

Relationships between TEQ from PCDDs, PCDFs, and dioxin-like PCBs and other common compounds of concern in fishes from the Saginaw Bay watershed

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INTRODUCTION

Select dibenzo-*p*-dioxin (PCDD), dibenzofuran (PCDF), and polychlorinated-biphenyl (PCB) congeners, mercury, arsenic, and a suite of other metals were measured in fillet tissue of nearly 500 fish collected from the Saginaw Bay watershed in 2007 and 2008. Water bodies from which fish were collected included the Pine, Tittabawassee, Saginaw, Shiawassee, Flint, and Cass Rivers and the Saginaw Bay of Lake Huron. Species included channel catfish, carp, smallmouth, largemouth, and white bass, freshwater drum, northern pike, walleye, perch, crappie, and white suckers. Average concentrations of Σ PCDDs and Σ PCDFs ranged from 1.3 – 18 and 2.2 – 59 pg/g (ww), respectively, while average Σ PCBs ranged from 15 – 150 ng/g (ww). Concentrations of these were greatest in carp and channel catfish and generally least in freshwater drum. Interestingly, the greatest average mercury concentrations were observed in freshwater drum and the greatest average arsenic level in smallmouth bass. Approximately 7% of all mercury results exceeded the State of Michigan's mercury fish consumption advisory trigger level of 0.5 ppm.

RATIONALE

- Recreational fishing is popular in the Saginaw Bay watershed
- Consumption advisories exist for many fish species from the Saginaw Bay watershed
- Fish contaminant data sets are often chemical-specific
- Saginaw Bay watershed receives agricultural and industrial inputs
- Concentrations of bioaccumulative compounds in fish may differ between lentic and lotic environments.

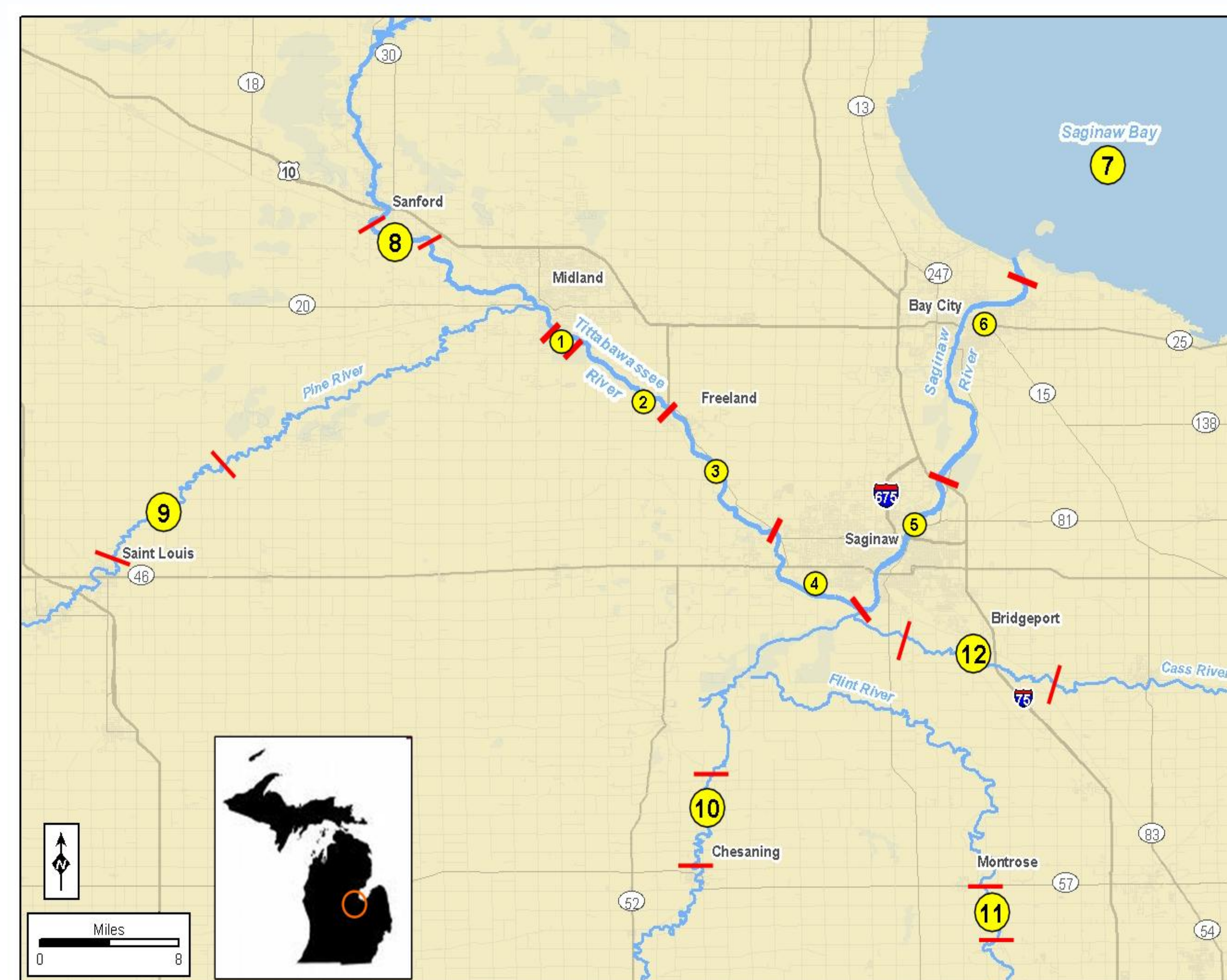


Figure 1. Fish collection locations 2007-2008

Acknowledgements

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METHODS

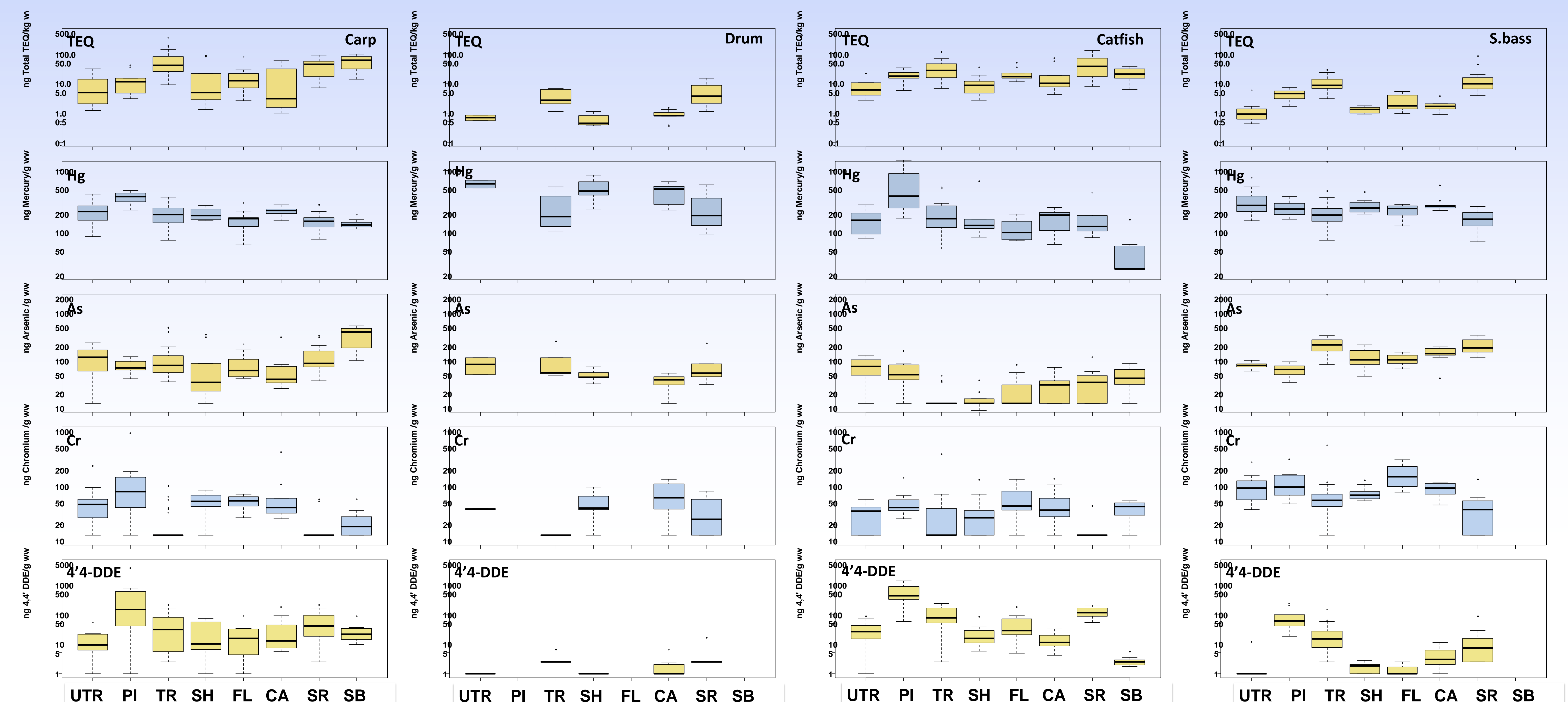
- Fish collected from six rivers & the Saginaw Bay in 2007 and 2008 (Figure 1); boneless fillet tissues removed
- Fish sizes based on Michigan fishing regulations
- 2007 fish analyzed for PCDD/PCDFs, 12 dioxin-like PCBs, and 65 other compounds from 7 classes
- 2008 fish analyzed for PCDD/PCDFs, 12 dioxin-like PCBs, and Hg, As, and DDT metabolites
- Mammalian TCDD-equivalent (TEQ, Van den Berg et al., 2006) calculated & compared across species and locations

RESULTS

- PCDD/Fs, dioxin-like PCBs, mercury, chromium detected in all fish; arsenic, 4,4'-DDE in $\geq 75\%$ of fish. Rest of compounds detected in $>5\%$ of all fish.
- Greatest mean Hg concentrations in drum (Fig. 2) from Upper Tittabawassee River.
- 4,4'-DDE elevated in Pine River carp and catfish (mean concentrations 10-20x other locations).
- On a watershed basis, greatest mean arsenic concentrations observed in smallmouth bass.
- Greatest sum furan concentrations observed in Tittabawassee River fish; greatest sum PCBs in Saginaw River; sum dioxin variable.
- Least Σ TEQtotal in *Lepomis spp.* (not shown), walleye (not shown), & drum.

Figure 2. Concentrations of mammalian TEQ (ng/kg, ww), mercury, arsenic, chromium, and 4,4'-DDE in fish collected from the Saginaw Bay watershed

Black bar represents median value; whiskers to extreme point not more than 1.5 times interquartile range from box; non-detects set equal to 1/2 detection limit



Carp

- Greatest TEQ concentrations
- No Hg concentrations > 0.5 ppm

Drum

- Generally least TEQ & DDE levels but 12/29 fish > 0.5 ppm Hg

Channel catfish

- Greatest Hg value (1.48 ppm) & mean DDE observed: 9/102 fish > 0.5 ppm Hg

Smallmouth bass

- Least variable of all species for TEQ, Hg, and As; greatest mean Cr levels

DISCUSSION

- Drum with Hg concentrations > 0.5 ppm averaged 18 years old vs. 12 years old for drum < 0.5 ppm; potentially influencing Hg concentrations. Age determination recommended for fish contaminant studies.
- 35 fish exceed state of MI Hg "Restrict consumption" trigger level of 0.5 ppm; none exceeded "No consumption" level of 1.5 ppm
- Extent to which "resident" fish move throughout watershed is unclear & likely a key factor contributing to exposure of fish to all compounds
- Elevated concentrations of multiple compounds in Pine River fish suggests potential source to Tittabawassee River
- In general, $\geq 50\%$ of Σ TEQtotal was from dioxin-like PCBs, regardless of location. Based on these data, state of MI TEQ trigger level (10 ppt) would be exceeded for many species & locations even in absence of dioxins and furans