Capabilities and Tools

IBA relies on advanced molecular approaches, and new and unique approaches to data analysis and visualization. A few of these capabilities are highlighted:

Advanced Molecular Approaches

» **Proteomics** – state-of-the-art capabilities for measuring intact proteins and peptides at sensitivities ranging from femtomole to zetomole

» **The Tree-of-Life (ToL)** – DNA array that assesses community structure and diversity by specific eukaryotic microorganism identification within a complex system

» **Metabonomics** – NMR and mass spectroscopy methods to identify metabolome components and mass and time tags for highly sensitive, rapid metabolite detection and profiling

Data Analysis and Visualization

» **Bayesian Statistical Framework** – a framework that integrates multiple data sets from proteomics, genomics, metabonomics, and lipid data, increasing the discovery of new relationships in exposure-response pathways

» **Visual Integration for Bayesian Evaluations (VIBE)** – a more intuitive, interactive approach to evaluating the integration of any combination of available data sources

» **BellaVista** – a tool for exploring biological relationship networks and visualizing protein-protein interactions, functional relationships and phylogenetic trees

Integrated Experimental Capabilities

» **Chemistry and chemical properties** – full range of instrumentation for measuring trace amounts of environmental pollutants ranging from metals to radionuclides to nanomaterials

» **Custom mesocosms** – systems designed to use native waters such as surface waters, ground water, and hyporheic zones with a variety of sediments

For more information, contact:

Ann Miracle
Environmental Characterization
and Risk Assessment
Pacific Northwest National Laboratory
ann.miracle@pnl.gov
509.372.4327 • 509.375.6936 (fax)

Web site: http://biomarkers.pnl.gov/

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

U.S. DEPARTMENT OF ENERGY

Printed on 100% post-consumer fiber paper, using soy-based ink.

PNNL-SA-68337

Pacific Northwest NATIONAL LABORATORY

Proudly Operated by Battelle Since 1965

Predictive Biomarkers for Sustainable Environments

Detecting environmental damage before it's too late

The world is facing a critical tipping point. Pollution and climate change threaten to significantly alter our environment, and environmental damage will ultimately disrupt our economy. Our efforts to monitor environmental health traditionally have focused on lagging indicators, such as the disappearance of higher life forms, like plants and animals. But success in preserving environmental health requires the early identification of environmental risks.

The Pacific Northwest National Laboratory has developed an environmental monitoring strategy based on predictive indicators that detect environmental risks before damage is seen in higher life forms.

Risk-based monitoring

The Integrated Biomarker Approach (IBA) identifies predictive indicators in microbial and fungal communities, detecting significant change in the earliest stages.

The key to IBA's success is its ability to integrate diverse data sets and discover unique biosignatures. The IBA approach discovers and measures not one, but many biomolecular signatures associated with community composition and functions within an ecosystem. Integrating these biomarkers leads to the mechanisms for biogeochemical transport—providing early warning signs of stress and damage to the ecosystem.

Integrated Biomarker Approach (IBA) is the revolutionary strategy that enables risk-based monitoring. This approach will lower environmental monitoring costs and limit damage to the environment through early detection.

In contrast, conventional environmental monitoring techniques, which are observational, do not detect risk until it can be seen in higher life forms. This form of monitoring is time consuming, labor intensive and costly.

IBA is a giant step forward in transforming environmental monitoring and assessment from compliance-driven to risk-based and from observational to predictive. IBA promises to provide more accurate and complete information about functional change within ecosystems than conventional techniques. The IBA approach encourages regional scale preservation of resources and continued stewardship and conservation that work towards healthy environments and clean water.

Understanding the effects of environmental contamination at this level offers huge opportunities—the ability to predict risk to the environment years before it appears in higher life forms, and the ability to act before irreversible damage is done. IBA's risk-based approach allows us to prevent environmental damage rather than simply remediate it, thus lowering the cost of environmental monitoring.

Types of problems we solve

IBA is an integrated systems approach to discovering biosignatures and identifying relevant environmental biomarkers, and can be applied to marine/coastal, freshwater and subsurface environments in order to:

- identify opportunities for early intervention
- offer cost-effective monitoring capabilities, and
- provide targeted, cost-effective remediation metrics.