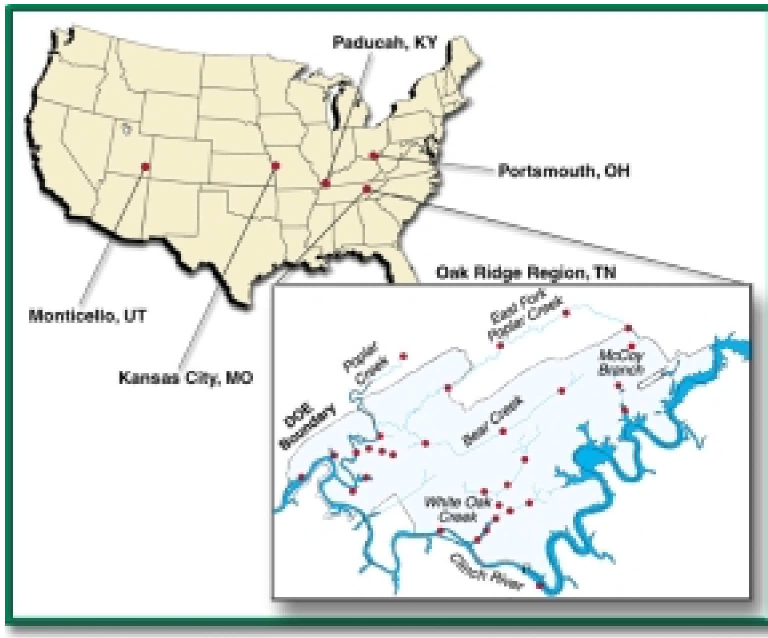
Biological Monitoring and Abatement Program

at the Oak Ridge National Environmental Research Park



The Biological Monitoring and Abatement Program (BMAP) at the Oak Ridge National Environmental Research Park was established in 1985 to assess compliance with environmental regulations and to help identify causes of adverse ecological impacts. The program uses multiple lines of evidence and an integrated approach to determine the ecological health of streams near U.S. Department of Energy (DOE) facilities in Oak Ridge, Tennessee (see inset). Since 1985, BMAP has established similar monitoring programs at several other DOE sites (see map).

Toxicity testing

BMAP data are vital for characterizing site conditions, documenting changes in the biological quality of water as a result of pollution abatement actions, and conducting ecological risk assessments. BMAP offers an integrative approach to assessment: periphyton, invertebrates, and fish are continuously exposed to varying levels of contaminants or stress, allowing time-averaged measurements of exposure. This approach is especially useful in studying contaminants that are discharged in pulses, because regularly scheduled analyses of water chemistry can miss a discharge event and thus underestimate maximum concentrations. Although tasks in specific BMAP projects can vary, the program offers a range of services: toxicity testing of aquatic environments and sediments, assessment of biological indicators (“bioindicators”), monitoring of the biological accumulation (“bioaccumulation”) of contaminants in aquatic and terrestrial species, surveys of aquatic communities, and special studies as needed.

Toxicity testing is conducted in the laboratory, using established protocols and standard test organisms as well as experimental, nonstandard procedures, if needed. Toxicity tests can provide additional data on long-term changes in pollutant loading to receiving streams and water quality in areas where community sampling is not performed. They can also provide an early warning of change.

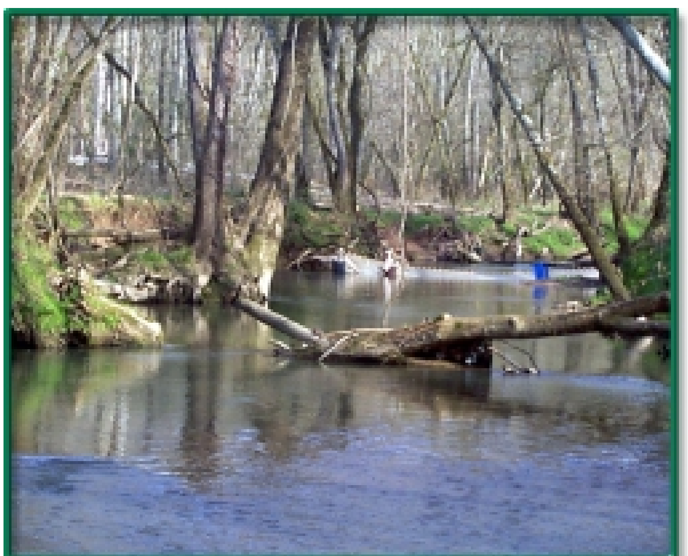
Bioindicators—such as blood enzymes, growth rate, organ weight, and reproduction rate—are analyzed to provide multiple measures of organism response to environmental stressors. Researchers analyze bioindicators that have different response times and that manifest at different biological levels—within the individual, the community, and the whole population. From the results, they establish causal relationships between stressors and biological effects. Bioindicators are useful in assessing the health of individual organisms or a species, such as redbreast sunfish (*Lepomis auritus*). They can also help distinguish the effects of anthropogenic stressors (e.g., contaminants) from the effects of natural stressors (e.g., scarcity of food or reductions in habitat).

Sample collecting

Bioaccumulation in individual organisms and whole populations is monitored to provide a direct measure of the potential human and ecological health concerns associated with contaminants. Bioaccumulation monitoring can be used to identify the sources of contamination, determine pathways and processes by which contaminants are transported to the organisms, and assess the effectiveness of source-reduction strategies.

Community surveys provide a direct assessment of the ecological health of streams and are the foundation of most monitoring programs. The surveys include periphyton—the complex community of algae and heterotrophic microbes on underwater surfaces—benthic macro-invertebrates—bottom-dwelling organisms that are visible without magnification—and fish and waterfowl, whose diversity in streams is often underestimated. Because these communities range in mobility, life span, sensitivity to stress, and position in the food chain, the surveys of the various communities offer a comprehensive assessment of ecological health.

Special studies are often conducted to identify contaminant sources, clarify causes of environmental effects, or elucidate the biological mechanisms involved. These special studies may include in situ bioassays, investigations of fish kills, pathological examinations, and measures of unique chemical–biological interactions (e.g., periphyton influences on stream pH). The flexibility of BMAP allows the use of such special studies as needs warrant.



Stream in monitoring program

The BMAP program has enabled researchers to document positive responses to remedial actions at DOE sites in Oak Ridge. For example, in East Fork Poplar Creek downstream of the Y-12 National Security Complex, bioindicators and community-level responses indicate an improvement in stream health, while toxicity tests and bioaccumulation studies show reductions in contaminant concentrations. Not all streams have shown such dramatic responses, however, partly because of the types of pollutants, the severity of initial impacts, the degree of remediation, and the long-term nature of recovery. BMAP results are delivered to the sponsor in the form of published documents and databases, and they are used in decision-making processes. The value of BMAP's integrated analyses is that they can unambiguously document ecological recovery and identify contaminant sources and facility operations that require additional review.

For more information: http://www.esd.ornl.gov/BMAP
Contact: Jim Loar, 865-574-7323, loarjm@ornl.gov