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Introduction

Fourth International Conference, *Mercury as a Global Pollutant*. Editors: J.W.M. Rudd, C.C. Gilmour and R.A. Bodaly. Hamburg, Germany: 4–8 August 1996.

Mercury contamination of fisheries and the environment have been with us for about 30 years, and during this time our realization of the scope of mercury contamination problems has increased progressively. There are now several types of mercury contamination problems that have different origins, but the same end effect – contamination of fisheries by methyl mercury, which is of concern to human populations and wildlife.

Awareness of the mercury contamination started three decades ago as point source contaminations from chlor-alkali plants and other sources. It then progressed to regional contaminations associated with acidic deposition (the mercury/acid problem), and more recently to global contamination as a result of long range transport and deposition of mercury. In addition, there is mercury contamination of fisheries in reservoirs. This contamination is not associated with point source contamination or long range transport of mercury, but instead has been linked to a stimulation of the mercury methylation process as a result of decomposition of flooded vegetation. Recently, the possibility of mercury contamination of fisheries as a result of global warming has been suggested due to increased net production of methyl mercury in sediments. Other issues, which are on the horizon, are the high concentrations of mercury that have recently been found in atmospheric deposition and snow samples in the high Arctic, and the mercury contamination of waterways by effluents from mining and smelting operations. In this case, it appears that mercury is being inadvertently released during the refining process as large volumes of ore is being refined. In general it seems that a major disturbance of an ecosystem very often leads to the elevation of methyl mercury concentrations in fish.

We now appreciate that that there are several geologic, chemical and biological reasons why mercury problems have been so persistent and varied over the past two decades and why new problems will very likely continue to appear in the future:

1. Natural concentrations of mercury in crustal material are relatively high as compared to other toxic heavy metals, and so modest increases in mercury released to the environment can be reason for concern. Unlike most toxic heavy metals, mercury is methylated by natural biogeochemcial processes. Methylmercury, unlike inorganic mercury and most other inorganic metals is biomagnified in food webs leading to concentrations in fish that can be toxic to consumers.
2. Mercury is very reactive chemically and biochemically undergoing dynamic aquatic, atmospheric and photochemical cycles. Mercury is one of the most particle reactive metals. In the aquatic environment, ligands of DOC, sulfide and chloride affect mobility, biological uptake and photochemical reduction. Inorganic mercury is methylated and methyl mercury is biologically demethylated and photodegraded, and these processes are important components of the global mercury that vary widely among ecosystems.
3. Ecosystem disturbances other than changes in mercury loading can effect mercury methylation and bioaccumulation. Classic examples are reservoir construction and lake acidification. Methylmercury production following wetland creation and global warming are emerging issues.

The articles in this volume were presented at the 4th in a series of International Conferences on Mercury as Global Pollutant. This series of conferences is a forum for the presentation of the results of mercury research in the atmosphere, geosphere and biosphere, including human toxicity. The Hamburg conference was attended by over 400 participants from 30 countries. Nearly 370 papers were presented that were divided into six major themes: Analytical, Human Health, Contaminated Sites, Aquatic systems, Atmosphere and Biogeochemical Cycling.

It was the decision of the technical advisory team to publish the Hamburg conference papers in the peer reviewed open literature. This has now been achieved through the preparation of six special issues that cover the topics of the conference. These publications will appear in the coming months and will contain about one-third of the original presentations. Copies of five special issues in the series can be obtained directly from their publishers as follows:

1. Analytical Development in the *Fresenius Journal of Analytical Chemistry*
2. Atmospheric Cycling in the journal *Atmospheric Environment*
3. Contaminated sites in the Springer Book Series *Environmental Science*
4. General Topics on Mercury in the journal *Science of the Total Environment*
5. Human Health Issues in the journal *Water, Air, and Soil Pollution*

The sixth special issue in this series of the proceedings of the Hamburg conference is the present one, which encompasses papers concerning the biogeochemistry of mercury in terrestrial and aquatic ecosystems and its bioaccumulation into fish. Four papers, (Cleckner et al.; Gilmour et al.; Hurley et al.; Krabbenhoft et al.) summarize some of the recent research on the mercury contamination in the food chain of the Florida Everglades. This research emphasizes the dynamic nature of mercury cycling and methyl mercury production in the Everglades. Four papers present research on the bioaccumulation of mercury by fish. Harris and Bodaly demonstrate how temperature, growth and diet can affect fish mercury concentrations. French et al. investigated mercury in fish in Newfoundland reservoirs and demonstrated correlations with reservoir age and area flooded. Doyon et al. compared mercury accumulation patterns in sympatric populations of lake whitefish and showed that age of maturity, feeding and growth appeared to affect rates of uptake. A new method of standardizing mercury concentration data for fish size, using polynomial regression with indicator variables, is introduced by Tremblay et al. Four papers are concerned with the cycling of mercury in lake catchments and an estuary. Lee et al. present input and output flux data for total mercury and methyl mercury in three Scandinavian catchments and compare these fluxes to other geographic locations. Driscoll et al. presents total and methyl mercury fluxes though a beaver impoundment in the Adirondacks and show that methyl mercury production occurred in the beaver impoundment. Lockhart et al. studied mercury fluxes to lake sediments and found that mercury accumulation in Canadian lakes was greater in the surficial sediments of central/southern lakes as compared to northern lakes. Benoit et al. studied cycling of mercury and methyl mercury in the Patuxent River estuary and discuss factors that may be controlling the distribution of total mercury and the production of methyl mercury in the ecosystem. Three papers are concerned with the uptake of methyl mercury by the lower food chain. Monson and Brezonik speciated mercury in the surface water and plankton of Northeastern Minnesota lakes and found seasonal patterns for concentrations and BAF’s. Nuutinen and Kukkonen determined that the presence of selenium decreased the uptake of methyl mercury in an oligochaete, and Morgan and Mason conducted methyl mercury uptake experiments with an estuarine alga, determining the affects of organic ligands. Two other papers complete this issue. Bodaly et al. investigated total and methyl mercury outputs from three sewage treatment plants and found that all plants were sinks for total mercury, but that sewage plants could be either sources or sinks of methyl mercury. Rea and Keeler describe a new microwave method for analysis of mercury in foliage that compared well with mercury analyzed by a hot acid digestion technique and by Instrumental Neutron Activation.

Our understanding of the biogeochemistry of mercury is now at a stage where mechanistic models of mercury cycling, methyl mercury production, and bioaccumulation have been successfully applied to aquatic ecosystems, and cross-system models may soon be possible. The papers in this special issue make important contributions toward the goal of being able to predict to what extent ecosystem disturbances will result in increased concentrations of methyl mercury in fish and other wildlife.