MERCURY TEAM

Mission

The mission of the Wisconsin District Mercury Research Laboratory (WDMRL) is to provide a better overall understanding of mercury contamination of aquatic ecosystems by conducting scientific studies and providing expert assistance to the USGS and other state and Federal agencies. Assistance is provided through consultation, drafting and reviewing proposals, field sampling, sample analysis, interpreting data, and drafting reports. We strive to provide the best possible data and service by remaining on the cutting edge of mercury research, and maintaining a state-of-the-art mercury analysis laboratory

Sampling pore waters in a wetland at the Experimental Lakes Area, Ontario Canada.

Team Members

David P. Krabbenhoft, Research Hydrologist/ Geochemistry
Mark L. Olson, Biologist
John F. DeWild, Hydrologic Technician
Shane D. Olund, Chemist
Paul D. Sternhagen, Hydrologic Technician
Todd M. Rudolph, Contract
M.T. Tate, Contract

USGS Field Team at the Mercury Experiment to Assess Atmospheric Loading in Canada at the U.S. (METAALICUS) project site.

PROJECTS

FLORIDA EVERGLADES MERCURY CYCLING

COOPERATOR:

U.S. Geological Survey,
Reston, Virginia

PROJECT CHIEF:

David P. Krabbenhoft

LOCATION:

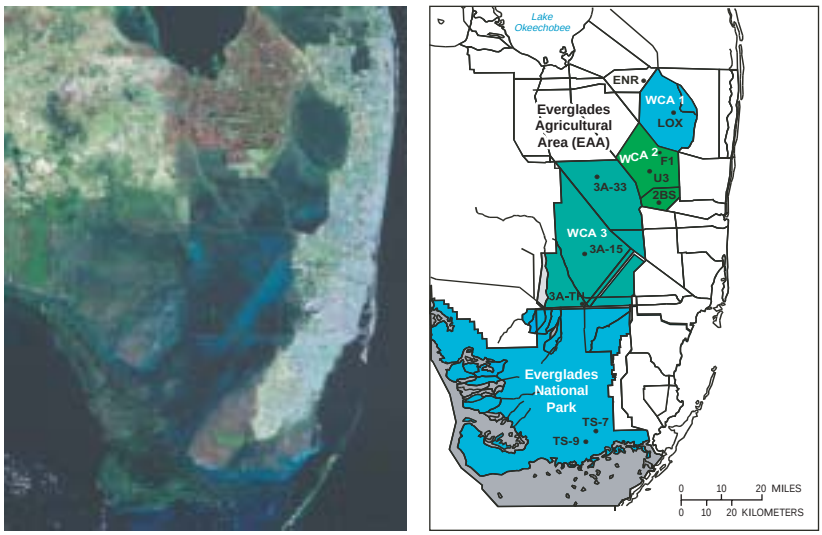
Florida Everglades

PROJECT NUMBER:

WI 19700

PERIOD OF PROJECT:

January 1995–Continuing



Satellite and field location maps of the Everglades Mercury Research site.

PROBLEM

Mercury contamination is one of the largest potential health risks to aquatic organisms, predatory animals, and humans. This great concern is the result of two observations: (1) mercury biomagnifies in the food chain to toxic concentrations even though it is found at very low aqueous concentrations, and (2) the principal source to most areas is atmospheric deposition. Thus, almost any aquatic ecosystem with a food chain is potentially susceptible to mercury contamination.

OBJECTIVE

The overall objective of this project is to provide a better understanding of the mercury contamination problem in the Florida Everglades and other aquatic ecosystems. Specific processes will be investigated, including particle and dissolved transport, volatilization, methylation, and interactions with dissolved organic carbon.

APPROACH

Mercury contamination of the Florida Everglades has been recognized as a serious problem for over a decade, yet solutions to the problem have remained elusive. Research conducted by the Wisconsin District Mercury Research Laboratory from 1995 to 2000 on the factors leading to high levels of mercury bioaccumulation revealed that in addition to mercury inputs, sulfate, phosphate, and organic carbon loading from upstream point sources, as well as water-level management, all likely contribute to the problem. To aid in the decision-making process for the Consolidated Everglades Restoration Program (CERP), which is an interagency program charged with developing the restoration plan for the Everglades, we have taken a new direction in our research to directly evaluate the relative importance of each of the co-factors. Briefly, we have installed 75 wetland enclosures at five sites in the Everglades, and within them we are performing chemical addition studies using stable isotopes of mercury, sulfate, phosphate and organic carbon to quantify the dose response of

each to the formation of methylmercury and bioaccumulation in the food web. Following each amendment, sediment, surface water, pore water, plant, and fish samples are collected at several time intervals for periods up to six months. With this type of information, we will be able to provide a much clearer quantitative context of the relative importance of each of the contributing factors to the mercury problem, and agencies responsible for direction. Everglades restoration efforts can more reliably make decisions on what preventive actions can made with regard to mercury toxicity in the Everglades.

PROGRESS (July 2001 to June 2002)

In November 2001, we initiated for the first time a full scale experiment of our dosing studies. The experiment was run through February 2002, and included three complete sampling periods during course of the study. Currently, we are analyzing the large number of samples that were generated from this experiment. Samples are analyzed on the new Inductively Coupled Plasma Mass Spectrometer (ICPMS) that is operated by the Mercury Studies Team, in the Wisconsin District Office. Early results suggest that there were significant responses to each chemical amendment, including some responses that were not anticipated. At the conclusion of the dosing study, a sediment-core incubation study was initiated to test the response of drying and rewetting cores to the production of methylmercury, which we observed in the natural environment after dry periods. This experiment is scheduled to continue through the end of May 2002.

PLANS (July 2002 to June 2003)

Plans for this time period call for the analysis of all the samples collected during the recent study, and the samples generated from the ongoing core-incubation experiment. Once all the sample results are available, we will prepare at least three reports on our results in the format of scientific journal papers. The interpretations and final conclusions of these experiments may be used to guide future tests to further evaluate the Everglades mercury problem and what can be done to mitigate its impact.

USGS field crews sampling in the Everglades.

NATIONAL MERCURY PROJECT

COOPERATOR:

Toxic Substances Hydrology Program

PROJECT CHIEF:

David P. Krabbenhoft

LOCATION:

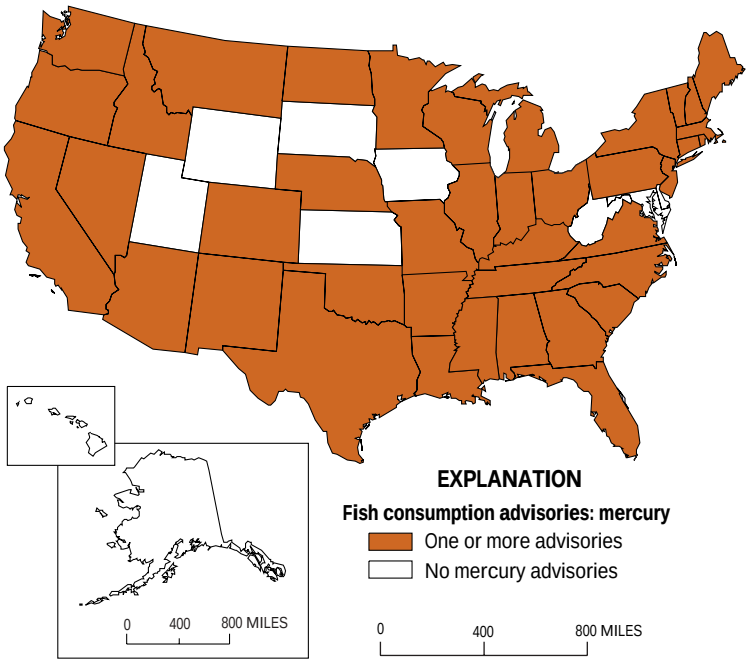
Nationwide

PROJECT NUMBER:

WI 22900

PERIOD OF PROJECT:

July 2001 to June 2006



PROBLEM

Mercury (Hg), which is distributed primarily by atmospheric pathways, is a global pollutant that we are still working toward trying to understand the magnitude, controlling factors, and its potential effects on ecosystems and humans. Consumption advisories for Hg-contaminated fish are currently in place for 41 United States. In some states, including Wisconsin, the problem is so acute that statewide advisories for the consumption of all sport fish have been issued. Despite increased awareness of the problem, it remains unclear whether current Hg releases, or ecosystem sensitivity to Hg loading controls the distribution of problem spots in the United States, and what positive outcomes might be realized from proposed Hg emissions reductions by the U.S. Environmental Protection Agency.

OBJECTIVE

The overall goals of this project are to seek to clarify the broader mercury problem from a scientific and resource management perspective, and provide information that will aid decision makers on what should be done to improve environmental Hg conditions. Specific tasks we are undertaking to achieve these goals are to: (1) fill critical data gaps that currently hinder a more complete understanding of mercury contamination across the United States, and (2) conduct research that will allow for a better quantitative understanding relating mercury releases to the environment and contamination levels in aquatic food webs.

APPROACH

To achieve these goals, the Wisconsin District Mercury Research Team is conducting a variety of field-oriented studies. First, in the summer of 2002 we are continuing our collaboration with the NAWQA program to collect fish, water and sediment samples from across the United States in a variety of watershed types. This synoptic type sampling will be followed by more intense sampling efforts a few of the watersheds where the goal will be to provide a detailed understanding of the processes that control mercury bioaccumulation in food webs. In addition, the Mercury Research Team is involved in two “mercury-loading” studies in the Ever-

glades of Florida and the Experimental Lakes Area (ELA) of Ontario, Canada, whereby the overall goal is to establish what the mercury dose to bioaccumulation response is for natural systems using traceable amounts of mercury stable isotopes. Previously, research of this kind has been conducted in laboratories or controlled environments where the natural response was not adequately represented. For the study site in Canada, we are dosing an entire watershed with three different stable isotopes of mercury (^{198}Hg, ^{200}Hg, and ^{202}Hg), which are being added to the wetland, upland forests, and lake, respectively. By applying different stable isotopes to the three major components of the watershed, we will be able to track where the mercury comes from, and at what time scales, that accumulates in fish.

PROGRESS (July 2001 to June 2002)

In the summer of 1998 the Wisconsin District Mercury Research Laboratory and the Toxic Substances Hydrology and National Water-Quality Assessment (NAWQA) Programs conducted a national sampling of fish, sediment and water from 106 sites that were located in 21 NAWQA study basins. This effort was the first of its kind, and provided many insights into the level of mercury contamination across the United States that had never been documented. In the spring of 2002, a similar effort will be conducted at about 140 sites located in 14 study basins across the United States.

We are now into our second year of dosing stable isotope studies in the Everglades, and one year of full isotope application to the whole watershed study in Canada. After each dosing, intense sampling is conducted to follow the pathways for the isotopes through the ecosystem, and the transformation sites and rates for methylmercury production. Samples are analyzed at the Wisconsin District Mercury Research Laboratory using the inductively coupled, quadra pole mass spectrometer that is capable of distinguishing among the isotopes of mercury at very low levels of addition.

PLANS (July 2002 to July 2003)

Plans for this time period call for continued sampling efforts at the 14 NAWQA study basins, but in a much more detailed manner to evaluate why some basins exhibit high levels of mercury bioaccumulation and others low. This work will be conducted collaboratively with the NAWQA program, National Research Program, and scientists from the Biological Resources Discipline. Analytical results from samples collected in 2002 will be used to identify the sites of more detailed examination. Once all the sample results are available, we will prepare at least three reports on our results in the format of scientific journal papers. The interpretations and final conclusions of these experiments may be used to guide future tests to further evaluate where and what kind of additional studies need to be conducted.

Sampling at Mokowanis Lake, Glacier National Park, during the High Elevation Lakes Study of 1999.