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National Water-Quality Assessment Program

The Pacific Northwest Stream Quality Assessment

In 2015, the U.S. Geological Survey (USGS) National Water-Quality Assessment (NAWQA) program is assessing stream quality in the Pacific Northwest. The goals of the Pacific Northwest Stream Quality Assessment (Pacific Northwest study) are to assess the quality of streams in the region by characterizing multiple water-quality factors that are stressors to aquatic life and to evaluate the relation between these stressors and biological communities. The effects of urbanization and agriculture on stream quality for the Puget Lowlands and Willamette Valley are the focus of this regional study (fig. 1). Findings will provide the public and policymakers with information regarding which human and environmental factors are the most critical in affecting stream quality and, thus, provide insights about possible approaches to protect or improve the health of streams in the region.

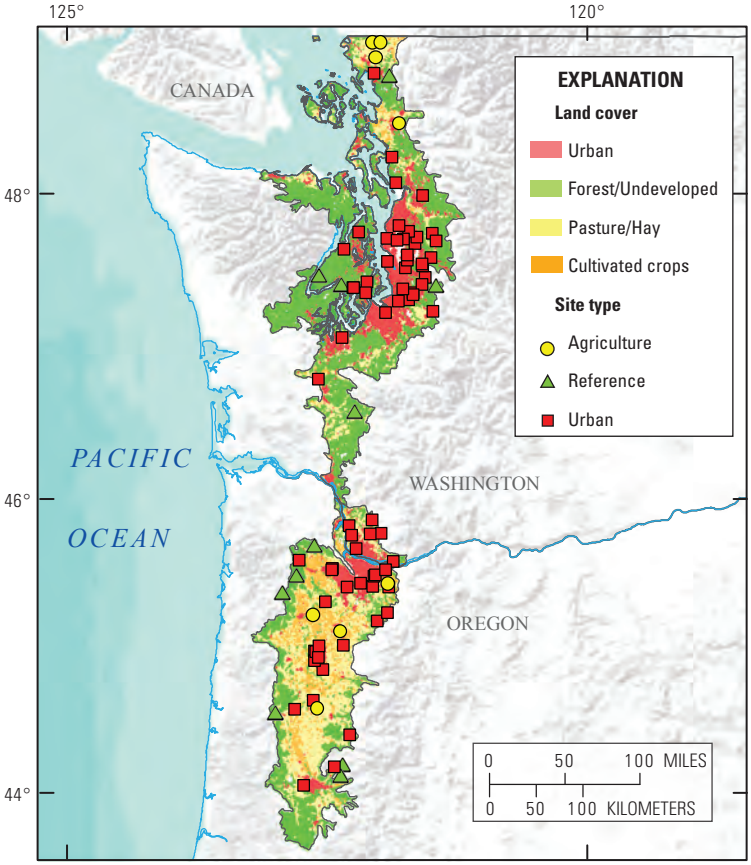

Figure 1. The Pacific Northwest Stream Quality Assessment study area. Study area boundary is based on the Willamette Valley and Puget Lowlands level 3 ecological regions (ecoregions) of the United States.

The Pacific Northwest study will be the third regional study by the NAWQA program, and it will be of similar design and scope as the first two—the Midwest in 2013 and the Southeast in 2014 (Van Metre and others, 2012, 2014).

Objectives

1. Determine the status of stream quality—contaminants, nutrients, sediments, toxicity of the bed sediments, streamflow, habitat, and biological communities—across the region.
2. Evaluate the relative influence of contaminants, nutrients, sediment, toxicity, streamflow, and habitat on biological communities in the streams sampled.
3. Evaluate relations between measured stressors and biological communities and the natural and anthropogenic characteristics of the watersheds.
4. Develop statistical models and management tools to predict concentrations of stressors, and, if possible, ecological conditions in wadeable streams across the region.

Approach

Eighty-eight sites are scheduled for sampling during April, May, and June 2015 in the region, with weekly sampling for 4 or 10 weeks at each site, depending on the land use in the watershed. Samples will be analyzed for contaminants, nutrients, and sediment (fig. 1). This water-quality "index" period will culminate with an ecological survey of habitat, algae, benthic invertebrates, and fish at all sites. Sediment will be collected during the ecological survey for analysis of sediment chemistry and toxicity. Rapid urban growth, particularly in the greater Seattle and Portland metropolitan areas, is causing water-quality concerns in the region. The study design therefore includes sampling 80 sites that reflect a wide range of urbanization, from dense urban watersheds to undeveloped reference watersheds. Eight sites representing the major types of agriculture in the region also will be sampled. The resulting data should span ranges of many specific stressors (for example, contaminants), allowing us to better understand the effects of those stressors on stream ecology.

Study Components

Assessing Ecological Condition—Algae, benthic macroinvertebrate, and fish communities will be sampled and physical habitat assessed once at all 88 sites in late June 2015. Samples will be collected along multiple transects within the stream reach following USGS NAWQA protocols (Moulton and others, 2002).

Water Sampling—By using depth- and width-integrating methods, water samples will be collected weekly at 70 urban and agricultural sites for 10 weeks and at reference and rural sites for 4 weeks preceding the ecological sampling to characterize the water chemistry during spring runoff, a period of potential concern for chemical runoff. Water samples will be analyzed for nutrients, suspended sediment, major ions, and about 230 dissolved pesticides and pesticide degradates. Some samples also will be analyzed for mercury, pharmaceuticals, and wastewater-indicator compounds.

Integrated Sampling—Passive polar organic chemical integrative (POCIS) samplers will be deployed in streams at about 75 sites for about 7 weeks to collect dissolved chemicals from stream water. These time-integrating samplers will be used to characterize longer-term chronic contaminant exposure to organisms. The POCIS samples will be analyzed for water-soluble pesticides and degradates, pharmaceuticals, and wastewater-indicator compounds.

Sediment Sampling—Streambed sediment will be sampled coincident with the ecological sampling at all 88 sites. Surficial bed sediment (about 1 inch of sediment on the stream bottom) will be collected from depositional areas and analyzed for trace elements, polycyclic aromatic hydrocarbons (PAHs), halogenated organic compounds (compounds containing chlorine or bromine atoms, such as DDT), pharmaceuticals, wastewater-indicator compounds, and hormones. Sediments tend to accumulate different contaminants than those found in the water and can be an important contaminant source to organisms.

Time-integrating suspended-sediment samplers will be deployed at about 13 sites to characterize sources of sediments entering the streams. These sediment samples will be analyzed for radionuclides and trace elements.

Toxicity Testing—Surficial bed-sediment samples from a subset of urban sites will be tested using standard whole-sediment toxicity tests conducted with amphipod crustaceans (*Hyalella azteca* 28-day exposures), midge larvae (*Chironomus dilutus* 10-day exposures), and freshwater mussels (*Lampsilis siliquoidea* 28-day exposures) to measure potential effects of contaminants on survival and growth. Amphipods, mussels, and fish are sensitive to many contaminants, notably some current-use insecticides and PAHs. This is of particular interest because a number of species of salmonids are threatened or endangered in Pacific Coast streams.

Continuous Monitoring—Stream-water level and temperature are being monitored continuously at all 88 sites across the region, and continuous water-quality monitors will be deployed at 6 sites. Continuous monitoring for parameters such as dissolved oxygen and nitrate concentration, in conjunction with periodic sampling of nutrients and periphyton biomass, can provide useful information on the effects of nutrients in streams.

Daily Pesticide Sampling—Small-volume automated pesticide samplers will be deployed at 7 streams to assess temporal variations in concentrations of about 230 pesticides and pesticide degradates. The samplers will collect daily and weekly composite samples that will be analyzed by the U.S. Environmental Protection Agency (EPA), Office of Pesticide Programs. Results will provide valuable information for determining short-term acute exposure of aquatic organisms to pesticides and for optimizing temporal sampling strategies.

Assessing Fish Health—A fish-health assessment approach, or "Juvenile Salmonid Scorecard," is being developed and tested at about 15 of the Pacific Northwest study sites in collaboration with researchers at the University of Washington. Key metrics include average growth rate, lipid content, and total calories, as well as the activity of 2 dozen gene transcripts from quantitative polymerase chain reaction (qPCR) measurements, which can indicate genetic responses in the fish to specific stressors (Moran and others, 2007). The Scorecard is designed to allow a tiered approach (a range of cost and complexity) and to be used by State and local agencies as a standard tool for evaluating salmonid health.

Oregon Department of Fish and Wildlife salmon spawning sign at Tickle Creek near Boring, Oregon, 2004. Photograph by Andy Arnsberg, Portland Bureau of Environmental Services.

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For Additional Information

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

For information on the NAWQA Regional Stream Quality Assessments, visit: http://water.usgs.gov/nawqa/studies/msqa/

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