USGS
science for a changing world

Vol. 9, No. 2, 2011/2012

GeoHealth Newsletter

The U.S. Geological Survey's Environmental Health Newsletter

What's In This Issue

USGS Activities Related to Environmental Health Science
- Understanding the Spread of Malaria in Hawaiian Birds
- Deadly Bat Disease Caused by Fungus
- Beak Deformities in Alaskan Wild Birds
- Wildlife Disease at the Urban Fringe
- Tracking Avian Influenza Virus in Alaskan Waterfowl
- Emerging Fish Virus in Western North America
- Where Birds Winter Might Impact Their Breeding Success
- Coral Reef Disease Hits Kaneohe Bay, Hawai'i
- Making Recreational Beaches Safer
- Antibiotics May Affect Subsurface Bacterial Communities
- Guiding Remediation of PCE-Contaminated Sediments
- Fumigants Detected in Drinking-Water Wells in South Carolina Sandhills
- Identifying the Cause of Perchloroethylene Contamination in Groundwater
- Fault Zone Potential Conduit for Uranium Contamination
- Exotic Contaminants from Lead-Zinc Mining Operations
- Potential Impacts of Natural Gas Extraction from Fayetteville Shale
- New Method for Sampling for Viruses in Water
- Study Shows Some Wells have too Much Radium
- Revised USGS Health-Based Screening Levels Available
- USGS Science on Mine Wastes Featured

(More information and contacts for each article can be found on the online version – http://health.usgs.gov/geohealth/v09_n02.html)

Upcoming Meetings

New Publications

USGS Activities Related to Environmental Health Science

Understanding the Spread of Malaria in Hawaiian Birds

Avian malaria, a mosquito transmitted disease, is thought to be responsible for the extinctions of many bird species native to the Hawaiian Islands. Avian malaria only affects birds, but its transmission and spread might be similar to human malaria. To help understand the epidemiology of avian malaria, U.S. Geological Survey (USGS) scientists in collaboration with scientists from the University of Wisconsin at Madison, the University of Hawaii at Hilo, and the University of Hawaii at Manoa, have developed a model of the spread of malaria in Hawaiian forest bird species.

The Amakihi Honeycreeper, *Hemignathus virens*, one of a few native honeycreeper species still common in native forests despite high avian malaria infection rates, along with two other Hawaiian honeycreepers (*Vestiaria coccinea* and *Himatione sanguinea*) and the most common introduced bird in the Hawaiian forests, the Japanese White-Eye (*Zosterops japonicas*), are included in the avian malaria model developed by USGS scientists and their colleagues. Photo credit: Dennis LaPointe, USGS.

The modeling approach has helped scientists understand the complex dynamics of avian malaria. The model integrates disease, climate, epidemiology, and population processes to understand how they contribute to disease transmission between mosquitoes and birds and to the impacts on Hawaiian bird species. Use of the model indicates that avian malaria can severely reduce the abundance and limit the distribution of susceptible Hawaiian birds. The model provides important insights into how mosquito dynamics are strongly controlled by temperature and rainfall. The model provides a framework for the evaluation of conservation programs to control disease epidemics and evaluate future risks, such as climate change, as well as identify areas where scientific data is deficient. Finally, this model may be useful for understanding the spread of similar diseases like human malaria, dengue fever, and West Nile virus.

Funding was provided by the USGS Wildlife: Terrestrial and Endangered Resources and Invasive Species Programs and a National Science Foundation Biocomplexity grant (DEB 0083944)

Deadly Bat Disease Caused by Fungus

Bat populations, which provide valuable insect control for the agricultural industry, are declining at an alarming rate due to an emergent disease, white-nose syndrome (WNS). Hibernating bat counts in the Northeast have declined by approximately 80 percent. The fungus *Geomyces destructans* has been definitively identified as the cause of WNS, according

USGS scientists set up an experiment to demonstrate that the fungus *Geomcyes destructans* causes white-nose syndrome in hibernating bats. Photo credit: David Blehert.

to research by USGS scientists and their partners. During the study, 100 percent of healthy little brown bats exposed to the fungus while hibernating in captivity developed WNS. Experiments also confirmed that *G. destructans* is spread by bat-to-bat contact. Additional studies have revealed that this fungus lives on the walls and floors of caves occupied by hibernating bats with WNS, demonstrating that the environment they inhabit likely also plays a role in the disease cycle.

WNS has been rapidly spreading since its discovery in New York State in 2007. Now found in 19 U.S. states and 4 Canadian provinces, the disease is affecting bats in the northeastern United States most severely. Knowing the cause of WNS and how the disease is spread will help decision makers develop management actions to preserve the ecologically and economically valuable bat populations of North America.

> "While our study confirmed that *G. destructans* is spread bat-to-bat, it is also important to note that virtually all pathogens, especially spore-producing fungi, are spread by multiple routes," said David Blehert, USGS microbiologist and an author of the study. "This is the reason that in an effort to further control the spread of white-nose syndrome, resource management agencies have implemented universal precautions, including limiting human access to sensitive environments occupied by bats, decontaminating equipment and clothing moved between these environments, and restricting the movement of equipment between sites."

Insect-eating bats provide ecological pest control services that are estimated to save the agricultural industry $3.7 to $53 billion each year. There is no known cure for white-nose syndrome, and diseases among free-ranging wildlife are difficult to stop once established.

Research to identify *G. destructans* as the WNS pathogen was conducted at the USGS National Wildlife Health Center in collaboration with scientists from USGS Fort Collins Science Center, University of Wisconsin–Madison, Wisconsin Veterinary Diagnostic Laboratory, The University of Tennessee—Knoxville, New York State Department of Environmental Conservation, the U.S. Fish and Wildlife Service, Wisconsin Department of Natural Resources, and Bucknell University. Funding was provided by USGS Wildlife: Terrestrial and Endangered Resources Program with additional contributions from U.S. Fish and Wildlife Service, Bat Conservation International, Inc., and Indiana State University Center for North American Bat Research and Conservation.

Beak Deformities in Alaskan Wild Birds

Since 1999, Alaskans have witnessed a startling increase in the number of local birds with beak deformities. Thousands of Black-capped Chickadees and smaller numbers of many other species of birds have appeared with grossly overgrown and crossed beaks, a condition that has been termed "avian keratin disorder." More recently, rapidly increasing numbers of other species, including Northwestern Crows, Downy Woodpeckers, Steller's Jays, and Black-billed Magpies have also been reported with beak deformities throughout the State. Nearly all of the species affected are year-round residents. The USGS, in collaboration with numerous partners, continues to investigate potential causes, including infectious disease, environmental contaminants, and nutritional deficiencies. Several recent publications further describe this epizootic event, including the observations that:

A Black-capped Chickadee with avian keratin disorder displaying overgrown and crossed beaks. Photo credit: Ken Whitten, courtesy of USGS.

- Black-capped Chickadees and Northwestern Crows in Alaska have the highest rates of gross abnormalities ever documented in wild birds.
- Deformities result from accelerated growth of the beak epidermis. Deformities develop over time and occur only in adult birds.
- The disorder results in severe health consequences and high mortality.
- A geographic expansion of this disorder may be occurring in North America. Despite extensive testing, the cause is currently unknown.

Additional research is currently underway, and the public is encouraged to use the Beak Deformity and Banded Bird Observation Report Web page to report sightings.

This study was funded by the USGS Wildlife: Terrestrial and Endangered Resources Program, U.S. Fish and Wildlife Service Environmental Contaminants Program, the National Science Foundation Graduate Research Fellowship Program, the University of Alaska Foundation Angus Gavin Memorial Bird Research Grant, and the Anchorage Audubon Society.

Wildlife Disease at the Urban Fringe

Wildlife biologists have found that:

- Bobcats, mountain lions, and domestic cats living in the same areas share pathogens.

- Bobcats and mountain lions are hosts for human plague.

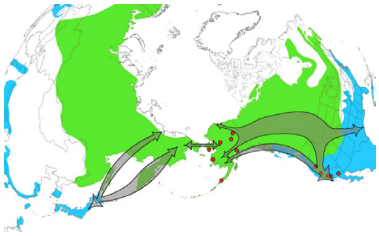
Wild cats, such as bobcats (*Lynx rufus*), are adapting to survive and forage in urban environments such as this freeway underpass outside of Los Angeles. Photo credit: USGS/Colorado State University.

These are two recent findings of USGS scientists who collaborated with scientists from the U.S. Department of Agriculture's National Wildlife Disease Program, Colorado State University-Fort Collins , and others to study disease ecology of wild cats in Colorado and southern California. As suburban communities push up against wildlands, interactions between the natural and human ecosystems increase. An important factor to monitor is the natural transmission and reservoir of diseases within wild animal hosts, especially in widely roaming species such as bobcats and mountain lions. Continued studies will examine how disease transmission dynamics in wild cats change with habitat fragmentation, and how wild cat movement and behavior may change with climate change and land use changes. This study was funded by the USGS Wildlife: Terrestrial and Endangered Resources Program, the National Science Foundation's Ecology and Evolution of Infectious Diseases Program, The Nature Conservancy, the Irvine Ranch Conservancy, and the Nature Reserve of Orange County.

Tracking Avian Influenza Virus in Alaskan Waterfowl

Since the outbreak of highly pathogenic H5N1 avian influenza in wild birds in Asia in 2005, Alaska has been on the lookout for this strain of bird flu. Alaska is likely one of the first places in North America that the H5N1 bird flu virus could arrive via wild birds because migratory pathways extend from wintering grounds in Asia and North America to breeding grounds in Alaska. Since 2005, over 50,000 wild birds have been tested in Alaska and no highly pathogenic H5N1 has been detected. However, wild birds are routinely infected by a less lethal form of flu called low pathogenic avian influenza. Birds often show no signs of illness from this more common flu. Researchers at the USGS Alaska Science Center and the USGS National Wildlife Health Center, along with numerous collaborators, have found a number of these low pathogenic viruses in Alaskan birds and have been using genetic sequencing techniques to determine if any of the viruses are being carried from Asian wintering grounds. Thus far, researchers have observed that:

Waterfowl, such as this female Northern Pintail (*Anas acuta*) have been outfitted with satellite transmitters so scientists can track the migratory patterns into and out of areas where avian influenza has been detected. Photo credit: USGS.



Global breeding (green) and wintering (blue) distributions of the Northern Pintail duck, a species that migrates both within and between Eurasia and North America (arrows). Red dots indicate areas where low pathogenic influenza viruses have been isolated from Northern Pintails in Alaska and California.

- Wild migratory birds that winter in Asia and North America overlap and inter-breed during the summer in several locations in Alaska and northeastern Russia.
- Birds that winter in Asia have migrated through highly pathogenic H5N1 outbreak areas and continued northwards toward the Bering Sea where migratory flyways of different hemispheres overlap.
- Bird species that migrate between Asia and North America frequently carry low pathogenic influenza viruses with Asian-origin genes to Alaska.
- No completely Asian viruses have been found in Alaska.

This study was funded by the USGS Wildlife: Terrestrial and Endangered Resources Program and the U.S. Fish and Wildlife Service.

Emerging Fish Virus in Western North America

Chinook salmon (*Oncorhynchus tshawytscha*) are found from the west coast of North America to Kamchatka, Russia, and are the largest of the Pacific salmon. Many populations in the western United States are listed as threatened or endangered under the Endangered Species Act. Photo credit: USGS.

Infectious Salmon Anemia Virus (ISAV) has caused severe disease in farmed Atlantic salmon in northern Europe, Chile, and the east coasts of Canada and the United States. Canadian researchers recently announced that wild Pacific salmon in British Columbia have tested positive for ISAV, the first reported detection of ISAV on the west coast of North America. Although ISAV does not infect humans, it could pose serious threats to both wild and farmed salmon populations should it become established. Surveillance for ISAV in western populations of wild salmon is therefore both ecologically and economically important.

The USGS Western Fisheries Research Center is providing diagnostic reagents, technical support, and advice to other Federal, tribal, and State biologists that will be testing for ISAV in both wild and hatchery populations of Pacific salmon in Alaska and Washington. Fish viruses commonly move

from wild to farmed populations, and the high fish densities in hatcheries could be associated with increased virulence and an ability of viruses to infect or "jump to" new species. If ISAV is confirmed in Pacific salmon on the west coast, next steps would be to test the susceptibility of Pacific salmon and other selected marine fish species to ISAV, assess the ability of salmon to act as carriers and reservoirs for future infections, determine the evolutionary potential of the virus to adapt or increase in virulence, and to analyze the resistance mechanisms in Pacific salmon or other fish species.

This work is funded by the USGS Wildlife: Terrestrial and Endangered Resources and Invasive Species and Contamiants Biology Programs.

Where Birds Winter Might Impact Their Breeding Success

By tracking Pacific Black Brant geese (*Branta bernicla nigricans*), a small migratory sea goose that nests on coastal tundra throughout the Arctic, a team of scientists showed that where the birds spend the winter determines whether they nest and breed the next summer. They further hypothesize that this effect could be more severe with climate change. The team of scientists from the USGS, University of Nevada, Reno, and U.S. Fish and Wildlife Service analyzed long-term data on the migration patterns of the Black Brant, which have typically migrated south for the winter months, and spent their time during the winter months mostly in bays along the Pacific coast of Mexico. Scientists were able to record where birds spent the winter by observing plastic leg bands on birds at three bays along Baja California, Mexico. The same birds were seen in Alaska the following summer. Females that wintered at the southern bay were much less likely to nest the next summer than females that wintered at the two other more northern locations. This difference was greater following the 1997-98 El Niño event, which raised ocean temperatures along the Baja California Peninsula. The El Niño effect foreshadows what is expected with climate change. Brant geese are steadily shifting their wintering grounds northward into the United States, including Alaska, which allows them greater breeding success. Between 30,000 to 40,000 Brant now spend the winter in coastal lagoons of southwest Alaska, whereas in the past only a few thousand overwintered in these locations. This study was funded by the USGS Wildlife: Terrestrial and Endangered Resources Program, the U.S. Fish and Wildlife Service, Ducks Unlimited, Ducks Unlimited de México, the National Science Foundation, The Black Brant Group, Inc., Phil Jebbia, and the Nevada Agricultural Experiment Station.

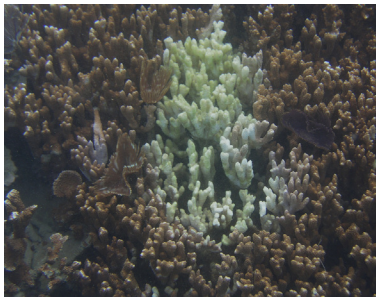
Male and female Pacific Black Brant geese (*Branta bernicla nigricans*) with goslings. Photo credit: USGS.

Coral Reef Disease Hits Kaneohe Bay, Hawai'i

Scientists have discovered an outbreak of coral disease called *Montipora* White Syndrome in Kane'ohe Bay, O'ahu, Hawai'i. The affected coral are of the species *Montipora capitata*, also known as rice coral. Rice corals provide valuable habitat, shelter, and foraging grounds for a variety of tropical marine fish and invertebrates, as well as being an integral part of the fundamental structure of coral reefs. These are one of the more abundant coral reef species in Hawai'i and are also an important source of tourism and other economic income, including fisheries.

Corals are basically modified anemones, which are a group of predatory—and often strikingly pretty—marine organisms related to jellyfish. Corals secrete a calcium carbonate skeleton covered by a thin layer of tissues that form the foundation of coral reefs. *Montipora* White Syndrome involves loss of tissues from the coral until the underlying white skeleton is exposed. Often, dead corals are then overgrown by algae, leading to permanent reduction in coral reefs and a change in the ecosystem from a coral-dominated to an algae-dominated reef.

The investigation of this recent outbreak has been led by the University of Hawai'i's Hawai'i Institute of Marine Biology in collaboration with University of Hawai'i – West O'ahu, and the USGS National Wildlife Health Center Honolulu Field Station. The USGS is applying biomedical tools for investigating animal diseases to coral reefs in order to characterize the changes seen in sick corals by looking at the whole coral as well as its cellular structure. As the causes of coral reef diseases are usually unknown, this research will help managers to determine the environmental drivers of these diseases, leading to better intervention and strategies to protect coral reefs and the surrounding marine ecosystems. USGS involvement in this study was funded by the USGS Wildlife: Terrestrial and Endangered Resources Program.



Coral reef affected by the coral disease *Montipora* White Syndrome. Note the large swath of white skeleton tissue surrounded by normal (brown) corals. Photo credit: Thierry Work.

Making Recreational Beaches Safer

USGS scientists have been directing efforts for protecting human health toward increasing the accuracy and timeliness of monitoring results at recreational beaches. Beaches are currently monitored for fecal indicator bacteria to determine microbiological water quality, and swimming advisories are issued or beaches are closed according to established water-quality standards. However, the time lag for laboratory test results has led managers and scientists to seek more rapid estimates of water quality in order to decrease excess beach

Protecting recreational beaches, such as Indiana Dunes National Lakeshore's West Beach on Lake Michigan, is challenged by the time required to test for fecal indicator bacteria in beach water. The skyline of Chicago, Illinois, can be seen on the horizon. Photo credit: Meredith B. Nevers.

closures and swimming advisories. USGS scientists have been fine-tuning the application of rapid testing by exploring variation in bacteria concentrations among recreational beaches. By characterizing beaches by source of contamination, it is possible to apply various monitoring strategies that more directly meet the needs of specific beaches. Point-source impacted beaches lend themselves to predictive modeling, a method that uses water and weather conditions to predict bacteria concentrations, which provides timely estimates of water quality. At beaches without a direct point source influence (such as a river or creek outfall), calculating water-quality standards based on local conditions, as outlined in national standards, may provide more accurate estimates of health risk and, generally, keep more beaches open for use. This study was funded in part by the USGS Ocean Research Priorities Plan and the Great Lakes Restoration Initiative.

Antibiotics May Affect Subsurface Bacterial Communities

U.S. Geological Survey (USGS) scientists documented adverse health effects on native groundwater bacteria exposed to the antibiotic sulfamethoxazole (SMX). SMX is a sulfonamide antibiotic that is commonly used to treat a variety of bacterial infections. Scientists found that very low concentrations of SMX (approximately 1 micromole per liter [μM]) could delay the start of cell growth, limit the bacteria's ability to process nitrate, and alter bacterial community composition. Scientists' concerns about antibiotic resistance in hospitals and community settings have increased their study of the potential spread of antibiotic-resistant bacteria and the effects of antibiotics in the environment. These results show that exposure to antibiotics could possibly affect the ability of bacteria in soil and aquifer sediments to naturally remove nitrate pollution in groundwater. Too much nitrogen, as nitrate, in groundwater used for drinking water can be harmful to infants. This study was funded by the USGS Toxic Substances Hydrology Program.

A USGS scientist prepares a sample to test the effect of antibiotics on naturally occurring bacteria. The glove box allows scientists to work with samples in an atmosphere without oxygen, the conditions under which the bacteria function. Photo credit: Jennifer C. Underwood, USGS.

Guiding Remediation of PCE-Contaminated Sediments

Through the ecological modeling of aquatic organisms living in sediments on the bottom of estuaries and lakes (benthic communities), and by collecting data on which aquatic organisms are or are not present, USGS and Stanford University scientists developed a tool to aid in decisions about the remediation of sediments contaminated with polychlorinated biphenyls (PCBs). The scientists defined the role (or function) of different organisms in the benthic community that live in or on the sediments at the Hunters Point Naval Shipyard Superfund Site, California. Then they compared the total function of benthic communities in PCB-contaminated and uncontaminated sediments. By relating the functional composition of a benthic community and its members to PCB bioavailability induced by *in situ* remediation, the scientists were able to provide information on the performance of the remediation solution. The ecological model developed by the scientists provides an estimation of the ecosystem recovery expected if the activated-carbon, *in situ* treatment is effective. This is the first time that the effectiveness of *in situ* sequestering of PCBs as a remediation solution has been measured in terms of the function and health of the benthic community.

Scientists collecting biological samples from mud flats near Hunters Point, a Superfund site in San Francisco Bay, California. The samples provided data for a tool that can help assess the effectiveness of the remediation of contaminated sediments. Photo credit: Richard Luthy, Stanford University.

This study was funded by the USGS Toxic Substances Hydrology, National Research, and Priority Ecosystem Science Programs and by the Strategic Environmental Research and Development Program (SERDP - ER-1552).

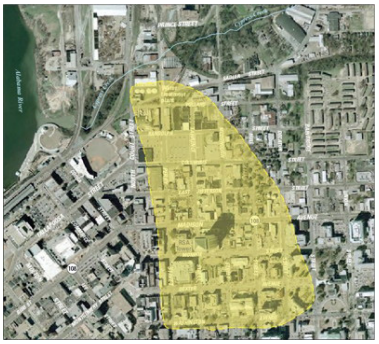
Fumigants Detected in Drinking-Water Wells in South Carolina Sandhills

Since 2005, the fumigants ethylene dibromide (EDB) and dibromochloropropane (DBCP) have been detected by scientists in several public and domestic wells used for drinking-water supply and irrigation near McBee, South Carolina. McBee is a small town of about 700 people located in the sandhills of Chesterfield County. EDB and DBCP have been detected at concentrations above their U.S. Environmental Protection Agency Maximum Contaminant Limits of 0.05 and 0.2 microgram per liter (μg/L), respectively. The source(s) and release histories of EDB and DBCP are unknown, but are believed to be related to their historical use as fumigants to control nematode damage in peach orchards between the 1940s and their ban in the late 1970s. However,

gasoline also contained EDB and is an alternative source of contamination to groundwater. The detection of EDB and DBCP in public-supply wells has raised health concerns because groundwater is the sole source of water supply in the McBee area. In April 2010, the USGS in cooperation with the Alligator Rural Water and Sewer Company started a study to provide additional data regarding the occurrence, distribution, and fate of EDB and DBCP in local groundwater. The investigation comprises an assessment of the use, release, and disposal history of EDB and DBCP in the area, the distribution of EDB and DBCP concentrations in the unsaturated zone, and transport and fate in groundwater. This study was made possible with funding from the South Carolina Department of Natural Resources.

USGS scientist collecting a water-quality sample from a public-supply well in Chesterfield County, South Carolina. Photo credit: Jim Landmeyer, USGS.

Identifying the Cause of Perchloroethylene Contamination in Groundwater



Approximate extent of the Capital City Plume Site, Montgomery, Alabama, in 2008. PCE plume concentrations exceeded 100 micrograms per liter. Modified from figure 3, USGS SIR 2011–5148, page 3.

USGS scientists identified the potential source areas of widespread groundwater contamination in downtown Montgomery, Alabama. Perchloroethylene (PCE) contamination of the shallow aquifer beneath the city most likely resulted from the past use and disposal of industrial wastewater from printing operations containing chlorinated solvents into the sanitary sewer and/or stormwater systems of Montgomery. The discovery of the industrial chlorinated-solvent PCE in a shallow public-supply well in 1991 and exposure of construction workers in 1993 to solvent vapors provided evidence that the shallow groundwater beneath Montgomery was contaminated. This led to numerous investigations that did not determine the source of the contaminated groundwater known by the moniker "Capital City Plume." Starting in 2008, a team of USGS scientists investigated the groundwater contamination with regard to potential source areas, contamination pathways, and the probable contaminant release history. The scientists sampled (1) pore water from the banks of a creek, (2) cores from trees in downtown Montgomery, and (3) groundwater. Analysis of the samples, combined with maps of historical land use since 1842, indicated that the PCE contamination likely resulted from disposal in the past of wastewater from commercial printing industries that contained chlorinated solvents. The source of contamination most likely resulted from solvent use and disposal at multiple industrial operations in downtown Montgomery between the 1940s and 1970s. The data also indicate that PCE and trichloroethylene (TCE), another chlorinated solvent, have been transported to the intermediate part of the shallow aquifer beneath the city. Funding for this study was provided by the U.S. Environmental Protection Agency Region 4 Superfund Program.

Fault Zone Potential Conduit for Uranium Contamination

The USGS was asked by the State of Colorado to examine the potential for uranium-contaminated water from the closed Schwartzwalder Mine, northwest of Denver, to seep into the adjacent Ralston Creek. Ralston Creek flows into Ralston Reservoir, one of several sources of drinking water for the Denver metro area. After the mine was closed in 2000, groundwater filled up most of the underground mine workings and created a "pool" of water with uranium concentrations in excess of 1,000 times the U.S. Environmental Protection Agency's drinking-water standard of 30 micrograms per liter (µg/L). USGS scientists determined that:

- Secondary faults that cross under Ralston Creek could act as conduits for or barriers to flow from the mine pool to Ralston Creek.
- While bedrock permeability is low, hydraulic gradients are sufficient to drive groundwater flow from the mine pool to Ralston Creek.
- Although the mine pool is currently about 4 meters below the

Although a cement bulkhead blocks the portal to Schwartzwalder Mine, Colorado, there is a large pool of 140,000,000 gallons of water in the mine with approximately 30 micrograms per liter of dissolved uranium. Ralston Creek is approximately 300 feet away and 100 feet below this portal. Photo credit: Jonathan Caine, USGS.

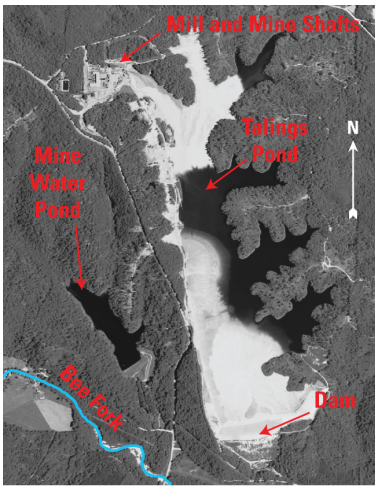
This carbonate fault vein bearing pitchblende (an olive-green-colored mineral containing uranium oxides) near the Schwartzwalder Mine is similar to the faults that run under Ralston Creek, Colorado. The largest known hydrothermal vein type deposit of uranium in the United States occurs at the Schwartzwalder Mine, Colorado. Photo credit: Jonathan Caine, USGS.

sealed entrances to the mine, future years with higher than average rainfall could increase the mine pool elevation above the entrances, and contaminated water could seep around the seals.

- The mine workings, mine pool water, mineralized fault zone, and contaminated parts of the alluvial aquifer are all potential sources of dissolved metals to Ralston Creek.

The State of Colorado issued an enforcement action against the mine permit holder in August 2010 requiring mine dewatering and treatment. Recent court decisions associated with litigation between the State and permit holder found sufficient evidence for potential conduits from the mine to the Creek to uphold the State's action. This study was funded by the USGS Mineral Resources Program and the Colorado Division of Reclamation Mining and Safety.

Exotic Contaminants from Lead-Zinc Mining Operations



Fletcher Mine complex, located in Reynolds County, Missouri, in the New Lead Belt in southeast Missouri. The complex includes mines, a mill, an impoundment that receives water pumped from the mine, and a zero-discharge tailings disposal area and pond. The mill extracted lead, zinc, and copper from the mined ore. Photo is from figure 7 in USGS SIR 2008–5140.

Potentially toxic organic compounds from lead-zinc mining activities were found at a mine site in the heart of the New Lead Belt in Missouri. Modern processes such as those employed in the mines and mills of the New Lead Belt have significantly minimized the volume and metals content of the liquid wastes discharged from mining operations. However, these processes rely heavily on potentially toxic organic compounds such as xanthates (organic acids) and other reagents. Mining-related environmental studies have traditionally focused on the release of metals and other inorganic materials and the effects of these releases on water quality and aquatic organisms. Therefore, little is known about the environmental occurrence of organic compounds associated with mining operations.

Large amounts of xanthate complexation reagents are used in the milling and extraction process. USGS scientists developed techniques to extract and measure these compounds in environmental samples. Xanthate reagents were not detected in environmental samples. However, trace amounts of xanthate degradation products were found in most sampled locations, including the tailings pond downstream (see photo). Dioctyl sulfosuccinate, a surfactant and process filtering aid, was also found at one mill discharge outlet but not downstream. Dioctyl sulfosuccinate was one of the primary dispersants used in the Deepwater Horizon oil spill in the Gulf of Mexico in 2010. This is the first time that these organic compounds have been detected downstream from lead-zinc mine and milling areas. The information from this study can be used by resource managers to assess the impact of mining operations on aquatic ecosystems. This study was part of a congressionally funded USGS investigation of the effects of mining in the Mark Twain National Forest, Missouri.

Potential Impacts of Natural Gas Extraction from the Fayetteville Shale

Hydraulic fracturing of a well in the Fayetteville Shale in north-central Arkansas. Photo credit: David A. Freiwald, USGS.

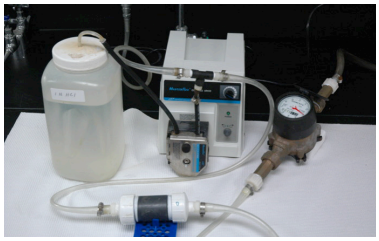
Since 2001, about 4,000 wells have been drilled in north-central Arkansas to extract natural gas from the Fayetteville Shale—the 4th largest recoverable gas play in the United States. Concerns over the possible effects of drilling and hydraulic fracturing on Cypress Creek and Brewer Lake, Arkansas, which provides nearly 60,000 Conway County residents with drinking water, have prompted the USGS to partner with State and Federal agencies, universities, and oil and gas producers to study the potential impacts of natural gas extraction from the Fayetteville Shale.

> "The information provided by the model will enable us to better plan and manage Conway's water supply needs for years to come," said Conway Corporation CEO Richie Arnold. "Brewer Lake is such a valuable resource to Conway and I am very pleased to see Southwestern Energy fund this study."

The USGS operates 13 streamgages that record streamflow in the counties experiencing the bulk of the drilling activities. In addition, water-quality and streamflow monitoring sites were established to gather baseline data for determining trends in water quality and quantity at two sites on the South Fork of the Little Red River. Water-quality samples were also collected at three lake sites on Greers Ferry Lake, a major drinking water supply for residents in central and north-central Arkansas. USGS scientists are collaborating with engineers from Southwestern Energy to construct a computer watershed model of the Cypress Creek Basin. The model will help scientists understand how changes in land use, such as additional gravel roads and well pads, could affect the quality of water flowing in Cypress Creek and into Brewer Lake. Scientists have sampled approximately 150 domestic wells and springs in Van Buren and Faulkner Counties as part of a groundwater-quality monitoring program. All groundwater samples were analyzed for major ions and trace metals by

Duke University. A subset of the samples is being analyzed for methane gas, and oxygen, hydrogen, strontium, and boron isotopes. Funding for this study was provided by the USGS Cooperative Water Program and a group of Federal and State agencies, universities, and corporations.

New Method for Sampling for Viruses in Water



Glass wool filter (in grey and white PVC canister in foreground) for processing large volumes of water to concentrate a variety of waterborne pathogens. Photo credit: USDA-ARS.

Detecting viruses in environmental samples can be challenging. Viruses are much smaller than bacteria, ranging in size from a few nanometers to hundreds of nanometers. A nanometer is one billionth of a meter. USGS scientists and their colleagues from the U.S. Agricultural Research Service and the University of Wisconsin–Madison have developed a universal glass wool filtration system for concentrating waterborne viruses and agricultural zoonotic pathogens for subsequent testing. The glass wool filters have several advantages:

- Construction is easy and the filters can be built to any size for meeting specific sampling requirements.
- The filters are highly portable.
- The filter parts are inexpensive, enabling cost-efficient sample collection.

Large sample volumes (100s to 1,000s of liters) can be processed. As such, sampling with minimal equipment can be completed in the field for finished drinking water, surface water, groundwater, and agricultural runoff. Glass wool filtration is effective for concentrating a variety of pathogen types, such as human enteric viruses, *Salmonella enterica*, *Cryptosporidium parvum*, and avian influenza viruses. The development of the filter was funded by the USGS Wildlife: Terrestrial and Endangered Resources Program and the U.S. Environmental Protection Agency.

Study Shows Some Wells have too Much Radium

About 3 percent of the wells in a study of untreated source water from 1,270 domestic, public supply, and monitoring wells between 1987 and 2005 had combined radium concentrations greater than the U.S. Environmental Protection Agency's (USEPA) standard for drinking water. This is one of the findings of a recent study by the USGS, in cooperation with the USEPA, to understand how radium is distributed in aquifers across the United States, and to develop a greater understanding of the conditions that control its release from aquifer materials.

Radium is a naturally occurring radioactive element that is produced from the decay of radioactive elements, such as uranium and thorium, and is a known carcinogen.

A USGS scientist measuring radioactivity with a field gamma-scintilometer on a quarry wall in the Northern Atlantic Coastal Plain. Aquifers in this region had some of the highest concentrations of radium primarily because of low pH conditions that release radium from the sediments. Photo credit: USGS.

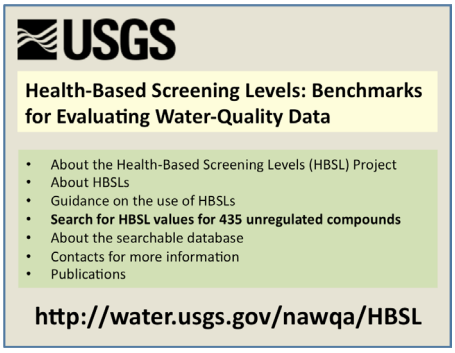
Almost all wells in the study with radium concentrations greater than the USEPA standard were located in the eastern United States. More importantly, one in five wells in the Mid-Continent and Ozark Plateau Cambro-Ordovician aquifer systems, and in the North Atlantic Coastal Plain aquifer system had combined radium concentrations greater than the USEPA standard. It is important to note that for this study untreated water was sampled, and that concentrations in sampled wells do not necessarily reflect the quality of finished water from wells with treatment systems.

Three common factors were found to be associated with the highest radium concentrations in groundwater: (1) oxygen-poor water, (2) acidic conditions (low pH), and (3) high concentrations of dissolved solids.

This study was funded by the USGS National Water-Quality Assessment (NAWQA) Program and the USEPA Office of Groundwater and Drinking Water.

Revised USGS Health-Based Screening Levels Available

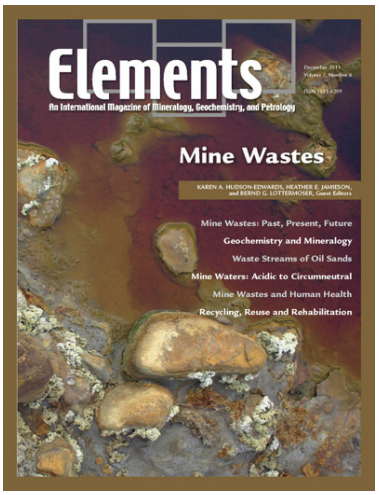
A comprehensive update of the USGS Health-Based Screening Level (HBSL) database has been completed, effective February 28, 2012. HBSLs are non-enforceable benchmark concentrations of contaminants in water that were developed by the USGS in collaboration with the U.S. Environmental Protection Agency (USEPA) and others.



As part of the update, the most current, peer-reviewed, publicly available human-health toxicity information from the USEPA was identified. The HBSL update resulted in revisions to HBSL values for 48 contaminants.

- New HBSL values are available for 17 contaminants that previously did not have HBSLs.
- HBSL values changed for 18 contaminants.
- HBSL values were removed for 6 contaminants.
- HBSL values were added for 7 isomers (such as cis- and trans- compounds). Previously, users were referred to the HBSL value for the mixed isomers.

USGS Science on Mine Wastes Featured



Elements Magazine, 2011, v. 7, no. 6 – ©Mineralogical Society of America – Cover image used with permission.

A recent issue of the international magazine *Elements* focused on the environmental impacts of mine wastes. USGS scientists Geoffrey S. Plumlee and Suzette A. Morman's article Mine Wastes and Human Health provides an overview of how mineral deposit geology and mineralogy influence potential occupational or environmental health issues associated with exposure to mine waste materials. Modern mining methods, when designed and implemented properly, prevent or greatly minimize the potential for adverse environmental and health impacts of mineral resource extraction. Nevertheless, examples of environmental-health problems linked to mining do occur in developing countries.

Another article in this special issue of *Elements*—Mine Waters: Acidic to Circumneutral—by USGS scientist D. Kirk Nordstrom provides an overview of how acid mine waters, often containing high concentrations of toxic heavy metals, can be generated from the mining of metallic deposits and coal. In addition, Nordstrom's article discusses the chemistry of mine drainage waters, including the wide range of pH values and the formation of efflorescent salts.

Upcoming Meetings

Geological Society of America North-Central Section 46th Annual Meeting, Dayton, Ohio, April 23-24, 2012

The theme of this year's meeting is "Change Through Time." The meeting will feature environmental-health related sessions on:

- Applications of Remote Sensing to the Geological and Environmental Sciences
- Mercury Biogeochemistry
- Watersheds, Hydrogeology, and Environmental Site Investigation in the Midwest Basin and Arches Region
- CO_2 Sequestration

http://www.geosociety.org/Sections/nc/2012mtg/

Geological Society of America Rocky Mountain Section 64th Annual Meeting, Albuquerque, New Mexico, May 9-11, 2012

The meeting will feature environmental-health related sessions on:

- Water Quality and Biogeochemistry before and after the Los Conchas Fire, Jemez Mountains, New Mexico
- Arsenic, Uranium, and Radionuclides: Geology and Health Impacts in the Southwest and Rocky Mountains

http://www.geosociety.org/Sections/rm/2012mtg/index.htm

Congress on Risks for Public Health and the Environment, Madrid, Spain, May 16-18, 2012

The goals of the conference are to increase public and political awareness of social, economic and environmental risks of current and new technologies and discuss effective means for technology and risk assessments, product approvals, and liability schemes. The conference will provide an opportunity for open public debate where scientists from different disciplines can address questions and issues such as:

- What are the public health and environmental risks of technologies such as modern biotechnology, nanotechnology, electromagnetic fields, and novel chemicals?
- What are the private and societal needs that are addressed by these technologies?
- What current policies and procedures shape and assess these technologies?
- What are the main barriers to avoiding or minimizing risks, and how can they be overcome?
- How can the precautionary principle be best applied?

http://www.health-defense.org/node/4

USGS Open House, Menlo Park, California, May 19-20, 2012

The USGS will once again be hosting a USGS Open House at its Menlo Park campus. This family-friendly carnival will showcase USGS science and resources with activity booths, films, and lectures.

http://openhouse.wr.usgs.gov/2012/index.html

12th World Congress on Environmental Health, Vilnius, Lithuania, May 22-27, 2012

The theme of the congress is "New Technologies, Healthy Human Beings and Environment." The congress's general topics include aspects of environmental health, such as health impact and health risk assessment, noise and electromagnetic fields impact, food safety, and public education. Additional environmental-health science topics will be presented, such as:

- Technologies for Water Pollution Reduction
- Quality of Drinking Water
- Health Impact Assessment
- Threats to Public Health from Chemicals and Biological Substances

http://www.ifeh2012.org/welcome

International Symposium on Public Health and Environmental Protection (PHEP2012), Macau, China, May 28-30, 2012

International Symposium on Public Health and Environmental Protection (PHEP) will be a symposium within the International Conference on Biomedical Engineering and Biotechnology. Topics presented at the symposium will include:

- Environmental Pollution
- Environmental Protection and Sustainable Development
- Environmental Protection and Public Health

http://www.icbeb.org/phep/

Contaminants of Emerging Concern in Water Resources II: Research, Engineering, and Community Action, Denver, Colorado, June 25-27, 2012

The American Water Resources Association (AWRA) is hosting this Specialty Conference that will focus on the detection, fate, and effects of Contaminants of Emerging Concern (CEC) including: nonprescription and prescription drugs, hormones, disinfectants, pesticides, pathogens, flame retardants and other industrial

chemicals, some household-cleaning products and fragrances, and nanomaterials.
Technical sessions will focus on:

- Occurrence and fate, transport, and effects of CECs in the environment
- CECs in wastewater and drinking water treatment plants
- Implications of CEC occurrence on water reuse
- Analytical tools for detecting CECs in the environment
- Assessments of potential human health risks and/or ecosystem effects
- Policy and engineering solutions to CEC issues
- Implications of CEC research for policy and decision making by water utilities and industry (pesticide, pharmaceutical, and household chemical makers)

http://www.awra.org/meetings/Summer2012/index.html

American Public Health Association Midyear Meeting: The New Public Health – Rewiring for the Future, Charlotte, North Carolina, June 26-28, 2012

The meeting will give attendees from Federal, State, local, and tribal agencies and organizations the educational, policy, and advocacy tools needed for keeping up with and anticipating the changes that will be necessary to "rewire" the public health infrastructure.

http://www.apha.org/Midyear/

Water Pollution 2012: 11th International Conference on Modelling, Monitoring and Management of Water Pollution, New Forest, United Kingdom, July 10-12, 2012

The objective of the conference is to provide a forum for the discussion and exchange of information between scientists, managers, and academics who represent various aspects of water contamination and water quality. The conference will cover the following topics:

- Water Quality
- Groundwater and Aquifer Issues
- Environmental Monitoring and Control
- Remediation
- Pollution Prevention
- Agricultural Contamination
- Wastewater Treatment and Management
- Offshore Pollution and Oil Spills
- Emerging Technologies
- Biosensors
- Health Risk Studies
- Nanoparticles

http://www.wessex.ac.uk/12-conferences/water-pollution-2012.html

3rd Conference on Environmental Pollution and Public Health (CEPPH 2012), Shanghai, China, August 10-12, 2012

The conference will present information on a wide range of topics related to environmental pollution and public health, such as:

- Methods of Monitoring Water Quality
- Modeling and Measuring of Water Pollution
- Water Resources and Quality Assessment
- Hydrobiology and Water Pollution
- Land Pollution and Its Effects on Health
- Environmental Toxicology

http://www.scirp.org/conf/cepph2012/

American Public Health Association 140th Annual Meeting and Exposition, San Francisco, California, October 27-31, 2012

The goal of the meeting is to provide health professionals and practitioners the opportunity to enhance their knowledge and exchange information on best practices, latest research, and new trends in public health. The meeting's program addresses current and emerging health science, policy, and practice issues in an effort to prevent disease and promote health.

http://www.apha.org/meetings/AnnualMeeting/

18th International Interdisciplinary Conference on the Environment, Portland, Maine, June 30-July 3, 2012

The conference is motivated by the increasing need to combine ideas and research findings from different disciplines to enhance the understanding of the interactions between the natural environment and human institutions. Conference presentations will focus on:

- What all disciplines have to offer with respect to understanding environmental and resource problems;
- Possible solutions that are available; and
- The implications of the globalization of environmental concerns.

http://ieaonline.org/?page_id=68

2nd International Conference on Environmental Pollution and Remediation, Montreal, Canada, August 28-30, 2012

The International Academy of Science, Engineering and Technology (International ASET Inc.) is sponsoring the 2nd International Conference on Environmental Pollution and Remediation. The Conference will feature the following environmental-health science topics:

- Water pollution and treatment
- Soil pollution and treatment
- Groundwater issues
- Oil spills
- Environmental safety regulations
- Environmental protection
- Impact of industrialization on the environment
- Pollution and health issues
- Nanotechnology impacts on the environment
- Environmental risk assessments

http://icepr2012.international-aset.com/

SETAC North America 33rd Annual Meeting: Advancing Science Though Innovation and Collaboration, Long Beach, California, November 11-15, 2012

The Society of Environmental Toxicology and Chemistry (SETAC) annual meeting covers environmental toxicology and chemistry, including but not limited to:

- Molecular and cellular biology as they relate to environmental toxicology and chemistry, hazard and risk assessment, and environmental/human-health related issues.
- Contributions to an understanding of ecological risk assessment and environmental hazards, including use and validation of mammalian models and systems.
- Ethical issues related to environmental toxicology and chemistry and risk assessment.

http://longbeach.setac.org/

32nd Annual Meeting of the Society for Risk Analysis, San Francisco, California, December 9-12, 2012

Risk analysis, including risk perception, risk assessment, risk management, and risk communication represents an interdisciplinary field that is the foundation of decision making across a myriad of disciplines. The annual meeting of the Society

for Risk Analysis (SRA) brings together nearly 1,000 international scientists and practitioners from a wide range of disciplines that share an interest in risk analysis.

http://www.sra.org/events_2012_meeting.php

Biohydrology Conference 2013: Bio Meets Hydrology, Landau/Pfalz, Germany, May 21-24, 2013

The conference will focus on the interaction between biological and hydrological systems, including positive impacts such as water harnessing and flood mitigation, and negative aspects including threats to food production, water repellency, and environmental degradation through land use practices. The conference will cover the following topics:

- Biohydrological Processes at Various Scales
- Climate Change, Land Use, and Biodiversity
- Coupled Land-Water Ecosystems
- Role of BioGeoChemical Interfaces in Hydrology

http://www.biohydrology2013.de/

New Publications

Coming Soon!

Cappelle, J., Gaidet, N., Iverson, S.A., Takekawa, J.Y., Newman, S.H., Fofana, B., and Gilbert, M., 2011, Characterizing the interface between wild ducks and poultry to evaluate the potential of transmission of avian pathogens: International Journal of Health Geographics, p. 60, doi:10.1186/1476-072x-10-60.

Cutting, K.A., Hobson, K.A., Rotella, J.J., Warren, J.M., Wainwright-de la Cruz, S.E., and Takekawa, J.Y., 2012, Endogenous contributions to egg protein formation in lesser scaup aythya affinis: Journal of Avian Biology, doi:10.1111/j.1600-048X.2011.05406.x.

Franco, J.N., Ceia, F.R., Patrício, J., Modesto, V., Thompson, J., Marques, J.C., and Neto, J.M., 2011, Population dynamics of *Corbicula fluminea* (Müller, 1774) in mesohaline and oligohaline habitats—Invasion success in a southern Europe estuary: Estuarine, Coastal and Shelf Science, doi:10.1016/j.ecss.2011.07.014.

Gray, J.E., Hines, M.E., Krabbenhoft, D.P., and Thoms, B., 2012, Methylation of Hg downstream from the Bonanza Hg mine, Oregon: Applied Geochemistry, v. 27, no. 1, p. 106-114, doi:10.1016/j.apgeochem.2011.09.019.

Kinney, C.A., Campbell, B.R., Thompson, R., Furlong, E.T., Kolpin, D.W., Burkardt, M.R., Zaugg, S.D., Werner, S.L., and Hay, A.G., 2011, Earthworm bioassays and seed germination for monitoring biosolids toxicity, aging and bioaccumulation of anthropogenic waste indicator compounds in biosolids-amended soil: Environmental Science and Technology.

Smith, K.S., Walton-Day, K., Hoal, K.O., Driscoll, R.L., and Pietersen, K., 2012, Pre- and post-remediation characterization of acid-generating fluvial tailings material, in 9th International Conference on Acid Rock Drainage (ICARD), Ottawa, Ontario, Canada, May 20-26, 2012.

Van Hemert, C., Handel, C.M., and O'Hara, T.M., 2012, Evidence of accelerated beak growth associated with avian keratin disorder in black-capped chickadees (*Poecile atricapillus*): Journal of Wildlife Diseases.

Published Recently!

Ackerman, J.T., Overton, C.T., Casazza, M.L., Takekawa, J.Y., Eagles-Smith, C.A., Keister, R.A., and Herzog, M.P., 2012, Does mercury contamination reduce body condition of endangered California clapper rails?: Environmental Pollution, v. 162, p. 439-448, doi:10.1016/j.envpol.2011.12.004.

Aeby, G.S., Williams, G.J., Franklin, E.C., Kenyon, J., Cox, E.F., Coles, S., and Work, T.M., 2011, Patterns of coral disease across the Hawaiian Archipelago—Relating disease to environment: PLoS ONE, v. 6, no. 5, doi:10.1371/journal.pone.0020370.

Andrews, W.J., Masoner, J.R., and Cozzarelli, I.M., 2012, Emerging contaminants at a closed and an operating landfill in Oklahoma: Ground Water Monitoring and Remediation, v. 32, no. 1, p. 120-130, doi:10.1111/j.1745-6592.2011.01373.x.

Arsnoe, D.M., Ip, H.S., and Owen, J.C., 2011, Influence of body condition on influenza a virus infection in mallard ducks—Experimental infection data: PLoS ONE, v. 6, no. 8, doi:10.1371/journal.pone.0022633.

Asta, M.P., Nordstrom, D.K., and McCleskey, B.R., 2012, Simultaneous oxidation of arsenic and Antimony at low and circumneutral pH, with and without microbial catalysis: Applied Geochemistry, v. 27, no. 1, p. 281-291, doi:10.1016/j.apgeochem.2011.09.002.

Badgley, B.D., Ferguson, J., Heuvel, A.V., Kleinheinz, G.T., McDermott, C.M., Sandrin, T.R., Kinzelman, J., Junion, E.A., Byappanahalli, M.N., Whitman, R.L., and Sadowsky, M.J., 2011, Multi-scale temporal and spatial variation in genotypic composition of *Cladophora*-borne *Escherichia coli* populations in Lake Michigan: Water Research, v. 45, no. 2, p. 721-731, doi:10.1016/j.watres.2010.08.041.

Barber, L.B., Brown, G.K., Nettesheim, T.G., Murphy, E.W., Bartell, S.E., and Schoenfuss, H.L., 2011, Effects of biologically-active chemical mixtures on fish in a wastewater-impacted urban stream: Science of the Total Environment, v. 409, no. 22, p. 4720-4728, doi:10.1016/j.scitotenv.2011.06.039.

Barber, L.B., Vajda, A.M., Douville, C., Norris, D.O., and Writer, J.H., 2012, Fish endocrine disruption responses to a major wastewater treatment facility upgrade: Environmental Science and Technology, v. 46, no. 4, p. 2121-2131, doi:10.1021/es202880e.

Battaglin, W., Sandstrom, M., Kuivila, K., Kolpin, D., and Meyer, M., 2011, Occurrence of azoxystrobin, propiconazole, and selected other fungicides in US streams, 2005-2006: Water, Air, and Soil Pollution, v. 218, no. 1-4, p. 307-322, doi:10.1007/s11270-010-0643-2.

Bevins, S.N., Carver, S., Boydston, E.E., Lyren, L.M., Alldredge, M., Logan, K.A., Riley, S.P.D., Fisher, R.N., Vickers, T.W., Boyce, W., Salman, M., Lappin, M.R., Crooks, K.R., and VandeWoude, S., 2012, Three pathogens in sympatric populations of pumas, bobcats, and domestic cats—Implications for infectious disease transmission: PLoS ONE, v. 7, no. 2, p. e31403, doi:10.1371/journal.pone.0031403.

Bradley, P.M., and Chapelle, F.H., 2011, Microbial mineralization of dichloroethene and vinyl chloride under hypoxic conditions: Ground Water Monitoring and Remediation, v. 31, no. 4, p. 39-49, doi:10.1111/j.1745-6592.2011.01339.x.

Brown, J.B., 2011, Application of the SPARROW watershed model to

describe nutrient sources and transport in the Missouri River Basin: U.S. Geological Survey Fact Sheet 2011-3104, 4 p.

Brown, J.B., Sprague, L.A., and Dupree, J.A., 2011, Nutrient sources and transport in the Missouri River Basin, with emphasis on the effects of irrigation and reservoirs: JAWRA Journal of the American Water Resources Association, v. 47, no. 5, p. 1034-1060, doi:10.1111/j.1752-1688.2011.00584.x.

Busch, J.D., van Andel, R., Cordova, J., Colman, R.E., Keim, P., Rocke, T.E., Leid, J.G., van Pelt, W.E., and Wagner, D.M., 2011, Population differences in host immune factors may influence survival of Gunnison's prairie dogs (*Cynomys gunnisoni*) during plague outbreaks: Journal of Wildlife Diseases, v. 47, no. 4, p. 968-973.

Byappanahalli, M.N., Yan, T., Hamilton, M.J., Ishii, S., Fujioka, R.S., Whitman, R.L., and Sadowsky, M.J., 2012, The population structure of *Escherichia coli* isolated from subtropical and temperate soils: Science of the Total Environment, v. 417-418, p. 273-279, doi:10.1016/j.scitotenv.2011.12.041.

Cain, D., Croteau, M.-N., and Luoma, S., 2011, Bioaccumulation dynamics and exposure routes of Cd and Cu among species of aquatic mayflies: Environmental Toxicology and Chemistry, v. 30, no. 11, p. 2532-2541, doi:10.1002/etc.663.

Caine, J.S., Johnson, R.H., and Wild, E.C., 2011, Review and interpretation of previous work and new data on the hydrogeology of the Schwartzwalder Uranium Mine and vicinity, Jefferson county, Colorado: U.S. Geological Survey Open-File Report 2011-1092, 44 p.

Cappelle, J., Gaidet, N., Iverson, S.A., Takekawa, J.Y., Newman, S.H., Fofana, B., and Gilbert, M., 2011, Characterizing the interface between wild ducks and poultry to evaluate the potential of transmission of avian pathogens: International Journal of Health Geographics, v. 10, Article number 60, doi:10.1186/1476-072x-10-60.

Chang, F.-c., Simcik, M.F., and Capel, P.D., 2011, Occurrence and fate of the herbicide glyphosate and its degradate aminomethylphosphonic acid in the atmosphere: Environmental Toxicology and Chemistry, v. 30, no. 3, p. 548-555, doi:10.1002/etc.431.

Coplen, T.B., and Qi, H., 2012, USGS42 and USGS43—Human-hair stable hydrogen and oxygen isotopic reference materials and analytical methods for forensic science and implications for published measurement results: Forensic Science International, v. 214, no. 1–3, p. 135-141, doi:10.1016/j.forsciint.2011.07.035.

Cozzarelli, I.M., Böhlke, J.K., Masoner, J., Breit, G.N., Lorah, M.M., Tuttle, M.L.W., and Jaeschke, J.B., 2011, Biogeochemical evolution of a landfill leachate plume, Norman, Oklahoma: Ground Water, v. 49, no. 5, p. 663-687, doi:10.1111/j.1745-6584.2010.00792.x.

Croteau, M.N., Misra, S.K., Luoma, S.N., and Valsami-Jones, E., 2011, Silver bioaccumulation dynamics in a freshwater invertebrate after aqueous and dietary exposures to nanosized and ionic Ag: Environmental Science and Technology, v. 45, no. 15, p. 6600-6607, doi:10.1021/es200880c.

Cutting, K.A., Hobson, K.A., Rotella, J.J., Warren, J.M., Wainwright-de la Cruz, S.E., and Takekawa, J.Y., 2011, Endogenous contributions to egg protein formation in lesser scaup *Aythya affinis*: Journal of Avian Biology, p. no-no, doi:10.1111/j.1600-048X.2011.05406.x.

Domagalski, J.L., and Johnson, H., 2012, Phosphorus and groundwater—Establishing links between agricultural use and transport to streams: U.S. Geological Survey Fact Sheet 2012-3004, 4 p.

Domagalski, J.L., and Johnson, H.M., 2011, Subsurface transport of orthophosphate in five agricultural watersheds, USA: Journal of Hydrology, v. 409, no. 1–2, p. 157-171, doi:10.1016/j.jhydrol.2011.08.014.

Dusek, R.J., Hall, J.S., Nashold, S.W., Teslaa, J.L., and Ip, H.S., 2011, Evaluation of Nobuto filter paper strips for the detection of avian influenza virus antibody in waterfowl: Avian Diseases, v. 55, no. 4, p. 674-676, doi:10.1637/9687-021511-ResNote.1.

Dybowska, A.D., Croteau, M.-N., Misra, S.K., Berhanu, D., Luoma, S.N., Christian, P., O'Brien, P., and Valsami-Jones, E., 2011, Synthesis of isotopically modified ZnO nanoparticles and their potential as nanotoxicity tracers: Environmental Pollution, v. 159, no. 1, p. 266-273, doi:10.1016/j.envpol.2010.08.032.

Fellers, G.M., Cole, R., Reinitz, D., and Kleeman, P., 2011, Amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) in coastal and montane California, USA, anurans: Herpetological Conservation and Biology, v. 6, no. 3, p. 383-394.

Fernandez, J.R.R., and Rocke, T.E., 2011, Use of rhodamine B as a biomarker for oral plague vaccination of prairie dogs: Journal of Wildlife Diseases, v. 47, no. 3, p. 765-768.

Futch, C.J., Griffin, D.W., Banks, K., and Lipp, E.K., 2011, Evaluation of sewage source and fate on southeast Florida coastal reefs: Marine Pollution Bulletin, v. 62, no. 11, p. 2308-2316, doi:10.1016/j.marpolbul.2011.08.046.

Ge, Z., Whitman, R.L., Nevers, M.B., Phanikumar, M.S., and Byappanahallia, M.N., 2012, Nearshore hydrodynamics as loading and forcing factors for *Ischerichia coli* contamination at an embayed beach: Limnology and Oceanography, v. 57, no. 1, p. 362-381, doi:10.4319/lo.2012.57.1.0362.

Gehrke, G.E., Blum, J.D., and Marvin-DiPasquale, M., 2011, Sources of mercury to San Francisco Bay surface sediment as revealed by mercury stable isotopes: Geochimica et Cosmochimica Acta, v. 75, no. 3, p. 691-705, doi:10.1016/j.gca.2010.11.012.

Gilbert, M., Newman, S., Takekawa, J., Loth, L., Biradar, C., Prosser, D., Balachandran, S., Subba Rao, M., Mundkur, T., Yan, B., Xing, Z., Hou, Y., Batbayar, N., Natsagdorj, T., Hogerwerf, L., Slingenbergh, J., and Xiao, X., 2010, Flying over an infected landscape—Distribution of highly pathogenic avian influenza H5N1 risk in south Asia and satellite tracking of wild waterfowl: EcoHealth, v. 7, no. 4, p. 448-458, doi:10.1007/s10393-010-0672-8.

Golden, H.E., Knightes, C.D., Conrads, P.A., Davis, G.M., Feaster, T.D., Journey, C.A., Benedict, S.T., Brigham, M.E., and Bradley, P.M., 2012, Characterizing mercury concentrations and fluxes in a coastal plain watershed—Insights from dynamic modeling and data: Journal of Geophysical Research, v. 117, no. G1, p. G01006, doi:10.1029/2011jg001806.

Graham, A.M., Aiken, G.R., and Gilmour, C.C., 2012, Dissolved organic matter enhances microbial mercury methylation under sulfidic conditions: Environmental Science and Technology, v. 46, no. 5, p. 2715-2723, doi:10.1021/es203658f.

Gray, J.E., Hines, M.E., Krabbenhoft, D.P., and Thoms, B., 2012, Methylation of Hg downstream from the Bonanza Hg mine, Oregon: Applied Geochemistry, v. 27, no. 1, p. 106-114, doi:10.1016/j.apgeochem.2011.09.019.

Hall, J.S., Franson, J.C., Gill, R.E., Meteyer, C.U., Teslaa, J.L., Nashold, S., Dusek, R.J., and Ip, H.S., 2011, Experimental challenge and pathology of highly pathogenic avian influenza virus H5N1 in dunlin (*Calidris alpina*), an intercontinental migrant shorebird species: Influenza and other Respiratory Viruses, v. 5, no. 5, p. 365-372, doi:10.1111/j.1750-2659.2011.00238.x.

Harris, H.S., Benson, S.R., Gilardi, K.V., Poppenga, R.H., Work, T.M., Dutton, P.H., and Mazet, J.A.K., 2011, Comparative health assessment of Western Pacific leatherback turtles (*Dermochelys coriacea*) foraging off the coast of California, 2005-2007: Journal of Wildlife Diseases, v. 47, no. 2, p. 321-337.

Hénaux, V., Samuel, M.D., Dusek, R.J., Fleskes, J.P., and Ip, H.S., 2012, Presence of avian influenza viruses in waterfowl and wetlands during summer 2010 in California—Are resident birds a potential reservoir?: PLoS ONE, v. 7, no. 2, p. e31471, e31471, doi:10.1371/journal.pone.0031471.

Huffman, R.L., Wagner, R.J., Toft, J., Cordell, J., DeWild, J.F., Dinicola, R.S., Aiken, G.R., Krabbenhoft, D.P., Marvin-DiPasquale, M., Stewart, A.R., Moran, P.W., and Paulson, A.J., 2012, Mercury species and other selected constituent concentrations in water, sediment, and biota of Sinclair Inlet, Kitsap County, Washington, 2007-10: U.S. Geological Survey Data Series 658, 50 p.

Hughes, W.B., and Younker, C.L., 2011, Organic compounds assessed in Chattahoochee River water used for public supply near Atlanta, Georgia, 2004-05: U.S. Geological Survey Fact Sheet 2011-3062, 6 p.

Jagucki, M.L., Musgrove, M., Lindgren, R.J., Fahlquist, L., and Eberts, S.M., 2011, Assessing the vulnerability of public-supply wells to contamination—Edwards Aquifer near San Antonio, Texas: U.S. Geological Survey Fact Sheet 2011-3142, 6 p.

Janssen, E.M.L., Thompson, J.K., Luoma, S.N., and Luthy, R.G., 2011, PCB-induced changes of a benthic community and expected ecosystem recovery following in situ sorbent amendment: Environmental Toxicology and Chemistry, v. 30, no. 8, p. 1819-1826, doi:10.1002/etc.574.

Katz, B.G., Eberts, S.M., and Kauffman, L.J., 2011, Using Cl/Br ratios and other indicators to assess potential impacts on groundwater quality from septic systems—A review and examples from principal aquifers in the United States: Journal of Hydrology, v. 397, no. 3–4, p. 151-166, doi:10.1016/j.jhydrol.2010.11.017.

Klimstra, J.D., Yee, J.L., Heinz, G.H., Hoffman, D.J., and Stebbins, K.R., 2012, Interactions Between methylmercury and selenomethionine injected into mallard eggs: Environmental Toxicology and Chemistry, v. 31, no. 3, p. 579-584, doi:10.1002/etc.1708.

Lam, T.T.-Y., Ip, H.S., Ghedin, E., Wentworth, D.E., Halpin, R.A., Stockwell, T.B., Spiro, D.J., Dusek, R.J., Bortner, J.B., Hoskins, J., Bales, B.D., Yparraguirre, D.R., and Holmes, E.C., 2012, Migratory flyway and geographical distance are barriers to the gene flow of influenza virus among North American birds: Ecology Letters, v. 15, no. 1, p. 24-33, doi:10.1111/j.1461-0248.2011.01703.x (Advanced Web release).

Landmeyer, J.E., Miller, S., Campbell, B.G., Vroblesky, D.A., Gill, A.C., and Clark, A.P., 2011, Investigation of the potential source area, contamination pathway, and probable release history of chlorinated-solvent-contaminated groundwater at the Capital City Plume site, Montgomery, Alabama, 2008-2010: U.S. Geological Survey Scientific Investigations Report 2011-5148, 53 p.

Landon, M., Green, C., Belitz, K., Singleton, M., and Esser, B., 2011, Relations of hydrogeologic factors, groundwater reduction-oxidation conditions, and temporal and spatial distributions of nitrate, central-eastside San Joaquin Valley, California, USA: Hydrogeology Journal, v. 19, no. 6, p. 1203-1224, doi:10.1007/s10040-011-0750-1.

Lathrop, T., and Moran, D., 2011, Organic compounds in White River water used for public supply near Indianapolis, Indiana, 2002-05: U.S. Geological Survey Fact Sheet 2010-3120, 6 p.

Lee, J.S., Ruell, E.W., Boydston, E.E., Lyren, L.M., Alonso, R.S., Troyer, J.L., Crooks, K.R., and VandeWoude, S.U.E., 2012, Gene flow and pathogen transmission among bobcats (*Lynx rufus*) in a fragmented urban landscape: Molecular Ecology, p. no-no, doi:10.1111/j.1365-294X.2012.05493.x.

Liao, L., Green, C.T., Bekins, B.A., and Böhlke, J.K., 2012, Factors controlling nitrate fluxes in groundwater in agricultural areas: Water Resources Research, v. 48, p. 18, W00L09, doi:10.1029/2011WR011008.

Lorch, J.M., Meteyer, C.U., Behr, M.J., Boyles, J.G., Cryan, P.M., Hicks, A.C., Ballmann, A.E., Coleman, J.T.H., Redell, D.N., Reeder, D.M., and Blehert, D.S., 2011, Experimental infection of bats with *Geomyces destructans* causes White-nose syndrome: Nature, v. 480, no. 7377, p. 376-378, doi:10.1038/nature10590.

Lozano, N., Rice, C.P., Pagano, J., Zintek, L., Barber, L.B., Murphy, E.W., Nettesheim, T., Minarik, T., and Schoenfuss, H.L., 2012, Concentration of organic contaminants in fish and their biological effects in a wastewater-dominated urban stream: Science of the Total Environment, v. 420, p. 191-201, doi:10.1016/j.scitotenv.2011.12.059.

Mahler, B.J., and Van Metre, P.C., 2011, Coal-tar-based pavement sealcoat, polycyclic aromatic hydrocarbons (PAHs), and environmental health: U.S. Geological Survey Fact Sheet 2011-3010, 6 p.

Maupin, M.A., and Ivahnenko, T., 2011, Nutrient loadings to streams of the continental United States from municipal and industrial effluent1: JAWRA Journal of the American Water Resources Association, v. 47, no. 5, p. 950-964, doi:10.1111/j.1752-1688.2011.00576.x.

McNutt, M.K., Camilli, R., Crone, T.J., Guthrie, G.D., Hsieh, P.A., Ryerson, T.B., Savas, O., and Shaffer, F., 2011, Review of flow rate estimates of the Deepwater horizon oil spill: Proceedings of the National Academy of Sciences, doi:10.1073/pnas.1112139108 (in Science Applications in the Deepwater Horizon Oil Spill Special Feature).

Millen, H.T., Gonnering, J.C., Berg, R.K., Spencer, S.K., Jokela, W.E., Pearce, J.M., Borchardt, J.S., and Borchardt, M.A., 2012, Glass wool filters for concentrating waterborne viruses and agricultural zoonotic pathogens: Journal of Visualized Experiments, no. 61, p. e3930, doi:doi:10.3791/3930.

Mohanram, A., Ray, C., Metge, D.W., Barber, L.B., Ryan, J.N., and Harvey, R.W., 2012, Effect of dissolved organic carbon on the transport and attachment behaviors of *Cryptosporidium parvum* oocysts and carboxylate-modified microspheres advected through temperate humic and tropical volcanic agricultural soil: Environmental Science and Technology, v. 46, no. 4, p. 2088-2094, doi:10.1021/es2003342.

Nevers, M.B., and Whitman, R.L., 2011, Beach monitoring criteria—Reading the fine print: Environmental Science and Technology, v. 45, no. 24, p. 10315-10321, doi:10.1021/es202568f.

Newman, S.H., Hill, N.J., Spragens, K.A., Janies, D., Voronkin, I.O., Prosser, D.J., Yan, B., Lei, F., Batbayar, N., Natsagdorj, T., Bishop, C.M., Butler, P.J., Wikelski, M., Balachandran, S., Mundkur, T., Douglas, D.C., and Takekawa, J.Y., 2012, Eco-virological approach for assessing the role of wild birds in the spread of avian influenza H5N1 along the central Asian flyway: PLoS ONE, v. 7, no. 2, doi:10.1371/journal.pone.0030636.

Nimick, D.A., Gammons, C.H., and Parker, S.R., 2011, Diel biogeochemical processes and their effect on the aqueous chemistry of streams—A review: Chemical Geology, v. 283, no. 1-2, p. 3-17, doi:10.1016/j.chemgeo.2010.08.017.

Nordstrom, D.K., 2011, Mine waters—Acidic to circmneutral: Elements, v. 7, no. 6, p. 393-398, doi:10.2113/gselements.7.6.393.

Plumlee, G.S., and Morman, S.A., 2011, Mine wastes and human health: Elements, v. 7, no. 6, p. 399-404, doi:10.2113/gselements.7.6.399.

Preston, S.D., Alexander, R.B., and Woodside, M.D., 2011, Regional assessments of the Nation's water quality—Improved understanding of stream nutrient sources through enhanced modeling capabilities: U.S. Geological Survey Fact Sheet 2011-3114, 6 p.

Ramey, A.M., Pearce, J.M., Reeves, A.B., Franson, J.C., Petersen, M.R., and Ip, H.S., 2011, Evidence for limited exchange of avian influenza viruses between seaducks and dabbling ducks at Alaska Peninsula coastal lagoons: Archives of Virology, v. 156, no. 10, p. 1813-1821, doi:10.1007/s00705-011-1059-z.

Reeves, A.B., Pearce, J.M., Ramey, A.M., Meixell, B.W., and Runstadler, J.A., 2011, Interspecies transmission and limited persistence of low pathogenic avian influenza genomes among Alaska dabbling ducks: Infection, Genetics and Evolution, v. 11, no. 8, p. 2004-2010, doi:10.1016/j.meegid.2011.09.011.

Risch, M.R., DeWild, J.F., Krabbenhoft, D.P., Kolka, R.K., and Zhang, L., 2012, Litterfall mercury dry deposition in the Eastern USA: Environmental Pollution, v. 161, p. 284-290, doi:10.1016/j.envpol.2011.06.005.

Riseng, C.M., Wiley, M.J., Black, R.W., and Munn, M.D., 2011, Impacts of agricultural land use on biological integrity—A causal analysis: Ecological Applications, v. 21, no. 8, p. 3128-3146, doi:10.1890/11-0077.1.

Runkel, R.L., Kimball, B.A., Walton-Day, K., Verplanck, P.L., and Broshears, R.E., 2012, Evaluating remedial alternatives for an acid mine drainage stream—A model post audit: Environmental Science and Technology, v. 46, no. 1, p. 340-347, doi:10.1021/es2038504.

Samuel, M.D., Hobbelen, P.H.F., DeCastro, F., Ahumada, J.A., LaPointe, D.A., Atkinson, C.T., Woodworth, B.L., Hart, P.J., and Duffy, D.C., 2011, The dynamics, transmission, and population impacts of avian malaria in native Hawaiian birds—A modeling approach: Ecological Applications, v. 21, no. 8, p. 2960-2973, doi:10.1890/10-1311.1.

Sedinger, J.S., Jason, L.S., Ward, D.H., Nicolai, C.A., and Conant, B., 2011, Carryover effects associated with winter location affect fitness, social status, and population dynamics in a long-distance migrant: The American Naturalist, v. 178, no. 5, p. E110-E123, doi:10.1086/662165.

Shapiro, A., 2011, The challenge of interpreting environmental tracer concentrations in fractured rock and carbonate aquifers: Hydrogeology Journal, v. 19, no. 1, p. 9-12, doi:10.1007/s10040-010-0678-x.

Singha, K., Li, L., Day-Lewis, F.D., and Regberg, A.B., 2011, Quantifying solute transport processes—Are chemically "conservative" tracers electrically conservative?: Geophysics, v. 76, no. 1, p. F53-F63, doi:http://link.aip.org/link/?GPY/76/F53/1.

Smith, D.J., Griffin, D.W., and Jaffe, D.A., 2011, The high life—Transport of microbes in the atmosphere: Eos, v. 92, no. 30, p. 249-250, doi:10.1029/2011eo300001.

Smith, D.J., Griffin, D.W., McPeters, R.D., Ward, P.D., and Schuerger, A.C., 2011, Microbial survival in the stratosphere and implications for global dispersal: Aerobiologia, v. 27, no. 4, p. 319-332, doi:10.1007/s10453-011-9203-5.

Stackelberg, P.E., Barbash, J.E., Gilliom, R.J., Stone, W.W., and Wolock, D.M., 2012, Regression models for estimating concentrations of atrazine plus deethylatrazine in shallow groundwater in agricultural areas of the United States: Journal of Environmental Quality, v. 41, no. 2, p. 479-494, doi:10.2134/jeq2011.0200.

Strona, G., and Lafferty, K.D., 2012, How to catch a parasite—Parasite niche modeler (PaNic) meets fishbase: Ecography, p. no-no, doi:10.1111/j.1600-0587.2012.07439.x.

Szabo, Z., dePaul, V.T., Fischer, J.M., Kraemer, T.F., and Jacobsen, E., 2012, Occurrence and geochemistry of radium in water from principal drinking-water aquifer systems of the United States: Applied Geochemistry, v. 27, no. 3, p. 729-752, doi:10.1016/j.apgeochem.2011.11.002.

Szabo, Z., Fischer, J.M., and Hancock, T.C., 2012, Principal aquifers can contribute radium to sources of drinking water under certain geochemical conditions: U.S. Geological Survey Fact Sheet 2010-3113, 6 p.

Takekawa, J.Y., Hill, N.J., Schultz, A.K., Iverson, S.A., Cardona, C.J., Boyce, W.M., and Dudley, J.P., 2011, Rapid diagnosis of avian influenza virus in wild Birds—Use of a portable rRT-PCR and freeze-dried reagents in the field: Journal of Visualized Experiments, no. 54, e2829, doi:10.3791/2829 (Includes an on-line video).

Takekawa, J.Y., Woo, I., Gardiner, R., Casazza, M., Ackerman, J.T., Nur, N., Liu, L., and Spautz, H., 2011, Avian communities in tidal salt marshes of San Francisco Bay—A review of functional groups by foraging guild and habitat association: San Francisco Estuary and

Watershed Science, v. 9, no. 3, p. 1-24.

Taylor, H., Antweiler, R., Roth, D., Alpers, C., and Dileanis, P., 2012, Selected trace elements in the Sacramento River, California—Occurrence and distribution: Archives of Environmental Contamination and Toxicology, p. 1-13, doi:10.1007/s00244-011-9738-z (Advanced Web release).

Ulrich, E.M., Morrison, C.N., Goldsmith, M.R., and Foreman, W.T., 2012, Chiral pesticides—Identification, description, and environmental implications, in Whitacre, D.M., ed., Reviews of Environmental Contamination and Toxicology: New York, Springer U.S., v. 217, p. 1-74, ISBN:978-1-4614-2329-4.

Underwood, J.C., Harvey, R.W., Metge, D.W., Repert, D.A., Baumgartner, L.K., Smith, R.L., Roane, T.M., and Barber, L.B., 2011, Effects of the antimicrobial sulfamethoxazole on groundwater bacterial enrichment: Environmental Science and Technology, v. 45, no. 7, p. 3096-3101, doi:10.1021/es103605e.

Vajda, A.M., Barber, L.B., Gray, J.L., Lopez, E.M., Bolden, A.M., Schoenfuss, H.L., and Norris, D.O., 2011, Demasculinization of male fish by wastewater treatment plant effluent: Aquatic Toxicology, v. 103, no. 3-4, p. 213-221, doi:10.1016/j.aquatox.2011.02.007.

Vittecoq, M., Elguero, E., Lafferty, K.D., Roche, B., Brodeur, J., Gauthier-Clerc, M., Missé, D., and Thomas, F., 2012, Brain cancer mortality rates increase with *Toxoplasma gondii* seroprevalence in France: Infection, Genetics and Evolution, v. 12, no. 2, p. 496-498, doi:10.1016/j.meegid.2012.01.013.

Webb, R.M.T., Sandstrom, M.W., Krutz, L.J., and Shaner, D.L., 2011, Simulation of branched serial first-order decay of atrazine and metabolites in adapted and nonadapted soils: Environmental Toxicology and Chemistry, v. 30, no. 9, p. 1973-1981, doi:10.1002/etc.597.

White, A.F., Schulz, M.S., Vivit, D.V., Bullen, T.D., and Fitzpatrick, J., 2012, The Impact of biotic/abiotic interfaces in mineral nutrient cycling—A study of soils of the Santa Cruz chronosequence, California: Geochimica et Cosmochimica Acta, v. 77, no. 0, p. 62-85, doi:10.1016/j.gca.2011.10.029.

Williams, G.J., Knapp, I.S., Work, T.M., and Conklin, E.J., 2011, Outbreak of *Acropora* white syndrome following a mild bleaching event at Palmyra Stoll, Northern Line Islands, Central Pacific: Coral Reefs, v. 30, no. 3, p. 621, doi:10.1007/s00338-011-0762-2.

Williams, L.B., Metge, D.W., Eberl, D.D., Harvey, R.W., Turner, A.G., Prapaipong, P., and Poret-Peterson, A.T., 2011, What makes a natural clay antibacterial?: Environmental Science and Technology, v. 45, no. 8, p. 3768-3773, doi:10.1021/es1040688.

Windham-Myers, L., Ward, K., Marvin-DiPasquale, M., Agee, J.L., Kieu, L.H., and Kakouros, E., 2011, Biogeochemical implications of episodic impoundment in a restored tidal marsh of San Francisco Bay, California: Restoration Ecology, doi:10.1111/j.1526-100X.2011.00849.x (Advanced Web release).

Wolfe, L.L., Shenk, T.M., Powell, B., and Rocke, T.E., 2011, Assessment of a recombinant F1-V fusion protein vaccine intended to protect Canada lynx (*Lynx canadensis*) from plague: Journal of Wildlife Diseases, v. 47, no. 4, p. 888-892.

Work, T.M., and Aeby, G.S., 2011, Pathology of tissue loss (White syndrome) in *Acropora sp*. corals from the Central Pacific: Journal of Invertebrate Pathology, v. 107, no. 2, p. 127-131, doi:10.1016/j.jip.2011.03.009.

Work, T.M., Forsman, Z.H., Szabó, Z., Lewis, T.D., Aeby, G.S., and Toonen, R.J., 2011, Inter-specific coral chimerism—Genetically distinct multicellular structures associated with tissue loss in *Montipora capitata*: PLoS ONE, v. 6, no. 7, doi:10.1371/journal.pone.0022869.

Writer, J.H., Barber, L.B., Ryan, J.N., and Bradley, P.M., 2011, Biodegradation and attenuation of steroidal hormones and alkylphenols by stream biofilms and sediments: Environmental Science and Technology, v. 45, no. 10, p. 4370-4376, doi:10.1021/es2000134.

Writer, J.H., Keefe, S.K., Ryan, J.N., Ferrer, I., Thurman, M.E., and Barber, L.B., 2011, Methods for evaluating in-stream attenuation of trace organic compounds: Applied Geochemistry, v. 26, Supplement, p. S344-S345, doi:10.1016/j.apgeochem.2011.03.071.

Writer, J.H., Ryan, J.N., and Barber, L.B., 2011, Role of biofilms in sorptive removal of steroidal hormones and 4-nonylphenol compounds from streams: Environmental Science and Technology, v. 45, no. 17, p. 7275-7283, doi:10.1021/es2008038.

Writer, J.H., Ryan, J.N., Keefe, S.H., and Barber, L.B., 2011, Fate of 4-nonylphenol and 17βestradiol in the Redwood River of Minnesota: Environmental Science and Technology, v. 46, no. 2, p. 860-868, doi:10.1021/es2031664.

Yang, Y.-Y., Gray, J.L., Furlong, E.T., Davis, J.G., ReVello, R.C., and Borch, T., 2012, Steroid hormone runoff from agricultural test plots applied with municipal biosolids: Environmental Science and Technology, v. 46, no. 5, p. 2746-2754, doi:10.1021/es203896t.

Yun, J., Ueki, T., Miletto, M., and Lovley, D.R., 2011, Monitoring the metabolic status of geobacter species in contaminated groundwater by quantifying key metabolic proteins with geobacter-specific antibodies: Applied and Environmental Microbiology, v. 77, no. 13, p. 4597-4602, doi:10.1128/aem.00114-11.

Zhang, Y., Hao, M., Takekawa, J.Y., Lei, F., Yan, B., Prosser, D.J., Douglas, D.C., Xing, Z., and Newman, S.H., 2011, Tracking the autumn migration of the bar-headed goose (*Anser indicus*) with satellite telemetry and relationship to environmental conditions: International Journal of Zoology, 323847, doi:10.1155/2011/323847.

References for Articles

Aeby, G.S., Williams, G.J., Franklin, E.C., Kenyon, J., Cox, E.F., Coles, S., and Work, T.M., 2011, Patterns of coral disease across the Hawaiian Archipelago--Relating disease to environment: PLoS ONE, v. 6, no. 5, doi:10.1371/journal.pone.0020370.

Bevins, S.N., Carver, S., Boydston, E.E., Lyren, L.M., Alldredge, M., Logan, K.A., Riley, S.P.D., Fisher, R.N., Vickers, T.W., Boyce, W., Salman, M., Lappin, M.R., Crooks, K.R., and VandeWoude, S., 2012, Three pathogens in sympatric populations of pumas, bobcats, and domestic cats--Implications for infectious disease transmission: PLoS ONE, v. 7, no. 2, p. e31403, doi:10.1371/journal.pone.0031403.

Caine, J.S., Johnson, R.H., and Wild, E.C., 2011, Review and interpretation of previous work and new data on the hydrogeology of the Schwartzwalder Uranium Mine and vicinity, Jefferson

county, Colorado: U.S. Geological Survey Open-File Report 2011-1092, 44 p.

Janssen, E.M.L., Thompson, J.K., Luoma, S.N., and Luthy, R.G., 2011, PCB-induced changes of a benthic community and expected ecosystem recovery following in situ sorbent amendment: Environmental Toxicology and Chemistry, v. 30, no. 8, p. 1819-1826, doi:10.1002/etc.574.

Kurath, G., and Winton, J., 2011, Complex dynamics at the interface between wild and domestic viruses of finfish: Current Opinion in Virology, v. 1, no. 1, p. 73-80, doi:10.1016/j.coviro.2011.05.010.

Landmeyer, J.E., Miller, S., Campbell, B.G., Vroblesky, D.A., Gill, A.C., and Clark, A.P., 2011, Investigation of the potential source area, contamination pathway, and probable release history of chlorinated-solvent-contaminated groundwater at the Capital City Plume site, Montgomery, Alabama, 2008-2010: U.S. Geological Survey Scientific Investigations Report 2011-5148, 53 p.

Lorch, J.M., Meteyer, C.U., Behr, M.J., Boyles, J.G., Cryan, P.M., Hicks, A.C., Ballmann, A.E., Coleman, J.T.H., Redell, D.N., Reeder, D.M., and Blehert, D.S., 2011, Experimental infection of bats with *Geomyces destructans* causes White-nose syndrome: Nature, v. 480, no. 7377, p. 376-378, doi:10.1038/nature10590.

Millen, H.T., Gonnering, J.C., Berg, R.K., Spencer, S.K., Jokela, W.E., Pearce, J.M., Borchardt, J.S., and Borchardt, M.A., 2012, Glass wool filters for concentrating waterborne viruses and agricultural zoonotic pathogens: Journal of Visualized Experiments, no. 61, p. e3930, doi:doi:10.3791/3930.

Nevers, M.B., and Whitman, R.L., 2011, Beach monitoring criteria--Reading the fine print: Environmental Science and Technology, v. 45, no. 24, p. 10315-10321, doi:10.1021/es202568f.

Nordstrom, D.K., 2011, Mine waters--Acidic to circmneutral: Elements, v. 7, no. 6, p. 393-398, doi:10.2113/gselements.7.6.393.

Plumlee, G.S., and Morman, S.A., 2011, Mine wastes and human health: Elements, v. 7, no. 6, p. 399-404, doi:10.2113/gselements.7.6.399.

Rostad, C.E., Schmitt, C.J., Schumacher, J.G., and Leiker, T.J., 2010, An exploratory investigation of polar organic compounds in waters from a lead–zinc mine and mill complex: Water, Air, and Soil Pollution, v. 217, no. 1-4, p. 431-443, doi:10.1007/s11270-010-0598-3.

Samuel, M.D., Hobbelen, P.H.F., DeCastro, F., Ahumada, J.A., LaPointe, D.A., Atkinson, C.T., Woodworth, B.L., Hart, P.J., and Duffy, D.C., 2011, The dynamics, transmission, and population impacts of avian malaria in native Hawaiian birds--A modeling approach: Ecological Applications, v. 21, no. 8, p. 2960-2973, doi:10.1890/10-1311.1.

Sedinger, J.S., Jason, L.S., Ward, D.H., Nicolai, C.A., and Conant, B., 2011, Carryover effects associated with winter location affect fitness, social status, and population dynamics in a long-distance migrant: The American Naturalist, v. 178, no. 5, p. E110-E123, doi:10.1086/662165.

Szabo, Z., dePaul, V.T., Fischer, J.M., Kraemer, T.F., and Jacobsen, E., 2012, Occurrence and geochemistry of radium in water from principal drinking-water aquifer systems of the United States: Applied Geochemistry, v. 27, no. 3, p. 729-752, doi:10.1016/j.apgeochem.2011.11.002.

Szabo, Z., Fischer, J.M., and Hancock, T.C., 2012, Principal aquifers can contribute radium to sources of drinking water under certain geochemical conditions: U.S. Geological Survey Fact Sheet 2010-3113, 6 p.

Underwood, J.C., Harvey, R.W., Metge, D.W., Repert, D.A., Baumgartner, L.K., Smith, R.L., Roane, T.M., and Barber, L.B., 2011, Effects of the antimicrobial sulfamethoxazole on groundwater bacterial enrichment: Environmental Science and Technology, v. 45, no. 7, p. 3096-3101, doi:10.1021/es103605e.

Work, T.M., Forsman, Z.H., Szabó, Z., Lewis, T.D., Aeby, G.S., and Toonen, R.J., 2011, Inter-specific coral chimerism--Genetically distinct multicellular structures associated with tissue loss in *Montipora capitata*: PLoS ONE, v. 6, no. 7, doi:10.1371/journal.pone.0022869.

Hebert T. Buxton, Managing Editor
David W. Morganwalp, Editor
Barbara T. Martinez, Guest Editor
Heather L. Kimmel, Guest Editor
Carly A. Morganwalp, Layout and Design

For additional information contact:
Herbert T. Buxton or David W. Morganwalp
U.S. Geological Survey
412 National Center
Reston, VA 20192
http://health.usgs.gov/

Each article in the on-line version of the newsletter has links to additional information.

The GeoHealth Newsletter provides information on: New USGS activities related to human health, upcoming meetings related to earth science and public health, and new and upcoming USGS health-related publications. The Newsletter is issued twice a year.

Sign up to receive e-mail notifications of new issues at:

http://health.usgs.gov/geohealth/ghnewsletter

Scan this with your smartphone QR code reader app to get past and future issues of the USGS GeoHealth Newsletter