

DDT, Other Contaminants in “Pristine” Western Waters

Although banned since 1972, the pesticide DDT recently has been found at high concentrations in fish in remote lakes of western national parks. The finding was part of a six-year federal study of airborne contaminants in 20 national parks in the West and Alaska.

The Western Airborne Contaminants Assessment Project (WACAP) was initiated to determine the risk to ecosystems and food webs in western national parks from the long-range transport of airborne contaminants. It was designed and implemented by the National Park Service’s (NPS) Air Resources Division in cooperation with many western national parks, the Environmental Protection Agency, U.S. Geological Survey, U.S. Forest Service, Oregon State University, and University of Washington.

In February, NPS announced key findings of the study. Of over 100 organic contaminants tested, 70 were found at detectable levels in snow, aquatic vegetation, lake sediment, and fish. Most concentrations were below levels of concern, but some appear to be accumulating in fish to the extent that they exceed thresholds for fish-eating wildlife and human consumption. Evidence suggests that the contaminants came from as far as Europe and Asia, and as near as the local county. The presence of contaminants in snow was well-correlated to nearby agricultural areas.

The contaminants of highest concerns for humans and wildlife were mercury, Dieldrin (an insecticide banned in 1987), and DDT. These compounds exceeded the human risk threshold for either subsistence or recreational fish consumption in certain fish (mostly trout) in national parks in Alaska, California, Montana, and Washington.

Visit www.nature.nps.gov/air/.

Stationarity is Dead

Such is the argument put forth by seven distinguished scientists in a two-page policy forum in the February issue of *Science*. Their point is that we can no longer expect natural systems to “fluctuate within an unchanging envelope of variability”—the definition of stationarity. Why? Because the human impact on the Earth’s climate is altering how natural systems function beyond the natural variability of the historic records from which we based the design of our water management systems.

So what? Our water supply, water management, and flood control systems have been designed and built to accommodate certain levels of risks. Those risks were developed from probability distribution functions (PDFs) of the historic record (measured by instruments) of such parameters as annual total and peak annual streamflow. The PDF provides engineers the boundaries—or envelope—within which they assume the natural system will fluctuate, and they design their systems accordingly.

But the boundaries are being broken; climate is changing. Greater variability in precipitation, evapotranspiration, and streamflow is occurring, straining—and sometimes exceeding—the capacity of our infrastructure. It no longer makes sense to design systems based on the historic record, and a new period of stationarity is not likely, given that the climate will continue to change for some time even if all anthropogenic contributions cease immediately.

How can we cope? The article’s authors offer several ways forward. Tradeoffs between costs, risks, benefits, and uncertainty must be evaluated. Stochastic models can be used to describe the temporal evolution of the PDFs of changing hydrologic variables. Paleoclimate data can be used to extend the historic record. Climate-change information needs to be more quickly and clearly conveyed to water managers. Climate models are

needed at higher resolutions to be useful to water managers, and they need to better represent and respond not only to natural surface-water and groundwater processes, but also to infrastructure, water use by various sectors, and land-cover changes. Finally, continuous data records must be maintained to provide critical input to models, especially as conditions change.

See Milly, P.C.D., J. Betancourt, M. Felkenmark, R.M. Hirsch, and others, 2008. Stationarity is dead: whither water management?, Science, 319:573-574, www.sciencemag.org.

High-Flow Experiment Performed in Grand Canyon

In early March, the U.S. Department of the Interior performed a high-flow test in Grand Canyon National Park. The goal of the experiment was to better understand whether higher flows can be used to rebuild eroded beaches downstream of Glen Canyon Dam by moving sand accumulated in the riverbed onto sandbars. The experiment and associated research activities were undertaken cooperatively by Interior’s U.S. Geological Survey, Bureau of Reclamation, National Park Service, and Fish and Wildlife Service.

Water was released by Reclamation from both the Glen Canyon Dam powerplant and bypass tubes at a maximum rate of approximately 41,500 cubic feet per second (cfs) for about 60 hours. For comparison, releases from Glen Canyon Dam have generally ranged between 8,000 and 20,000 cfs since 1996.

Previous high-flow tests were conducted in 1996 and 2004. The 1996 test ran for eight days at around 45,000 cfs, and the 2004 test ran for 60 hours at about 41,000 cfs. Scientists said the 2008 experiment differed from previous tests because more sand was available to rebuild sandbars. As of January 2008, sand supplies in the river were at a 10-year high, with a volume of around 2.7 million tons—about twice the amount available in 2004 due to tributary inflows below the dam over the previous 16 months.

Before-and-after photos and time-lapse videos taken at various points in the canyon show how the shoreline changed in the first month after the flood. In some places sand accumulated and in others it eroded; USGS scientists said in an early April press conference that it was too early to determine the net effect of the flood on restoring shoreline beaches. However, they noted that the sandbars created after the 1996 high flow had much steeper faces than those that formed in the 2004 and 2008 events, likely due to variations in sand supply and the magnitude and length of the events.

Studies being performed in conjunction with the test include documenting habitat changes to determine how backwater habitats are used by native and non-native fishes, and looking at how higher flows affect the aquatic food base, rainbow trout recruitment and emigration, riparian vegetation, non-native fishes,

and archaeological resources in close proximity to the Colorado River. Data will be collected through fall 2008, and initial reports are expected to be released in late 2008 and 2009. The next high flow release is scheduled for 2012.

Visit www.gcmrc.gov/research/high_flow/2008.

Copper May Inhibit Effects of Endocrine Disruptors

Results of a study published recently in *Environmental Toxicology and Chemistry* indicate that the presence of copper may inhibit the effects of endocrine-disrupting compounds (EDCs) on aquatic ecosystems. The investigation was performed by scientists in China using four targeted EDCs. EDCs are increasingly being detected in wastewater that is released into aquatic environments, where they can cause estrogenic activities that impair the reproductive systems of aquatic

species. According to the researchers, copper is often present in aquatic systems at part-per-billion concentrations, where it interacts with various organic compounds.

The researchers studied the specific reactions copper undergoes with the four EDCs. They found that copper-EDC complexes have less estrogenic activities than noncomplexed EDCs, leading them to conclude that the presence of copper causes a reduced combination effect with EDCs in water.

See Park, J.Y., B.C. Lee, J.S. Ra, and others, 2008. *Effect of copper complexation on the estrogenic activities of endocrine-disrupting compounds using E-screen bioassay*, *Envir. Tox. And Chem.*, 27(3): 535-541.

Chromium Removal Test Begins

In February, Glendale [California] Water and Power (GWP) began a pilot test to

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remove hexavalent chromium (chromium 6) from groundwater. The testing process, called modified reduction-coagulation-filtration (RCF), adds a reducing agent and an iron compound to convert chromium 6 in groundwater to harmless chromium 3, then filters out the iron and chromium 3. The traditional RCF process has proved successful in industrial-scale installations in the United States. The modified process was adapted for drinking-water applications and achieves far greater chromium 6 removal at a much lower cost, according to a City of Glendale press release.

Glendale, in coordination with Los Angeles and Burbank, has been researching technologies to remove chromium 6 from drinking water. Much of the groundwater supplies in the San Fernando Valley have been contaminated with various chemicals, including chromium 6, from past industrial waste disposal practices. Peter Kavounas, Water Services Administrator for GWP, noted that the potential for nationwide application of the results accounts for financial participation from many national agencies in this study. The \$4.5 million research effort has been funded by the U.S. Environmental Protection Agency, State of California Proposition 50 water bonds, the American Water Works Research Foundation, and businesses and cities in the San Fernando Valley.

Small-scale testing began at the University of Colorado and progressed to larger-scale testing at Glendale's Water Treatment Plant and other locations. The next step will be large demonstration-scale installations at a well site in Los Angeles and adjacent to the Glendale Water Treatment Plant. Construction of demonstration facilities was expected to begin this summer.

Visit www.ci.glendale.ca.us/mgmt-svcs/press_release.asp?AnnouncementID=554.

Value of Playas for Recharge Studied

Tens of thousands of playa lakes dot the Southern High Plains, and Agricultural

Research Service (ARS) plant physiologist Dennis Gitz is investigating their role in aquifer recharge. The ephemeral lakes form when rainwater fills natural clay depressions. Gitz found that this water flows continually, if slowly, down into the underlying Ogallala aquifer.

The recharge rate for cropland over the Ogallala is negligible due to evapotranspiration. Part of the question is whether the recharge rate of playas is significant enough to warrant their protection by adding filtering borders of gamagrass or switchgrass. Grass borders would ensure that playas continue to add significant amounts of clean water to the Ogallala and help extend its useful life.

To measure the recharge rate of the Ogallala for both cropland and playas, Gitz and colleagues from Texas Tech University are using soil temperature probes to track rainwater's downward movement through soil. They have installed instruments to monitor weather conditions and water levels at 14 playas and are developing instruments for 16 more. The data will be used to calculate infiltration as the difference between expected water evaporation rates and actual water losses.

Read more at www.ars.usda.gov/is/AR/archive/apr08/aquifer0408.htm.

Study Evaluates Augmentation Options

During the recent years of drought in the Southwest, the seven Colorado River Basin states watched reservoir levels in lakes Powell and Mead drop, and recognized the importance of not only reaching agreement on how to share shortages of Colorado River water, but also of identifying other sources of water for the Southwest. The states funded engineering firms CH2MHill and Black & Veatch to evaluate potential measures that could be used to augment the water supply. The results were released last spring.

Twelve augmentation options were evaluated according to the criteria of

water supply benefit; water quality; and technical, reliability, environmental, and permitting issues. The analysis only considered technical aspects for water managers; it did not make recommendations, prioritize options, or consider cost. The most reliable options were judged to be brackish and ocean water desalination, conjunctive use (water banking), reduction of power-plant consumptive use, and water reuse. Coalbed methane-produced water and stormwater storage were judged least reliable, and reservation evaporation control, river basin imports, vegetation management (such as saltcedar removal), water imports from ocean routes (undersea aqueduct, tanker transport, water bags, iceberg towing), and weather modification (cloud seeding) were judged to have moderate or variable reliability.

The complete report can be requested from SNWA at www.snwa.com/html/wr_colrvr_augmentation.html. A summary table is available at www.snwa.com/assets/pdf/augmentation_summary.pdf.

USGS Releases GWFLOW

The USGS recently released a new model to simulate groundwater and surface-water interactions. Ground-water and Surface-water FLOW (GSFLOW) simultaneously accounts for climatic conditions, runoff across the land surface, subsurface flow and storage, and the connections among terrestrial systems, streams, lakes, wetlands, and groundwater. It is applicable to watersheds that range from a few square miles to several thousand, and for time periods of months to several decades.

The model will be used to examine water availability under USGS's proposed Water for America Initiative. A major aspect of the initiative, which would complete a comprehensive census of the nation's water resources in the next ten years, is to investigate how groundwater and surface-water interactions affect the overall availability of the resource.

GSFLOW is available for no charge at water.usgs.gov/nrp/gwsoftware/gsflo/gsflo.html.