National Water-Quality Assessment Program--Ozark Plateaus Biological Study

Background

The U.S. Geological Survey (USGS) began implementation of the National Water-Quality Assessment (NAWQA) Program in 1991 to provide a nationally consistent description of current water-quality conditions, define long-term trends, and to identify, describe, and explain the major factors that affect water quality for a large part of the Nation's surface- and ground-water resources. The NAWQA program will produce water-quality information that will be useful to policy makers and managers at the Federal, State, and local levels.

When fully implemented, the NAWQA Program will include 60 study units, which incorporate parts of most major river basins and aquifer systems in the United States. These study units range in size from less than 1,000 mi^2 (square miles) to more that 60,000 mi^2 and include about 60 to 70 percent of the Nation's water use and population served by public water-supply systems. The Ozark Plateaus region was among the first 20 NAWQA study units selected for investigation. The initial phase of the Ozark Plateaus study began in 1991 and is expected to continue through 1996. Intensive water-quality and biological investigations will be conducted for 3 years, followed by 5 to 6 years of low-level monitoring, with the cycle perpetually repeated. This fact sheet focuses on the biological component of the NAWQA Program in the Ozark Plateaus study unit.

Description of the Ozark Plateaus Study Unit

The Ozark Plateaus study unit is approximately 48,000 mi^2 in size and includes parts of northern Arkansas, southeastern Kansas, southern Missouri, and northeastern Oklahoma. The study unit is drained by seven major river systems -- the White, Neosho-Illinois, Osage, Gasconade, Meramec, Black, and the St. Francis Rivers. Land use in the study unit is primarily forest and agriculture (includes pasture and cropland). The 1990 population within the study unit was approximately 2.3 million people.

Five ecoregions (regions of greatest homogeneity of geology, natural vegetation, soil type, and land use) are present in the study unit. These ecoregions correspond closely with the physiographic sections. The Ozark Highlands, the largest ecoregion, is analogous with the Salem and Springfield Plateau physiographic sections. The Boston Mountains ecoregion corresponds with the Boston Mountains section, the Central Irregular Plains ecoregion with the Osage Plains section, and the Mississippi Alluvial Plain ecoregion with the Mississippi Alluvial Plain section. The fifth ecoregion, the Interior River Lowland, is present only in the extreme northeastern corner of the study unit. Surface geology and stream gradient are major factors in distinguishing these ecoregions.

The streams of the Ozark Highlands are typically clear, high gradient, riffle and pool type with coarse gravel, cobble, boulder, and bedrock substrates of limestone, dolomite, and chert. Base flows usually are maintained during the dry season by springs and seeps. The Ozark Highlands is the most species rich and diverse fish faunal region of the Ozark Plateaus study unit.

The Boston Mountain ecoregion streams are clear, extremely high gradient, riffle and pool type with gravel, cobble, boulder, and bedrock substrates of sandstone, shales, and limestone. There is little streamflow in the dry season because there are few springs and seeps in the Boston Mountains. The fish fauna of the Boston Mountains are nearly as species rich and diverse as the fauna in the Ozark Highlands ecoregion.

The Central Irregular Plains ecoregion streams have high alluvial banks, turbid water, long pools lacking defined riffles with silt, sand, and bedrock substrates of shale, limestone, and sandstone. The streams have intermittent or low base flows because of the lack of large spring flows. This ecoregion is the least diverse fish faunal region of the study unit.

The Mississippi Alluvial Plain ecoregion streams are straight with long

pools, poorly defined riffles, and high alluvial banks. The streambed substrate is clay, sand, small gravel, and organic material. The streams have consistent flow because of the holding capacity of the alluvial material of the lowlands, which slowly releases water into the streams and ditches during the dry season. The fish fauna of the Mississippi Alluvial Plain are not as diverse as the Ozark Highlands or Boston Mountains ecoregions.

Biological Study Objective and Approach

The objective of the biological component of the NAWQA Program is to improve understanding of relations among physical, chemical, and biological characteristics of streams as an integral part of interpreting water-quality status and trends. The biological component of the Ozark Plateaus study is designed to implement a sampling network to describe the occurrence, temporal and spatial characteristics of aquatic communities and contaminants, and to develop hypotheses about the possible causes of observed characteristics. The biological sampling activities include reconnaissance of potential sampling sites, a bed-sediment and tissue-contaminant survey, ecological surveys, and synoptic studies.

Reconnaissance of sampling sites of the Ozark Plateaus study unit occurred in 1992. Observations of general riparian habitat, land use, channel substrate, accessibility and suitability were made at about 60 potential surface-water sites. Twelve sites were selected in small (34 to 54 mi^2) and medium (323 to 943 mi^2) size basins with relatively homogenous land uses (indicator sites) and one site was selected in a basin (527 mi^2) that integrates several major land uses and physiographic sections. These 13 sites (fixed sites) are monitored continuously for stream discharge. Monthly and high-flow water column samples are collected and analyzed for major ions, trace elements, nutrients, organic carbon, and physical properties such as dissolved-oxygen and suspended-sediment concentrations.

The bed-sediment and tissue-contaminant survey involved the sampling of 26 sites for trace elements and hydrophobic organic contaminants during low flow conditions. Because the analytes of concern tend to associate with particulate matter in most natural surface-water regimes, fine bed sediments were sampled from stream depositional zones such as pools and backwaters. Tissue was collected from the Asiatic clam (*Corbicula fluminea)* at all sites where sufficient numbers were available. This clam is very widespread in the study unit and much of the United States. Tissue-contaminant concentrations at sites within the Ozark Plateaus study unit and between other NAWQA study units can be more easily compared when a single species is used. Various fish species were used when Asiatic clams were not present. At some sites both *Corbicula* and a fish tissue were collected. The longear sunfish (*Lepomis megalotis*) was used most often because of its widespread distribution and abundance throughout the study unit. Soft tissues of clams or whole fish are used for hydrophobic organic compound analysis; soft tissues of clams or fish livers are used for trace element analysis. A minimum of five organisms are collected and composited for each analysis.

The ecological surveys are designed to characterize the fish, invertebrate, and algal communities and their associated habitat at each of the 13 fixed sites. These surveys directly assess the biological integrity of the streams and are sensitive to land use changes, contaminant influences, habitat degradation, and instream events such as flooding. These surveys are conducted at sampling sites representing selected environmental settings within a defined stream length called the “sampling reach.”

The fish ecological survey is designed to characterize community structure of fishes at selected sites. The structure of a fish community is defined by the species present, their relative abundances, and size distributions. Electrofishing and seining the sampling reach are the primary sampling techniques used to conduct the fish survey. The fish collected are identified, weighed, measured, and checked for external anomalies.

The invertebrate community survey was designed congruently and performed concurrently with the algal community survey. Species distribution and community-structure characterization are the primary goals of these surveys. The invertebrate and algal sample-collection methods focus on qualitative and semi-quantitative surveys. The qualitative survey targets each microhabitat within the sampling reach. The semi-quantitative survey targets the richest and the depositional habitats within the sampling reach, which are mainly the riffle and pool geomorphic units, respectively.

Stream-habitat assessments provide baseline information on environmental settings so that changes of natural or anthropogenic nature can be identified, estimated, or predicted. Habitat assessments also can assist in identification of limiting physical factors critical to biological communities. Habitat information includes gradient, sinuosity, stream order, altitude, channel width, bank stability, bed substrate, canopy angle, aspect, and riparian and aquatic vegetation identification.

Biological synoptic studies consist of modified ecological surveys made at about 30 to 50 sites in the study unit. The synoptic studies are generally at nongaged sites where a single survey is made to assess the comparability of the fixed sites with other sites representing the same land use and physiographic type. The synoptic studies will also contribute to our understanding of contaminant source, species occurrence, and spatial distribution.

The biological data for the Ozark Plateaus NAWQA study will be reviewed and stored in a computerized data base. These data will be used for the determination of biological indices, taxa richness, and community structure. Multivariate analysis will be used for site and reach comparison.

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Further Information

The Ozark Plateaus NAWQA study is headquartered in the USGS office in Little Rock, Arkansas, with a project office located in Rolla, Missouri. Further information on the Ozark Plateaus NAWQA study can be obtained from:

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