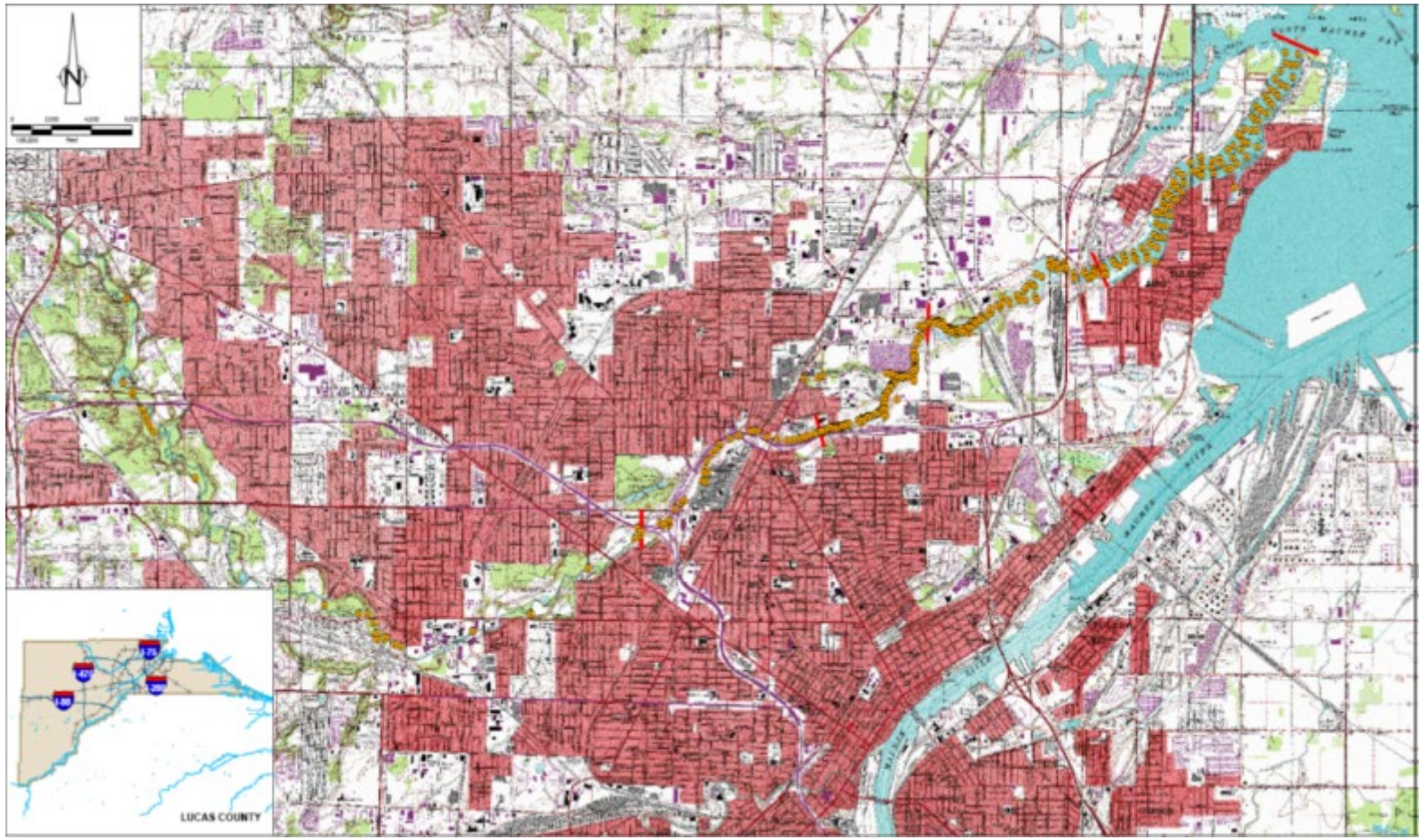
OTTAWA RIVER
OH

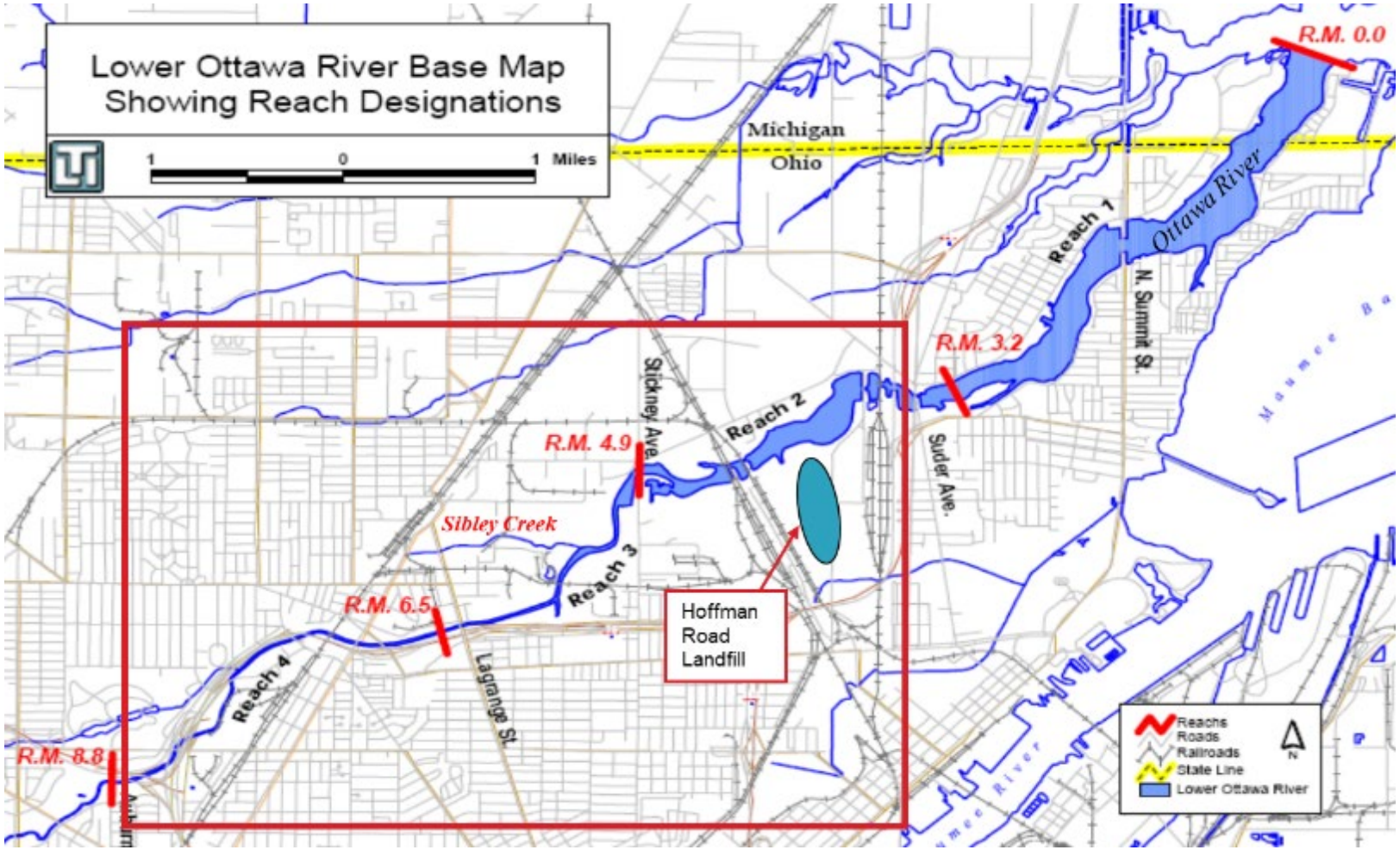
SCOTT CIENIAWSKI, USEPA GLNPO, AND
MARC MILLS, USEPA ORD

Ottawa River Site Overview

Site Vicinity



Project Area



Objectives of Remediation

- Primary COC are PCBs
- Secondary COCs are PAHs and lead
- Sediment PCB concentrations and remediation goals

River Reach	Pre-Construction SWAC (µg/kg)	Post-Construction SWAC Goal (µg/kg)	Long-Term Recovery SWAC Goal (µg/kg)
Reach 4	500		
Reach 3	6,600		
Reach 2	1,000		
Reach 1	800		
Reaches 1 to 4		1,500	250

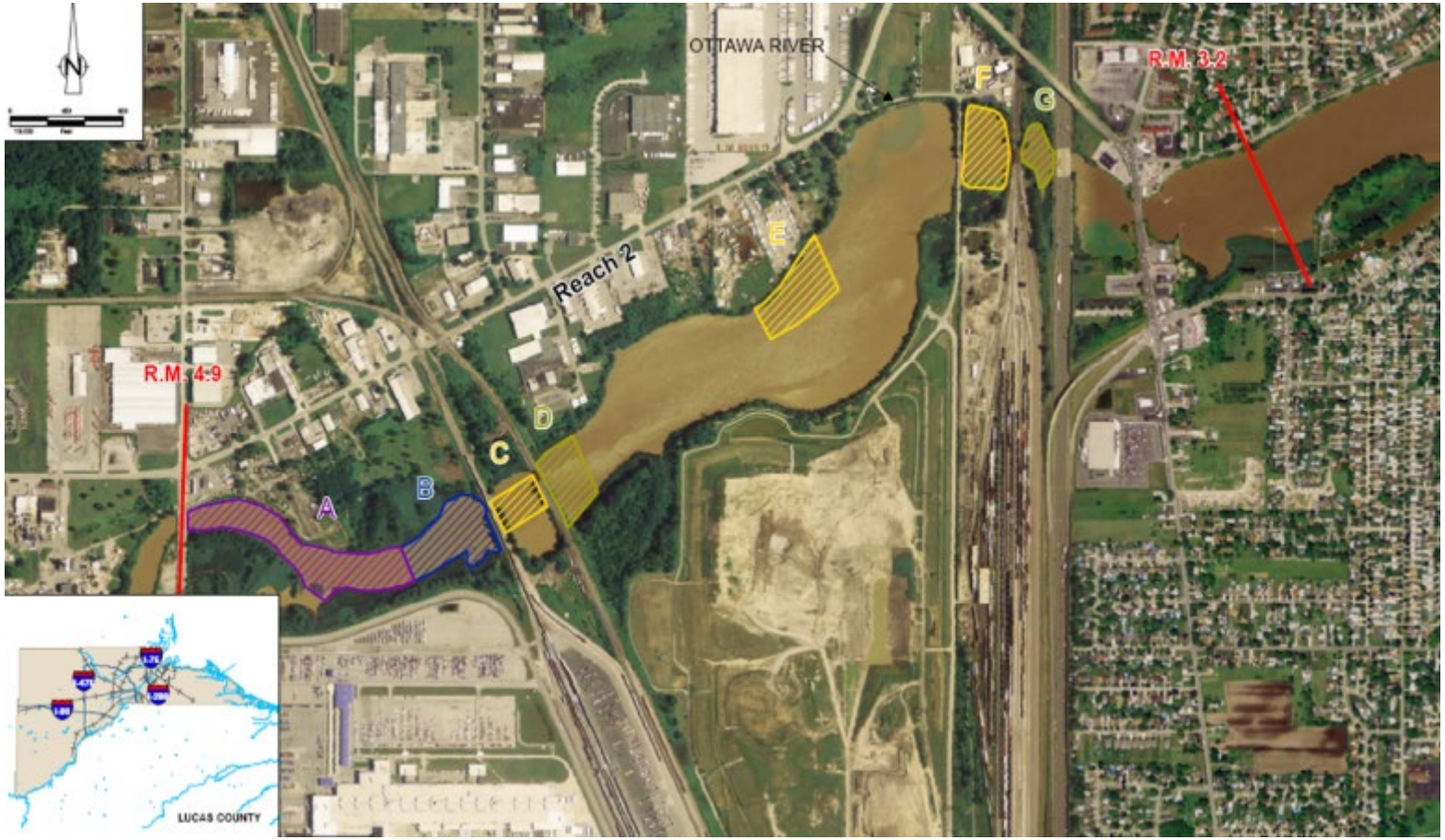
Summary of Remedy

- 1986 to 1995: landfill closures
- 1986 to present: combined sewer overflow reductions
- 1998 to 1999: early remediation of Reach 3 source tributary
- 2006 to 2010
  - 275,000 cubic yards of hydraulic dredging (Reaches 4 to 2)
  - No post-dredge cover placed
  - $43 million construction cost

Reach 4 Remediation (RM 8.8 to 6.5)

Reach 3 Remediation (RM 6.5 to 4.9)

Reach 2 Remediation (RM 4.9 to 3.2)



Key Take-Home Messages

- Be realistic regarding recovery timeframes
- Set protective cleanup goals, but be willing to accept uncertainty in remedial approach
  - Significant benefits to be gained by getting most of the way there
  - Don’t let the perfect project be the enemy of the good project
  - 5-year review process provides opportunity for adaptive management

Research to support GLNPO –

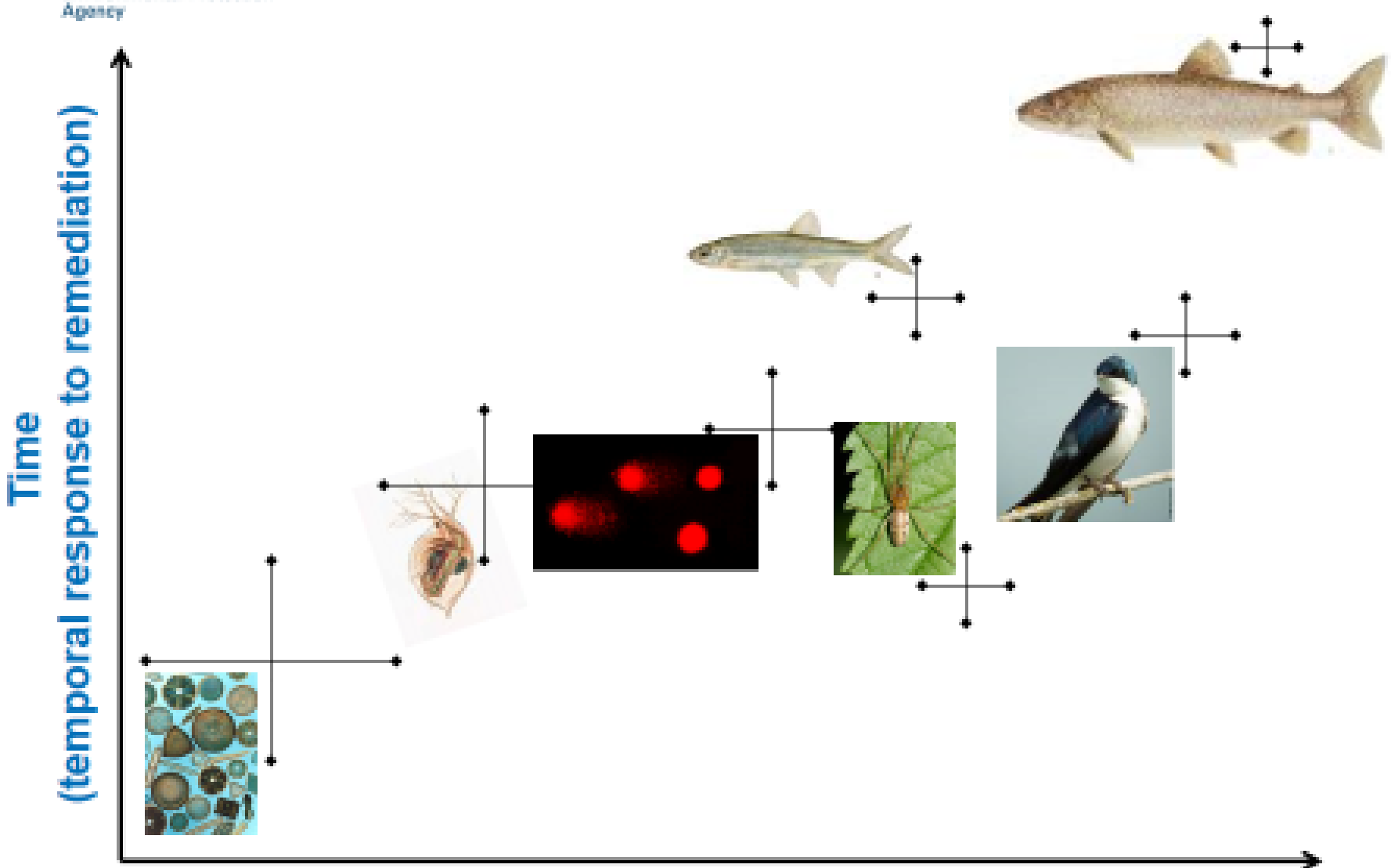
Remedy Effectiveness

Weight of Evidence Approach using Multiple Lines of Evidence

- Biological LOE – assesses biological endpoints, e.g., fish reproduction, diversity of species, toxicity
- Chemical LOE – measures that relate to contaminant concentrations, e.g., post-remedial surface weighted concentrations, reductions in fish tissue levels
- Physical LOE – volume and mass removed, e.g. pounds of PCBs dredged
- Modeling - physical and hydrodynamic modeling, performance modeling, food web modeling

Biological indicators

EPA United States Environmental Protection Agency



Office of Research and Development
Ecological Exposure Research Division, National Exposure Research Laboratory

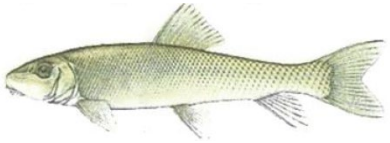
Prepared by
Marc Mills and
David Walters

Food Web Tissue Sampled

Fish Composited Across Each of the 3 Reaches

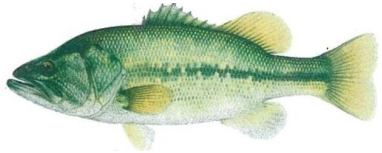
White Sucker

3-5/Reach > 200 mm



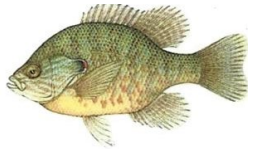
Large Mouth Bass

3-5/Reach > 250 mm



Pumpkinseed

3-5/reach > 80 mm

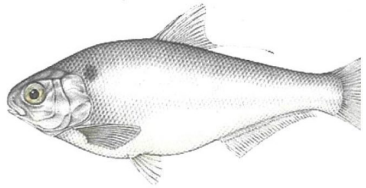


Brown Bullhead

> 10/reach > 250 mm

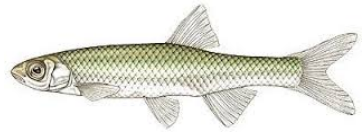
Gizzard Shad

3-5/Reach > 180 mm



Emerald Shiner

2-3 reps >25 g/reach

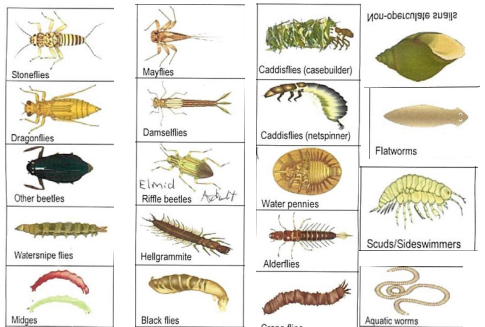


Spiders Tetragnathids

4 Reps per station >2 gm

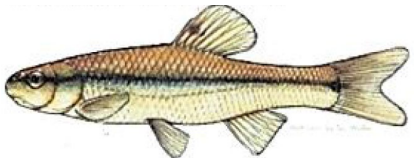
Macroinvertebrates

2 reps/Station > 1gm



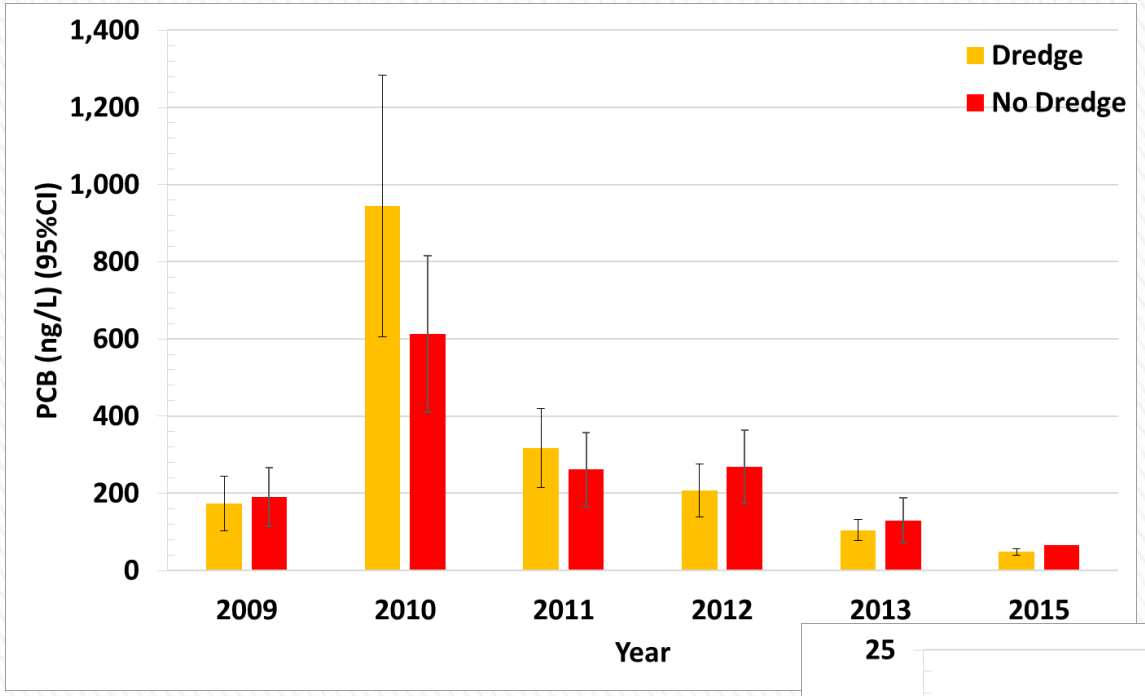
Bluntnose Minnow

2-3 reps >25 g/reach

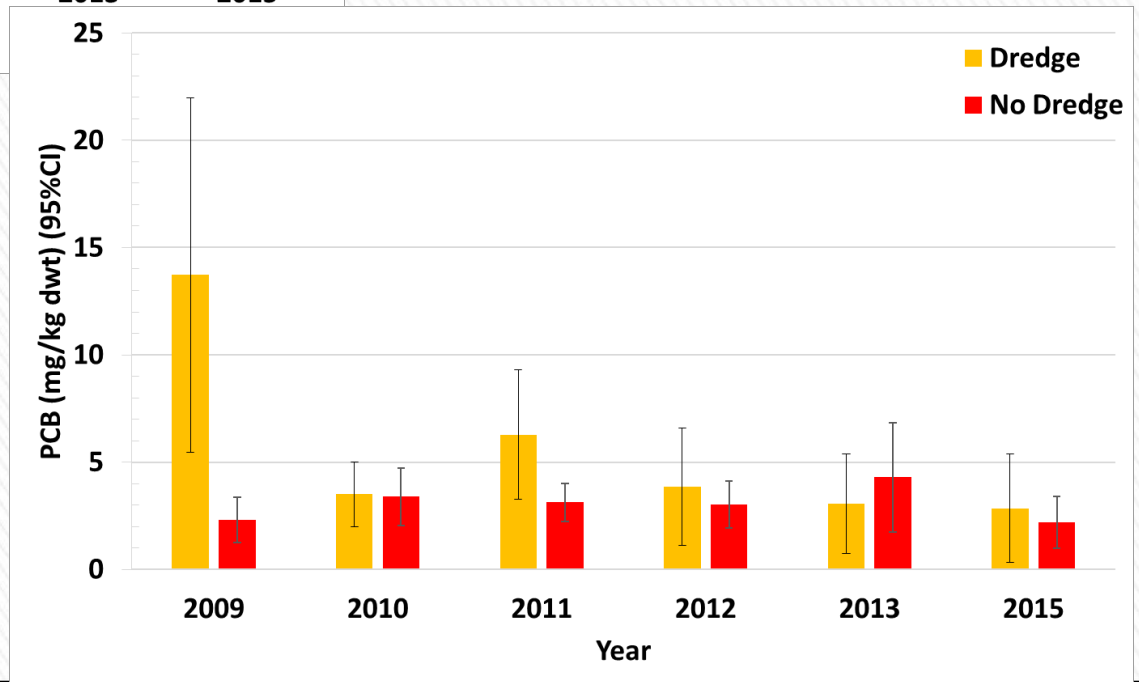


Chemical LOE's

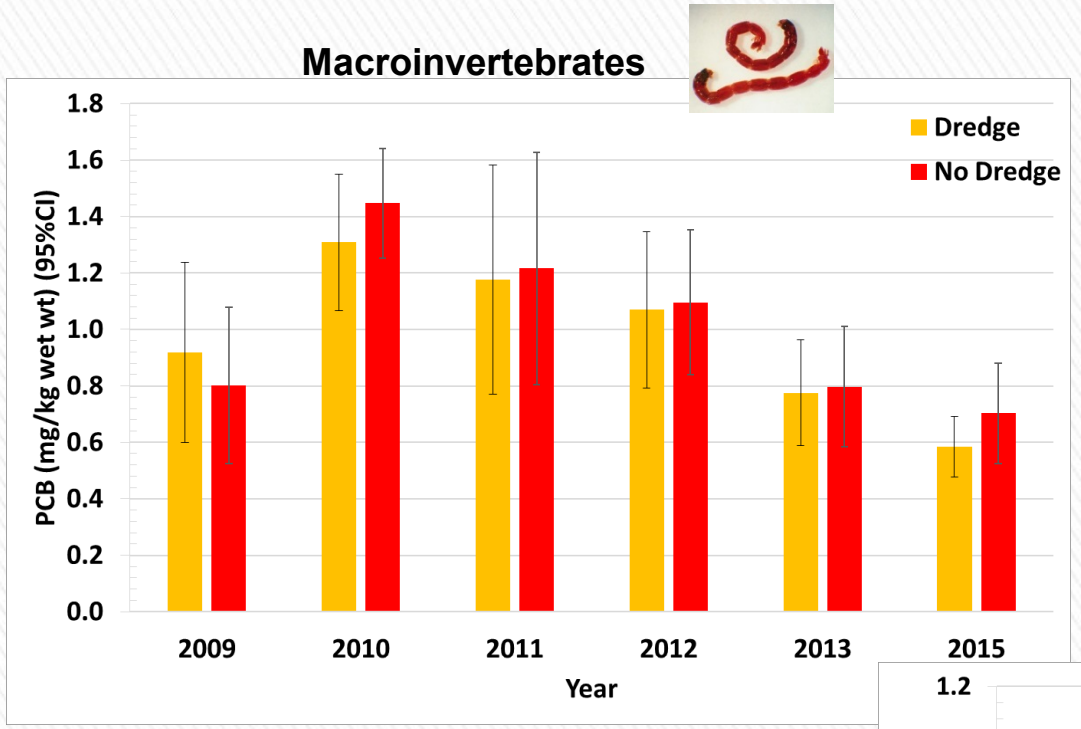
PCBs in water

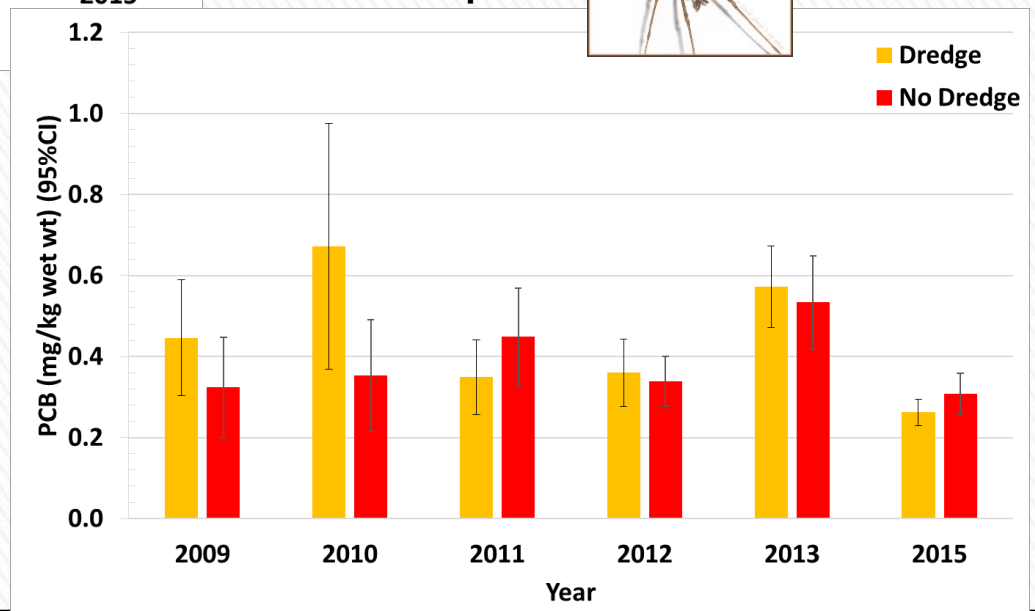


PCBs in sediment

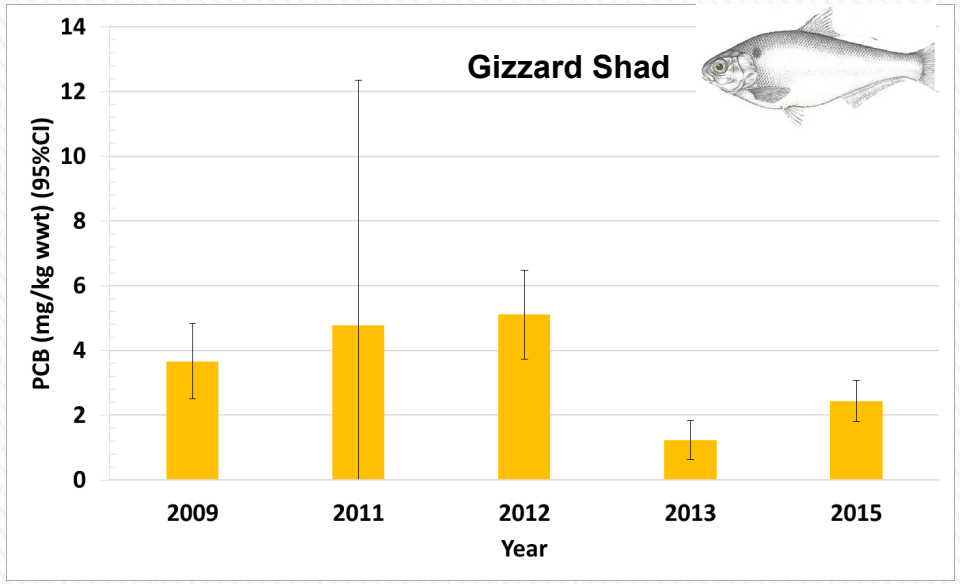


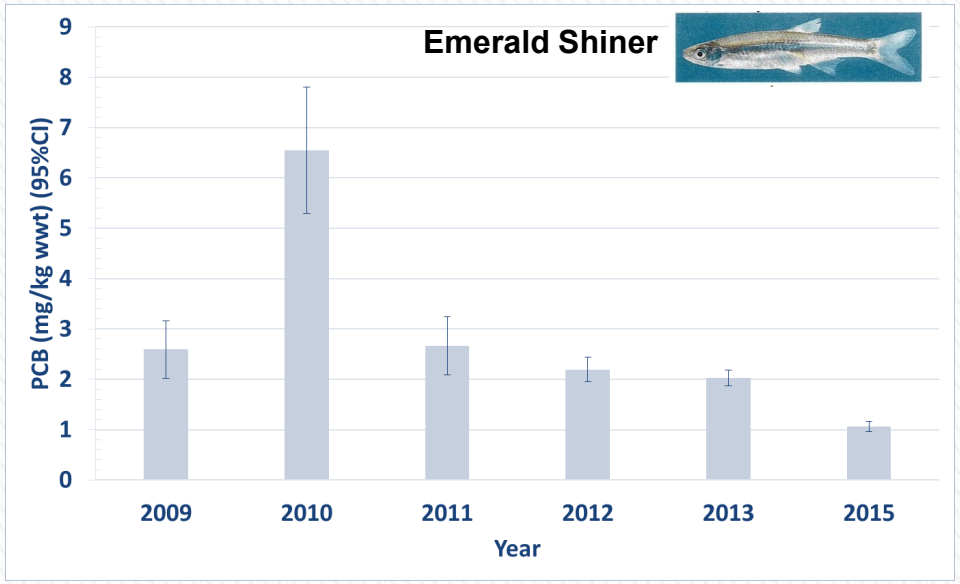
Biological LOE's: COCs in Macroinvertebrates & Spiders

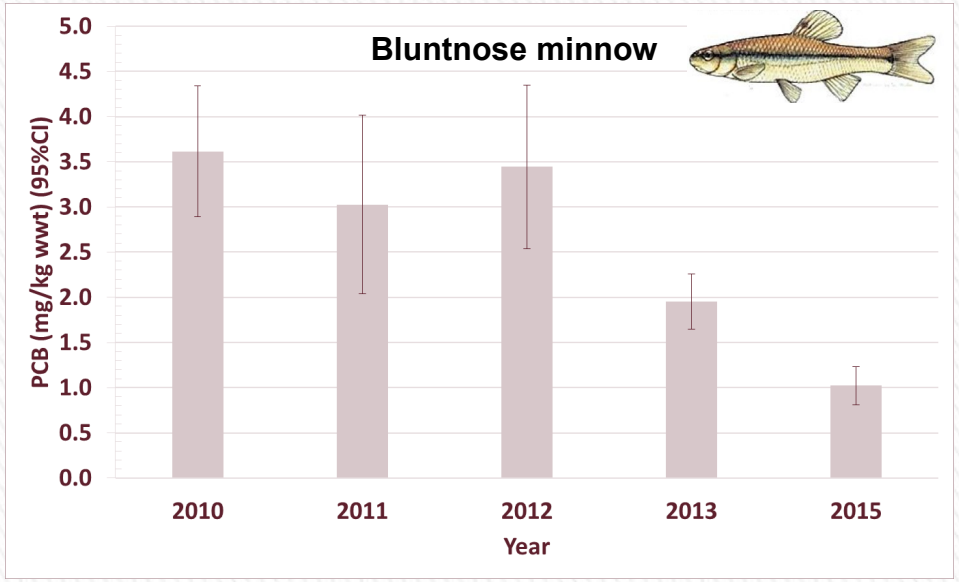




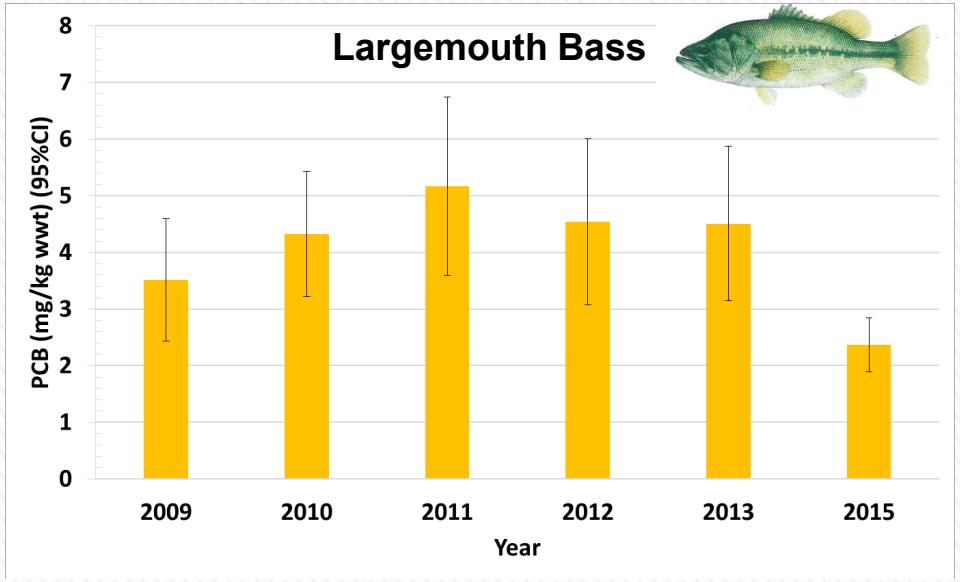
Biological LOE's: Small short lived fish

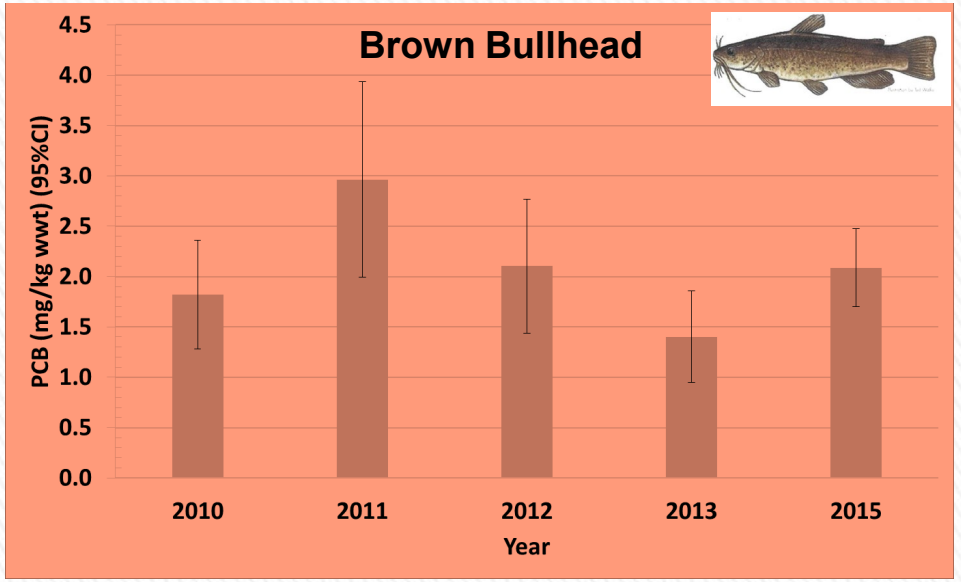


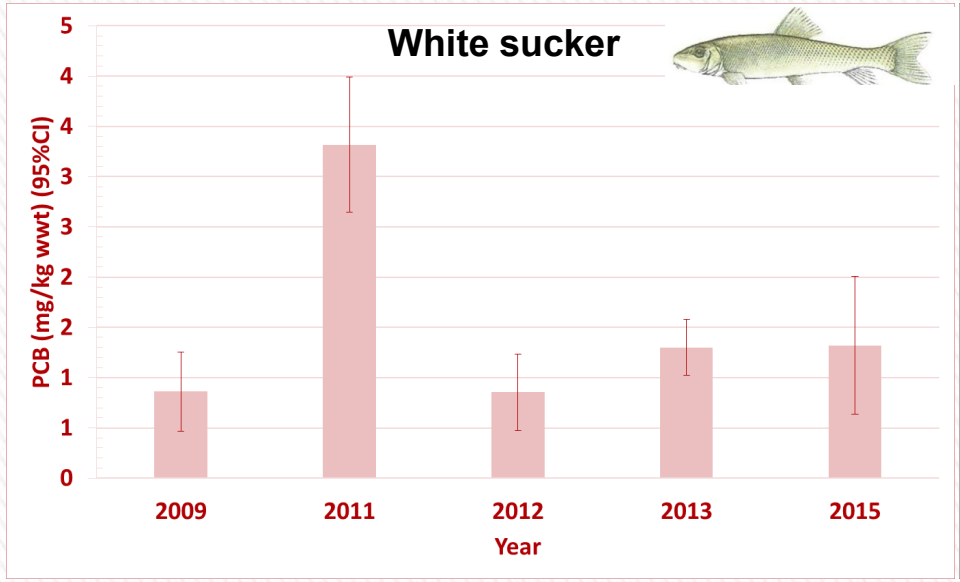


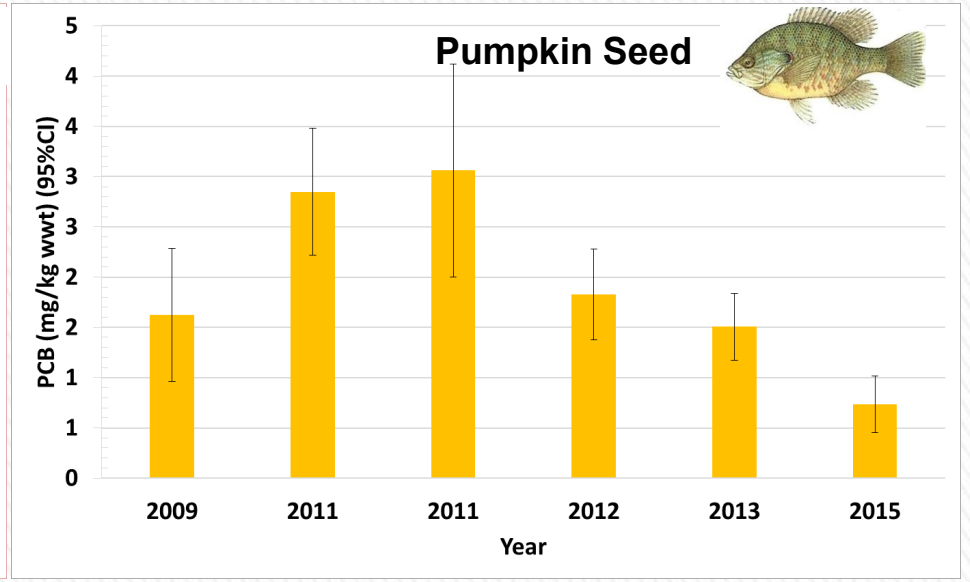


Biological LOE's: Higher trophic fish

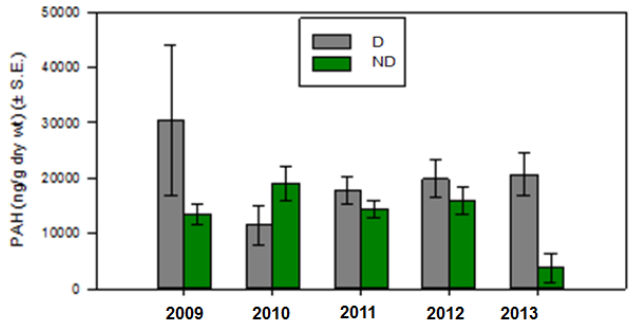




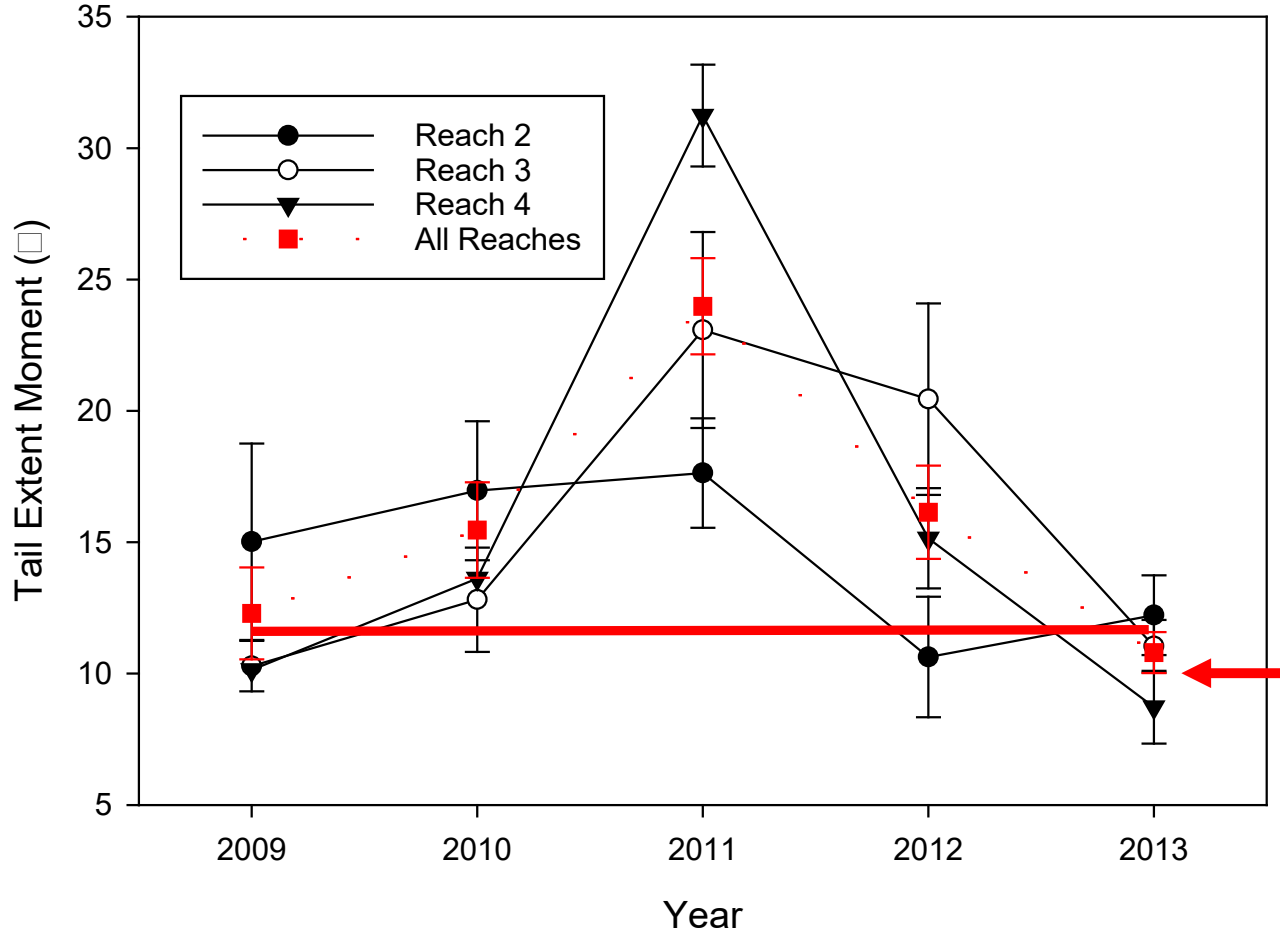


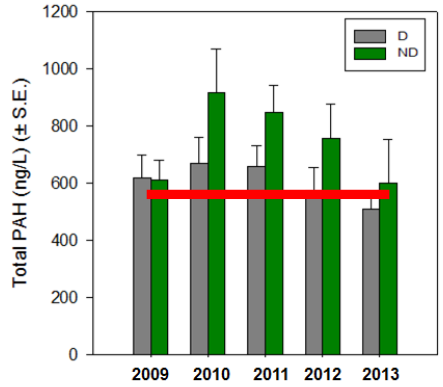


Results
Comet Assay



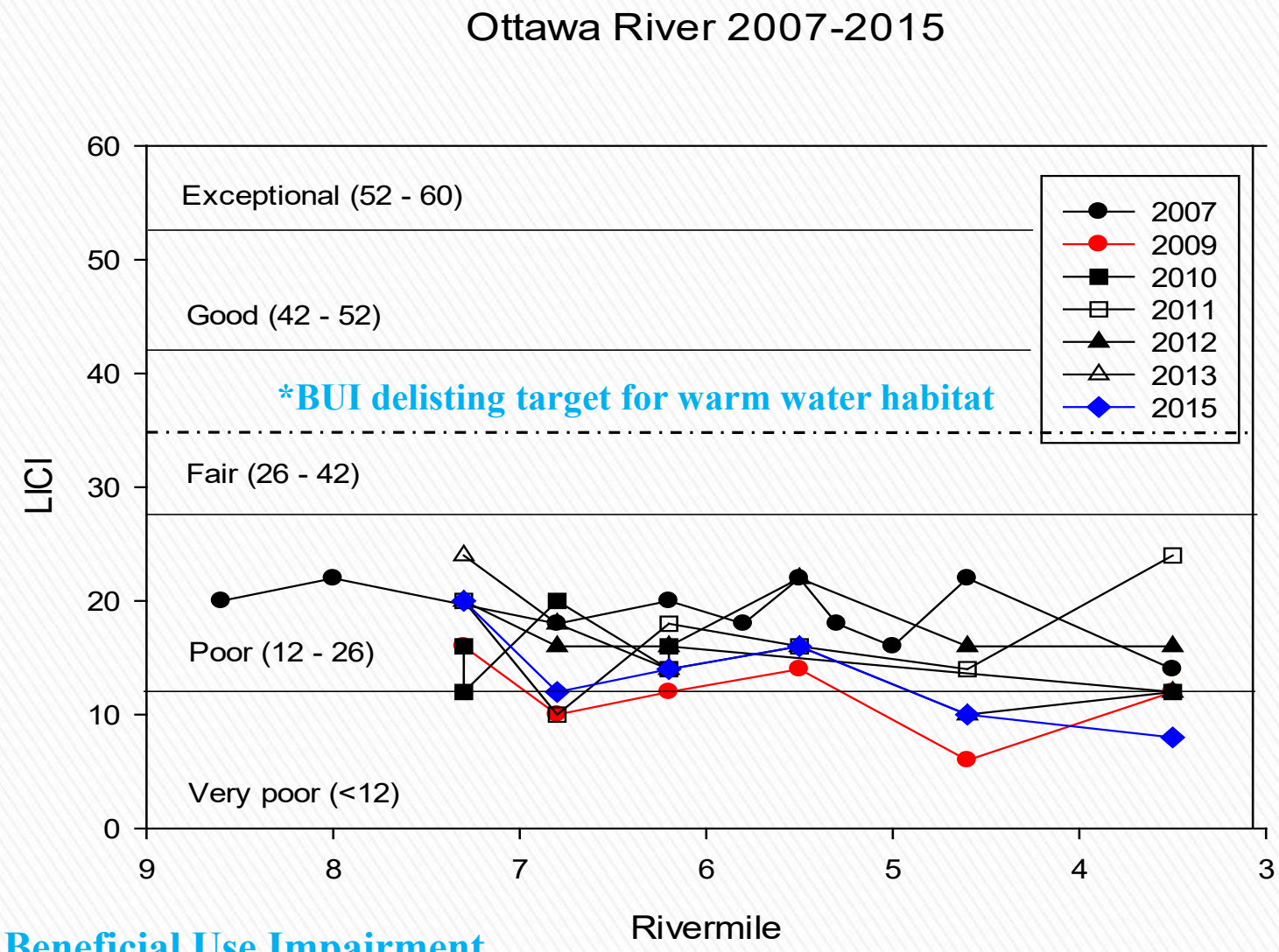
DNA Damage in Ottawa R. bullheads by Reach and Year





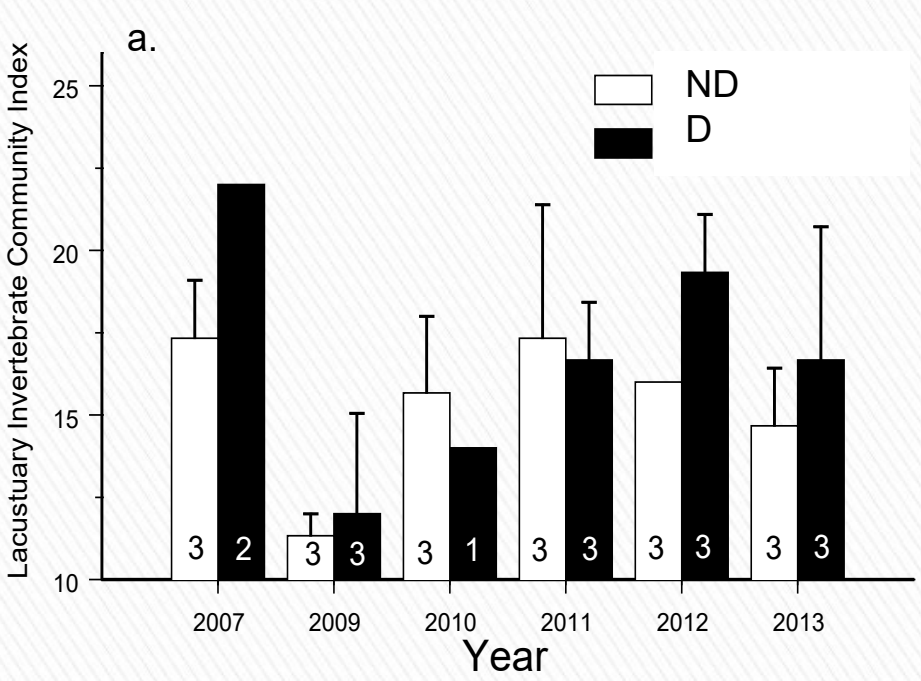
All Reaches

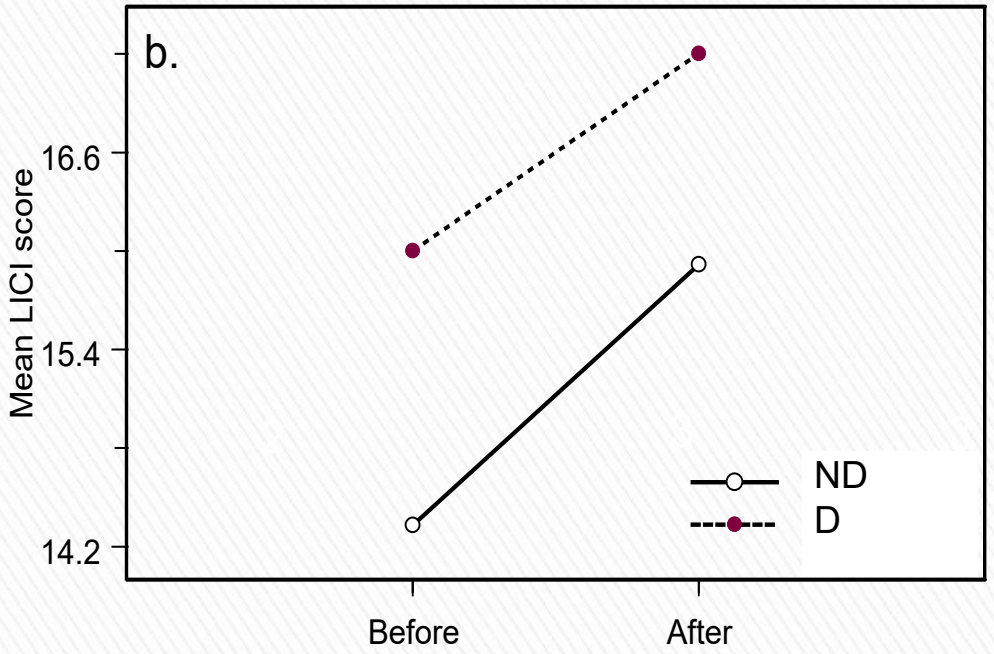
Biological LOE: Macroinvertebrates Lacustuary Invertebrate Community Index (LICI)



*BUI Beneficial Use Impairment

Mean Lacustuary Invertebrate Community Index (LICI) scores



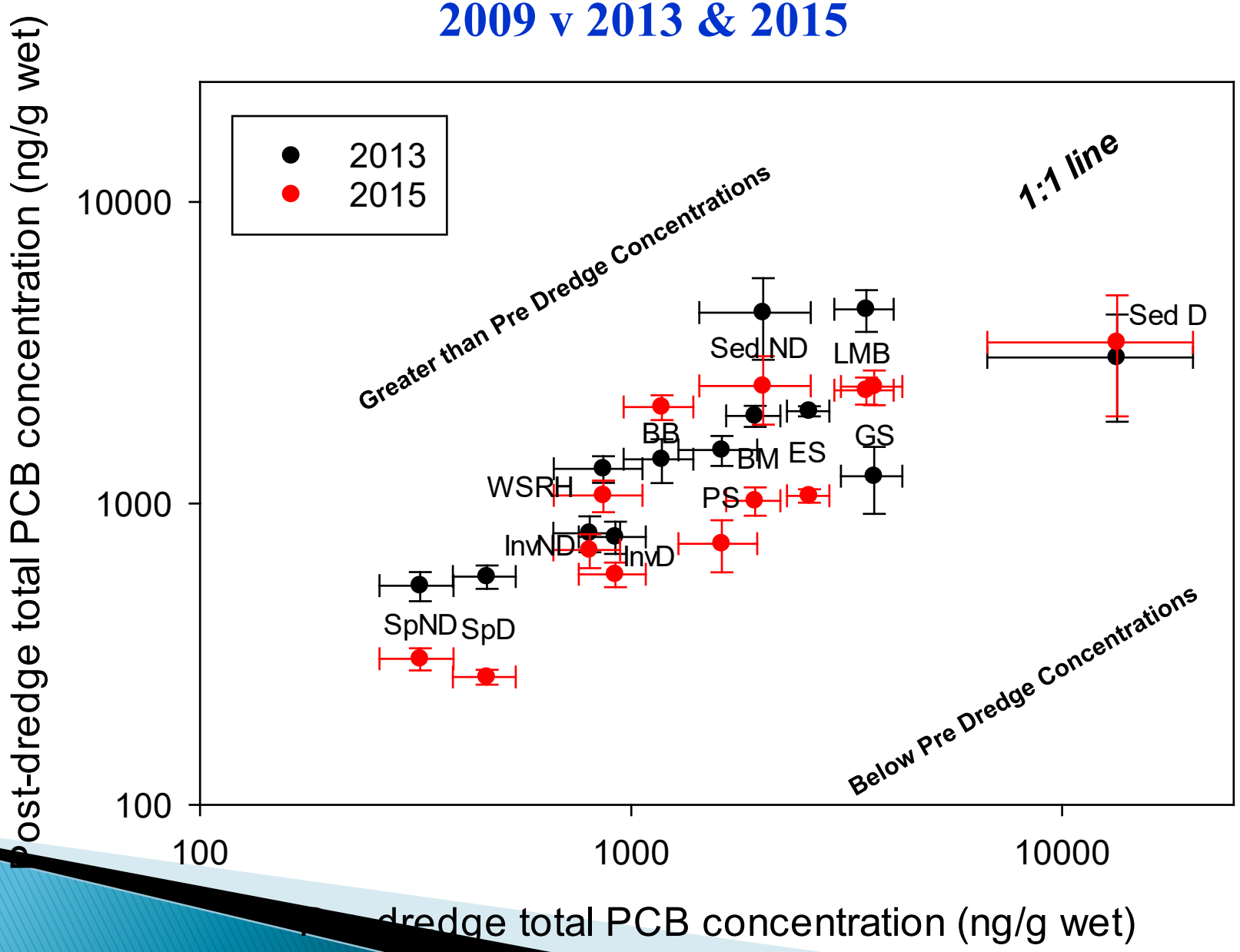


***Numbers at base of bars are the number of stations sampled.**

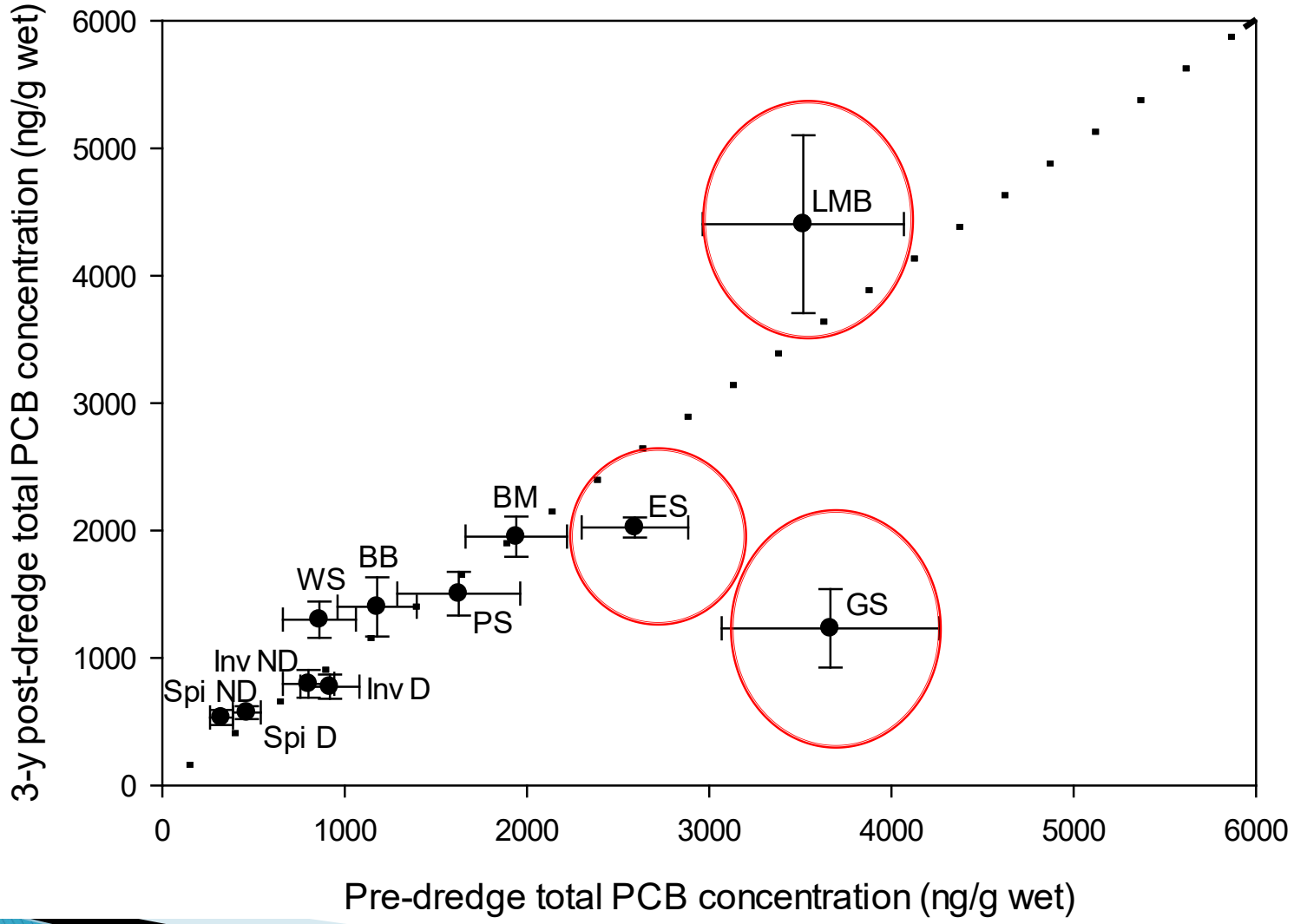
Mean LICI scores (± 1 SE) by year (a). Data from 2007 collected by Ohio EPA.

Interaction plot showing the mean LICI score for DMU treatment Before and After the remediation (b).

Biological and Chemical LOE's:
Trophic Level PCB Concentrations
2009 v 2013 & 2015



Summary of Different Trophic Level
1:1 Plot of 2009 v 2013 Concentrations



Findings and conclusions

- Sediment concentrations decreased after remediation
- Water concentrations unchanged/slightly decreased after remediation

- Macroinvertebrates & Spider tissue concentrations showed little statistical change compared to pre-remedy condition
- Despite the large physical disruption associated with remediation (dredging) there was no decline in the LICI score.

- **2013 Gizzard shad and emerald shiners showed lower tissue concentrations compared to pre-dredging across the entire project area.**
- Higher trophic level fish showed no statistical change compared to pre-dredging (Largemouth Bass, White Suckers, Bullhead, Pumpkinseed, & Bluntnose minnows)
- **Brown bullhead showed a trend toward a decrease in DNA damage across all reaches from the 2011 high.**

- **Based on modeling performed during the design phase, it was anticipated that the long-term clean up goals would be met approximately 10 years (2020) after the completion of dredging activities**


07.09.2012


07.09.2012


07.09.2012

Biological lines of evidence

Current practice

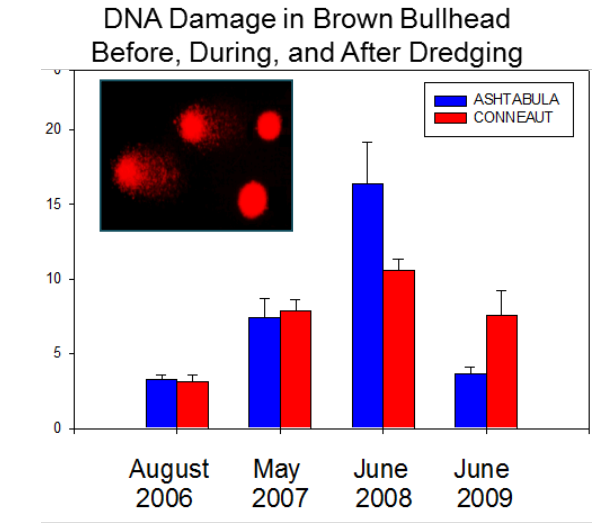
- Fish tissue for human consumption
- Standard sediment tox. and bioacc. testing
- Benthic survey
- Histopathology, common endpoints for biota

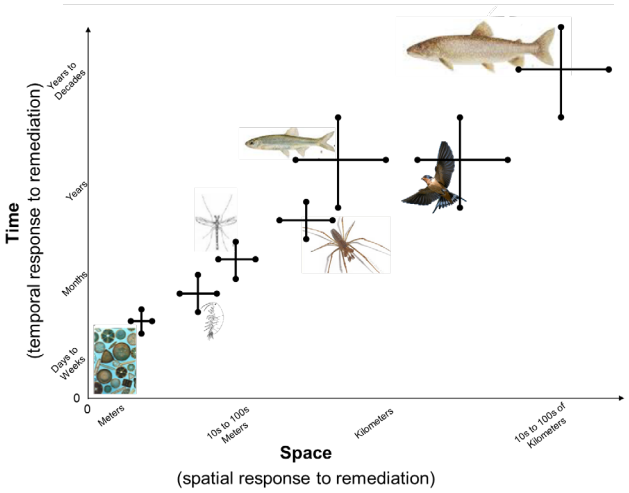
Innovative (examples)

- Benthic body burden
- Short lived fish
- Bioaccumulation – alternative biological and surrogate measures (Tenax, SPMEs, etc)
- Fish (IBI)/habitat quality/Genetic damage
- Benthic survey (e.g. L-ICI)
- Bivalve uptake
- Riparian indicators (avian, spiders, etc)
- SOP (performance based)/QAQC/Interlab comparisons
- Reference locations

Current

Innovative





Chemical lines of evidence

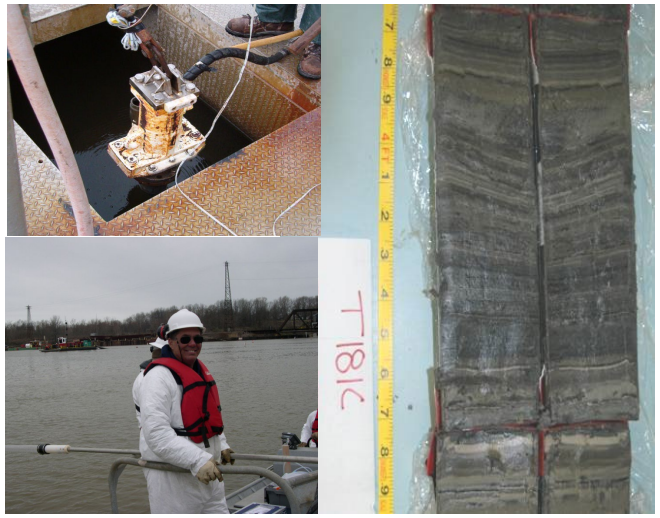
Current practice

- Sediment chemistry – surface & segmented core sampling
- Water Chemistry

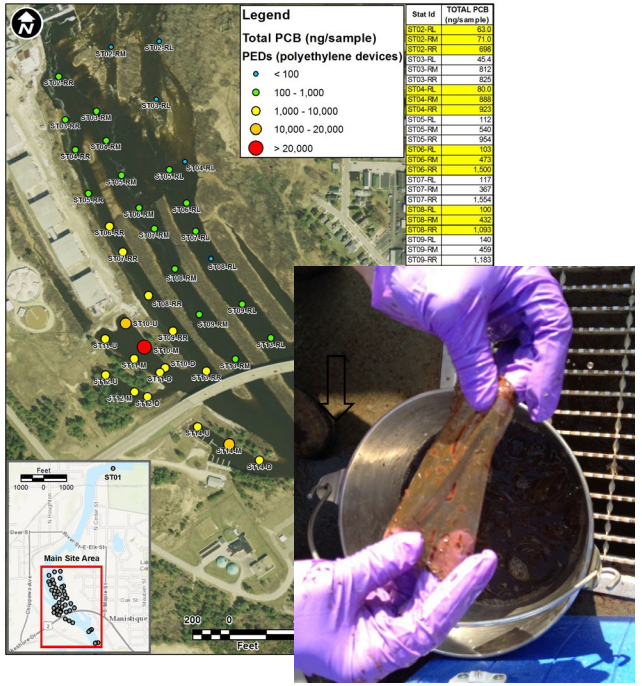
Innovative (examples)

- Passive samplers (e.g., PEDs, SPMEs)
- Porewater (direct and passive)
- Groundwater intrusion
- Legacy contaminants versus CECs
- Rapid screening – direct analysis techniques
- Qualitative level screening for additional contaminants (legacy and CECs)
- Advanced Chemical Forensics
- Common SOPs/QA

Current



Innovative



Physical lines of evidence

Current practices

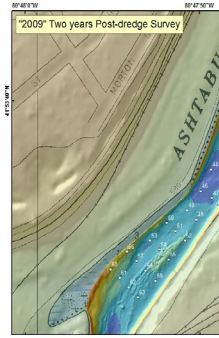
- Single-beam Bathymetry
- Turbidity
- Sediment transport modeling

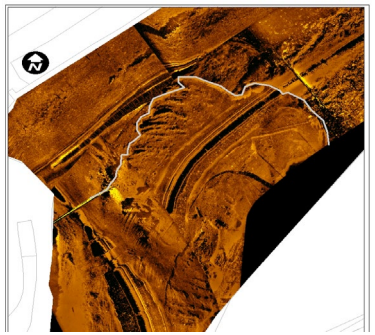
Innovative (examples)

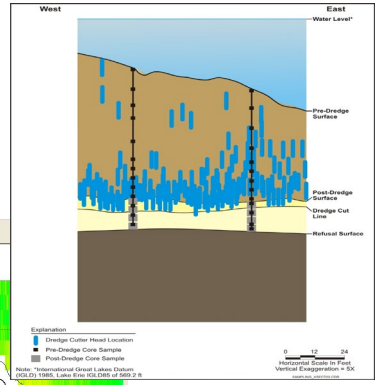
- Grain size analyses of dredge materials and "residuals"
- Particle tracking
- Hydrodynamics & plume monitoring
- GW-surface water interactions
- Sediment traps for transport of sediment and COCs
- Multi-beam Bathymetry/side scan sonar
- Diver assisted probing and SPI camera for residuals

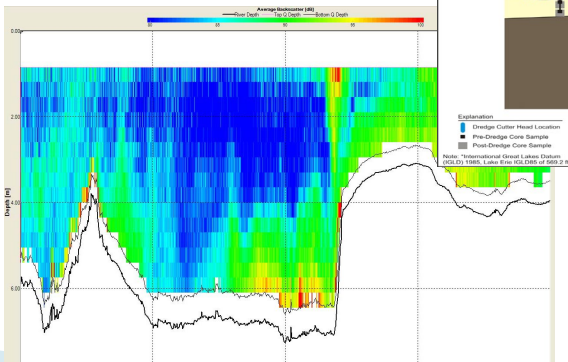
Current

Innovative









Methods

Fish

EPA & FWS Electroshocking

EPA Fyke Netting

Logged and processed

Macrobenthos

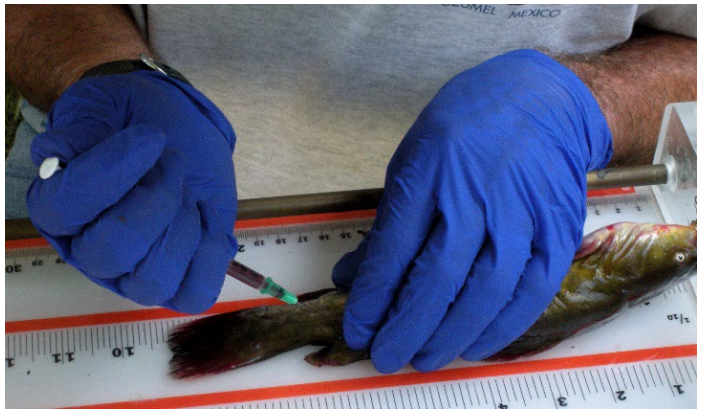
20 HDs/rep 2 reps/site
18 sites over 3 reaches

Deployed 6 weeks and processed in field

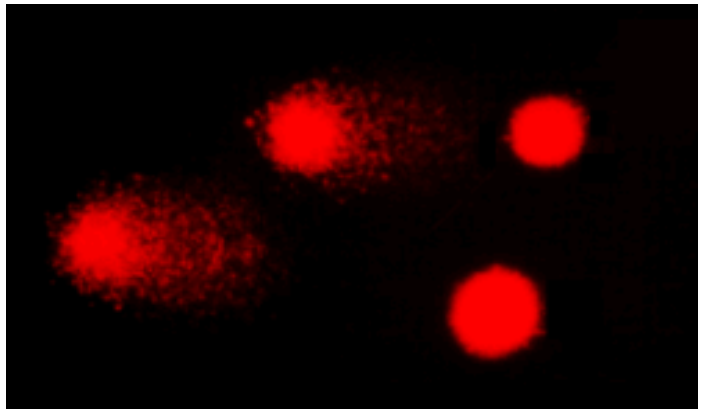
Time sorted to > 1gm wet wt

Methods

Comet Assay to Measure Genotoxicity

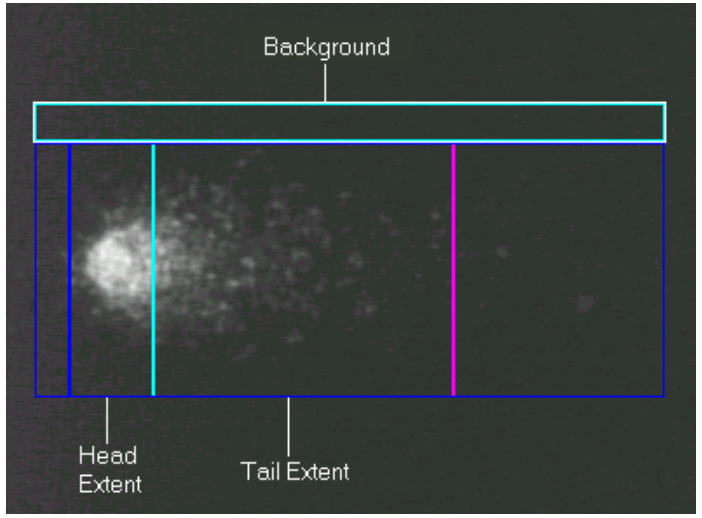


Collect Blood and Liver in Field



Fluorescence microscopy image of Comet Assay blood cells

Preserve samples in the field



Measuring DNA damage parameters using image analysis

Methods
Spiders

- Tetragnathid (longjaw spider)
  - riparian specialist
  - aquatic insect specialist
  - riparian vegetation and human structures