Research

More research is needed to further clarify the toxicological attributes of the chemical to develop reliable, accurate and expedient analytical methods, and to develop cost-effective treatment methods for remediating contaminated water. Since 1998, the UC Center for Water Resources has awarded three research grants for studies of perchlorate in water. They are:

- ***Bioremediation of Perchlorate in Groundwater*** (William Frankenberger, UC Riverside; funding period: 1998-2000)
- ***The Catalysis of Perchlorate Ion Electroreduction at Transition-Metal Electrodes*** (W. Ronald Fawcett, UC Davis; funding period: 2002-2004)
- ***Development of Biosensors for Real-Time Analysis of Perchlorate in Water*** (William Frankenberger, UC Riverside; funding period: 2004-2006)

The Center welcomes submissions of proposals that advance the science and technology for managing perchlorate in water.

California Active in Regional Coordinated Water Quality Program

Farmers will be able to assess crop management for nitrate based on soil type and crops, public perception of water quality issues will be better understood and policy makers will know whether buffer strips will reduce microbial contamination caused by nonpoint runoff thanks to research conducted by the Southwest States and Pacific Islands Regional Water Quality Coordination Program.

The Coordination Program, part of the USDA Cooperative State Research, Education and Extension Service (CSREES) National Water Quality Program, is designed to make research, education and extension resources of the land grant university system more accessible to federal, state and local water quality improvement efforts in US Environmental Protection (EPA) Region 9. The Coordination Program is comprised of representatives from four state universities, six Pacific Island institutions and two tribal colleges. Dr. Laosheng Wu, Associate Director of the UC Center for Water Resources, serves as the California State Water Quality Coordinator for the Program.

In March 2003, the coordinators met with representatives from EPA Region 9 to discuss outreach and research needs related to water quality. Four projects were selected for funding

1. A survey of public attitudes of water quality in the Southwest states and Pacific Islands;
2. A program to develop a potential Hazard Index for nitrate in the Southwest states;
3. An assessment of regional Approaches to water protection from nonpoint sources of microbial contaminants;
4. A demonstration of BMPS on piggeries in the Commonwealth of the Northern Mariana Islands.

The Public Survey

To assess the needs of public education and outreach programs, a 37-question survey was sent to more than 4,000 randomly selected residents in the region. In a survey section titled, "How do you feel about the environment?", survey recipients were asked to rate several water issues as "not important," "somewhat important," "very important," "extremely important," or "no opinion."

The top ranked environmental issue identified by respondents was clean drinking water. In California, more than 90 percent ranked clean drinking water along with household water supply, clean groundwater, and clean rivers, streams and lakes as either "extremely" or "very important" (See Table 1). The same four issues also ranked above 90 percent in Arizona and Nevada, although in different order.

Region 9 results will be combined with those already compiled from a similar survey conducted in EPA's Pacific Northwest Region 10 to identify broader issues in Southwest states.

Table 1
The importance of water issues in Calif.

Issue	Extremely or Very Important in CA
Clean drinking water	98.6 %
Clean groundwater	92.6 %
Clean rivers, streams, lakes	92.5 %
Household water supply	91.6 %
Water for agriculture	84.7 %
Watershed restoration	72.8 %
Aquatic organism protection	69.6 %
Water for power generation	69.3 %
Wetlands / riparian areas	68.8 %
Water for industry	63.9 %
Water for recreation	52.1 %

Nitrate Hazard Index

Nitrate pollution of groundwater is a serious concern in California. In agricultural regions, the most common sources of nitrogen pollution are fertilizers and animal waste.

As a result of a study conducted by Dr. Wu and other researchers at UC Riverside, a potential Hazard Index (HI) for nitrate for approximately 500 soils has been completed with a HI for approximately 150 crops nearing completion. The HI is designed to be used by growers as a self-assessment tool to determine the potential hazard of groundwater degradation by nitrate based on the irrigation system, soil and crop grown on a given field. A website to allow for

easy access by farmers and consultants is under development. Users will be able to log in to the website, input their soil, crop and irrigation information and receive an HI value for their system. The user will then be directed to management guidelines that are specific to each individual case.

The concept for a potential HI for nitrate was released in 1994 by a Nutrient Technical Advisory Committee appointed by the California State Water Resources Control Board. Before the committee's recommendation could be implemented, an HI number had to be assigned to all the soils and crops in California. UC Riverside researchers assumed responsibility for the project, expanding the scope of the studies to include Arizona and Nevada and develop HI numbers for various soil types and crops. Workshops introducing the index and its utility will be held at various locations in California, Arizona and Nevada this fall and winter.

Nonpoint Source Microbial Contaminants

The most significant threat to water quality is nonpoint source pollution, which includes runoff from city streets, construction sites and agricultural fields, leaking underground storage tanks, accidental spills and abandoned mines. Controlling nonpoint pollution is very difficult because it does not come from a single source.

Researchers at the University of Nevada, UC Davis and the Nevada Bureau of Health Protection Services are testing the effectiveness of several nonpoint source pollution management practices – including stream buffers and sedimentation ponds – to reduce microbial loading. Meanwhile, researchers at the University of Hawaii are evaluating the effectiveness of buffer strips to prevent microbial and nutrient movement from a grazed area in a tropical setting. Together, the two projects will evaluate the effectiveness of and need for management practices in very diverse climatic, vegetative and soil zones (alpine and tropical).

Focusing on regional issues and collaborative efforts has enabled each of these projects to incorporate a wider study area than would have been possible under more traditional state based funding. As a result, each state and island benefits from shared research and resources, and reaps the benefits of what no state could have accomplished alone.

In addition to the funded projects, individual states and islands are developing and supporting water quality improvement efforts that meet their specific needs. Information on the program, the projects and individual state activities can be found at the regional website, http://ag.arizona.edu/region9wq. Workshops for extension, state and federal partners on the management of sources of microbial contamination will be conducted in Nevada, California, Hawaii and Arizona.

On a national scale, state water quality coordinators, other university scientists, USDA-CSREES staff members, EPA staff and others who work with water quality issues will meet February 7-9, 2005, in La Jolla, California at the USDA-CSREES National Water Quality Conference. More information is available at http://www.soil.ncsu.edu/swetc/waterconf/ain.waterconferenc.htm.

Director's Message

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that the increase in water required to meet the increasing population is the amount of water required to meet their needs in the city. Frequently overlooked is the amount of water needed to produce the additional food the increased population will consume. The amount of water required to provide the unavoidable evapotranspiration required to produce food for an individual by far exceeds the amount of water used for household activities, even under wasteful domestic practices. The amount of water used to produce the food that we eat is highly dependent on our diet. Although I am not proposing this as a practice for individuals to follow; from a global perspective, one can "conserve" more water by the chosen diet than by other common water conservation practices in the home such as low-volume toilets, etc. In this regard, a low-carb diet is not particularly water efficient.

NOTE: Please reference "The Amount of Water We Eat" Currents, Winter 2003, Volume 4, Issue 1, p. 3

International Salinity Forum

Scientists from throughout the world will gather at the International Salinity Forum, April 25-27, 2005 at the Riverside Convention Center in Riverside to address the critical issue of salinization of irrigated lands.

The Forum is sponsored by the Natural Resources Conservation Service, Agricultural Research Service, U.S. Bureau of Reclamation, UC Center for Water Resources, Bureau of Land Management, International Water Association and the National Salinity Program of Australia. The Forum will benefit policy makers, agricultural producers and professionals from around the globe. Expected outcomes are networking, sharing new technology, improving strategic plans, training professionals, and increasing awareness. Detailed information and on-line registration can be found at www.waterresources.ucr.edu.

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