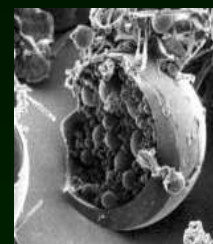


Site-Specific Chronic Selenium Aquatic Life Criterion for a Coal-Fired Power Plant Discharge on the Ohio River

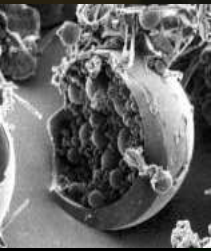


Rob Reash
American Electric Power Columbus, Ohio
Water and Ecological Resources Section



Objectives

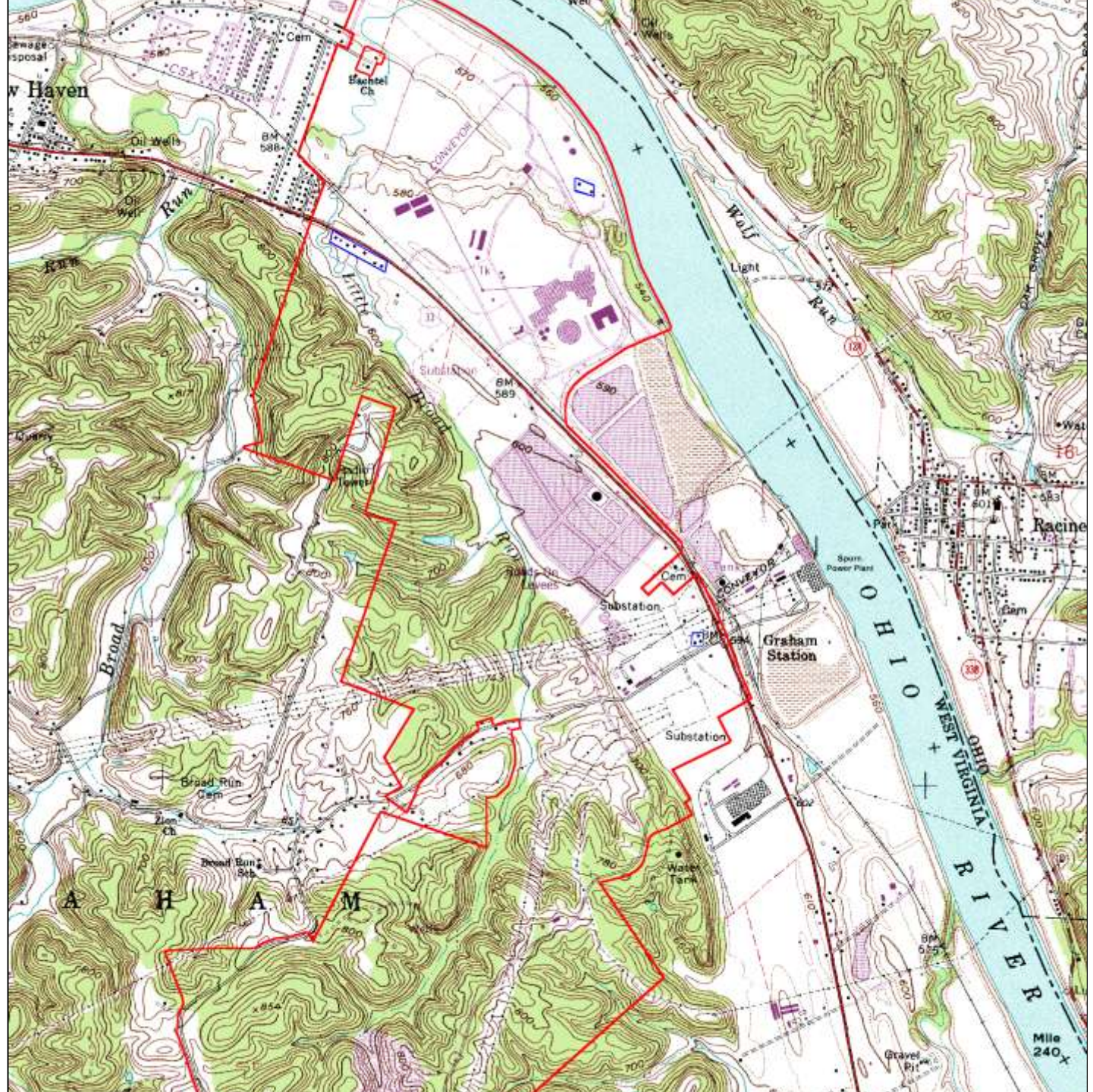
- ➔ Assess Se bioaccumulation in a simplistic food chain (water→periphyton→forage fish→piscivore) in a high-exposure setting.
- ➔ Evaluate methods to determine a potential site-specific Se water criterion.





Mountaineer Plant

- ➔ Located on Ohio River near New Haven, WV.
- ➔ 1,300 MW facility w/ SCR, wet FGD, and demonstration-scale carbon capture w/underground injection.
- ➔ FGD WWTP fitted for phys-chem processes and organo-sulfide for enhanced Hg removal.
- ➔ ABmet selenium bioreactor operational late 2011. Must meet average Se WQBEL of 33 $\mu\text{g/L}$ by 7/2011.





Methods

- ➔ Collection of forage and piscivore fish in acute mixing zone (known fish concentrator); 2010 and 2011.
- ➔ Analysis of total Se, As, and Hg, and MeHg, in whole body (forage fish), fillet, and/or ovary samples. Trace metal analysis of periphyton samples.
- ➔ Chemical analysis of mixing zone and reference water samples.







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Separar a lo largo

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CAUTION/PRECAUCIÓN:
SHARP CUTTING EDGE
BORDE MUY CORTANTE

HOLDS WRAP IN PLACE FOR NEXT USE.

AVOID CONTACT & STAY IN A SAFE
LOCATION / EVITE EL CONTACTO Y
GUARDE EN UN LUGAR SEGURO

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

CAUTION/PRECAUCIÓN:
SHARP CUTTING EDGE
BORDE MUY CORTANTE

Keeps Fishs
Mantiene el pescado

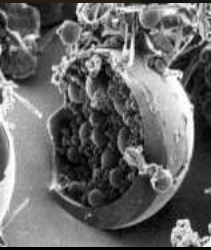
Keeps the Plastic Wrap
Mantiene el plástico

Keeps the Seal
Mantiene el sello

Keeps the Seal
Mantiene el sello

Expected New Se Water Quality Criteria

- ➔ Water criteria: 2.3 $\mu\text{g/L}$ for lake/lentic waters.
3.9 $\mu\text{g/L}$ for running waters.
- ➔ Reasonable potential is likely even if you discharge very low levels.
- ➔ Ovary criterion $\sim 17 \text{ mg/Kg}$.
- ➔ Permitting issue: if agency determines RP based on water criterion and places Se WQBEL, you need a mechanism to remove the WQBEL if ovary criterion is attained.





Water Analysis Results (mean values)

Parameter	Reference	Mixing Zone
As ($\mu\text{g/L}$)	0.9	5.6
Se ($\mu\text{g/L}$)	< 0.3	23.6
Zn ($\mu\text{g/L}$)	4.2	13.5
Al (mg/L)	0.30	1.1
Hardness (mg/L)	136	814
TDS (mg/L)	261	1,522
Sulfate (mg/L)	81	458
pH (s.u.)	7.97	8.26

Periphyton Analysis Results

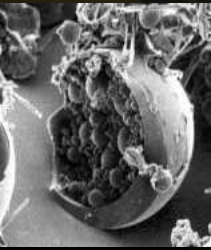
➔ Sept 2010 sampling:

- Mixing zone samples w/elevated levels of Cu, Mg, Mo, Ni, Se, Tl. Avg [Se] = 8.14 mg/kg dry wt.
BCF = 509 (mixing zone); 735 (reference)

➔ Oct 2011 sampling:

- Mixing zone samples w/elevated levels of Mo, Se, Tl. Avg [Se] = 24.4 mg/kg
BCF = 1,061 (mixing zone); 4,567 (reference)

- ## ➔ For both sampling events, levels of Hg in reference samples were higher.





Forage Fish Analysis Results

- ➔ Species: channel shiner/emerald shiner mix
- ➔ Tissue analyzed: whole body composites.
- ➔ Reference avg [Se] = 2.25 mg/kg dry wt.
- ➔ Mixing zone avg [Se] = 3.70 mg/kg
- ➔ BAFs (periphyton → forage fish): 1.64 (reference) and < 1 for mixing zone.



Piscivore Fish Tissue Results

➔ April 2010

Species	Tissue	Reference Se (mg/kg)	Mixing zone Se (mg/kg)
HSB	Ovary	----	23.1
	Fillet	4.23	12.2
Bluegill	Ovary	----	3.80
	Fillet	3.0	2.99

Piscivore Results (cont.)

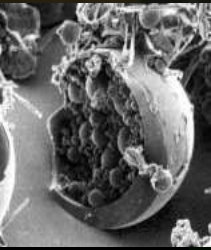
➔ August 2010

species: sauger

tissue analyzed: fillet

reference avg [Se] = 3.2 mg/kg

mixing zone avg [Se] = 3.4 mg/kg





Piscivore Results (cont)

→ October 2011

Species	Tissue	Reference Se (mg/kg)	Mixing zone Se (mg/kg)
Bluegill	Whole body	----	5.0
	Fillet	3.1	----
HSB	Fillet	2.8	6.8
Sauger	Fillet	2.4	2.4



Calculation of Site-Specific Se Criterion to Protect HSB

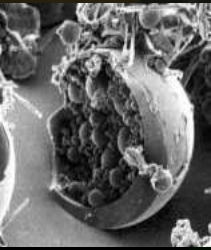
$$C_{\text{water}} = C_{\text{predator}} / (BCF_{\text{algae}} \times TTF_{\text{cons}} \times TTF_{\text{pred}})$$

$$C_{\text{water}} \frac{17 \text{ mg/kg (EPA ovary criterion)}}{(509 \text{ L/kg} \times 0.1 \times 6.2)}$$

$$= 53.9 \text{ } \mu\text{g/L}$$

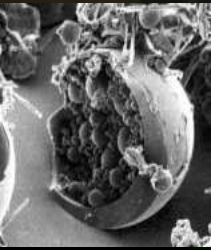
Conclusions – Fish Tissue Results

- ➔ No evidence of bioaccumulation risks to bluegill and sauger.
- ➔ HSB may be at risk of Se bioaccumulation.
- ➔ HSB ovary [Se] exceeds anticipated EPA ovary criterion, however is only slightly higher than LMB reproductive threshold (21 mg/kg).
- ➔ HSB have HIGH growth rate (all fish collected for Se analysis were either age 1+ or 2+).



Conclusions

- ➔ Se bioaccumulation risks must be assessed species-by-species
- ➔ Periphyton (also true of algae) K_d value is most variable and may not be needed.
- ➔ In this study, only HSB had tissue levels of concern.
- ➔ Whatever method is used to derive a SS criterion, trophic relationships must be understood; important for understanding routes of exposure.





Thank you for your attention

➔ Questions?