

Roane County Long Term Recovery Committee December 16, 2009

Overview of Biological Monitoring and
Evaluation of Metals Release During Time
Critical Dredging Work

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Overview of Studies

- Fish Bioaccumulation and Health Studies For Exposure to Coal Ash Released to Aquatic Ecosystem
 - TDEC, TWRA, ORNL & TVA
- Evaluation of Metals Release During Time Critical Dredging Work
 - US Army Corps of Engineers; Engineering Research & Development Center (ERDC)

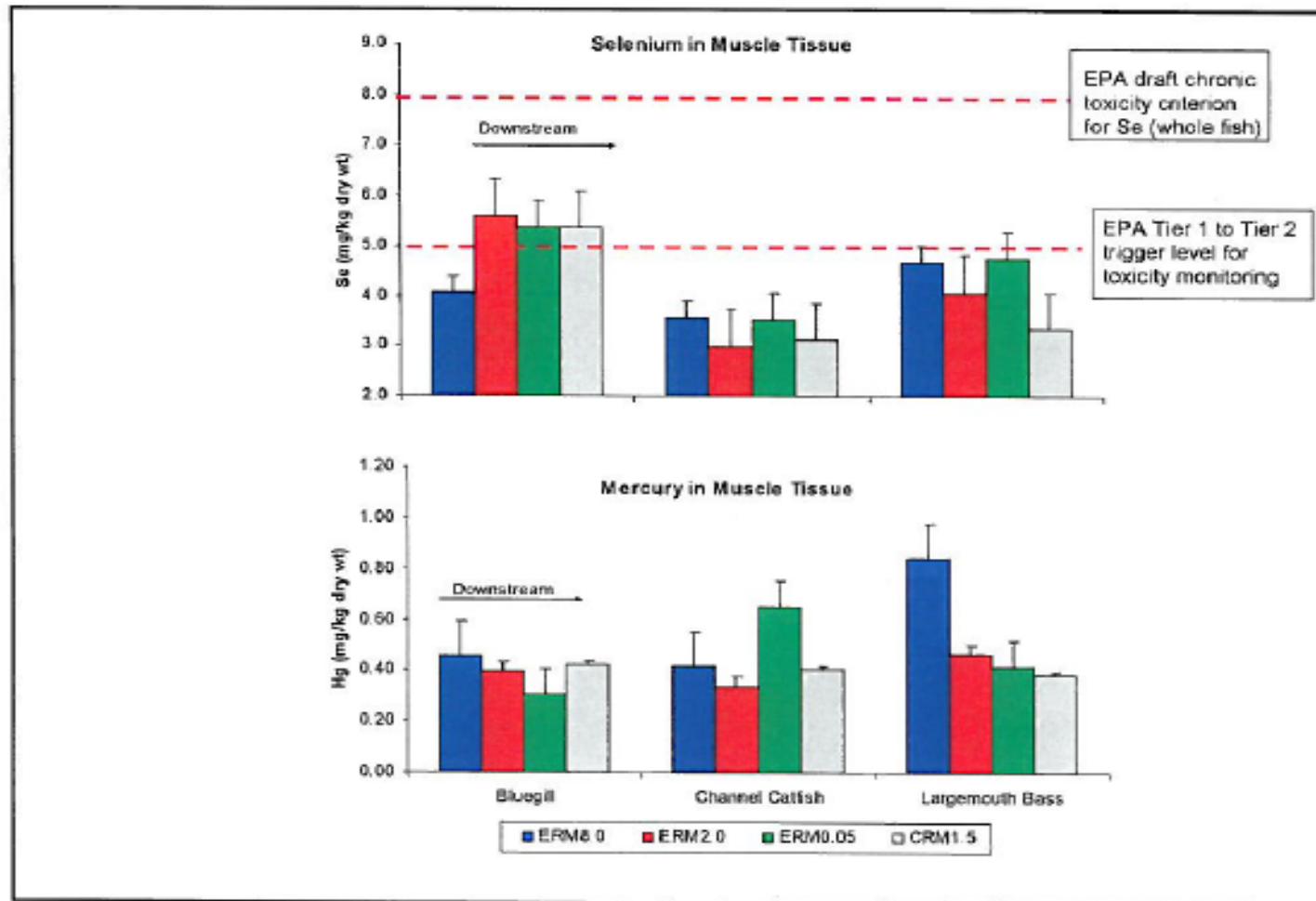
ORNL Fish Bioaccumulation and Health Studies

- ORNL tested bluegill (BG), largemouth bass (LMB), channel catfish (CC) and forage fish from 4 sites in Emory/Clinch Rivers in early 2009;
- Fish fillets analyzed for metals (human health)/Whole body fish analyzed for metals (fish eating wildlife);
- Fish Health assessed by blood chemistry, organ condition, and overall physiology.

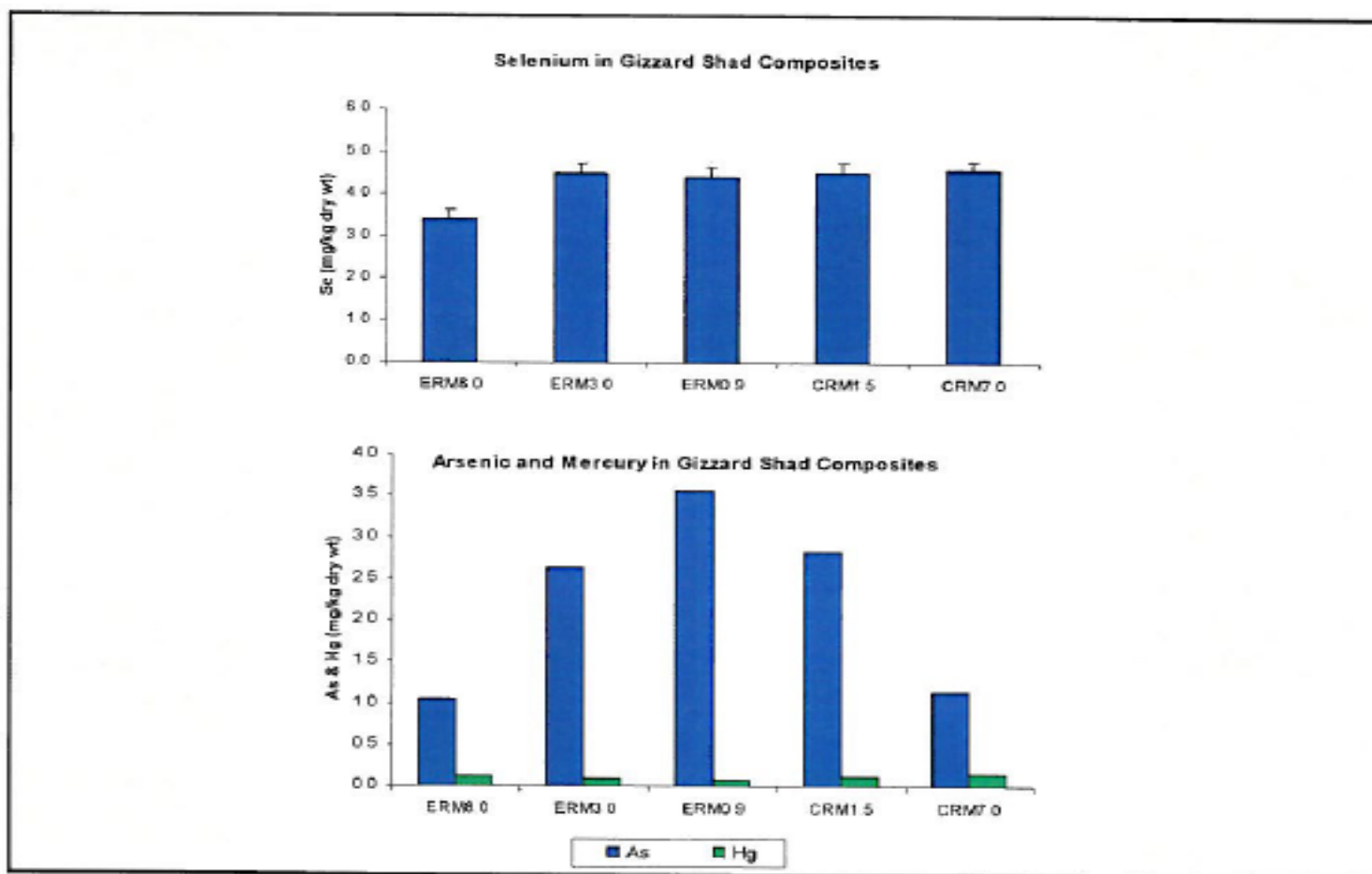
ORNL Fish Monitoring Stations



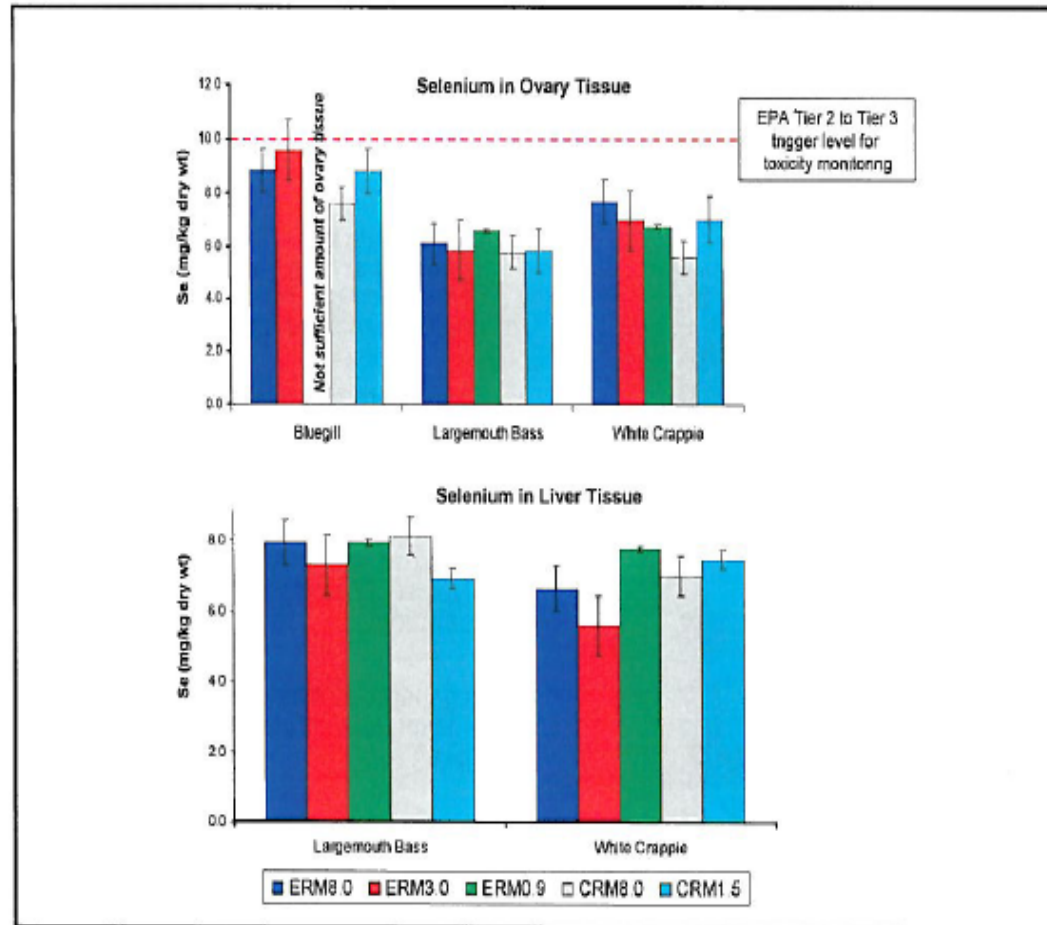
Selected Fish Tissue Results



Selected Forage Fish Results



Selenium in Fish Ovary/Liver



Preliminary Conclusions

- Slight elevations in fish tissue in some species downstream of ash spill;
- Concentrations in fish tissue below levels of concern for human health (except mercury);
- EPA guidance for mercury in fish fillets is 0.30 ppm. Highest levels were in Emory reference station. Fish advisory for mercury posted by TDEC prior to ash spill;
- Reproductive impacts uncertain at this time. More investigation to be conducted; and
- Fish health indicators were similar downstream of the spill to those upstream of the spill. No clear correlation between fish contaminant levels and fish health.

Future Monitoring

- ORNL conducted bioaccumulation/fish health studies in Fall 2009. Spring and Fall events planned for 2010.
- Various other surveys underway or scheduled to assess potential impacts to wildlife (terrestrial birds, aquatic/shoreline birds, terrestrial mammals, otters, mussels, benthic macroinvertebrates).
- Fish community surveys conducted by TVA and TWRA at spill locations in 2009 do not show changes in diversity or abundance. Fish spawn migration up Emory not impaired by ash spill.
- Impacts to fishery appear limited to physical burial.
- Emory/Clinch water quality and Kingston water supply monitoring to continue throughout cleanup process.
- Comprehensive Emory/Clinch/TN River sampling and analysis plan out by January 2010.

ERDC Summary

- Experiments designed to evaluate changes in coal ash chemistry and metals release during Time Critical dredging work.
- Reduction – “Selenite” (SE IV); a gain of electrons.
- Oxidation – “Selenate” (SE VI); a loss of electrons. More toxic form of selenium.
- Aggressive, 10-day agitation tests with Emory River water to represent worst case scenarios under pure O₂ (aerobic) and N₂ (anaerobic) conditions. Elutriate water analyzed for changes in chemistry.

Analysis of Fly Ash

- Total elemental concentrations of the three ash samples, many elements elevated compared to native soils
- There is little variability in concentration between samples
- Sequential extraction data suggest some metals are in 'environmentally mobile' fractions

Analyte	Fly Ash Sampling Location		
	Emory River	Sluice Channel	Storage Pile
TOC ^a	44930	16780	51840
TIC ^b	170	370	120
Aluminum	30600	29900	18600
Antimony	0.233	0.212	0.145
Arsenic	65.8	76.2	46.9
Barium	655	515	510
Beryllium	7.15	6.03	4.88
Cadmium	0.576	0.631	0.272
Calcium	9090	6510	6780
Chromium	48.7	49.2	33.5
Cobalt	25.6	23.1	16.9
Copper	84.1	76.4	50
Iron	17700	22200	17500
Lead	36.4	33.1	20.2
Magnesium	2780	2380	1940
Manganese	153	187	88.7
Mercury	0.0732	0.0294	0.0279
Molybdenum	4.04	4.23	3.2
Potassium	4690	4890	2760
Nickel	52.6	49.9	34
Selenium	6.97	6.08	5.44
Sodium	709	608	482
Silver	0.426	0.335	0.22
Thallium	2.19	2.04	1.35
Vanadium	133	124	86.2
Zinc	77.4	72.1	41.5

^a Total organic carbon. ^b Total inorganic carbon.

Summary of ERDC Findings

- Did NOT observe oxidation changes in coal ash chemistry under extreme aerobic and anaerobic simulations.
- Did observe some standard dissolution of metals over 10 day test period (e.g. metals concentrations in water increased slightly).
- No oxidation observed in Arsenic or Selenium (seeing only Selenite...not Selenate).
- Minnows and Mussels exposed to 10 day elutriate water did not show significant impacts to survival or growth.
- Conditions in ecosystem will improve as Time Critical dredging work continues.