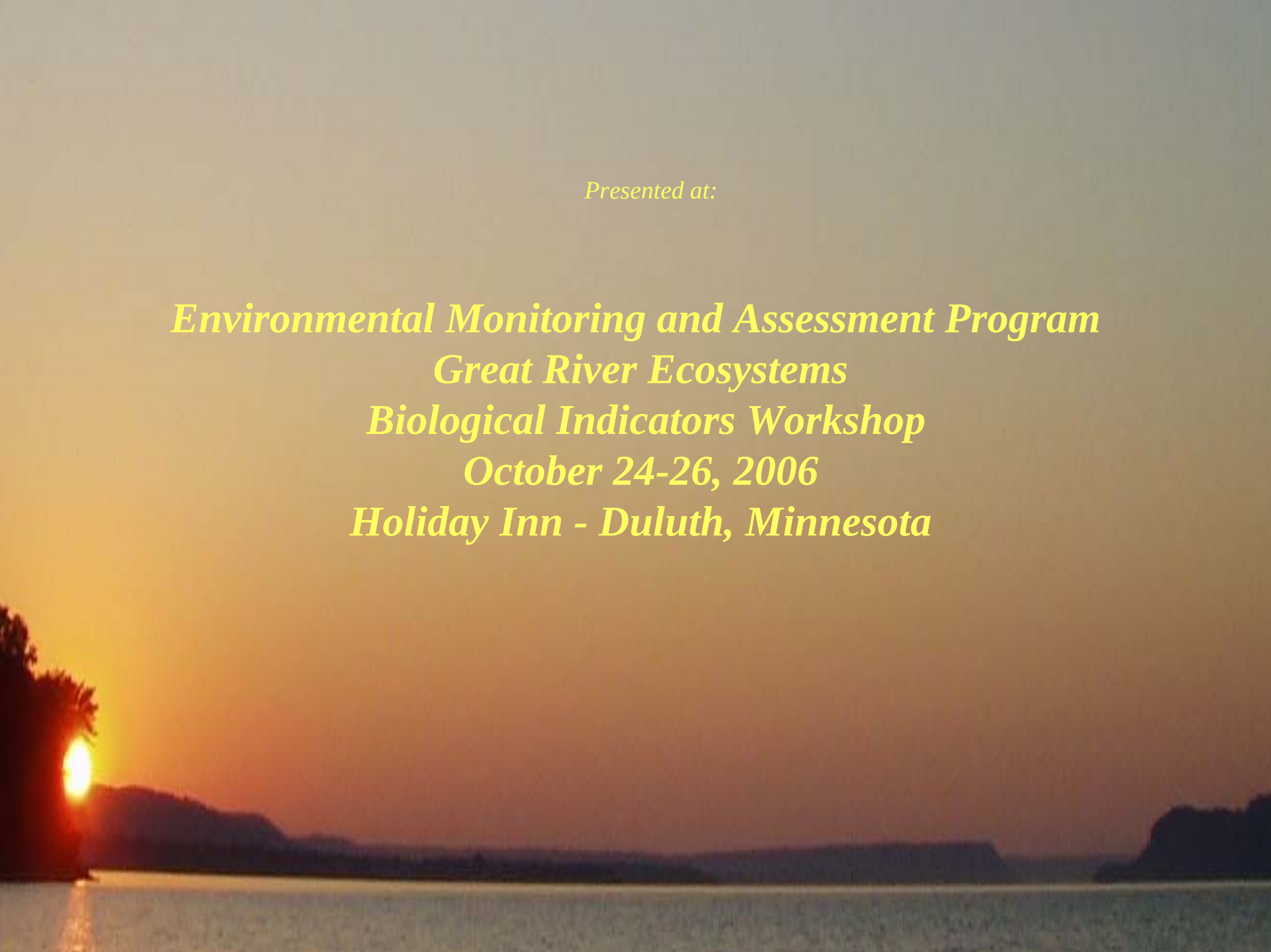


Presented at:

Environmental Monitoring and Assessment Program
Great River Ecosystems
Biological Indicators Workshop
October 24-26, 2006
Holiday Inn - Duluth, Minnesota

Update On EMAP GRE Contaminant Indicators Fish Tissue, Sediment Toxicity, Sediment Chemistry, Stable Isotopes

NERL Cincinnati - Jim Lazorchak, Dan Bender, Jim Odell, David Walters, Karen Blocksom
NERL RTP - Mark Strynar/Andy Lindstrom/

Dynamac c/o NERL Cincinnati - Paul Grimmett, Gerilyn Ahlers, Amy Parks

TMG c/o NERL Cincinnati- Mark Smith, Herman Haring

EMAP GRE Indicators Workshop

November 24, 2006

Fish Tissue Contaminants

- Fish tissue contaminants are an indicator of bioaccumulation of persistent toxic substances in the environment and can be used to estimate exposure to contaminants associated with fish consumption for higher trophic levels, including humans.

- Focus is on whole fish because of its emphasis on the health of the ecosystem. Although whole-fish contamination is primarily an indicator of risk to piscivorous wildlife, whole-fish data are still relevant for estimating human exposure to contaminants through fish consumption.

- Potentially can be used to assess “Reference Condition”.

- Use of whole fish reduces sample processing effort in the field because no gutting, skinning, or filleting of fish is necessary.

Fish Tissue Contaminants continued

- At every EMAP-GRE site, two fish samples are collected: a small-fish sample and a large-fish sample.
- The small-fish sample includes individuals of one species (if possible) whose adults are small and live 1-2 years.
- The large-fish sample includes individuals of one species (if possible) whose adults are larger and live 3-5 years.
- Each of the Large Fish and Small Fish samples are composited separated to provide an average concentration at each site

Fish target species list for tissue analysis

Priority	Common name	Size range (mm)	3-cm size classes
SMALL target species			
1	emerald shiner	< 120	1 - 4
2	river shiner	< 120	1 - 4
3	spotfin shiner	< 120	1 - 4
4	bullhead minnow	< 120	1 - 4
5	silver chub	< 120	1 - 4
6	another minnow species	< 120	1 - 4
7	gizzard shad	< 150	1 - 5
LARGE target species			
1	sauger	120 - 180	5 - 6
2	sauger	180 - 240	7 - 8
3	sauger	> 240	≥ 9
4	largemouth bass	180 - 240	7 - 8
5	largemouth bass	240 - 300	8 - 10
6	largemouth bass	> 300	≥ 11
7	other black bass	> 180	≥ 7
8	brown trout	> 120	≥ 5
9	rainbow trout	> 120	≥ 5
10	channel catfish	120 - 180	5 - 6
11	channel catfish	450 - 510	16 - 17
12	channel catfish	180 - 450	7 - 15
13	freshwater drum	>120	≥ 5
14	shorthead redhorse	>120	≥ 5
15	other redhorse species	>120	≥ 5
16	bluegill	>120	≥ 5
17	longear sunfish	>120	≥ 5
18	other sunfish species	>120	≥ 5
19	common carp	>180	≥ 7
20	smallmouth buffalo	>120	≥ 5
21	river carpsucker	>120	≥ 5
22	flathead catfish	>120	≥ 5
23	white bass/wiper	>120	≥ 5
24	quillback	>120	≥ 5

Target analytes for composite fish tissue samples.

Detection limit for mercury is 0.01 ppm. Detection limit for all other analytes is 0.001 ppm. Number in parentheses is the CAS number.

Mercury (7439-97-6)

21- Pesticides
Aldrin (309-00-2)
Chlordane-cis (5103-71-9)
Chlordane-trans (5103-74-2)
2,4'-DDD (53-19-0)
4,4'-DDD (72-54-8)
2,4'-DDE (3424-82-6)

4,4'-DDE (72-55-9)
2,4'-DDT (789-02-6)
4,4'-DDT (50-29-3)
Dieldrin (60-57-1)
Endosulfan I (959-98-8)
Endosulfan II (33213-65-9)
Endrin (72-20-8)

Heptachlor (76-44-8)
Heptachlor Epoxide (1024-57-3)
Hexachlorobenzene (118-74-1)
Hexachlorocyclohexane [Gamma-BHC/Lindane] (58-89-9)
Mirex (2385-85-5)
trans-Nonachlor (3765-80-5)
cis-Nonachlor (5103-73-1)
Oxychlordane (27304-13-8)

20 - PCB Congeners, 8, 18, 28, 52, 44, 66, 101, 77 (coplaner), 118, 153, 105, 138, 187, 128, 180, 170, 195, 206, 209, 126 (coplaner),

6 - Polybrominated Diphenyl Ethers (PBDE) congeners 47, 99, 100, 153,154, and 183

Percent Moisture and Lipid content

Status of EMAP GRE Fish Tissue Analyses

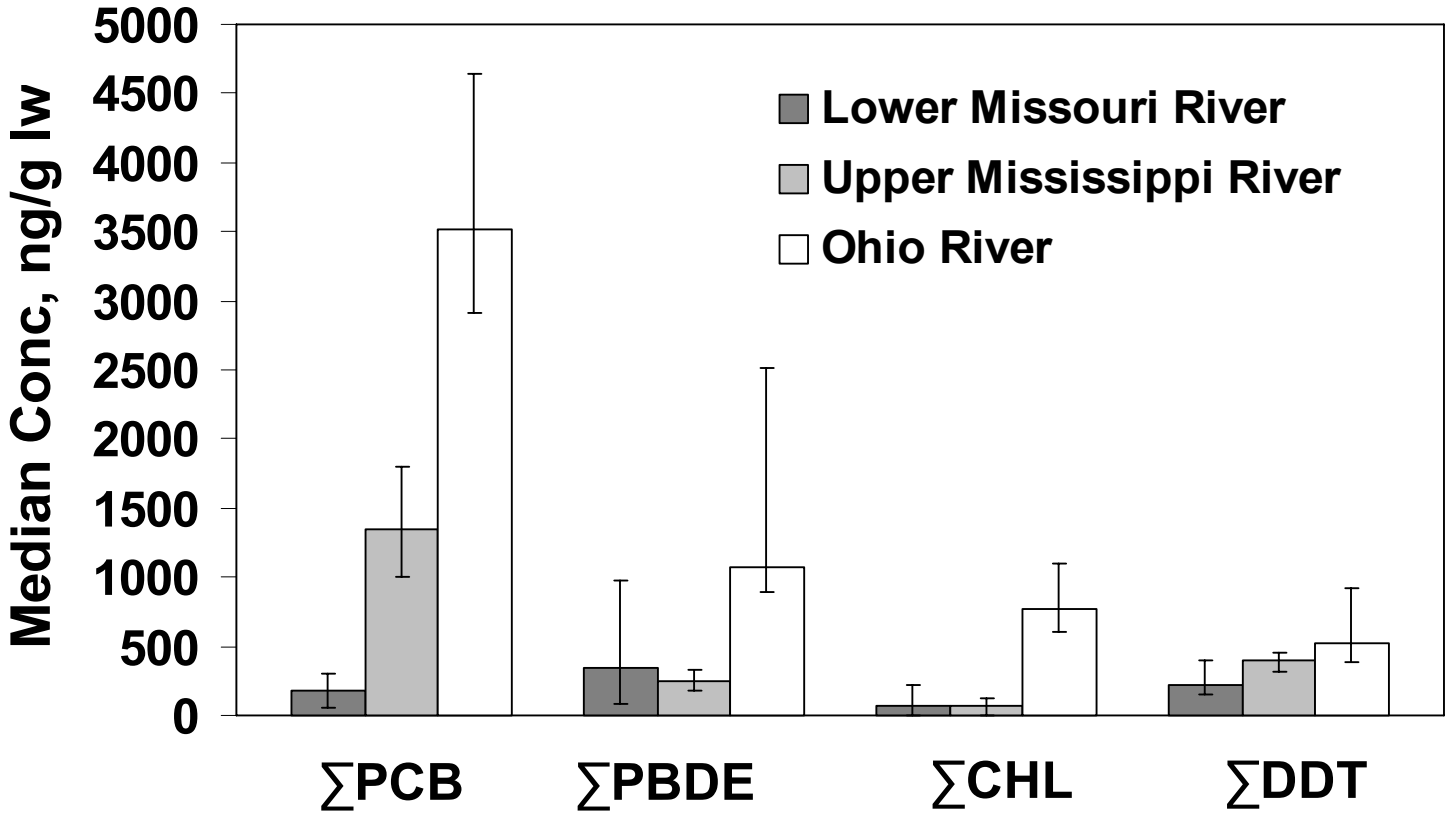
2004 EMAP:

- 133 Large Fish Received, Analyzed
- 130 Small Fish Received, Analyzed

2005 EMAP:

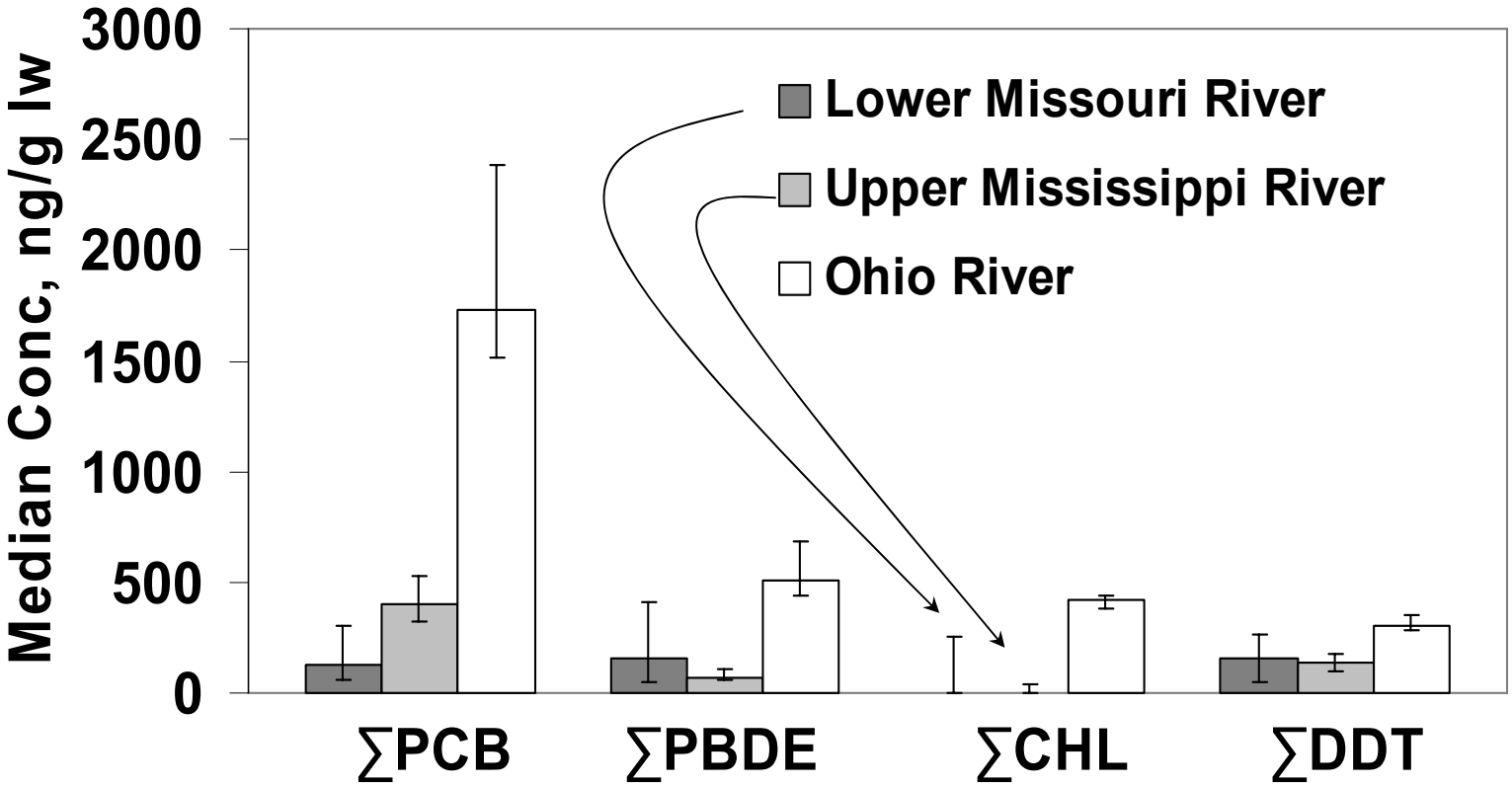
- 213 Large Fish
- 207 Small Fish

2004 Chemistry results for Large fish collected from the Ohio, Upper Mississippi & Lower Missouri rivers



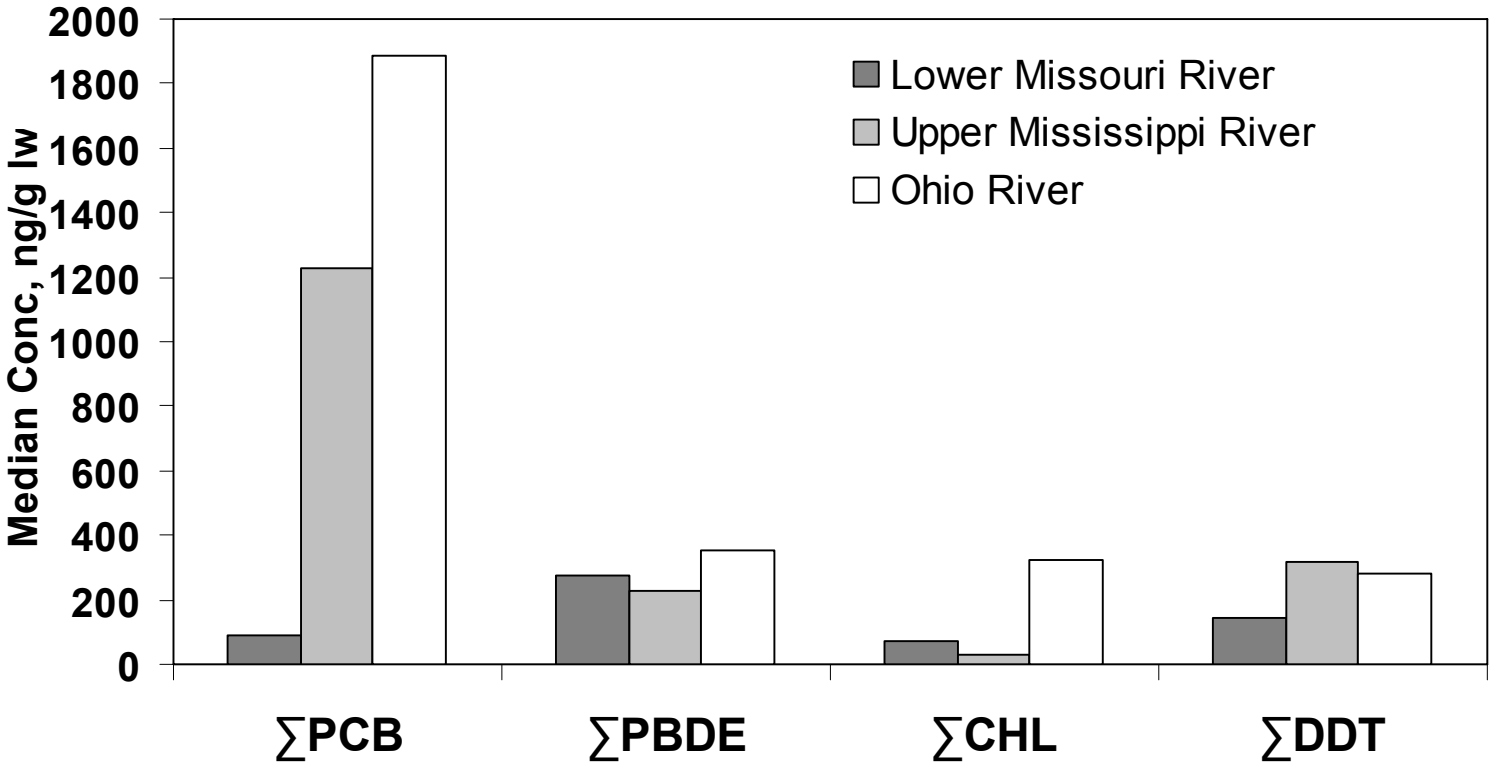
∑PCBs, ∑PBDEs, ∑CHL, & ∑DDT median concentrations and the 95% confidence intervals

2004 Chemistry results for Small fish collected from the Ohio, Upper Mississippi & Lower Missouri rivers



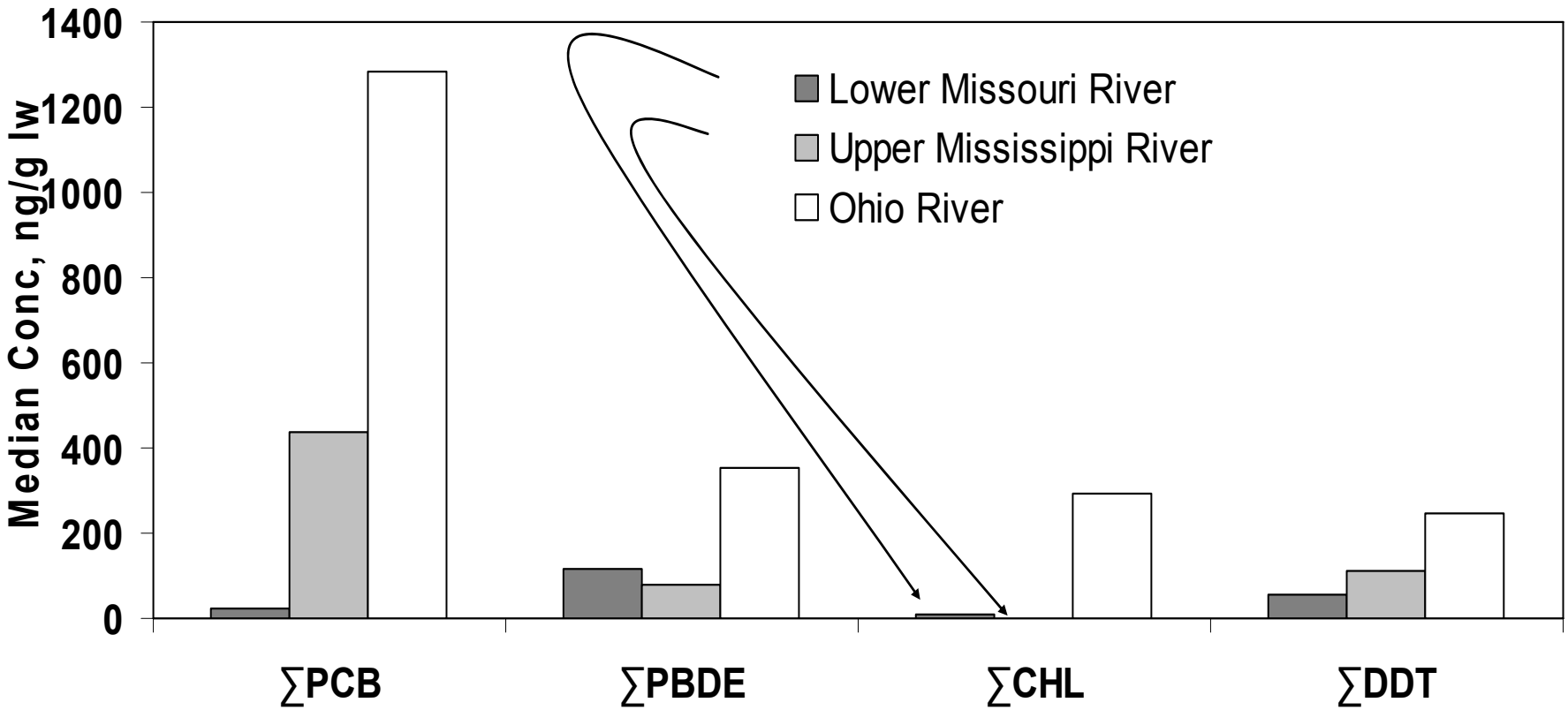
∑PCBs, ∑PBDEs, ∑CHL, & ∑DDT median concentrations and the 95% confidence intervals

2005 Chemistry results for large fish collected from the Ohio, Upper Mississippi & Lower Missouri rivers



∑PCBs, ∑PBDEs, ∑CHL, & ∑DDT median concentrations (95% CIs not yet calculated)

2005 Chemistry results for small fish collected from the Ohio, Upper Mississippi & Lower Missouri rivers



∑PCBs, ∑PBDEs, ∑CHL, & ∑DDT median concentrations

Fish Tissue – 2004 Preliminary Results Continued

- Upper Mississippi River (UMR) smallmouth bass mean lipid concentration = 2.2% (N = 7, Range 1.5 – 2.9%) vs. Lower Missouri River (LMR) smallmouth bass, the mean lipid concentration = 4.0% (N = 6, Range 2.5 – 5.2%).

- Sauger – Ohio River = 2.0% (N=10), UMR = 3.5% (N=10)

- Drum – LMR = 3.5% (N=19), Ohio R = 4.5% (N=9),
  UMR = 4.7% (N=6)

- Emerald Shiner – UMR = 3.2% (N=12), LMR = 4.2% (N=12),
  Ohio River 5.1% (N=37)

Status of EMAP GRE Sediment Toxicity

3 Methods Used

7-day EPA EMAP Method (all Samples)

10-day EPA OW Method (20%)

7-day EPA Reduced Volume Method

End Points

% Survival = Acutely Toxic - Statistically Lower Growth = Chronically Toxic

Chemistry Analyses - samples found to be toxic in priority 1 or 2.

Priority 1 = Acutely toxic in two or more methods or If only one method tested

Priority 2 = Acutely toxic in one and chronically in one

Priority 3 = Chronically toxic only

Status of EMAP GRE Sediment Toxicity

2004 EMAP GRE Sediment Toxicity Samples

165 samples received and tested.
- 31 (18.8%) found to have acute toxicity
- 17 (10.3%) found to have chronic toxicity

- 31 samples submitted for chemical analyzes

2005 EMAP GRE Sediment Toxicity Summary Results

222 samples received - 221 tested- one sample left on loading dock over the weekend
- 29 (13.1 %) found to have acute toxicity
- 85 (38.5%) found to have chronic toxicity

- 30 samples submitted for chemical analysis

2006 EMAP GRE Sediment Toxicity Samples

108 samples received and tested (to date).
- 14 (13.0%) found to have acute toxicity
- 29 (26.9%) found to have chronic toxicity

New Analyses

Stable isotope analyses of EMAP GRE samples

David Walters

Analyze fish tissue homogenates for stable isotope ratios of C ($\delta^{13}C$) and N ($\delta^{15}N$).

Objectives:

First, we will describe variation in $\delta^{13}C$ and $\delta^{15}N$ for selected species throughout the Great Rivers. This variation will be used to draw inference on differences in riverine foodwebs at a large spatial scale.

Second, we will use $\delta^{13}C$ and $\delta^{15}N$ as predictor variables to help explain variation in tissue contamination among the Great Rivers.

Progress:

Subsampling of tissue homogenate from 2004 samples complete and ready for analysis.

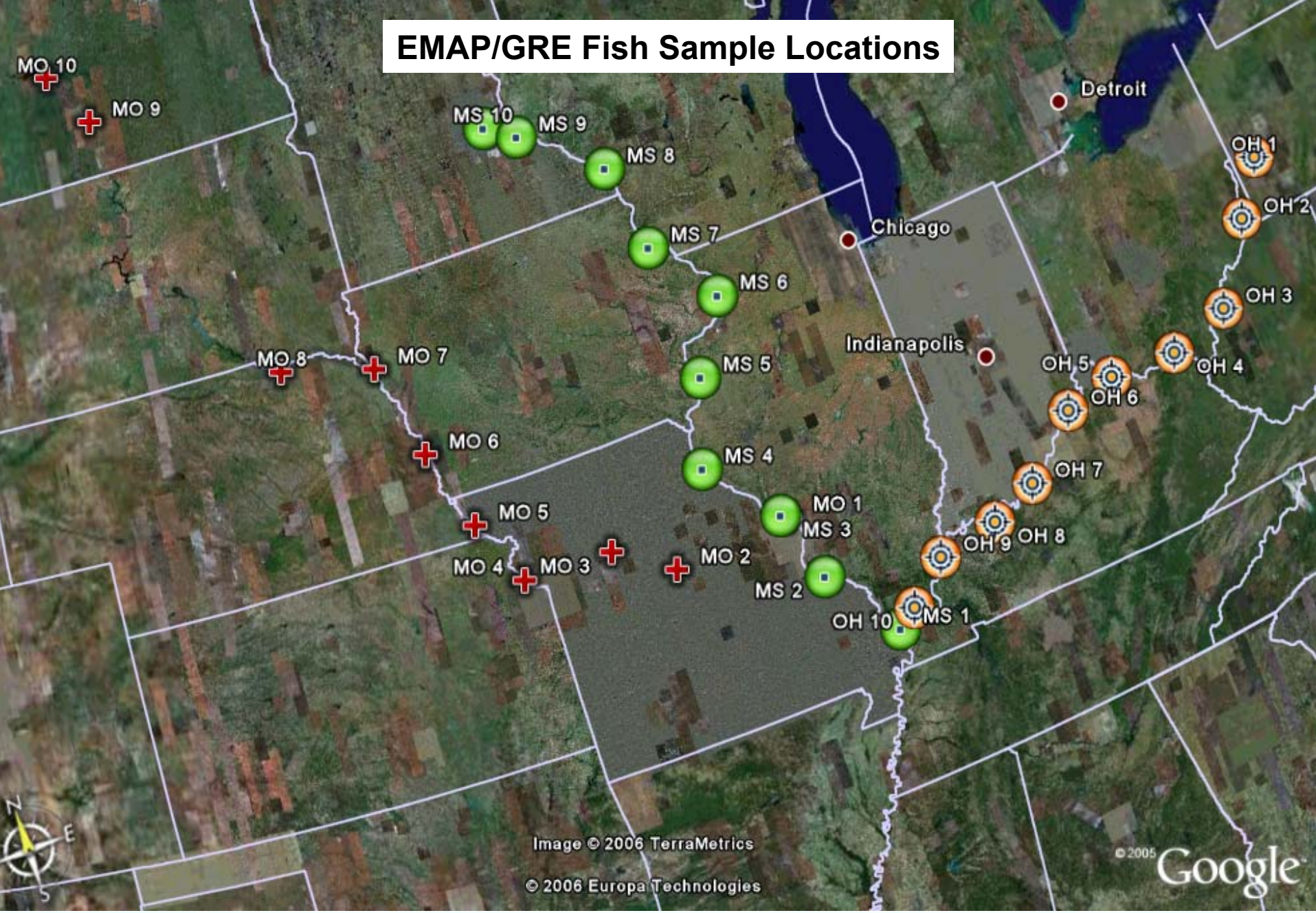
Subsampling of 2005 fish tissue homogenates in progress

Simplified Acquisition Prepared for SI Analyses Waiting for CR to be over.

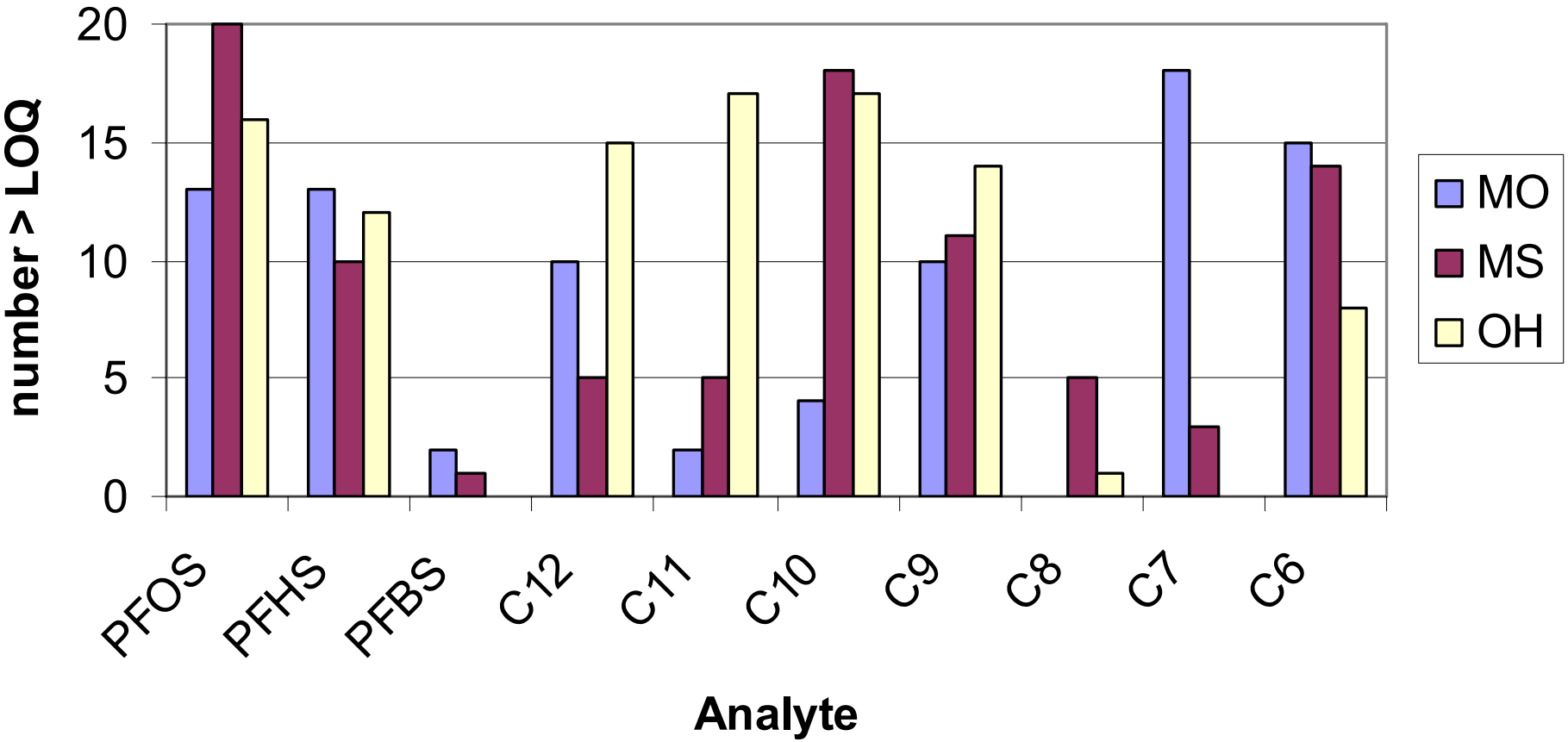
Pilot Analyses
Perfluorinated Compounds
(PFOS, PFOA, PFHS, and other Perfluorinated Acids (C6-C12) Mark Strynar - NERL/HEASD

- Literature data on Liver samples only.
- Pilot Methods developed by Strynar/Lindstrom 2005 on existing 2004 homogenates.
- Analyze 10 Large and 10 Small Fish Samples from each river to determine whether analytical methods detect significant PFCs.

EMAP/GRE Fish Sample Locations

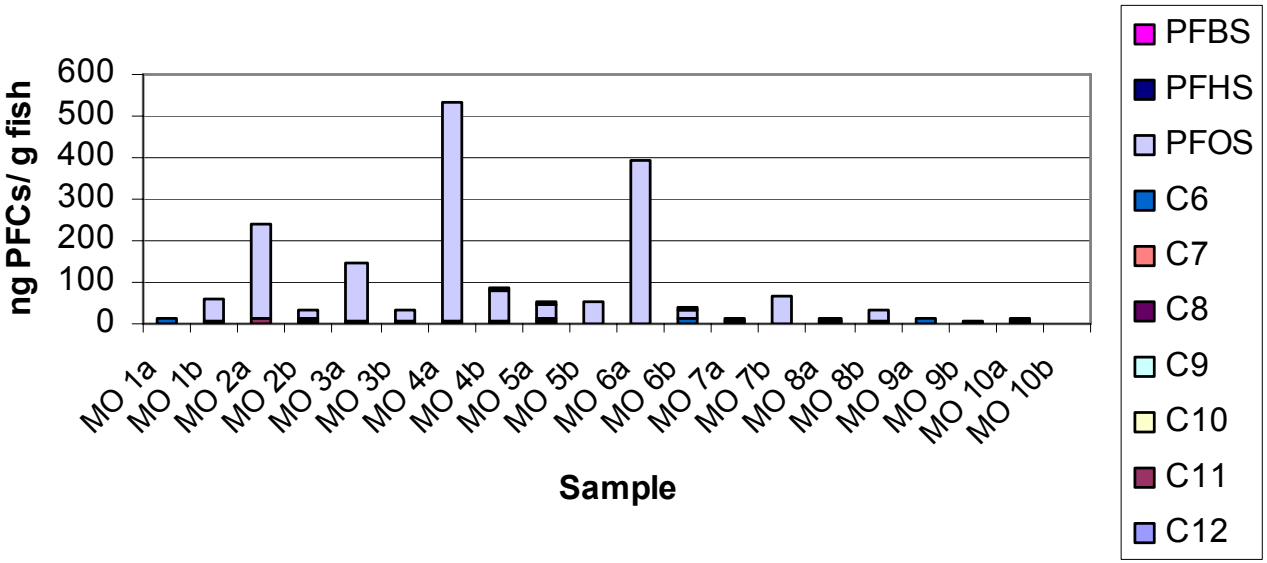


Number of samples above LOQ for all rivers and PFCs

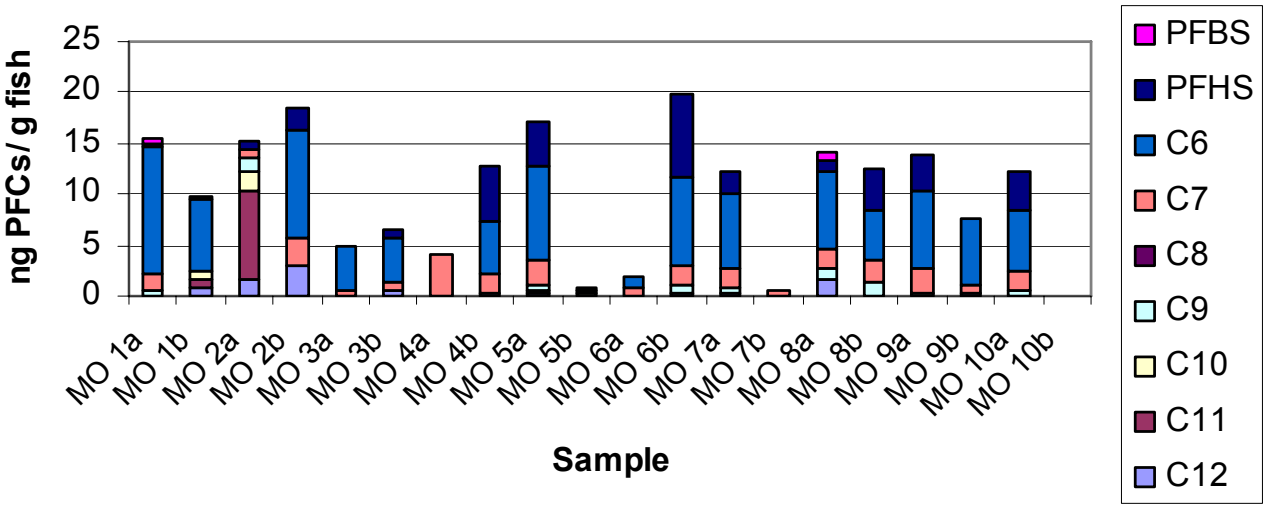


At each location for each compound the highest possible value is 20

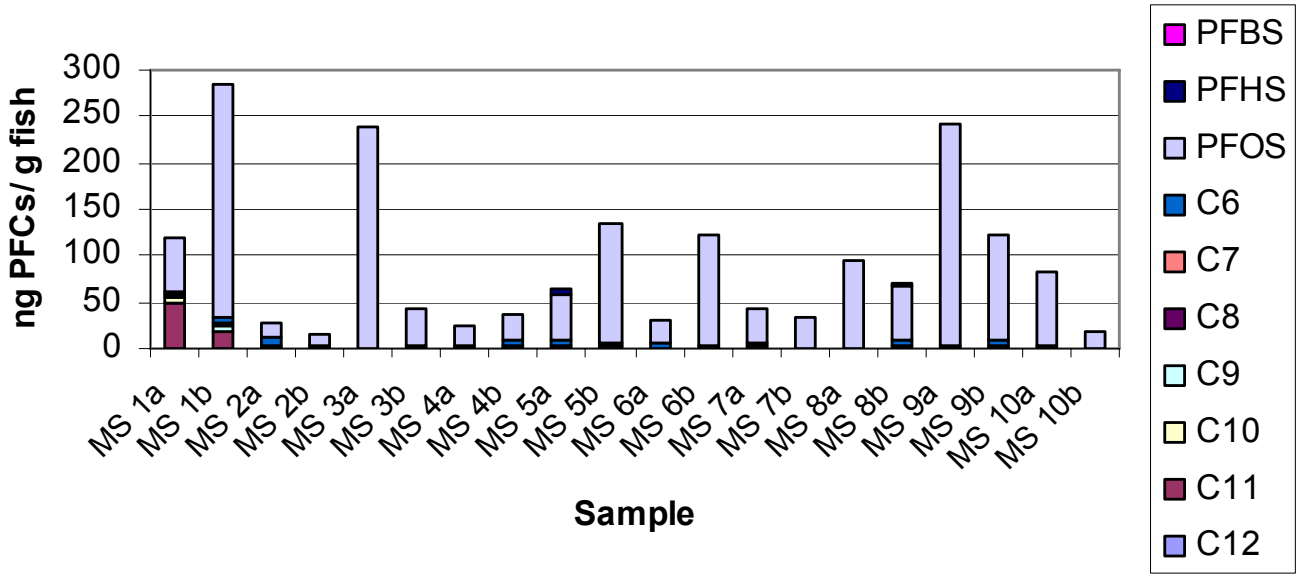
Total PFCs in Missouri River Fish



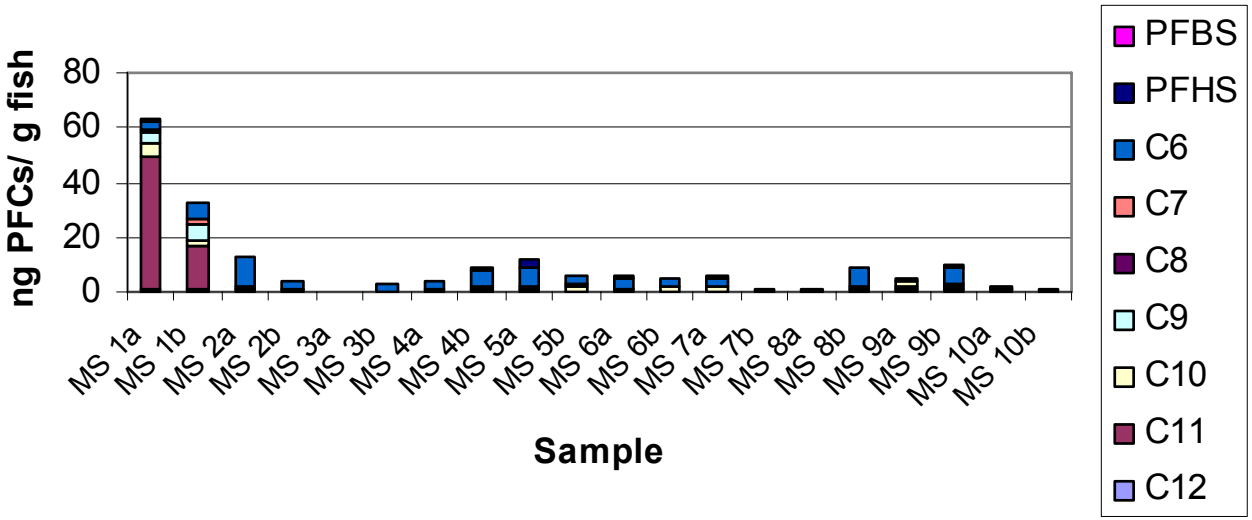
Total PFCs (without PFOS) in Missouri River Fish



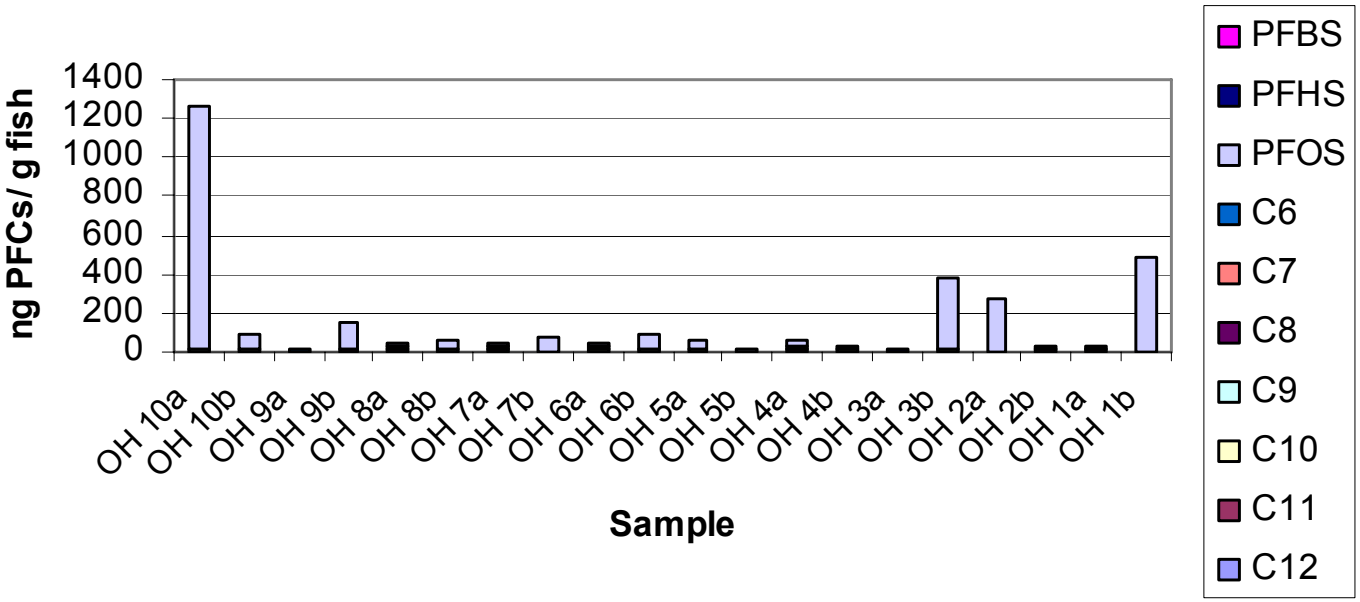
Total PFCs in Mississippi River Fish



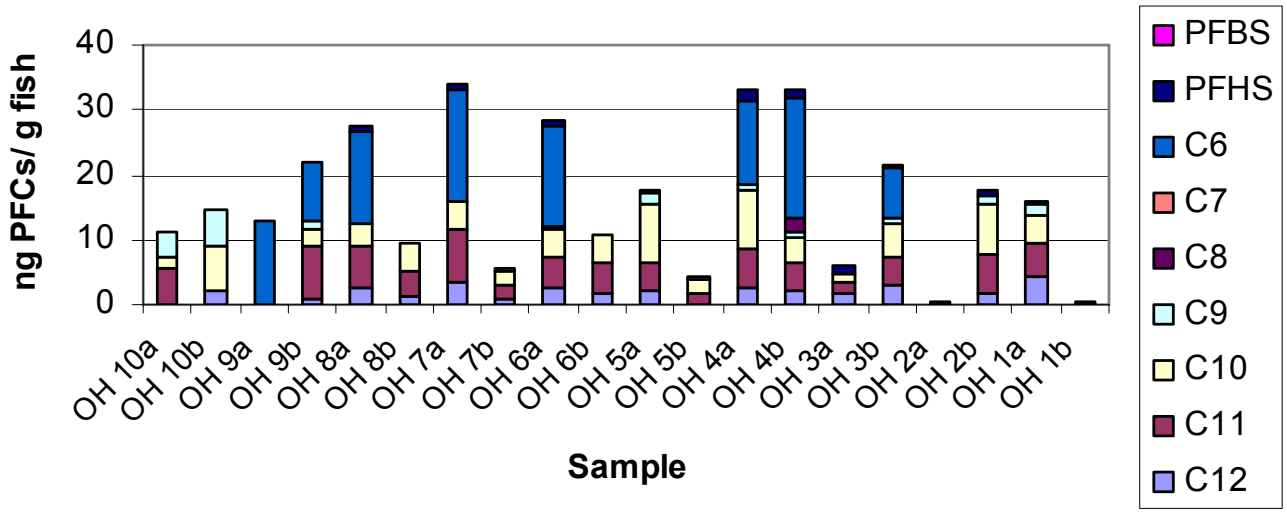
Total PFCs (without PFOS) in Mississippi River Fish



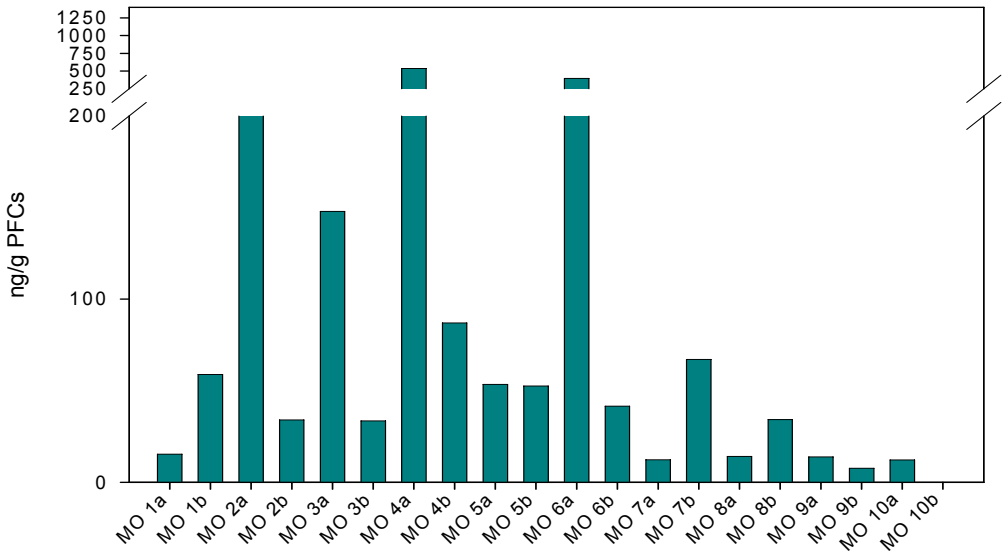
Total PFCs in Ohio River Fish

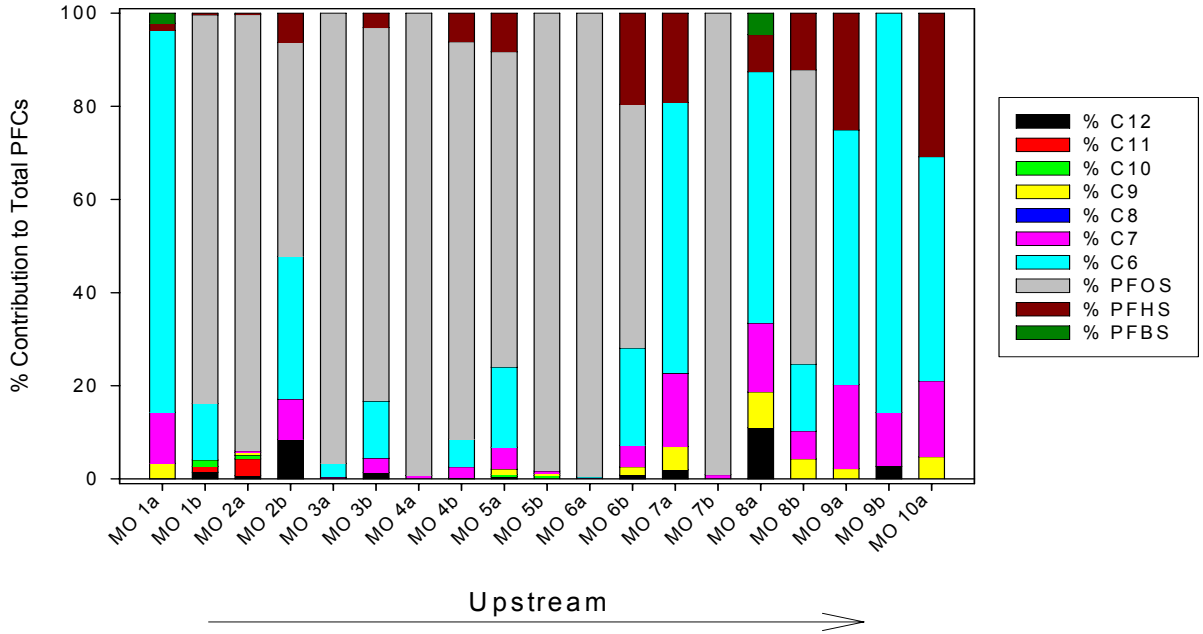


Total PFCs (without PFOS) in Ohio River Fish

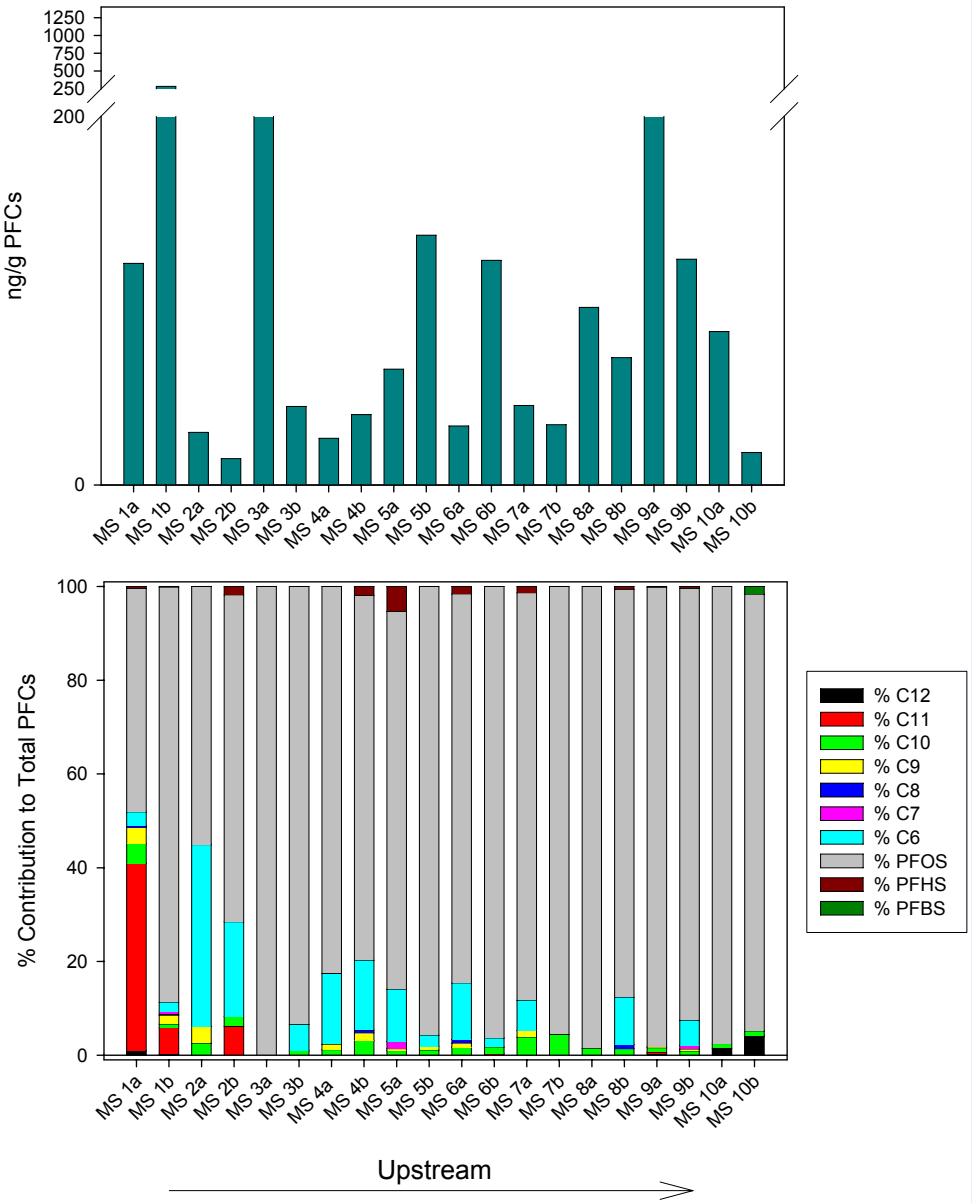


PFCs in Missouri River Whole-fish Homogenates

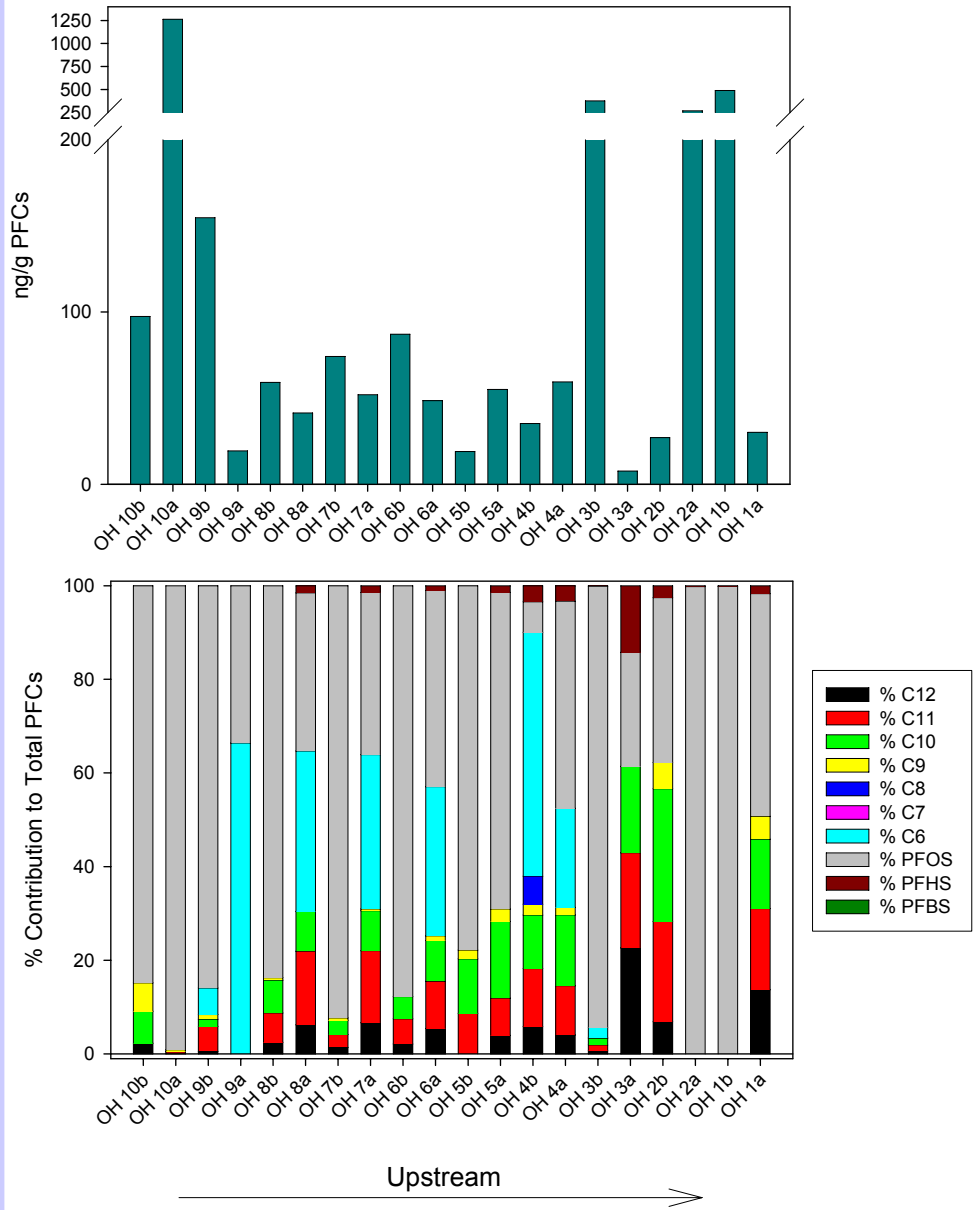




PFCs in Mississippi River Whole-fish Homogenates



PFCs in Ohio River Whole-fish Homogenates



Indicator Type	Ecological sub-type	Metric variable name Metric	Metric type	Units
Fish Contaminants	PCBs - 20 congeners	Detection Limit	Numeric	1 ppb
	Pesticides - 21	"	Numeric	"
	PBDEs	"	Numeric	"
	PFOS	"	Numeric	
	Mercury	"	Numeric	5 ppb
	PCBs - 20 congeners	Wildlife Value - Birds - Kingfisher	Numeric	0.44 ppm
		Wildlife Value - Mammals - Mink	Numeric	0.13 ppm
	Chlordane	Wildlife Value - Birds - Kingfisher	Numeric	0.0045 ppm
		Wildlife Value - Mammals - Mink	Numeric	0.83 ppm
	DDT & Metabolites	Wildlife Value - Birds - Kingfisher	Numeric	0.02 ppm
		Wildlife Value - Mammals - Mink	Numeric	0.36 ppm
	Dieldrin	Wildlife Value - Birds - Kingfisher	Numeric	0.36 ppm
		Wildlife Value - Mammals - Mink	Numeric	0.02 ppm
	Endrin	Wildlife Value - Birds - Kingfisher	Numeric	0.22 ppm
		Wildlife Value - Mammals - Mink	Numeric	0.04 ppm
	PBDEs	Wildlife Value - Birds - Kingfisher	Numeric	
		Wildlife Value - Mammals - Mink	Numeric	
	PFOS	Wildlife Value - Birds - Kingfisher	Numeric	
		Wildlife Value - Mammals - Mink	Numeric	
	Mercury	Wildlife Value - Birds - Kingfisher	Numeric	0.03 ppm
		Wildlife Value - Mammals - Mink	Numeric	0.07 ppm
Sediment Toxicity	Survival	H. azteca survival	numeric	%
Sediment Toxicity	growths	H. azteca growth	numeric	ug/surv individual
Sediment Toxicity	Control Survival	H. azteca control survival	numeric	%
Sediment Toxicity	Control Growth	H. azteca control growth	numeric	ug/surv individual