Welcome to the USGS NAWQA Program Quarterly Highlights, April 2011

Highlights are from the USGS National Water-Quality Assessment Program (NAWQA), which has assessed the physical, chemical and biological characteristics of streams, rivers, and groundwater across the Nation since 1991.

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In this quarter's highlights:

Ecology

- Online guide to diatoms of the United States is available, with readily-accessible web images for identification. For more information on the study, access the technical announcement or contact: Sarah Spaulding, (303) 492-5158.

The online guide was developed with support from the NAWQA Program and the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) and National Aquatic Resource Surveys (NARS). The guide is targeted for use by laboratory analysts, taxonomists, ecologists, students, water resource managers and the public. Diatoms are algae that reflect the biotic condition of streams, lakes and estuaries and are important indicator organisms because they are sensitive to natural and human impacts, and monitoring their condition provides information about ecosystem health. Together with aquatic invertebrates and fish, diatoms are included in Federal and State monitoring and assessment programs as key indicators of biotic condition.

- Effects of nutrients and stream habitat on algal communities in the western U.S. - Access the full study, published in the journal Environmental Monitoring and Assessment (175:397-417). For more information on the study, contact Bob Black, (253) 552-1687. Learn about other NAWQA nutrient enrichment studies.

Although nutrients typically were the most important variables in explaining variation in algal communities, environmental factors operating at multiple scales also were important, including erosion and deposition habitats. Such findings can be of benefit to the development of nutrient thresholds and criteria.

Groundwater

- Nitrogen contamination in surficial aquifers – A Growing Legacy? – Access the full study, published in a featured article of the February 2011 issue of Environmental Science and Technology. For more information on the study, contact Jim Tesoriero, (503) 251-3202. Learn about other NAWQA nutrient studies.

The use of nitrogen fertilizers to support agriculture and growing global populations has increased 20-fold since 1945 and, as a result, concentrations of nitrate have nearly doubled in shallow groundwater measured across the Nation(from 4 to about 7.5 milligrams per liter) since 1983. Groundwater movement is slow and residence times in most shallow aquifers are on the order of several decades. A reservoir of nitrogen has been accumulating in shallow aquifers for at least 60 years. Transformation of nitrate to other forms through denitrification is slow, resulting in relatively stable nitrate concentrations over time; the study reports concentrations that are more than 65 percent of nitrate concentrations in samples that entered the groundwater system prior to 1983. Shallow groundwater continues to move into deeper parts of the aquifers where concentrations are expected to increase accordingly over time and potentially affect drinking-water resources used for public supply for decades to come.

- Septic systems show impacts on shallow groundwater quality – Access the full study, published in the February 2011 issue of Journal of Hydrology (397, 151-166). For more information on the study, contact Brian Katz, (850) 553-3671. Learn about other NAWQA contaminant transport studies.

Findings show that impacts on groundwater quality from septic systems are most evident in shallow monitoring and domestic wells (generally less than 60 feet below land surface) in the Eastern Glacial Deposits aquifer and the Northern High Plains aquifer that are associated with relatively high numbers of housing units using septic systems, high permeability of overlying sediments, mostly oxic conditions, and shallow wells. Overall, little to no influence from septic systems was found for water samples from deeper public-supply wells.

- Human activities can increase concentrations of naturally occurring trace elements in some water-supply wells – Access the full study, published in the journal of Applied Geochemistry. For more information, contact Joe Ayotte, (603) 226-7810. Learn about other NAWQA contaminant transport studies.

The effects of human-induced alteration of groundwater flow patterns on concentrations of naturally occurring trace elements were examined in five hydrologically distinct aquifer systems in the USA, including High Plains aquifer near York, Nebraska; Floridan aquifer system near Tampa, Florida; Paleozoic aquifers in eastern Wisconsin; basin-fill aquifer underlying the California Central Valley near Modesto; and Coastal Plain aquifers of New Jersey. Although naturally occurring, these trace elements can exceed concentrations that are considered harmful to human health. The results show that pumping-induced hydraulic gradient changes and artificial connection of aquifers by well screens can mix groundwater from different depths that are chemically distinct. Chemical reactions between these mixed groundwaters and solid aquifer materials can result in the mobilization of trace elements such as uranium, arsenic, and radon.

- Changing water quality in the Edwards aquifer – Access the full USGS Scientific Investigations Report (2010-5129, 93 p.) online. For more information on the study, contact Mary Lynn Musgrove, (512) 927-3522.

Geochemistry, age-dating and isotopic data from 136 sites help to characterize changes in water quality in the Edwards aquifer, including in (1) wells completed in the shallow, unconfined, and urbanized part of the aquifer in the vicinity of San Antonio (shallow/urban unconfined category), (2) wells completed in the unconfined (outcrop area) part of the regional aquifer (unconfined category), and (3) wells completed in and springs discharging from the confined part of the regional aquifer (confined category). Results indicate that the shallow/urban unconfined part of the aquifer is most affected by anthropogenic contaminants and the unconfined (outcrop) part of the aquifer is the least affected. The high frequency of detection for anthropogenic contaminants aquifer-wide and in samples of deep, confined groundwater indicates that the entire aquifer is susceptible to water-quality changes as a result of anthropogenic activities.

- Age of groundwater is determined using environmental tracers – Access the full USGS Scientific Investigations Report (2010-5229) online. For more information on the study, contact Steve Hinkle, (503) 251-3237.

This USGS report summarizes age data interpreted from measured concentrations of environmental tracers in groundwater from nearly 1,400 groundwater sites across the U.S. The tracers of interest are chlorofluorocarbons (CFCs), sulfur hexafluoride (SF_6), and tritium/helium-3 ($^3H/^3He$).

- Estimates of 2005 domestic water use and population served are now available – Access the full USGS Open-File Report online (2010-1223). For more information on the study, contact Molly Maupin, (208) 387-1307. Learn about other NAWQA studies in the Nation's principal aquifers.

Estimates for self-supplied domestic withdrawals and the population served for 20 aquifers in the United States for calendar year 2005 are provided. These estimates are based on county-level data for self-supplied domestic groundwater withdrawals and the population served by those withdrawals, as compiled by the USGS National Water Use Information Program. In 2005, total groundwater withdrawals for self-supplied domestic use from the 20 aquifers represented about 63 percent of the total self-supplied domestic groundwater withdrawals across the U.S.; the population served by the withdrawals represented about 61 percent of the total self-supplied domestic population in the United States.

Streams

- Groundwater contributes substantial phosphorus to some streams in the Piedmont, Blue Ridge, and Valley and Ridge Physiographic Provinces of the Eastern U.S. - Access the full USGS Scientific Investigations Report (2010-5176, 38 p.) online. For more information on the study, contact Judy Denver, (302) 734-2506, ext. 229.

Groundwater contributions vary among different hydrogeologic and land-use settings of the Piedmont, Blue Ridge, and Valley and Ridge Physiographic Provinces in the eastern U.S. In crystalline and siliciclastic settings, phosphorus from mineral or human sources may be effectively transported by groundwater and contribute a substantial fraction to base-flow stream loads. Phosphorus transport is limited, however, from groundwater to streams in areas underlain by carbonate rocks because of natural geochemical controls. The potential for geologic contributions of phosphorus is an important consideration in watershed management because concentrations of phosphorus in streams at base flow commonly exceed ecological criteria for streams in the study.

- Organic compounds common in White River water used for public supply near Indianapolis - Access the USGS fact sheet (2010-3120, 6 p.) online. For more information on the study, contact Tim Lathrop, (317) 290-3333, ext. 182. The White River study is part of ongoing Source Water-Quality Assessment (SWQA) investigations of community water systems that withdraw from rivers across the United States.

A total of 97 of 277 organic compounds, generally man-made and including, in part, pesticides, solvents, gasoline hydrocarbons, personal-care and domestic-use products, disinfection by-products, and manufacturing additives were detected at the intake of the White River North treatment plant, one of several community water systems on the White River near Indianapolis, Indiana. The diversity of compounds detected indicated a variety of different practices (wastewater discharge, industrial, agricultural, domestic, and others) and pathways (treated-wastewater outfalls, overland runoff, and groundwater discharge) affecting the source-water supply. About two-thirds of the 46 compounds commonly detected in source water also were commonly detected in finished water (after treatment but before distribution), generally at low concentrations (below 0.1 microgram per liter).

- Organophosphate pesticide concentrations decrease in California and Pacific Northwest streams – Access the full study, published online in the Journal of the American Water Resources Association. For more information on the study, contact Hank Johnson, (503) 251-3472.

Trends in pesticide concentrations for 15 streams in California, Oregon, Washington, and Idaho were determined for the organophosphate insecticides chlorpyrifos and diazinon and the herbicides atrazine, s-ethyl diproplythiocarbamate (EPTC), metolachlor, simazine, and trifluralin. Decreasing trends most often were observed for diazinon, and reflect a shift to alternative pesticides by farmers, commercial applicators, and homeowners because of use restrictions and product cancelation. Consistent trends were observed for several herbicides, including upward trends in simazine at urban-influenced sites from 2000 to 2005, and downward trends in atrazine and EPTC at agricultural sites from the mid-1990s to 2005.

- Good news, bad news on decadal trends in nitrogen and phosphorus in major California streams – Access the USGS Scientific Investigations Report (2011-5228), "*Trends in Nutrient concentrations, Loads, and Yields in Streams in the Sacramento, San Joaquin, and Santa Ana River Basins, California, 1975-2004*" online. For more information on the study, access the technical announcement or contact Robert Kent, (619) 225-6151.

Nitrogen and phosphorus concentrations decreased in streams of the Santa Ana Basin during 1975–2004, as improved wastewater treatment was implemented basinwide. Nutrient concentrations in the San Joaquin Basin during the same period increased in association with increased land application of nutrients. In the Sacramento Basin nutrient trends were mostly downward.

- Sink or Source? A new model measures organic carbon in U.S. surface waters – Access the USGS Open-File Report (2010-1276) online. For more information on the study, access the technical announcement or contact Dick Smith, (703) 648-6870. Learn about other NAWQA hydrologic modeling and analysis tools.

A new carbon model, developed by USGS in collaboration with researchers from Resources for the Future and Pennsylvania State University, contributes information on the role of rivers as sources and sinks for organic carbon at regional and continental scales. Findings show that in-stream photosynthesis by algae is a major contributor of organic carbon in large rivers of the U.S. It is the largest source of organic carbon delivered to coastal waters from the Mississippi-Atchafalaya River Basin and the Pacific Northwest. Terrestrial sources of carbon, such as from forests and wetlands, are dominant in other coastal waters, including waters of the North Atlantic, the South Atlantic Gulf, California, the Texas Gulf, and the Great Lakes.

- Controls on methylmercury in stream water in two small basins in the eastern U.S. –The full study, published in the journal ES&T (March 15, 2011 issue, v. 46, p. 2048-2055), is available online. For more information on the study, contact Paul Bradley, (803) 750-6125. Learn about other NAWQA mercury studies.

Methylmercury (MeHg) concentrations were assessed across multiple ecological scales in the Edisto (South Carolina) and Upper Hudson (New York) River basins. The results indicated that, even in geographically, climatically, and ecologically diverse streams, production in wetland/floodplain areas, hydrologic transport to the stream aquatic environment, and conservative/non-conservative attenuation processes in open water areas are fundamental controls on dissolved MeHg concentrations and, by extension, MeHg availability for potential biotic uptake.

- Transport of agricultural herbicides varies by watershed, chemical and soil properties, rainfall intensity, and time of year in an intermittent stream in Nebraska –The full study, published in the journal Applied Engineering in Agriculture (v. 27, no. 1, p. 63-74), is available upon request from Paul Capel, (612) 625-3082. Learn about other NAWQA agricultural transport studies.

In this study, properties that control the transport of 6 herbicides and 12 herbicide-degradates were examined during the 2004 growing season in an intermediate-scale agricultural watershed (146 hectare) that is drained by a first-order intermittent stream.

- Tillage practices, by watershed, aggregated across the Nation – Access this USGS data-series report and maps that document county-level tillage practices by 8-digit hydrologic unit watersheds. For more information, contact Nancy Baker, (317) 290-3333, ext 185.

County-level data were prepared in cooperation with the Conservation Technology Information Center, including three types of conservation tillage (no-till, ridge-till, and mulch-till), reduced tillage, and intensive tillage. The dataset includes total planted acreage by tillage type for selected crops (corn, cotton, grain sorghum, soybeans, fallow, forage, newly established permanent pasture, spring and fall seeded small grains, and "other" crops) for 1989-2004. This national dataset can be useful in spatial and statistical analyses of land-management practices and their possible effects on the quality of water in nearby surface-water bodies and groundwater.

Atmosphere

- Glyphosate in air and rain – Access the full study, published online in the journal of Environmental Toxicology and Chemistry. For more information on the study, contact Paul Capel, (612) 625-3082.

Ambient levels of glyphosate, the most widely used herbicide in the U.S., and its major degradation product, aminomethylphosphonic acid (AMPA), are assessed in air and rain. The frequency of glyphosate detection ranged from 60 to 100 percent in both media. It is not known what percentage of the applied glyphosate is introduced into the air. It is estimated that an average of 97 percent of the glyphosate in the air is removed by a weekly rainfall greater than 30 millimeters.

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