**January 9, 2007**

**The Electric Power Research Institute (EPRI) issued the following statement in response to the BioScience article, "Biological Mercury Hotspots".**

**EPRI finds:**

1. **The Modeling Does Not Fully Include Important Sources of Mercury**

*Because the study described in the paper carried out only a limited modeling exercise, there is no way of judging whether the conclusions about local mercury source contributions to deposition in their "case study" are reasonable or not.*

2. **Mercury Emissions Trading Will Not Exacerbate "Hotspots"**

*Both EPRI and U.S. EPA studies have shown that mercury credits will be preferentially generated by Eastern power plants, such as those in the study area, with relatively high proportions of divalent mercury in their mercury emissions.*

3. **In the analysis no Comparison of Modeled Deposition to Observed Data is Carried Out**

*Thus one has no way of knowing whether the modeled deposition from all included sources (not just utilities) represents the data well or not. Model validation is missing.*

4. **The Modeling Used Does Not Consider Mercury Chemistry**

*Processes critically important for determining deposition patterns and source contributions are completely ignored by the study.*

5. **No Link Between Mercury Deposition and Mercury in Ecosystems Is Provided**

*The "case study" of deposition provided stands distinct from the balance of the study, with no substantial foundation in data analysis or verification and no technical linkage to the resulting tissue levels of mercury in the ecosystems studied.*

A more detailed assessment follows.

**Comments by**

**Electric Power Research Institute**

**on BioScience Article**

**"Biological Mercury Hotspots"**

*Reference:*

> D.C. Evers, Y-J. Han, C.T. Driscoll, N.C. Kamman, M.W. Goodale, K.F. Lambert, T.M. Holsen, C.Y. Chen, T.A. Clair, and T. Butler; "Biological Mercury Hotspots in the Northeastern United States and Southeastern Canada," *BioScience 57*(1) 29-43 (January 2007)

***Background***

The January 2007 issue of the technical journal *BioScience* contains an article by David C. Evers et al. regarding a statistical data analysis of mercury levels in waterfowl and fish in selected lakes of the Northeastern United States and Southeastern Canada.

The authors define a "biological mercury hotspot" as a geographic area (0.5x0.5 degree latitude and longitude) within which one or more waterways contain records of 10 or more fish (yellow perch) or waterfowl (common loon) samples whose tissue levels of mercury have been determined to be at levels indicative of either human health risks of concern, or wildlife risk criteria. These levels were selected to represent either exceedances of the U.S. EPA fish tissue criterion for mercury toxicity, or levels in waterfowl documented as indicative of threats to nesting or successful fledgling (young bird) maturation.

The analysis found five noncontiguous areas, each of one or more grid cells, fitting those criteria; an additional group of 10 areas yielded tissue samples with mercury levels of concern in indicator species other than yellow perch and common loons (or in whole-animal samples vs. tissue samples).

After identifying these "biological hotspots," the authors carry out a single "case study" to model mercury deposition in one of the five hotspots found. The location modeled, the Merrimack River Valley, New Hampshire, included four coal-fired power plants in the defined source region, as well as other mercury sources from a 2002 New England source inventory. The deposition model used was the U.S. EPA-supported ISCST3 (Industrial Source Complex-Short Term) model.

The authors then carried out a sensitivity study of the case study site, modeling the four included power plants with 50% and 90% cuts from their 2002 mercury emissions. They conclude that the Merrimack station is a major contributor to the deposition in the hotspot studied (the Merrimack River watershed) because the greatest percentage drops in deposition are within 20 km of the Merrimack power plant when *all* power plant emissions are cut.

***Comments on the Paper***

**The Modeling Does Not Fully Include Important Sources of Mercury**

Because the study described in the paper carried out only a limited modeling exercise, there is no way of judging whether the conclusions about local mercury source contributions to deposition in their "case study" are reasonable or not. EPRI modeling results for mercury deposition due to all mercury sources – local, regional, national, and global – are similar to those of the authors, but the EPRI results have been compared to wet deposition data to validate the modeling results, and

employ multiscale physical-chemical models of all mercury atmospheric processes. Since the numerical results between the two studies are similar, even though the EPRI study involved all known natural and anthropogenic mercury sources globally while the Evers et al. study involved a very limited set of New England-only sources, there are clearly other aspects of the two studies that are inconsistent. For example, there is no data validation of the Evers et al. modeling study, immediately raising the question of whether other assumptions in that case study remain valid. One example is the use of either a 70% or 92% portion of the Merrimack power plant mercury emissions as divalent. Both percentages are significantly higher than EPRI estimates of a 52% divalent fraction for that source. Use of that lower fraction would immediately reduce the total deposition by 18% and 40% respectively. That is because the authors chose to use a mercury deposition model, ISCST3, which does not include any atmospheric mercury chemistry, so treats all deposition as "local" (near-source), with the exception of physical dispersion of the material.

**Mercury Emissions Trading Will Not Exacerbate "Hotspots"**

The U.S. EPA Clean Air Mercury Rule (CAMR) would allow coal power plants that cut their mercury emissions beyond the federal- and state-allocated limits to sell the additional cuts in emissions in an open market to other utilities. In theory, this would allow those purchasing utilities to increase their emissions. Evers et al. express concern that "hotspots" would be worsened by increased utility mercury emissions due to such credit purchases. In fact, both EPRI and U.S. EPA studies have shown that mercury credits will be preferentially generated by Eastern power plants, such as those in the study area, with relatively high proportions of divalent mercury in their mercury emissions. Divalent mercury is more readily captured by existing controls, so those Eastern power plants will be able to economically cut emissions beyond their targeted levels. These same studies reveal that the credits generated are most likely to be "banked" by the originating utilities for use in future generating capacity at lower emission caps. Credits that are sold are likely to go to power plants further west in the United States whose current and future emissions are primarily elemental mercury, which plays little role in U.S. deposition.

**No Comparison of Modeled Deposition to Observed Data is Carried Out**

A number of New England locations are monitored for mercury wet deposition by stations of the international Mercury Deposition Network. The authors' use of the ISCST model allows calculated deposition values to be compared to those observations. For 2005, for example, the Underhill, Vermont, MDN station shows an annual wet deposition value of 7.4 micrograms per square meter. Unfortunately, the authors' receptor domain did not extend far enough to incorporate any of the New England MDN stations, including those in western Maine near the New Hampshire border, and on Cape Cod, Massachusetts. Thus one has no way of knowing whether the modeled deposition from all included sources (not just utilities) represents the data well or not. Model validation is missing.

**The Modeling Used Does Not Consider Mercury Chemistry**

Unfortunately, the ISCST3 model used is a physical dispersion model, and does not incorporate any mercury atmospheric chemistry. Thus it forces the modeled deposition at all locations both near and distant from emission sources to reflect the original composition of the mercury at the time of emission. This is particularly problematical for the more distant sources from the receptor area of interest, such as the Mt. Tom power plant, located at a substantial distance from the Merrimack River receiving waters. The result is that all deposition is incorrectly treated as "local," as if the emitting source is nearby (a distance never defined in the paper). In addition, recent evidence that divalent mercury emitted from power plants – the form for which the deposition is calculated - may be readily converted chemically to elemental mercury, the form which undergoes no net deposition in the authors' case study. This conversion to elemental mercury appears to be more complete and rapid for power plants with greater fractions of divalent mercury in their stack emissions. Thus processes critically important for determining deposition patterns and source contributions are completely ignored by the study.

**No Link Between Mercury Deposition and Mercury in Ecosystems Is Provided**

The case study provided by Evers et al. looks exclusively at the putative link between the chosen set of mercury sources and the modeled downwind deposition in a restricted location. Yet the bulk of the analysis focused on fish and bird tissue levels of mercury, with no linkage provided to deposition values or sources distances. Instead, the study leaves the analysis incomplete, not extending deposition values or modeled deposition changes to resulting changes in fish tissue or bird tissue mercury. Because the analysis does not incorporate all mercury sources, but rather a small set of nearby sources alone, and does not include mercury chemistry in the modeling, it forces the allocation of deposition to relatively nearby sources, all within two hundred kilometers or so. Meteorologically, these sources constitute both “local” and “regional” distances, but the selection of the Merrimack River in southern and central New Hampshire provides a concentration of sources at local scales (about 50 km or so at most). There is, in addition, no attempt to incorporate water body chemistry, which is the final determinant of whether and how much deposited divalent mercury is converted to the organic methylmercury form that can be taken up by plankton, fish, and other animals (and humans). Thus, the “case study” of deposition provided stands distinct from the balance of the study, with no substantial foundation in data analysis or verification and no technical linkage to the resulting tissue levels of mercury in the ecosystems studied.