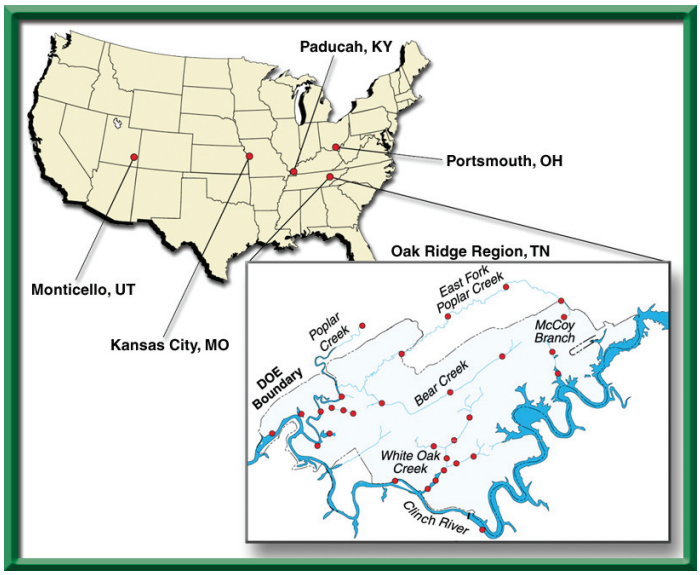
Biological Monitoring and Abatement Program
on the Oak Ridge Reservation



BMAP activities have occurred at DOE facilities located across the United States.

The Biological Monitoring and Abatement Program (BMAP) at the Oak Ridge National Environmental Research Park was established in 1985 to document compliance with environmental regulations and help identify causes of adverse ecological impacts to aquatic environments. The program uses an integrated approach with multiple lines of evidence to determine and monitor the ecological health of streams near U.S. Department of Energy (DOE) facilities in Oak Ridge, Tennessee (see map inset), and other locations across the United States (see map).

BMAP data are vital for characterizing site conditions, documenting changes in biota (e.g., periphyton, invertebrates, fish) resulting from pollution abatement and remedial actions, and conducting ecological risk assessments. Unlike water quality assessments that provide only a snapshot of physical and chemical characteristics at the time of sampling, BMAP assessments focus on biota that are continuously exposed to varying levels of contaminants or other stresses. Thus, the condition and responses of the biota reflect an integration of changes and prevailing conditions in their physical and chemical environment. This approach is especially useful in studying contaminants that are released in pulses because routine analyses of water quality can fail to detect random and infrequent discharges, thereby underestimating or even missing toxicologically important events. Although tasks in specific BMAP projects vary, the program offers a range of services: toxicity testing of aquatic environments and sediments, assessment of biological indicators (bioindicators), monitoring of biological accumulation (bioaccumulation) of contaminants, surveys of aquatic biota, and special studies designed to address specific problems or questions.

EPA-recommended methods are used for most toxicity tests.

Toxicity testing is conducted in the laboratory using established protocols and standard test organisms as well as more experimental, nonstandard tests, if needed. Toxicity tests can provide additional data on long-term changes in water quality and pollutant loading in streams where community sampling may not be 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 these 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 those of natural stressors (e.g., scarcity of food, reduction in habitat).

Bioaccumulation in individual organisms 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 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 may include periphyton (the complex community of algae and microbes on underwater surfaces), benthic macroinvertebrates (bottom-dwelling organisms that are visible without magnification), fish, and waterfowl. Because these communities range in mobility, life span, sensitivity to stress, and position in the food chain, surveys often include more than one of these groups to offer a more comprehensive assessment of ecological health.

Community surveys require the collection of aquatic organisms, such as mayfly nymphs.

Special studies are conducted to identify contaminant sources, clarify the magnitude or 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) that can help distinguish between natural and manmade disturbances. The flexibility of BMAP allows the use of such special studies when needed.

BMAP has enabled researchers to document positive responses to remedial actions at DOE sites. For example, in East Fork Poplar Creek downstream of the Y-12 National Security Complex in Oak Ridge, bioindicators and community-level responses indicate an improvement in stream health, while toxicity tests and bioaccumulation studies show reductions in contaminant concentrations. However, not all streams have shown such dramatic responses, possibly due to factors such as the types of pollutants, the severity of initial impacts, and the type and success of remediation.

Electrofishing equipment is used to collect fish for community assessments, bioindicator studies, and contaminant analyses.

BMAP results, delivered to the sponsor in the form of published documents and databases, are used in decision making and environmental management. The value of BMAP's integrated analyses is that they can unambiguously document ecological recovery, identify contaminant sources and facility operations requiring additional review, and provide a unique long-term data set showing ecological recovery.

For more information about BMAP, contact Mark J. Peterson at 865-576-3461, petersonmj@ornl.gov, or visit the BMAP website at http://www.esd.ornl.gov/BMAP.

For more detailed information on the National Environmental Research Park, contact Pat Parr, the Oak Ridge National Laboratory natural resources manager, at 865-576-8123, parrpd@ornl.gov, or check the park's website at http://www.esd.ornl.gov/facilities/nerp.

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