Mercury Contamination in the Northeast

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Raymond P. Curran interviewed Dr. Driscoll in March 2007; Dr. Driscoll, you were the principal author of a paper published in the January 2007 edition of BioScience concerning mercury contamination in the Northeast. Why should we in the Adirondacks (residents, decision makers and researchers) be concerned about this issue?

Driscoll: Mercury is a toxic substance—a neurotoxin—and its route of exposure is primarily through the aquatic food chain, so to the extent that we (and wildlife) consume fish we are exposed to mercury. In fact, New York State has issued human health advisories concerning consumption of fish contaminated by mercury for many Adirondack lakes. The Adirondacks are particularly vulnerable for three reasons: (1) The Adirondacks are heavily forested, and forests are an effective filter of mercury and other pollutants from the atmosphere. (2) The Adirondacks have abundant wetlands, which facilitate the conversion of mercury from its ionic form to methyl mercury, which is efficiently transferred up the aquatic food chain. And (3) the Adirondacks are nutrient poor. Because of the low productivity of Adirondack lakes, its fish have higher concentrations. A given amount of mercury is distributed among lesser amounts of aquatic biomass, hence leading to higher concentrations in those organisms. Unproductive lakes tend to have higher concentrations of mercury in fish than higher productivity lakes. Another factor is the interaction of mercury with other pollutants; the Adirondacks have been impacted by acid rain and that enhances mercury accumulation in fish and other aquatic organisms.

Curran: What methods did you use to collect the data for your paper?

Driscoll: The report is a synthesis of existing research from many studies. We compiled data on concentrations in organisms from the states and provinces of Canada at sites where enough consistent data existed to determine the levels of contamination. We used a series of 40 kilometer square grid cells to conduct a spatial analysis across the region. In those cells we looked for multiple sites with consistently high concentrations in fish, mammals, and other organisms to determine "hotspots." By looking at the data geographically, we were trying to address a problem brought up by the Environmental Protection Agency’s announcement of the Clean Air Mercury Rule (CAMR). To justify its approach utilizing uniform nationwide emission standards, the EPA stated that there are not "hotspots" for mercury contamination around the country. Hence we addressed the spatial distribution patterns.

Curran: What are the key findings of your work?

Driscoll: We found five "biological mercury hotspots" in the Northeast and nine “areas of concern.” Had we more data, our results might have been more conclusive for those nine “areas of concern.” One of the hotspots is the Adirondacks. The Catskills is an area of concern.

The detection of these hotspots has implications for how we manage mercury. The CAMR is a “cap and trade program.” The controversy over a cap and trade program concerns timing of controls and unconstrained trading across geographic boundaries. Many states want to know, for example, if the hotspots would recover under CAMR. If you have trading that does not allow for control of mercury sources near hotspots, might the hotspots not recover at rapid enough rates? Our findings suggest that the new rule could perpetuate these biological mercury hotspots. Moreover, there may be biological mercury hotspots in other areas of the country that have not been documented.

Curran: Focusing on the Adirondacks, how extensive is mercury contamination?

Driscoll: It is fairly extensive, but there are a lot of water bodies we don’t know a lot about. For example, even though we suspect problems in the Tug Hill—with high levels of deposition—we have few data. For this reason, the state has issued a blanket health advisory for the Adirondacks and Catskills.

Curran: For how long has mercury been a critical problem?

Driscoll: We collected cores from lakes to try to reconstruct mercury loading in the Adirondacks. What we found is that starting around 1900, there has been a three- to tenfold increase in mercury deposited in lake sediments, a level consistent with changes in emissions from coal fired power plants for the northeastern United States over that period. Beginning about 1980, virtually all of the sites show about a 30% decrease. This recent decrease is likely due to decreases in mercury use, controls on sulfur dioxide emissions from power plants and controls on incinerators.

Curran: Like the accumulation of carbon dioxide in the atmosphere, are we committed to the effects for decades ahead?

Driscoll: We don’t have good long-term monitoring data for mercury and this is a critical need. There need to be measurements of mercury in critical compartments of ecosystems over time.

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such as atmospheric deposition, surface waters and biota. Controls have been enacted over emissions from incinerators, medical and municipal waste, and now controls are scheduled to be placed over electrical utilities. We don’t have the data to track trends of mercury over time. If we can use acid rain as a model, this shows that forest watershed/lake ecosystem recovery is very slow. The detected reduction in levels in lake sediments, however, shows that controls can be effective.

**Curran:** What are the primary sources for mercury impacting the Adirondacks?

**Driscoll:** Incinerators, medical waste and municipal waste have been controlled since the early 1990s, but the largest unregulated source is emissions from electric utilities. That source contributes about 45% of the total.

**Curran:** What do you predict will be the trends in levels of mercury deposition over the next 5 to 20 years?

**Driscoll:** Hopefully it is trending down, although we do not have enough long-term data to verify that. My guess is that like acid rain it will slowly decrease. Part of the problem is that the rule applies for the whole country, and it has an extended period of implementation. Controls will not be completed until about 2025. Further, with the ability to cap and trade, will reductions be uniform across the country? Or will the market place determine where reductions occur?

**Curran:** What does the increased use of coal fired power plants in distant places like China and Texas portend for the Adirondacks?

**Driscoll:** When mercury is released from coal fired power plants, on average, about half is in the elemental form and half in an oxidized form. The elemental forms stay in the atmosphere for up to six months and can be transported over long distances. Oxidized mercury falls out near the source. Since the oxidized form is readily deposited and is not transported great distances, it is the more regional and local sources that cause our problems. So new utilities as far away as Texas and China are unlikely to have a substantial effect.

**Curran:** Are there activities we can undertake in the management of our Adirondack terrestrial and aquatic ecosystems to mitigate the effects of mercury?

**Driscoll:** Characteristics of Adirondack ecosystems lend themselves to bioaccumulation of mercury and its toxic effects. Decreasing atmospheric emissions of mercury should be the primary management task to decrease mercury pollution. Reducing sulfur dioxide levels should also have a benefit for reducing mercury in the Adirondacks. Controlling other characteristics of watershed and aquatic ecosystems that influence mercury dynamics are more problematic (such as reducing forests, draining wetlands, and dramatically increasing lake productivity), because these characteristics are fundamental to the values and functions of Adirondack natural resources. Manipulating them would cause other harm. The main thing is to inform people about the risks associated with exposure to mercury and provide people with information to make more choices. That some species such as walleye accumulate mercury to elevated concentrations has implications for which species to manage for, which might be an interesting issue to discuss.

**Curran:** You have long conducted research on transboundary air pollution issues affecting the Adirondacks. How does mercury compare to or interact with other pollutants?

**Driscoll:** Mercury contamination is closely linked to sulfur emissions. They both come from the same sources—mostly coal. They will interact in the atmosphere. Once they are deposited their effects are closely interconnected. The same bacteria that reduce sulfur process mercury and produce methyl mercury, the acidification of lakes seems to facilitate the bioaccumulation of mercury. As a result, there would be some benefits to using a multi pollutant approach to address these air pollutants.

**Curran:** For future mercury contamination research, what are the most important remaining issues to continue to investigate?

**Driscoll:** We don’t have a good deal of experience on the transport and fate of mercury; an extensive history such as the research on acid rain doesn’t exist. Reports that some terrestrial species (such as bats and Bicknell’s thrush) are bio-accumulating raise the issue of how they get that methyl mercury. Other potential biological mercury hotspots, such as the Tug Hill and Catskills should be monitored and studied. Long-term studies are needed to better characterize the nature of the problem. We need a better understanding of the transport and transformations of mercury in a typical Adirondack lake watershed. Also, how do ecosystems respond to changing mercury deposition?

**Curran:** Are there other sources of information in addition to your BioScience article about mercury you might recommend for someone with an interest in pursuing this subject matter?


**Curran:** Thank you, Dr. Driscoll, for taking the time to explain this important and complex issue in a way that will be accessible to many readers.