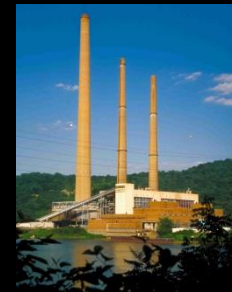
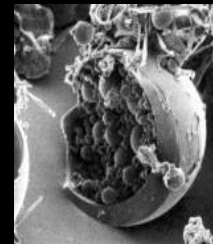


# Mercury Regulation and Reduction: An Electric Utility Perspective



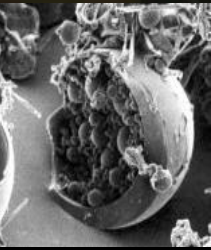
**Rob Reash**

American Electric Power, Columbus, OH  
Water & Ecological Resource Services



# Presentation Overview

- Hg regulations affecting the steam electric utility industry.
- Regulations that have “left the station” vs. “coming attractions”.
- Air emissions and solid waste.
- Wastewater.





## *Hg Polices and Regulations: where does the industry stand?*

- ➔ “Virtual elimination” is technically impossible for a naturally-occurring trace element.
- ➔ Industry is not opposed to incremental Hg reductions as long as the benefits are:
  - > Predictable and measurable
  - > Based on reasonable assumptions
  - > Weighed against the costs
- ➔ Advanced removal technologies require time to R&D, install, and operate.



# *Regulations that have “left the station”*

- ➔ CAA MATS rule: though Supreme Court recently ruled that EPA must consider costs of compliance, most utilities have already chosen (and in many cases, installed) technologies to achieve Hg emission limit of 1.2 lb/mmBTU.
  
- ➔ AEP compliance strategies to meet Hg limit:
  - > Activated carbon injection (ACI) w/baghouse
  - > ACI w/ dry FGD
  - > ACI w/ wet FGD
- \* All strategies assume prior installation of SCR

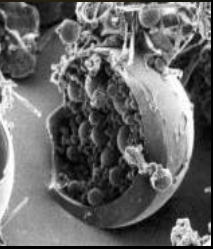


## *“left the station” (cont.)*

- ➔ Coal combustion residual rule (RCRA): affects disposal of bottom ash, fly ash, and FGD solids.
- ➔ Does not specifically require Hg removal in solid waste, but many utilities will phase out wet ash disposal (i.e., convert to dry disposal). This conversion will decrease the mass of Hg discharged to water bodies.

# *“Coming attractions”*

- ➔ Steam electric effluent guidelines (ELG rule; CWA)
  - > Final rule to be issued by EPA in late September.
  - > Will establish minimum treatment levels for As, Hg, and Se, and nutrients. Heavy focus on FGD wastewater.
  - > Could require elimination of both fly ash and bottom ash wet disposal.





# *Existing Hg regulatory programs*

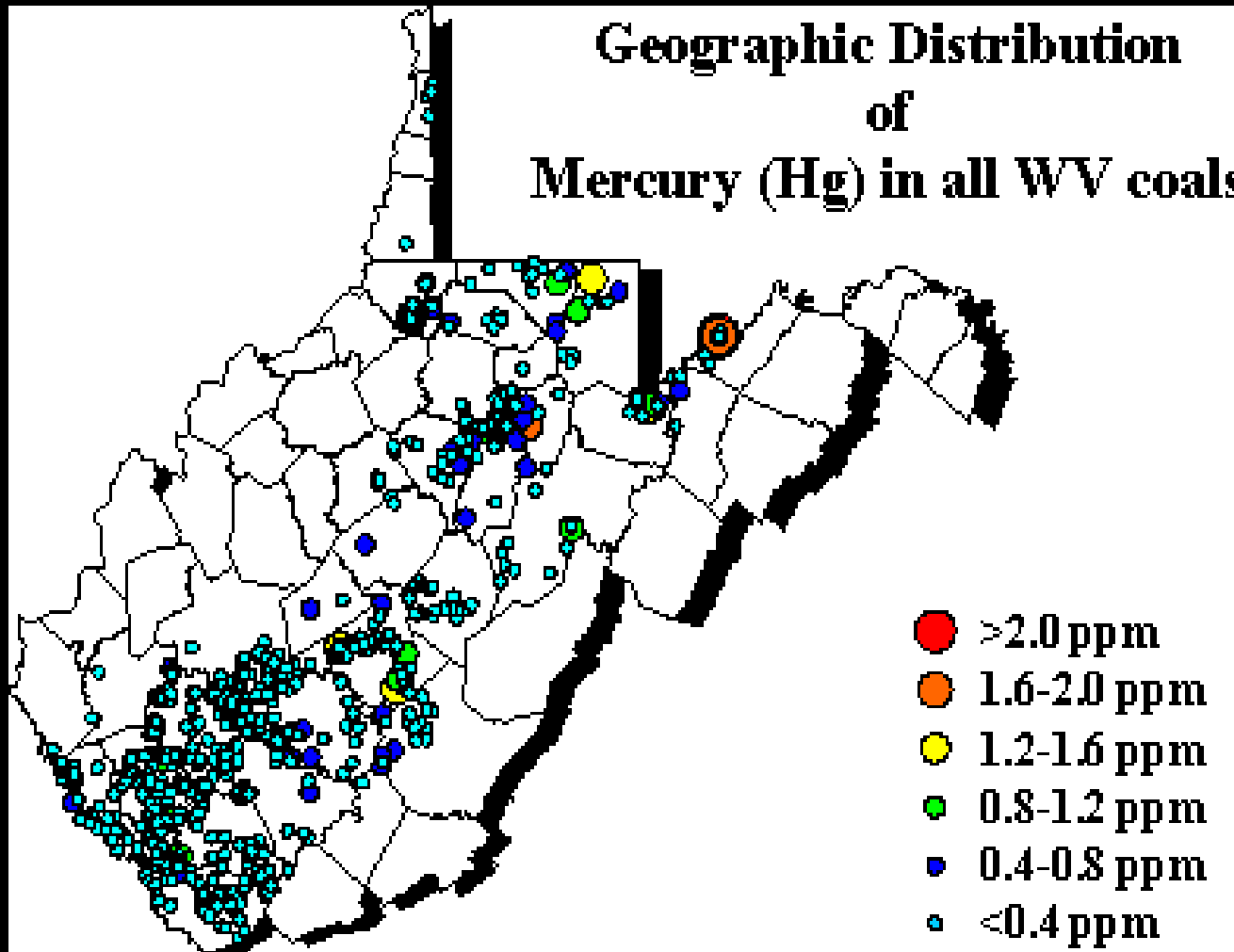
- ➔ Water quality-based effluent limits (WQBELs); based on water column or fish tissue criteria.
- ➔ Total maximum daily loads (e.g., required due to fish consumption advisories)
- ➔ Waterbody-specific requirements (e.g., mercury mixing zone ban for the Ohio River).

# *Hg research project vignettes*

AEP/EPRI collaboration



# Geographic Distribution of Mercury (Hg) in all WV coals



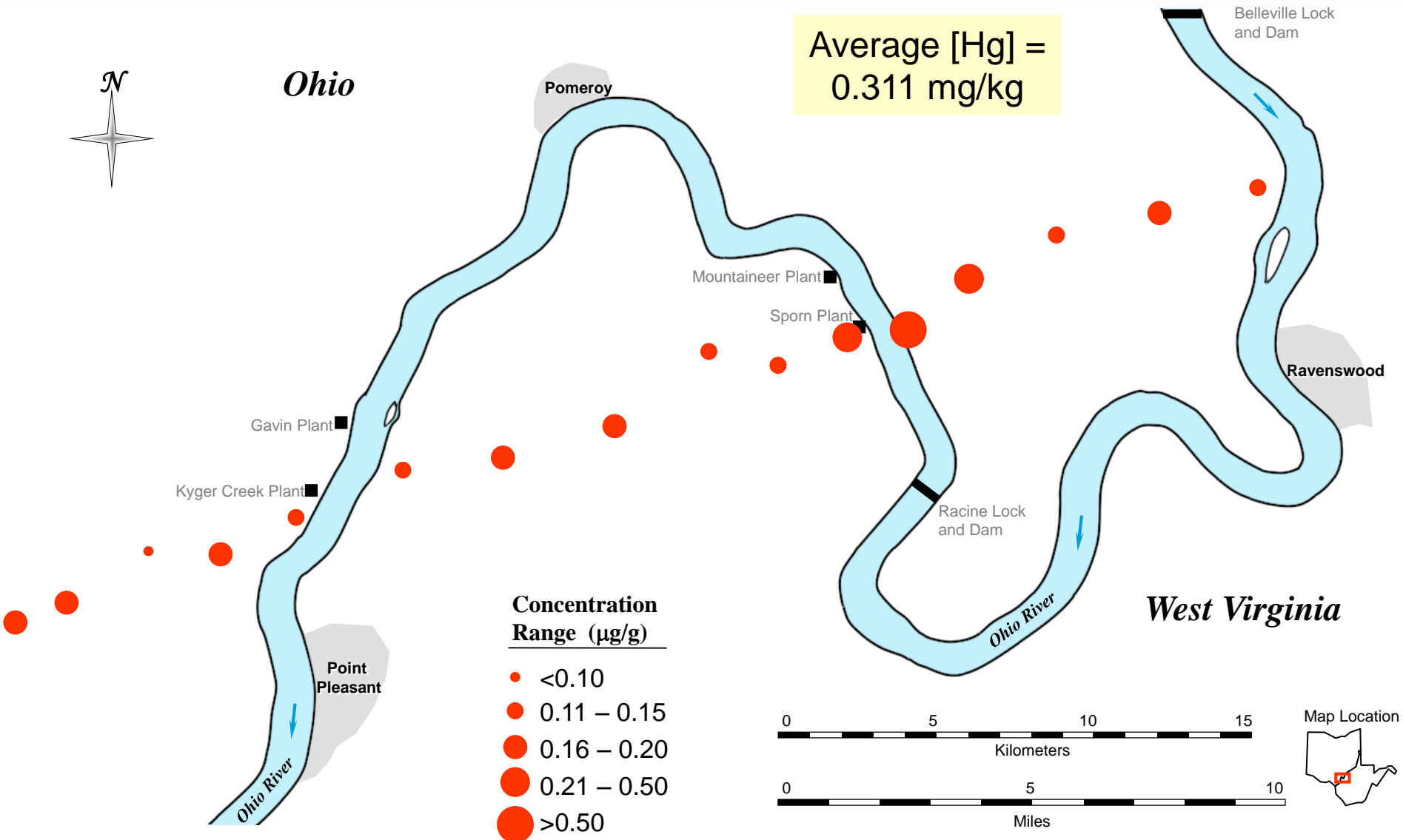
***Hg and other trace elements in lichens  
collected near coal-fired power plants***



# *Flavoparmelia caperata*



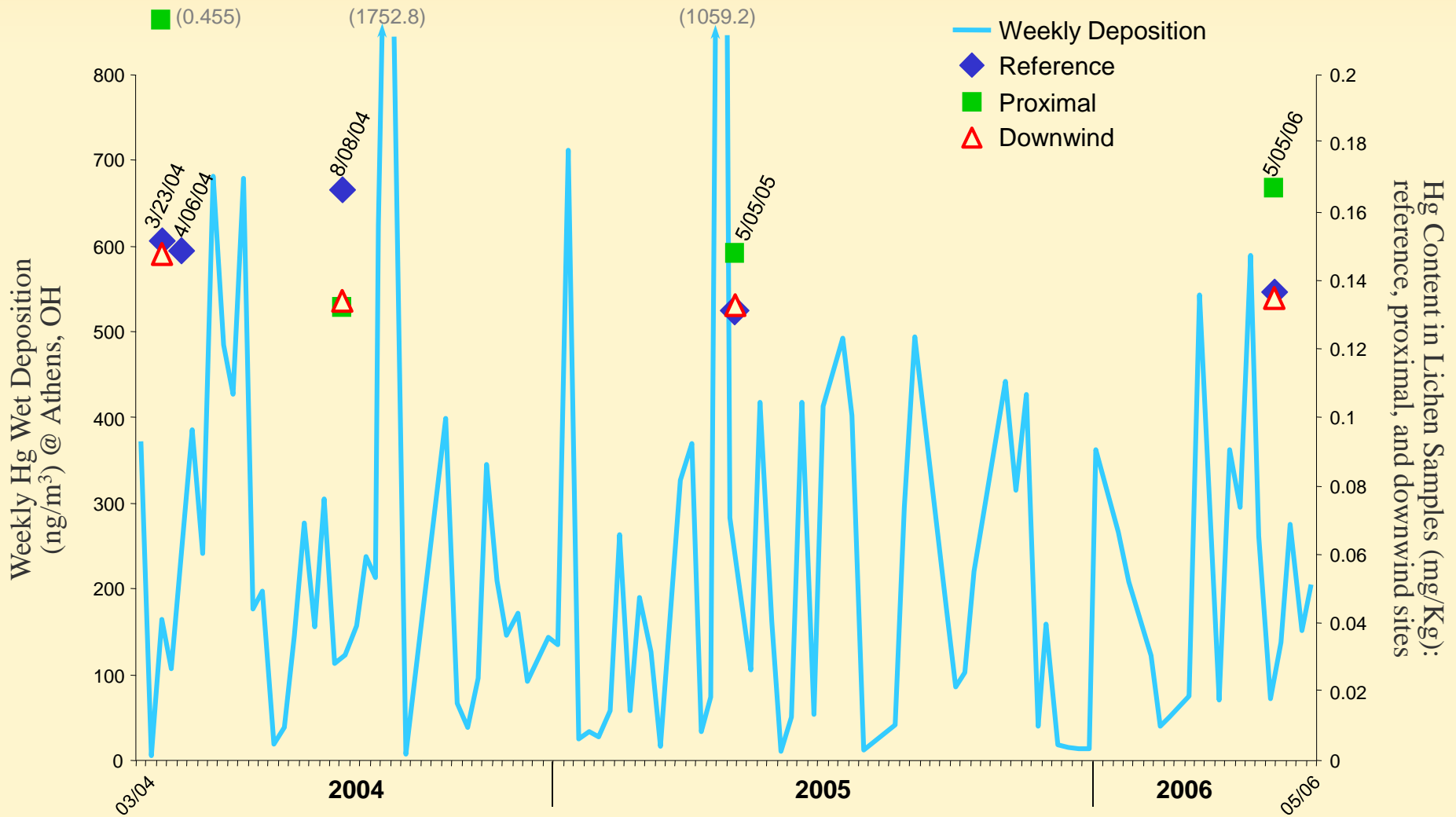
# Mercury content (mg/kg – dry wt.) in *Flavopamelia caperata* samples collected near four coal-fired power plant sites, March 2004 (before ozone season)



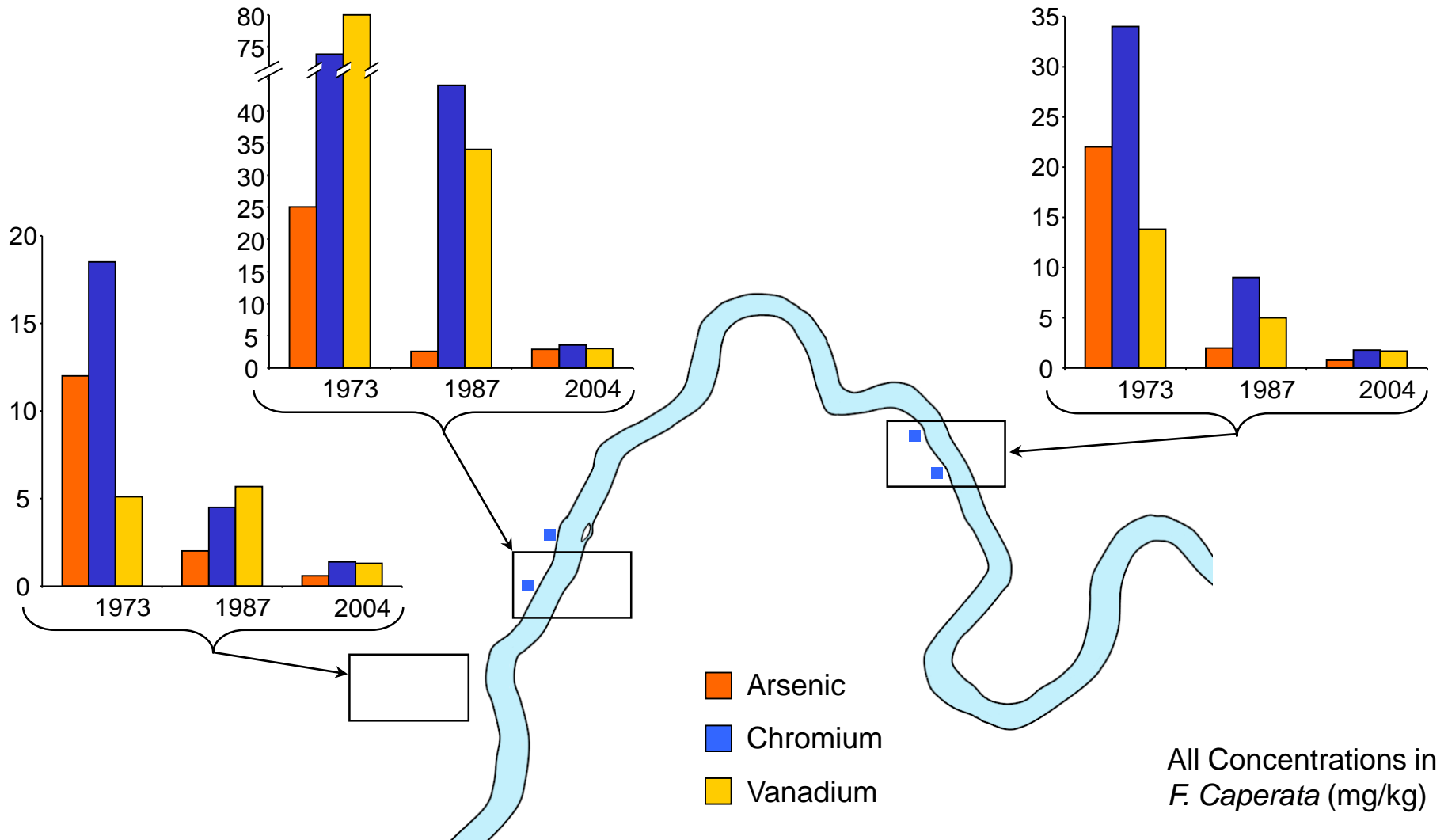
# ***Analysis of Reference and Plant-Influenced Hg Levels in Lichens, 2004-2006***

	<b><i>Reference</i></b>	<b><i>Plant-Influenced (proximal)</i></b>
No. of samples	21	36
Hg – <b><i>Average</i></b> concentration	0.158 mg/Kg	0.174 mg/Kg
Hg – <b><i>Median</i></b> concentration	0.162 mg/Kg	0.149 mg/Kg
Hg – <b><i>Maximum</i></b> concentration	0.202 mg/Kg	0.580 mg/Kg
1-way ANOVA using log- transformed concentrations	No significant differences (P=0.74)	

# Plot of mean Hg levels in lichen samples at three locations (reference, proximal and downwind) versus measured weekly Hg wet deposition at Athens, Ohio

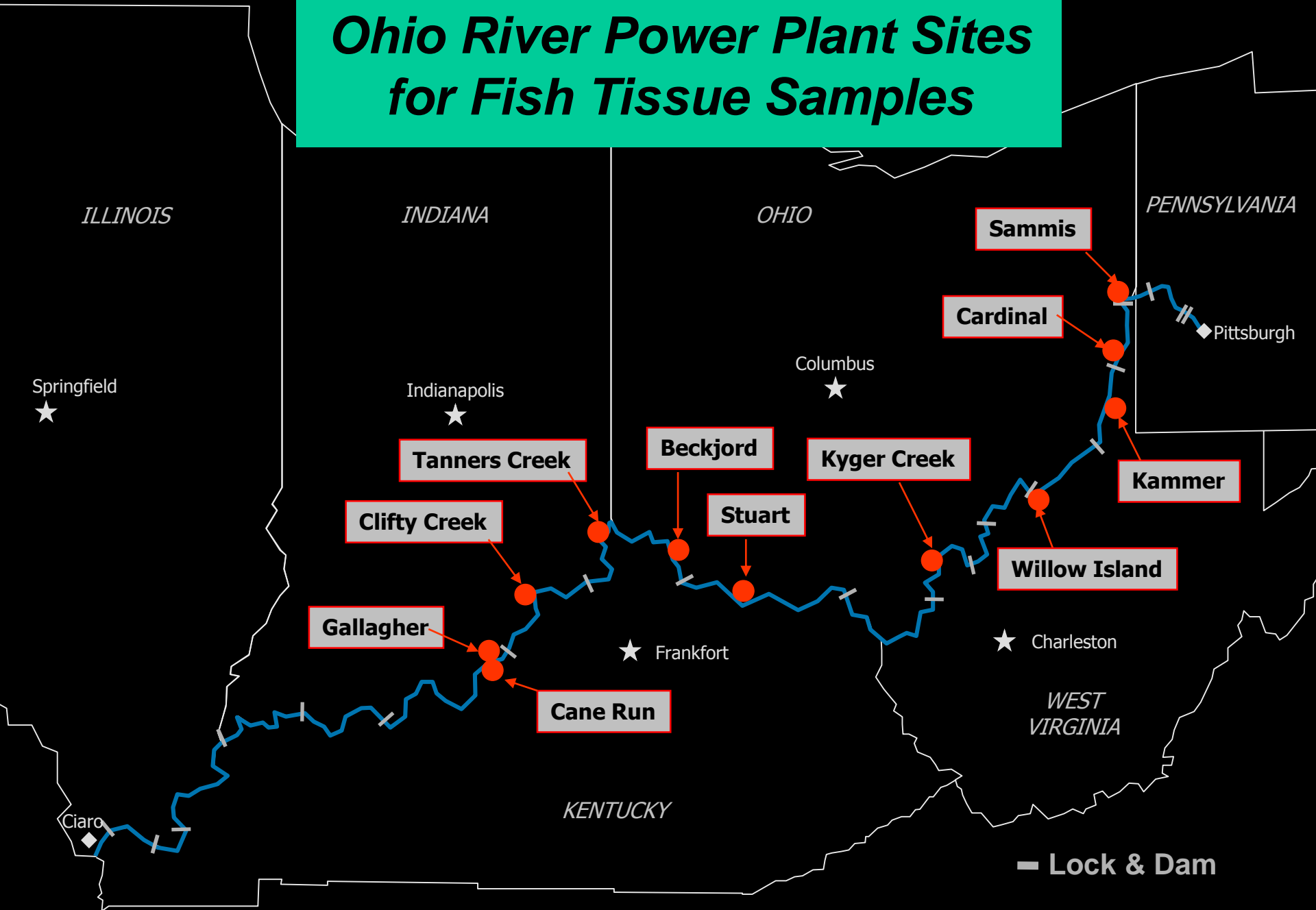


**Temporal variation in concentrations (mg/kg – dry wt.) of As, Cr, and V in composite samples of *F. caperata* at background and power plant-influenced locations 1973-2004.**



***Hg and Se in fish proximal to power plants  
and in fly ash-affected streams***

# Ohio River Power Plant Sites for Fish Tissue Samples





**GLAD** SimplyCooking  
Microwave Steaming Bags

Crisp, tender vegetables  
without the pots & pans

**GRAB**  
HOLDS WRAP IN PLACE FOR NEXT USE.

CAUTION/PRECAUCION  
SHARP CUTTING EDGE  
BORDE MUY CORTANTE

KEEP OUT OF REACH OF CHILDREN  
MANTENGASE FUERA DEL  
ALCANCE DE LOS NIÑOS

CAUTION/PRECAUCION  
SHARP CUTTING EDGE  
BORDE MUY CORTANTE

74 75 76 77

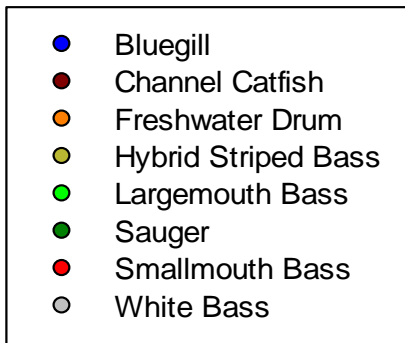
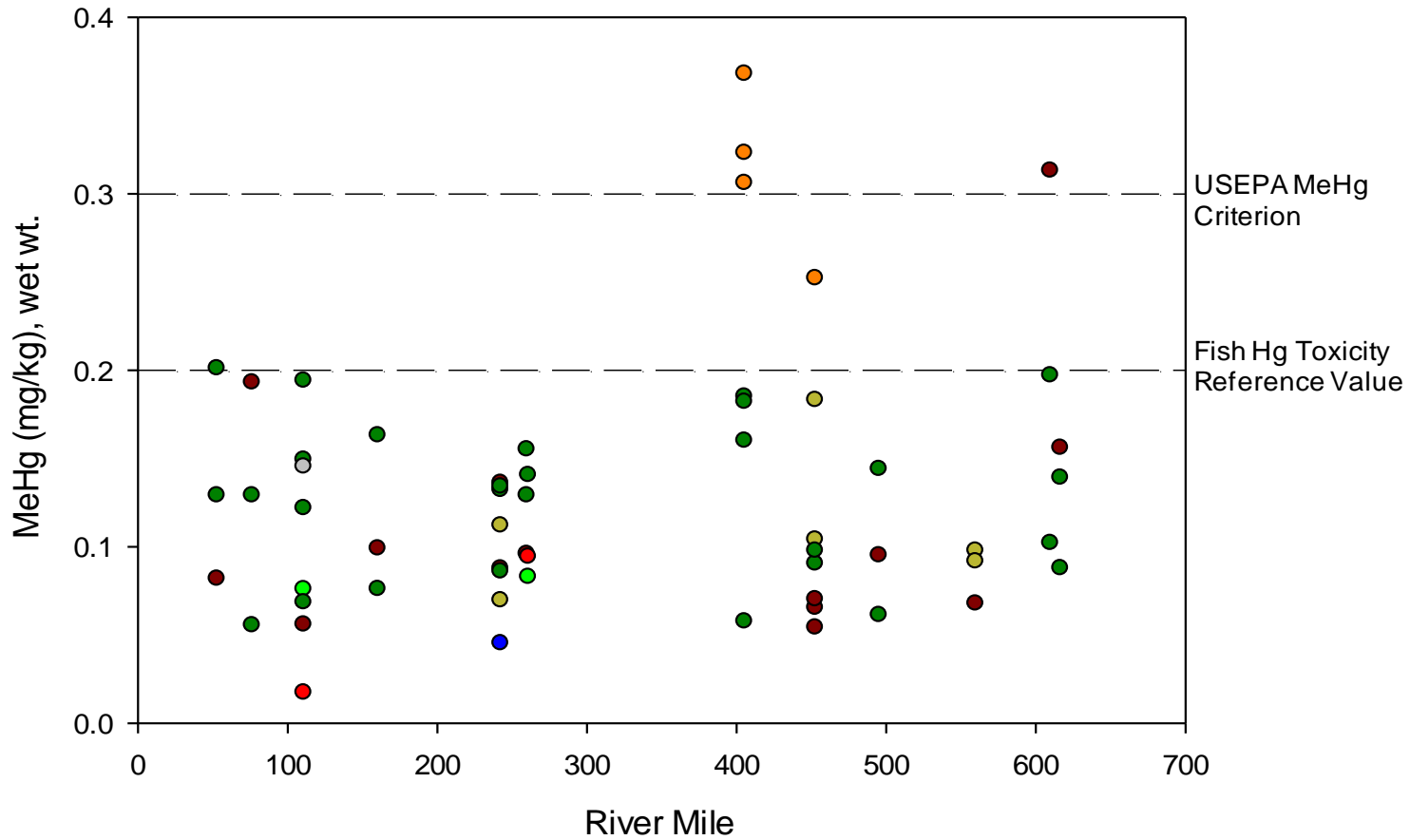
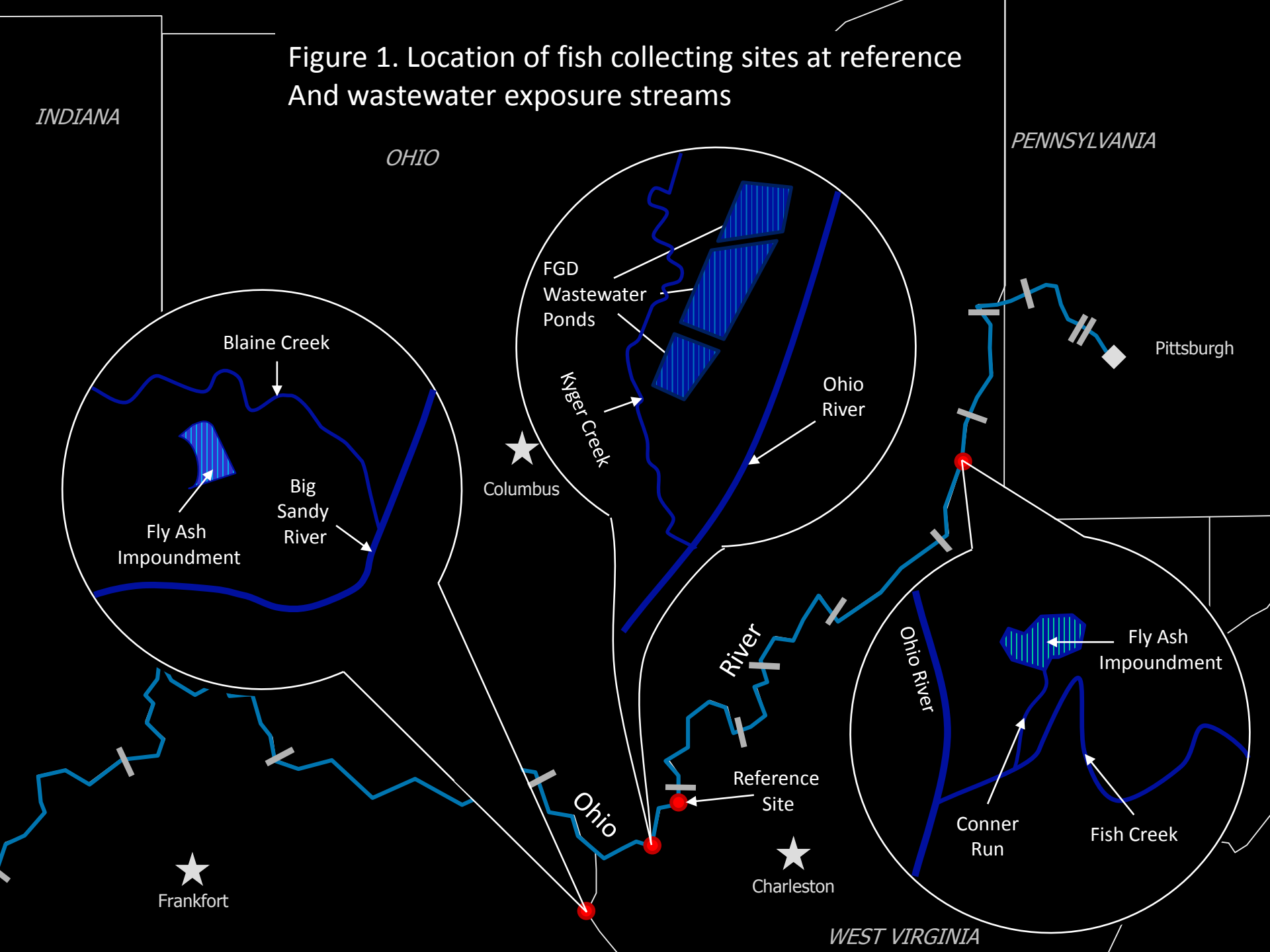
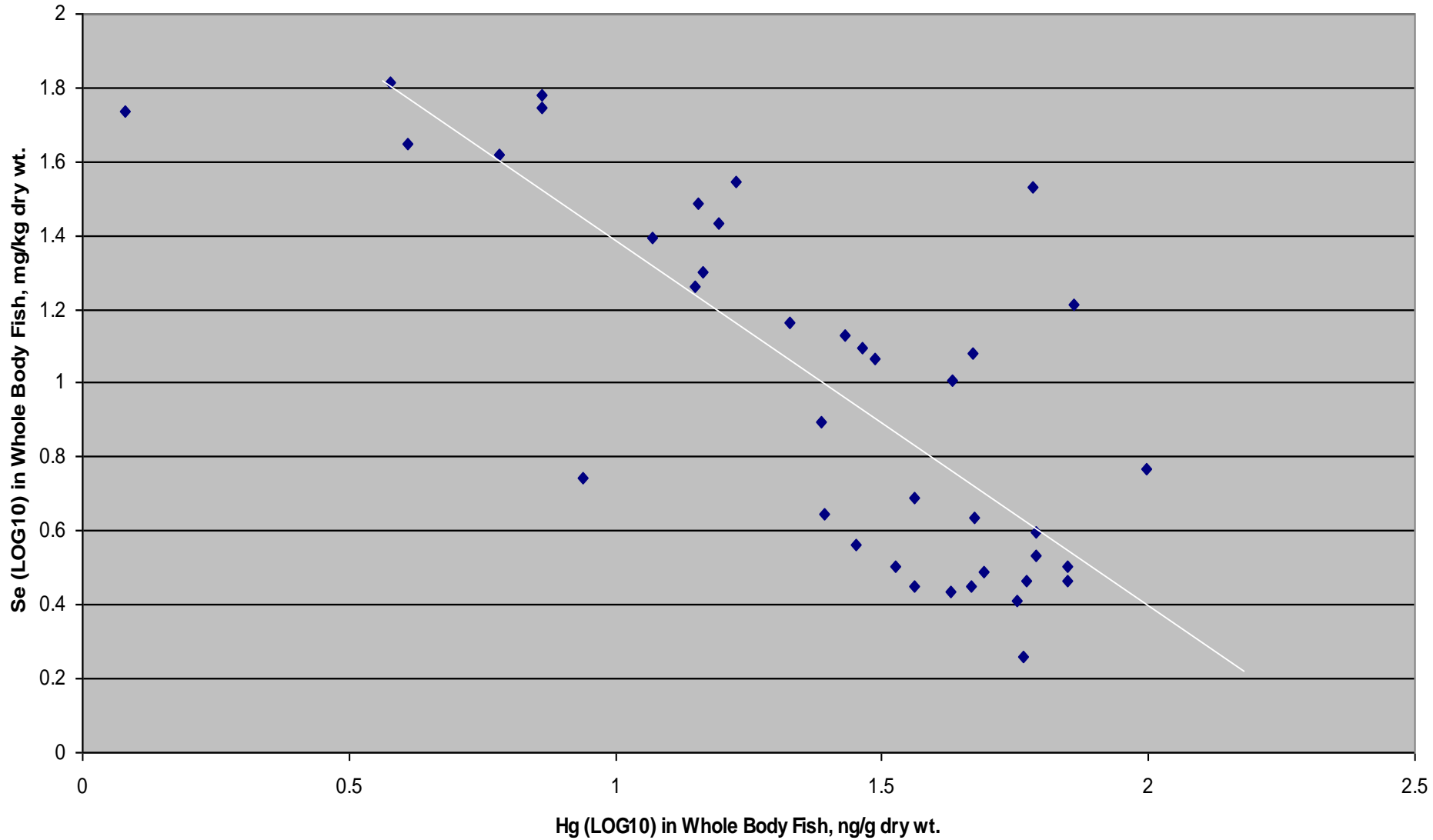


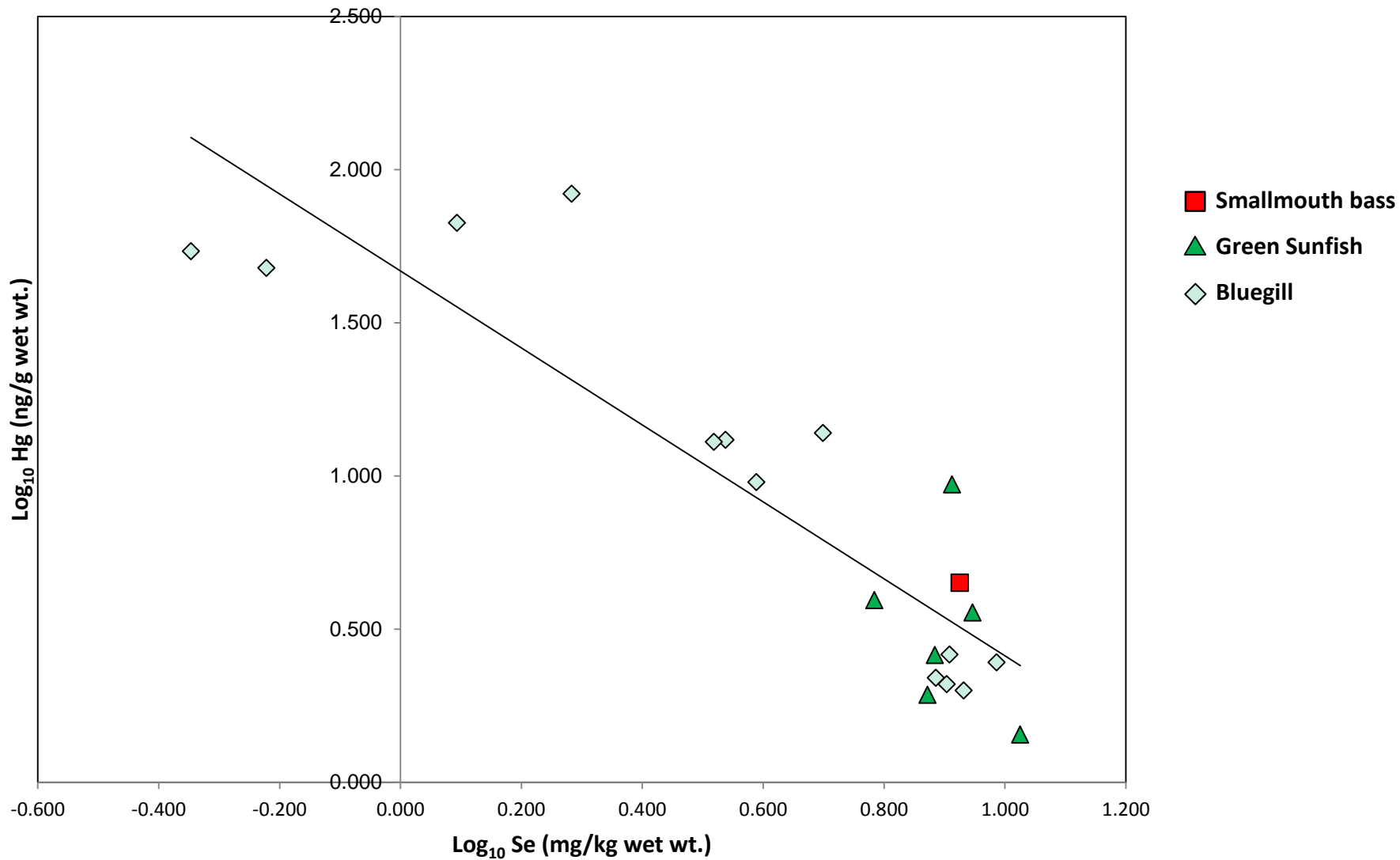
Figure 1. Location of fish collecting sites at reference And wastewater exposure streams



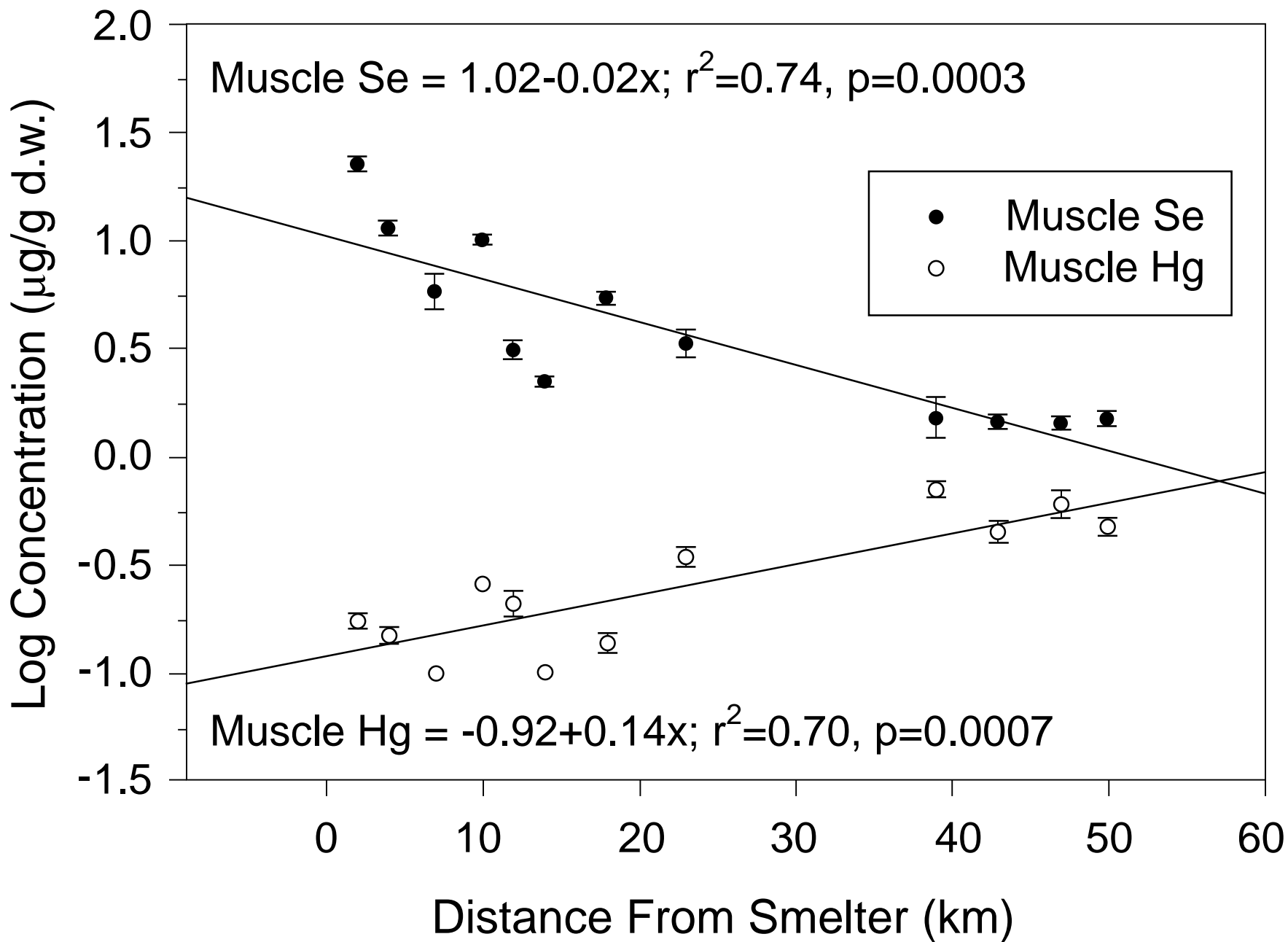
Plot of Whole body Hg vs. Whole body Se, all Fish Combined ( $r^2 = 0.66$ )



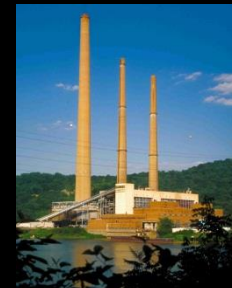
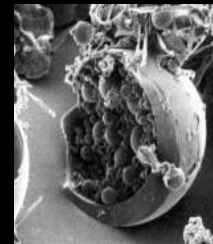
Plot of  $\text{Log}_{10}$  Hg vs.  $\text{Log}_{10}$  Se in Fillet Samples - Sunfish Species from Exposure Sites  
( $r^2 = 0.79$ ;  $P < 0.00001$ )



*Reash, R.J. et al. 2015. Mercury and other trace elements in Ohio River fish collected near coal-fired power plants: interspecific patterns and consideration of consumption risks. Integrated Environmental Assessment and Management 11: 474-480*



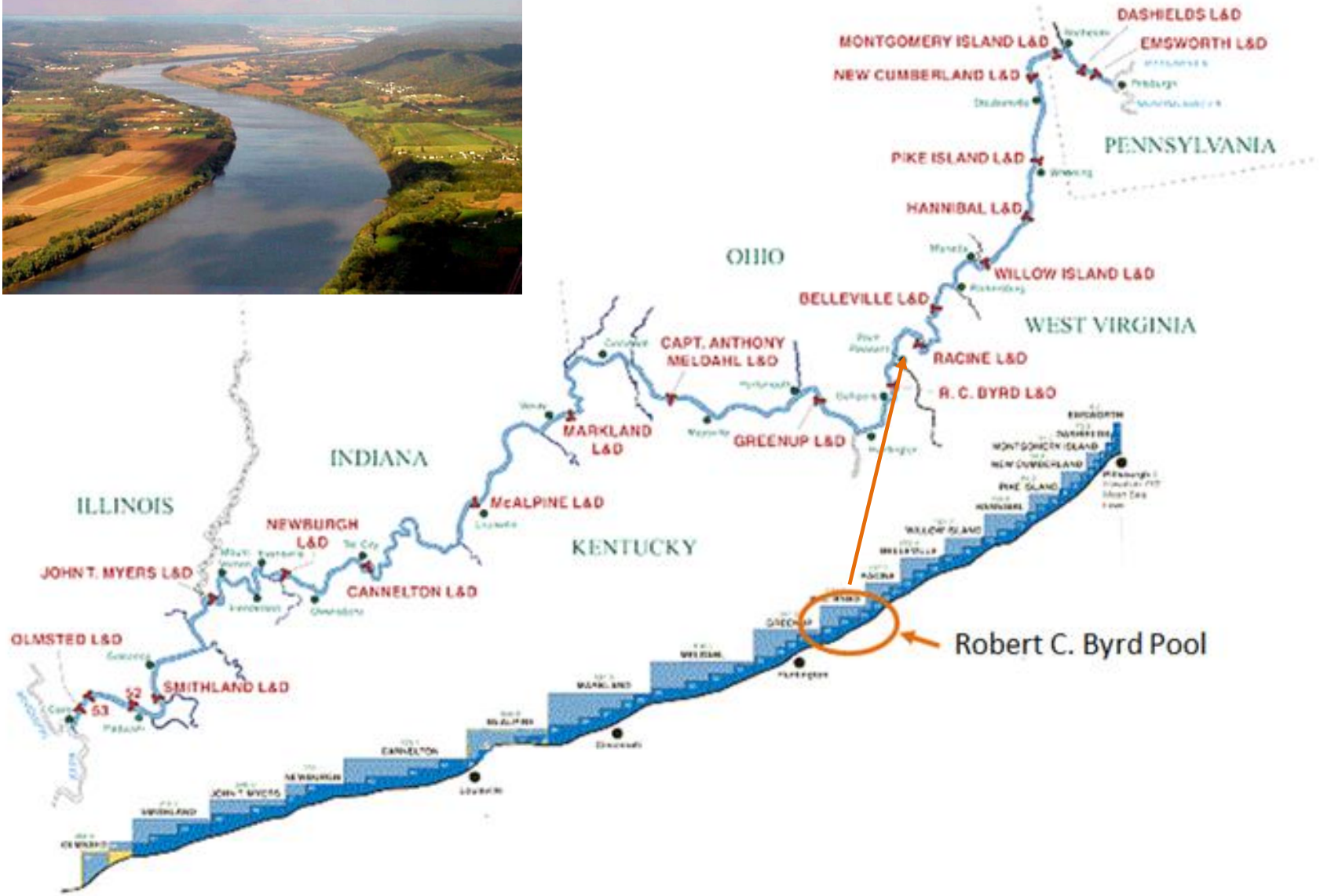
# Mercury Modeling of the Ohio River Using D-MCM: Final Results



Robin J. Reash  
American Electric Power, Columbus, OH

Reed Harris, Consultant



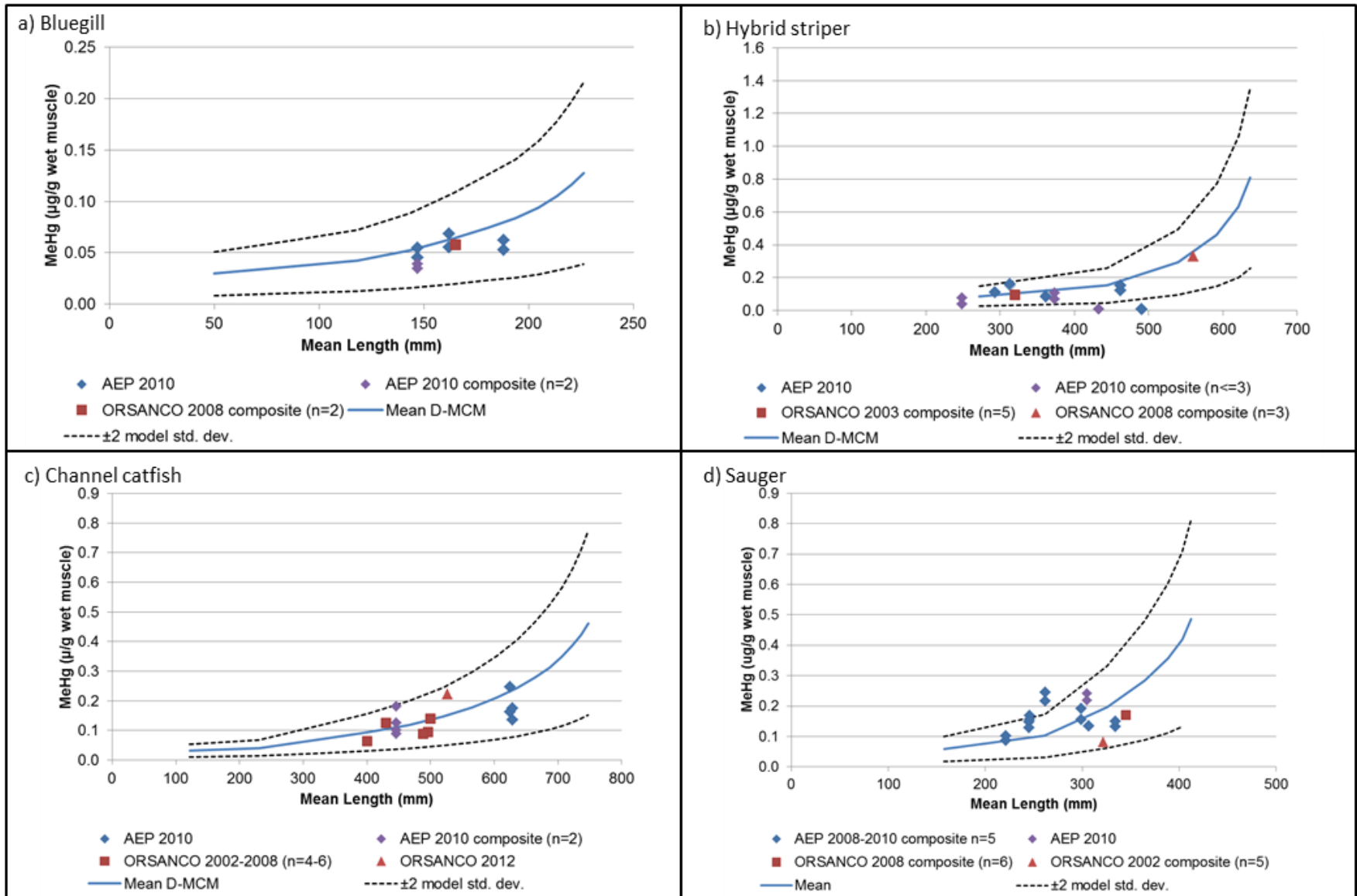




# *How was model run?*

- ➔ Model run simulated for 100-year period (allows for steady-state equilibrium).
- ➔ Results for year 101 evaluated.
- ➔ Sensitivity analysis (influence of a single variable) and probabilistic analysis (influence of aggregate variables on response variable uncertainty) performed.

# Predicted and Observed MeHg in Fish in Robert C. Byrd Pool



# Results – Hg and MeHg in water

→ In Byrd Pool, sources of water THg:

→ 80% from upstream

→ 19% from Kanawha River

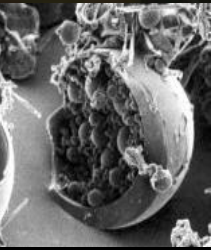
→ < 1% for both air deposition and point-sources

→ 95% of total MeHg from upstream

→ water column methylation < 1% of total MeHg

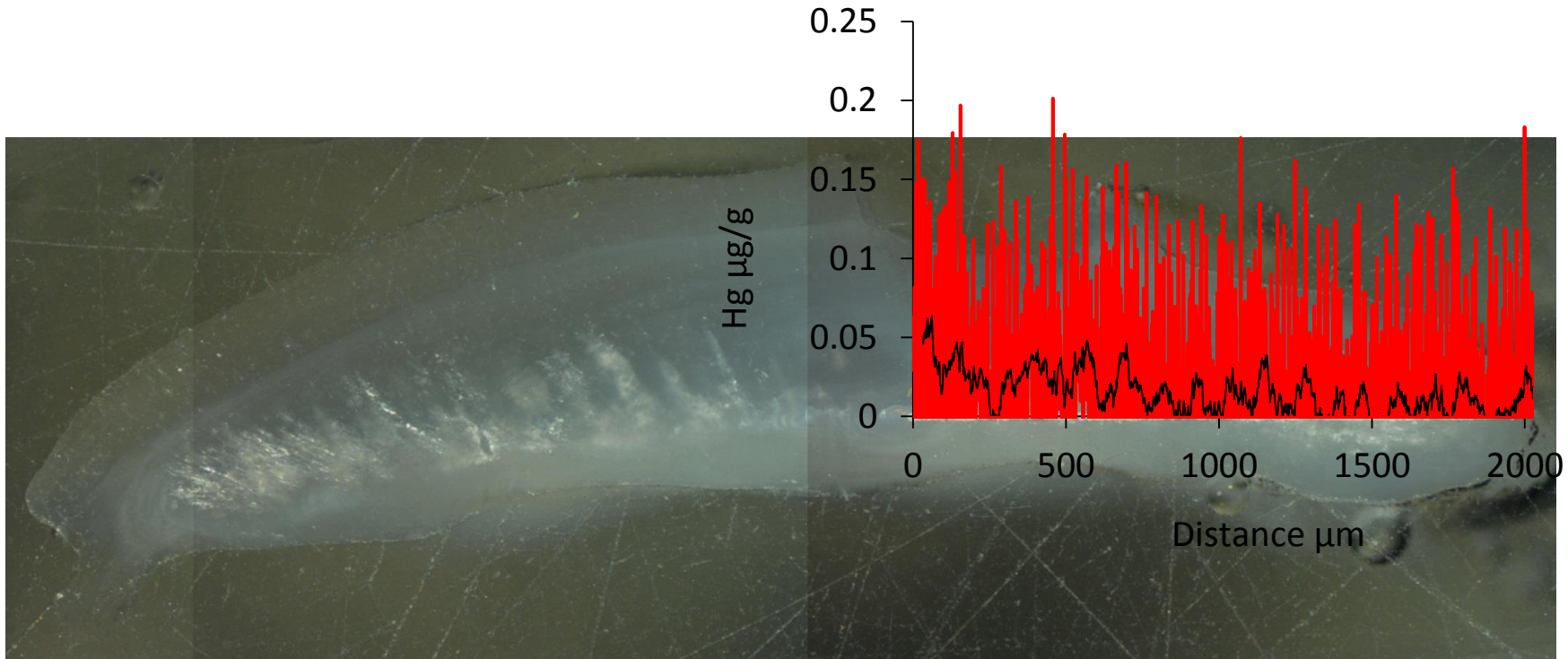
→ sediment methylation negligible

☀ **Methylation potential in Ohio River is LOW.**



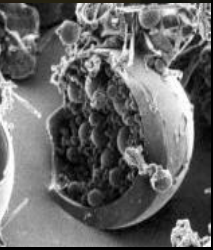
***Hg and Se in otoliths – fish from  
reference and fly ash-affected sites***

Profile of otolith Hg in hybrid striped bass collected from Ohio River Mile 242 (reference). Age = 2+. Fillet MeHg = 0.133 mg/kg



# Concluding points

- ➔ Mercury is a global problem which requires global solutions.
- ➔ Mercury-selenium interactions are real; risk considerations should be based on levels of both trace elements in fish.
- ➔ The utility sector has made contributions to understanding Hg sources, cycling, and potential risks.
- ➔ As always, there is more research to be done.





# *MY CONTACT*

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# Questions ??

