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A Collaboration Between the U.S. Geological Survey and the U.S. Environmental Protection Agency

The Midwest Stream Quality Assessment

In 2013, the U.S. Geological Survey (USGS) National Water-Quality Assessment Program (NAWQA) and USGS Columbia Environmental Research Center (CERC) will be collaborating with the U.S. Environmental Protection Agency (EPA) National Rivers and Streams Assessment (NRSA) to assess stream quality across the Midwestern United States. The sites selected for this study are a subset of the larger NRSA, implemented by the EPA, States and Tribes to sample flowing waters across the United States (*http://water.epa.gov/type/rsl/monitoring /riverssurvey/index.cfm*). The goals are to characterize water-quality stressors—contaminants, nutrients, and sediment—and ecological conditions in streams throughout the Midwest (fig. 1) and to determine the relative effects of these stressors on aquatic organisms in the streams. Findings will contribute useful information for communities and policymakers by identifying which human and environmental factors are the most critical in controlling stream quality. This collaborative study enhances information provided to the public and policymakers and minimizes costs by leveraging and sharing data gathered under existing programs.

In the spring and early summer, NAWQA will sample streams weekly for contaminants, nutrients, and sediment. During the same time period, CERC will test sediment and water samples for toxicity, deploy time-integrating samplers, and measure reproductive effects and biomarkers of contaminant exposure in fish or amphibians. NRSA will sample sites once during the summer to assess ecological and habitat conditions in the streams by collecting data on algal, macroinvertebrate, and fish communities and collecting detailed physical-habitat measurements. Study-team members from all three programs will work in collaboration with USGS Water Science Centers and State agencies on study design, execution of sampling and analysis, and reporting.

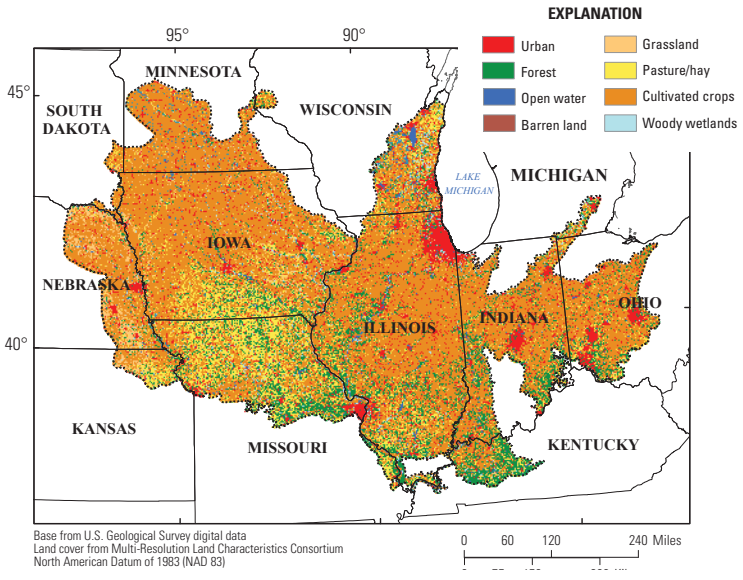


Figure 1. Midwest Stream Quality Assessment study area. Study-area boundary is based on aggregated Level 3 Ecoregions (ecological regions) of the United States (*http:/www.epa.gov/wed/pages/ecoregions.htm* accessed on October 19, 2012).

Objectives

In perennial (year-round) streams in the Midwest,

1. Assess the status of ecological conditions; the geographic distribution of spring-summer seasonal concentrations of contaminants, nutrients, and sediment; and the toxicity of water and sediment.
2. Assess relations among concentrations of contaminants, nutrients, and sediment; toxicity of water and sediment; and ecological conditions in the sampled streams.
3. Identify and evaluate statistically the natural and anthropogenic factors in the watersheds affecting concentrations of contaminants, nutrients, and sediment, and ecological conditions in sampled streams.
4. Develop models to predict concentrations of contaminants, nutrients, and sediment, and, if possible, ecological conditions in the region on the basis of findings from objectives 2 and 3.

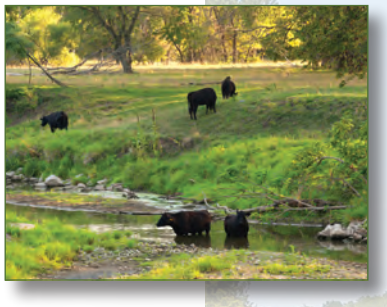
Approach

As many as 100 sites will be sampled jointly by study partners across the region (fig. 1). The jointly sampled sites in the Midwest Stream Quality Assessment are expected to include about 50 sites selected by the EPA using a probabilistic design, which are a subset of the approximately 150 NRSA sites in the midwestern study area, and about 50 sites selected by the USGS using a targeted design to ensure coverage of a wide range of land-use conditions. In combination, the sites sampled will provide the data necessary to assess the water quality and ecological condition of streams and to support empirical modeling of factors affecting those conditions for extrapolation to unsampled streams in the region.

The 50 USGS targeted sites will be added primarily to achieve full coverage of stressor levels found in the region, mainly by adding reference sites, low-intensity agricultural sites, and urban sites. The targeted sites also will include a few sites with long-term data or those identified as high priority by the States or USGS Water Science Centers in the region, to put study findings in a temporal context and to augment local studies.

Study Components

Ecological Condition—Algae, benthic macroinvertebrates, and fish communities will be sampled and physical habitat assessed once during summer 2013. Samples will be collected along multiple transects within the stream reach in accordance with USEPA protocols (U.S. Environmental Protection Agency, 2009). Additionally, basic water chemistry, including nutrient data, will be collected at the same time as the biological data.



Water Sampling—By use of depth- and width-integrating methods, water samples will be collected weekly at each site for about 3 months preceding the ecological sampling, to capture the heavy agrochemical use and runoff season. Water samples will be analyzed for nutrients, suspended sediment, sulfate, chloride, and about 250 dissolved pesticides and pesticide degradates.

Integrated Samplers—Passive samplers deployed in streams for extended periods will be used to collect dissolved chemicals from stream water and mimic the respiratory exposure of aquatic organisms. Two types of samplers will be deployed, one type to concentrate hydrophobic contaminants such as polycyclic aromatic hydrocarbons (PAH) and the other to concentrate polar chemicals such as water-soluble pesticides and degradates. The concurrent deployment of the passive samplers with weekly water sampling will also allow comparison of contaminant exposure measured by the two approaches.

Shi-Kwun Wang

Sediment Sampling—Streambed sediment will be sampled coincident with the ecological sampling. Surficial bed sediment will be collected from depositional areas, composited, and sieved. Sediment samples will be analyzed for about 25 trace elements and 120 currently used pesticides at all sites. At sites with urban land use in the basin, analyses also will include about 40 PAHs and about 60 halogenated organic compounds.

Toxicity Testing—Ambient water samples will be used to conduct 7-day toxicity tests to measure survival and reproduction of cladocerans (*Ceriodaphnia*) and survival and growth of fish (fathead minnow, *Pimephales promelas*). Bed-sediment samples will be tested by means of a 28-day whole-sediment toxicity test with amphipods (*Hyalella azteca*) or freshwater mussels to measure effects on survival and growth. Amphipods and mussels are sensitive to many contaminants, notably some current-use insecticides, and a number of species of freshwater mussels and fish, such as the Topeka shiner (*Notropis topeka*; see photo) are endangered in Midwestern streams.

Konrad Schmidt, MN DNR

Fish and Amphibian Field Studies—Caged organisms (fathead minnows or leopard frogs, *Lithobates* species) will be deployed at a small subset of sites to test whether exposure to atrazine and other stressors in the field might cause effects on reproduction and organism health, similar to effects observed previously in laboratory exposures (Tillitt and others, 2010). Measured endpoints will likely include egg production, growth metrics, histopathology, levels of steroid hormones and vitellogenin (an egg-related protein), and other biomarkers.

Additional Opportunities

Opportunities are available to gain additional valuable information in the region and to optimize resources through partnerships with other monitoring or research studies. Possible examples include additional monitoring at some or all sites to evaluate mercury fate and fish contamination; analysis for endocrine-disrupting compounds in stream water; and analysis for the herbicide glyphosate, the most widely used pesticide in the region (but one that requires specialized analysis and is typically not included in assessments of pesticides in streams). To facilitate these and additional collaborative studies, the USGS and EPA are seeking input from States and other interested parties on site selection, local issues and priorities, and complementary research topics.

References

Tillitt, D.E., Papoulias, D.M., Whyte, J.J., and Richter, C.A., 2010, Atrazine reduces reproduction in fathead minnow (*Pimephales promelas*): Aquatic Toxicology, v. 99, no. 2, p. 149–159.

U.S. Environmental Protection Agency, 2009, National Rivers and Streams Assessment Field Operations Manual: Washington, D.C., EPA–841–B–07–009 [variously paged].

For Additional Information

Visit the NAWQA Web site to access reports, water-quality data, and maps: *http://water.usgs.gov/nawqa*.

Visit the EPA Web site to access information on the National Rivers and Streams Assessment: *http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm*.

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