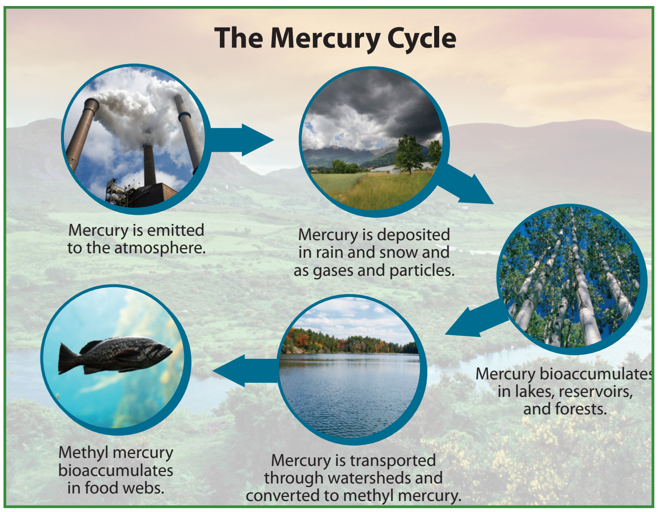
MercNet

Tracking mercury in air, water, land, fish and wildlife

Why Do We Need Environmental Mercury Monitoring?

Although mercury is a naturally occurring element, human activities, such as power generation from coal-fired power plants, have increased human and wildlife exposure, primarily through eating mercury-contaminated fish. After mercury is emitted to the atmosphere, it deposits to the Earth's surface as ionic mercury. Within watersheds and lakes, natural processes convert ionic mercury to methyl mercury—a toxic form that is readily magnified to high concentrations in the food web.



Mercury concentrations in fish and wildlife in the United States now routinely exceed human and wildlife health thresholds. Fish consumption advisories blanket the entire nation, including significant coastal advisories, as shown in the map below. For more information, visit the EPA fish advisories web page *http://www.epa.gov/waterscience/fish/*.

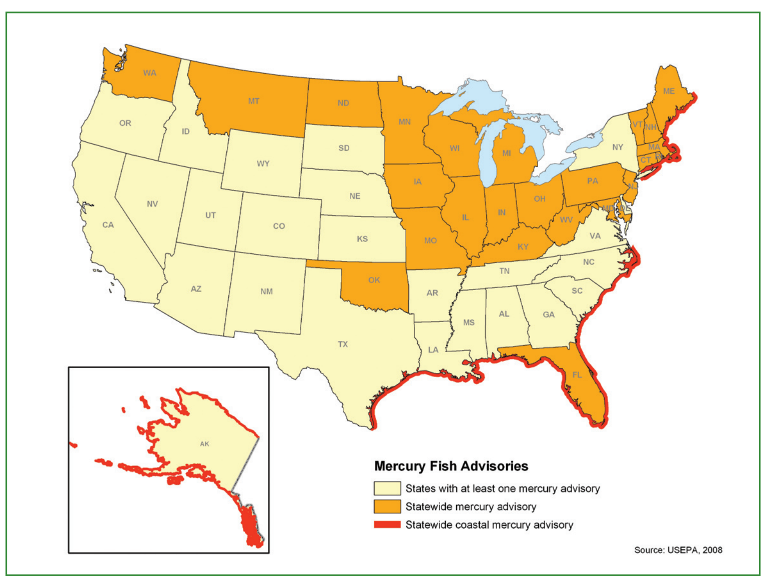
The most at-risk and sensitive Americans include women of childbearing age who may become pregnant, nursing mothers, and children younger than 12 years old. The most highly exposed people, due to fish consumption habits, include: recreational fishers and their families, some Native American populations, Asians and Pacific Islanders, and subsistence fishers who fish to meet their families' nutritional needs.

At present, scientists must rely on limited information to understand and quantify the critical linkages between mercury emissions and environmental response and potential human health concerns. Successful design, implementation, and assessment of solutions to the mercury pollution problem require standardized and comprehensive long-term information—information that is currently not available.

What Will Mercury Monitoring Tell Us?

Mercury policy development, implementation, and assessment require substantially improved mercury monitoring. A comprehensive long-term mercury monitoring program focused on ambient concentrations, mercury deposition, watershed cycling, and biological effects would allow scientists and managers to assess mercury in the environment, linking changes in emissions and deposition with ecosystem effects and response. The monitoring network described here would provide answers to critical environmental policy questions, such as:

- Are mercury emissions and deposition to the environment changing as a result of current policies and programs?
- Are further emissions reductions necessary?
- Are ecosystems responding to changes in mercury pollution?
- Have fish tissue concentrations changed sufficiently to revise fish consumption advisories?
- What human and wildlife populations continue to be at risk due to high concentrations of mercury in fish?
- How much are threatened and endangered species impacted by mercury pollution?



Mercury fish advisories

What Kind of Mercury Monitoring Do We Need?

There is a vision for mercury monitoring. In 2003, an EPA-sponsored workshop convened by the Society for Environmental Toxicology and Chemistry gathered scientists from across the United States and several other countries to devise a national mercury monitoring program. A roadmap for a comprehensive national mercury monitoring program emerged from this workshop, detailed in a peer-reviewed journal article published in 2005 and a 2007 book.

At a follow-up National Mercury Monitoring Workshop in May 2008, U.S. and Canadian scientists from state, federal, academic, and private institutions agreed upon the overall goal of a network:

> "Establish a policy-relevant network to systematically monitor, assess, and report on indicators of nationwide changes in atmospheric mercury deposition and concentrations of mercury in land, water, and biota in coastal and freshwater ecosystems in response to changing mercury emissions over time."

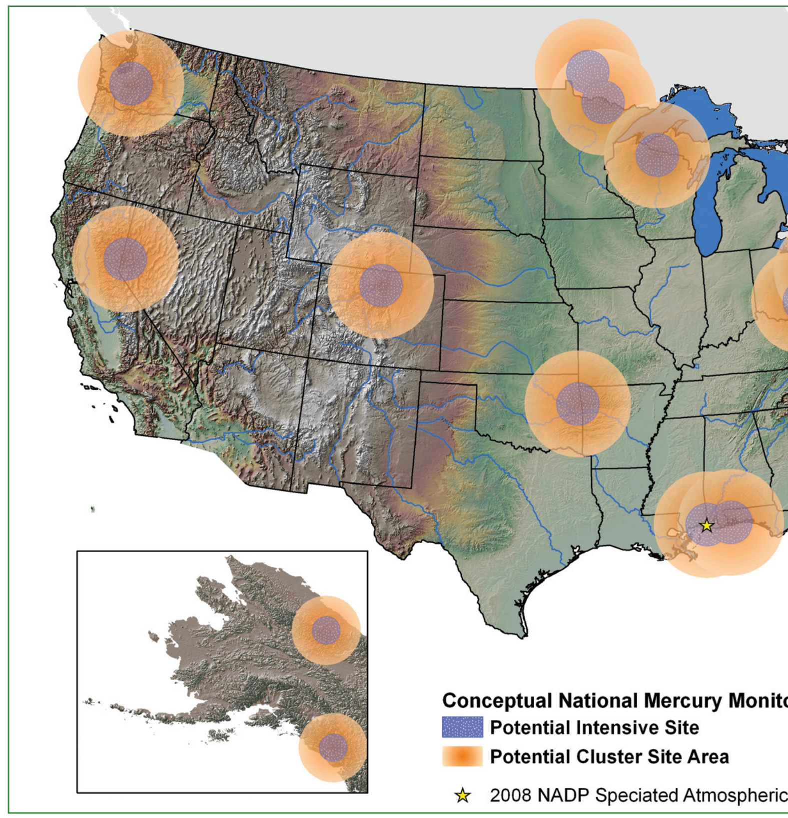
Workshop scientists considered the conceptual framework for a mercury monitoring network, such as depicted in the map on the right. They agreed on several monitoring design elements:

- A national distribution of sites to understand the sources, consequences, and changes in U.S. mercury pollution;
- A network of 10-20 intensive sites, accompanied by about 20 cluster sites for each intensive site;
- Intensive monitoring sites would establish cause and effect relationships between mercury pollution and environmental change, and data would be used to test and evaluate models;
- Cluster sites would be near an intensive site and provide a general understanding of environmental responses for a region or ecosystem type;
- Monitoring sites would be multi-media (air, water, sediments, fish, and wildlife);
- The network must run for an extended period (10-40 years) to quantify the range of responses expected for many ecosystem types;
- The network should build on existing monitoring efforts, where possible, to maximize information, benefits and coordination with existing resources.

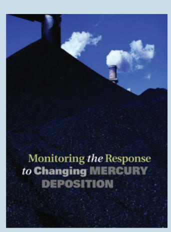
Intensive and Cluster Sites

Within an ecoregion, detailed intensive study sites (intensive sites) and less inte
number of clustered sites (cluster sites) would be conducted. Individual sites w
similar ecological characteristics (e.g., southeastern coastal plain streams) but p
characteristics. Selection criteria for cluster sites would be based on multiple fa
water-body type, and would represent remote and impacted sites, dry regions,
as well as a wide range of ecosystem types, potential exposure "hot spots," and

Continuous, multimedia monitoring of both changes in mercury loading an
assimilation into fish and wildlife would be conducted at a handful of inten
is expected would be emphasized, although background sites would also b

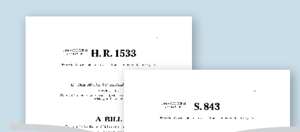


Conceptual National Mercury Monitoring Network



USEPA/SETAC North American Workshop on Mercury Monitoring and Assessment, Pensacola, FL

Mason et al. 2005, *ES&T* 39:14A-22A



Comprehensive Mercury Monitoring Bills introduced in House and Senate

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Recent progress has been made in underst

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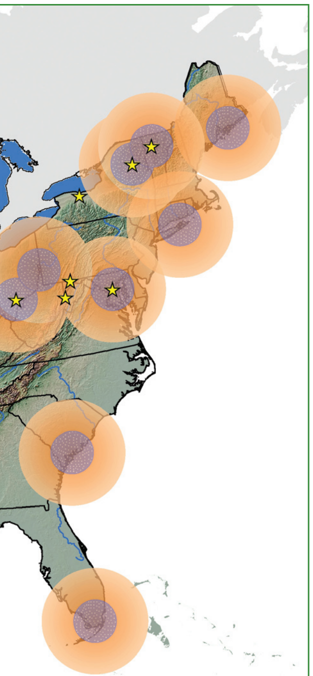


oring Network

Mercury Initiative Site

Indicators of Environmental Change

At intensive and cluster sites, the primary indicators presented in the table on the right would be measured over a prolonged period of time. These indicators were chosen to reduce the confounding impacts of short-term variability while integrating the signal to ascertain environmental change. Along with the collection of ancillary measurements, these indicators can be used to assess linkages between mercury emissions, atmospheric deposition, and concentrations in fish and wildlife, or trends in different ecosystem compartments. These indicators were also selected based on a number of attributes, as described in Mason et al., 2005:

- Comparable across ecosystems;
- Integrate variability in space and time;
- Simple to interpret;
- Easy to sample;
- Respond to mercury loading on a relatively short time scale;
- Able to be tied to changes in methylmercury production; and
- Theoretically and empirically sound.

Types of Indicators for Cluster or Intensive Sites

Indicator	Site	Frequency
Air and watershed		
Atmospheric mercury speciation; wet and dry deposition flux	IN	C
Weekly wet deposition and flux[a]	CL	W
Hg evasion/flux[a]	IN	M
Watershed yield (surface-water and groundwater flux)	CL	M
Chemical characterization		
Historic sediment depth profile[b]	IN	I
THg, MeHg, and %MeHg in surface (0-2 cm) sediment	CL	S
THg, MeHg in surface water	CL	S
THg, MeHg water-column profiles	IN	S
Aquatic biota		
Phytoplankton and algae	IN	M
Zooplankton/benthic inverterbrates	IN	M
Yearling fish	CL	S
Piscivorous/commercial fish	CL	A
Wildlife[c]	CL	A

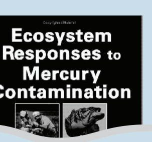
Site: IN = intensive sites only; CL = cluster and intensive sites

Frequency of sampling: C = continuously; W = weekly; M = monthly; S = every 6 months; A = annually; I = every 3 to 5 years.

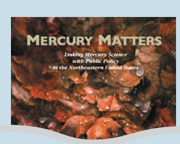
[a] Event-based wet depostion collection at intensive sites, weekly integrated sampling at cluster sites. At intensive sites, flux estimates would include wet, dry, gaseous, and particulate deposition; throughfall and litterfall; and snowpack sampling as appropriate. Hg concentration and evasion fluxes would be for both aquatic and terrestrial environments.

[b] Intensive sites and a subset of cluster sites would be sampled to determine historic mercury trends.

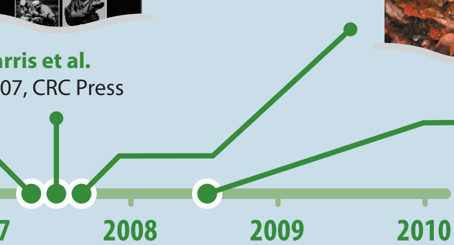
[c] Birds, small and larger mammals; both short-term and integrative sampling.



arris et al.
07, CRC Press



Northeastern mercury scientists from the Hubbard Brook Research Foundation published two papers in *BioScience* on mercury in the environment. Both papers indicated the need for a comprehensive and integrated nationwide mercury monitoring program.



National Mercury Monitoring Workshop
May 5-7, 2008, Annapolis, MD

anding and tracking the mercury problem.

Who Is Collaborating in MercNet Now?

NADP speciated atmospheric mercury site, Beltsville, MD

Collaboration and partnerships among existing mercury scientists and monitoring programs are integral to MercNet. A broad cross-section of agencies and institutions are working to coordinate mercury monitoring activities, building on current efforts and encouraging new collaborative relationships.

To monitor mercury in the atmosphere, the National Atmospheric Deposition Program (NADP) membership of federal agencies, states, tribes, academic institutions, industry, and other organizations are collaborating to establish a new, coordinated network for monitoring mercury in the atmosphere. NADP launched this network by initially leveraging existing sites measuring atmospheric mercury. Data from these sites will be collected and managed in a central archive. Network-wide operating protocols will enable comparison of data across sites. Data quality will be ensured by a centralized quality assurance program.

At present, eight atmospheric mercury monitoring stations are participating in NADP to provide high resolution, high quality atmospheric data. New, additional sites will be added to the network, as funding becomes available. NADP plans to offer a publicly accessible database of long-term atmospheric mercury measurements.

Several of the sites currently making speciated atmospheric mercury measurements as part of the NADP initiative are also collecting mercury data in other media. These are highlighted as potential intensive sites on the Conceptual National Mercury Monitoring Network map. (See Figure 2.) For more information, visit the NADP mercury initiative webpage *http://nadpweb.sws.uiuc.edu/amn/*.

In conjunction with the NADP efforts, MercNet seeks to utilize existing expertise through active coordination of experts throughout states and tribes who for years have been monitoring mercury in air, water, land, fish, and wildlife as part of ongoing programs.

The May 2008 National Mercury Monitoring Workshop was an important step in building broad community support for a comprehensive, integrated monitoring network. The workshop included MercNet participants from federal agencies (U.S. Environmental Protection Agency, U.S. Geological Survey, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, National Park Service), state and tribal agency representatives, NADP, industry, and scientists from academic and private research institutions.

The workshop was part of an ongoing effort to enhance mercury monitoring in the United States through coordination of existing monitoring, and, should new funding sources become available, implementation of new and coordinated, policy-relevant monitoring efforts.

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Researchers have revealed mercury is a ubiquitous contaminant and exhibits maximum impact on wetlands.