

# Fish Tissue Contaminants



# Workgroup Conference Call Highlights

- The Workgroup welcomes new members:
  - Gary Klase (OEPA) replacing Mylynda Shaskus
  - Magan Meade (IN Dept. of Health)
    - filling a 3 year old vacancy on the workgroup
- Ohio River Fish Consumption Advisory Protocol
  - Ohio River FCA website online/updated  
[www.orsanco.org/fca](http://www.orsanco.org/fca)
    - Several suggestions for improvement will be reviewed
  - 4 of 6 states and ORSANCO have signed MOU
    - IL members are in agreement and adoption is in progress
    - Follow-up with PA is still pending

# Workgroup Conference Call Highlights

- Changes to the proposed advisories were discussed
  - Still under review by PA and KY
  - IL advisory changes were noted
- Further discussions included:
  - ORSANCO's draft Aquarium Questionnaire
    - **Not** a statistically designed survey
    - No cost, anecdotal information:
      - Will provide valuable insight to better identify target species
      - May lay the foundation for a more robust future study

# Workgroup Conference Call Highlights

- PCBs in fish tissue criterion for 305(b) use assessments
  - IN uses 0.02 ppm
  - 1537 of 1559 Ohio River samples since 1983 (99%) are >0.02ppm total PCBs
    - nearly all of the 22 samples >0.02ppm are sunfishes, black bass and crappie below RMI 721
  - Based on the fish tissue data, a river-wide impairment of fish consumption use for total PCBs seems justified



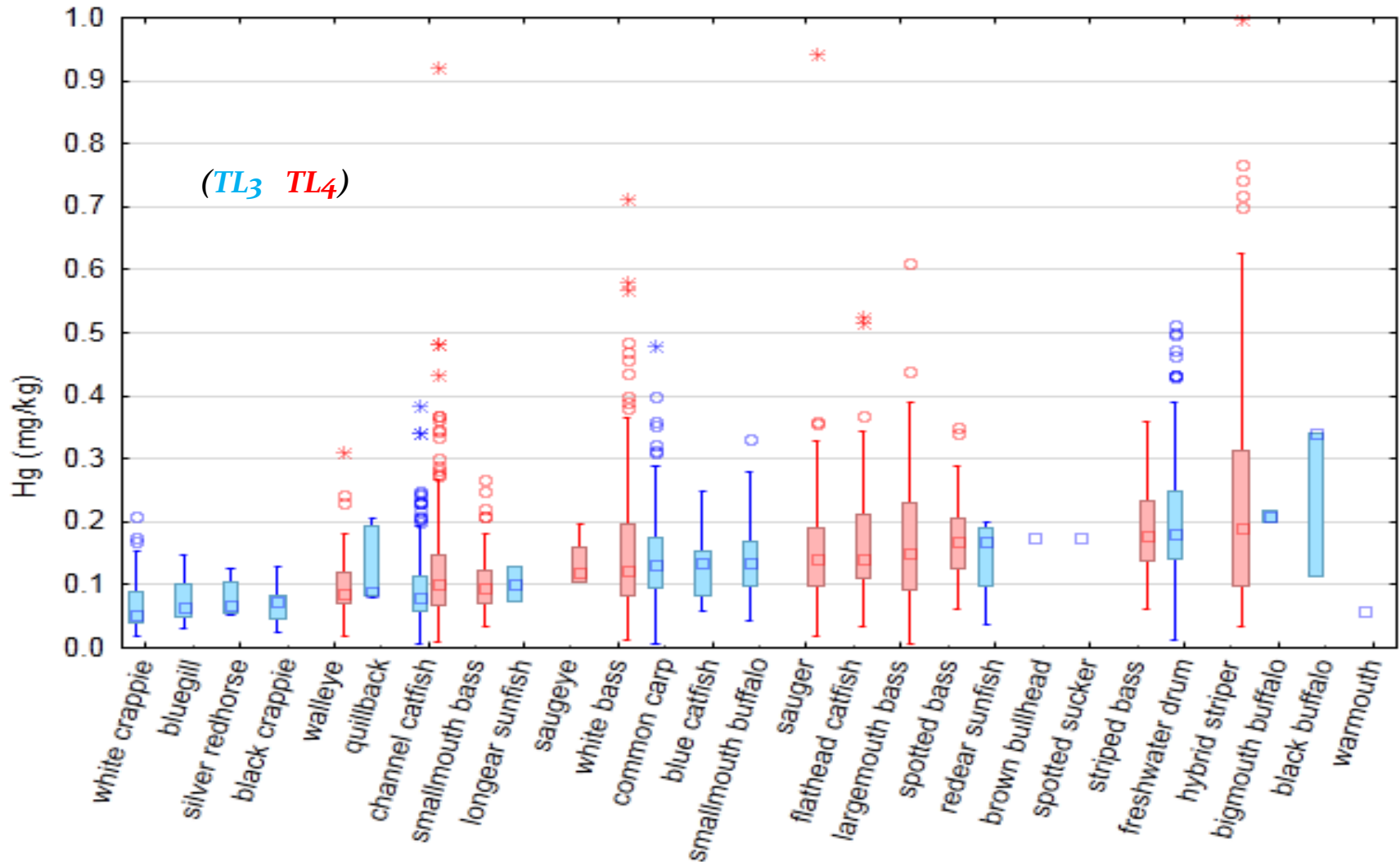
# Workgroup Conference Call Highlights

- Discussed analyzing for Methyl Hg only (dropping total)
  - 305(b) requires MeHg
  - Could estimate total Hg for consumption advisories
  - Group decided more data & analyses were needed
- Discussed collecting serum/biopsy vs fillets
  - Preventing sample degradation due to desiccation is key
- Discussed ORSANCO's *Total Hg In Fish Tissue – Trends Analysis* poster at the NWQM Conference

# Mercury in Fish Tissue on the Ohio River Spatial and Temporal Trends - Preliminary Analyses Update

- Analyses are ongoing:
  - Data qualification and preliminary analyses concluded in May
  - More detailed analyses of data from different timeframes
  - Investigating total Hg analysis methods
- We are working to address challenges and analysis factors:
  - **Specific species**
  - **TL assignments**
  - **Varying size classes**
  - **Spatial patterns**
  - **Analysis timeframes**
  - **Analytical method**

# Total Hg; Species Comparisons



## Total Hg: TL Comparisons

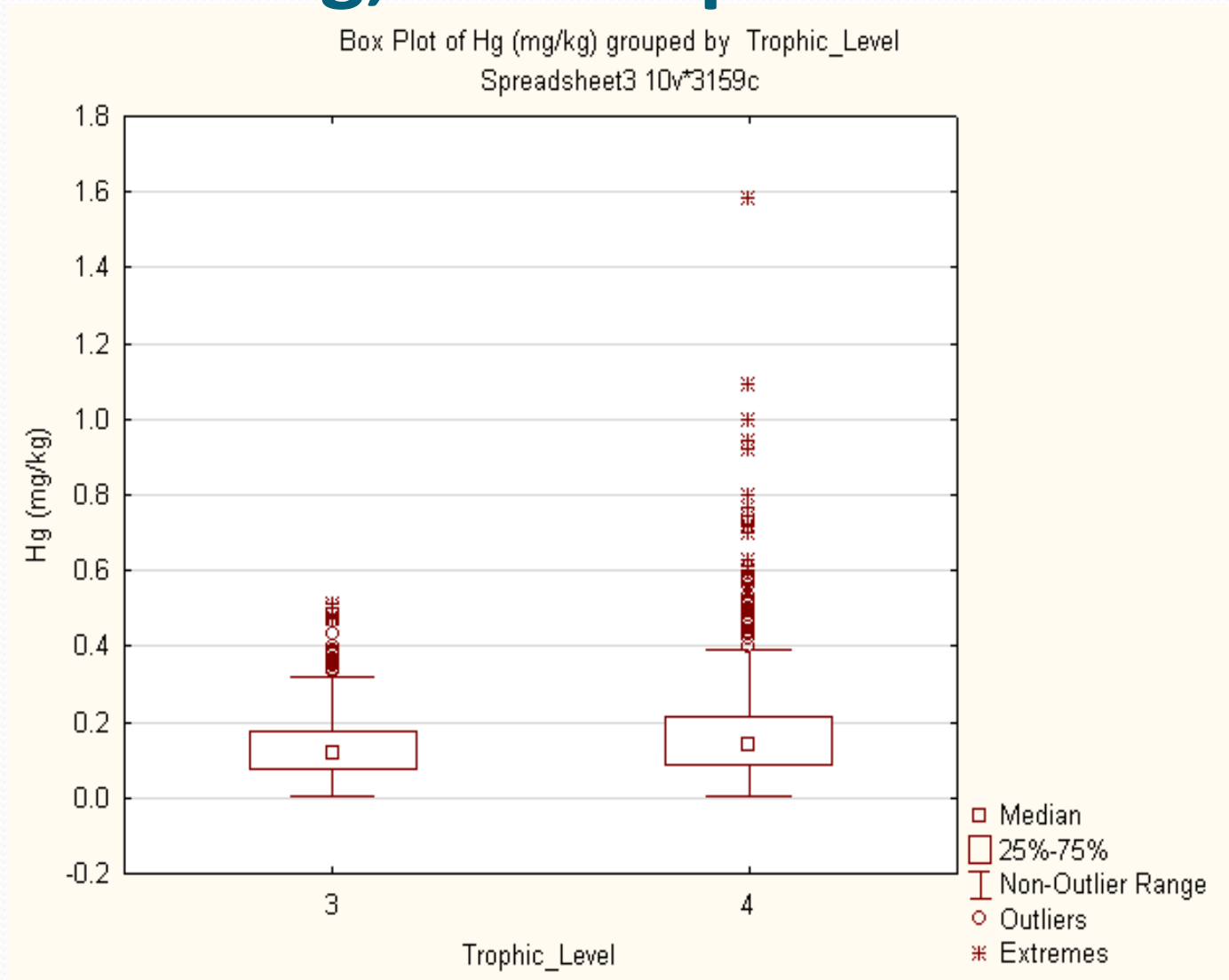
Box Plot of Hg (mg/kg) grouped by Trophic\_Level  
Spreadsheet3 10v\*3159c

Y-axis: Hg (mg/kg)

X-axis: Trophic\_Level

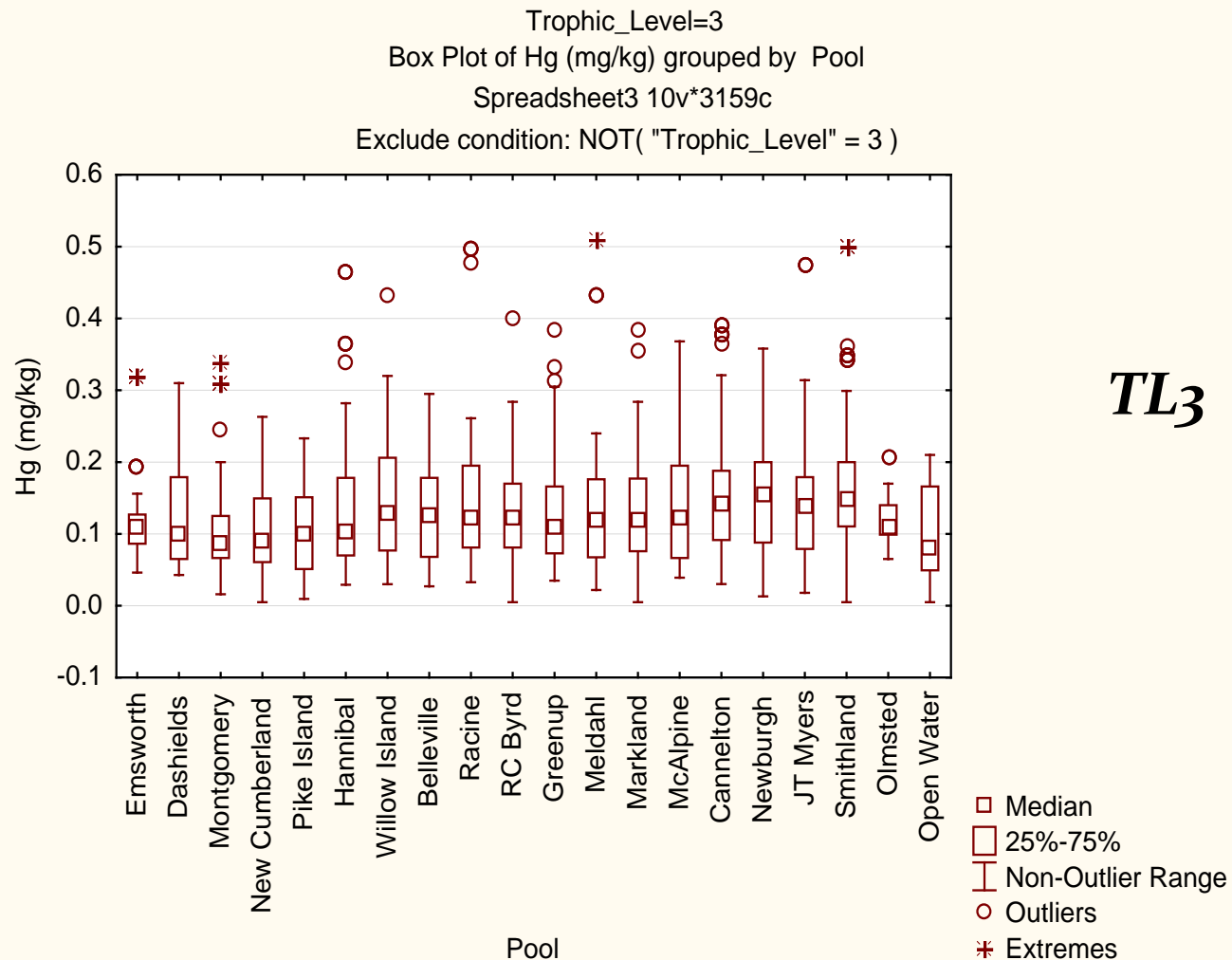
Legend:

- Median
- 25%-75%
- Non-Outlier Range
- Outliers
- Extremes

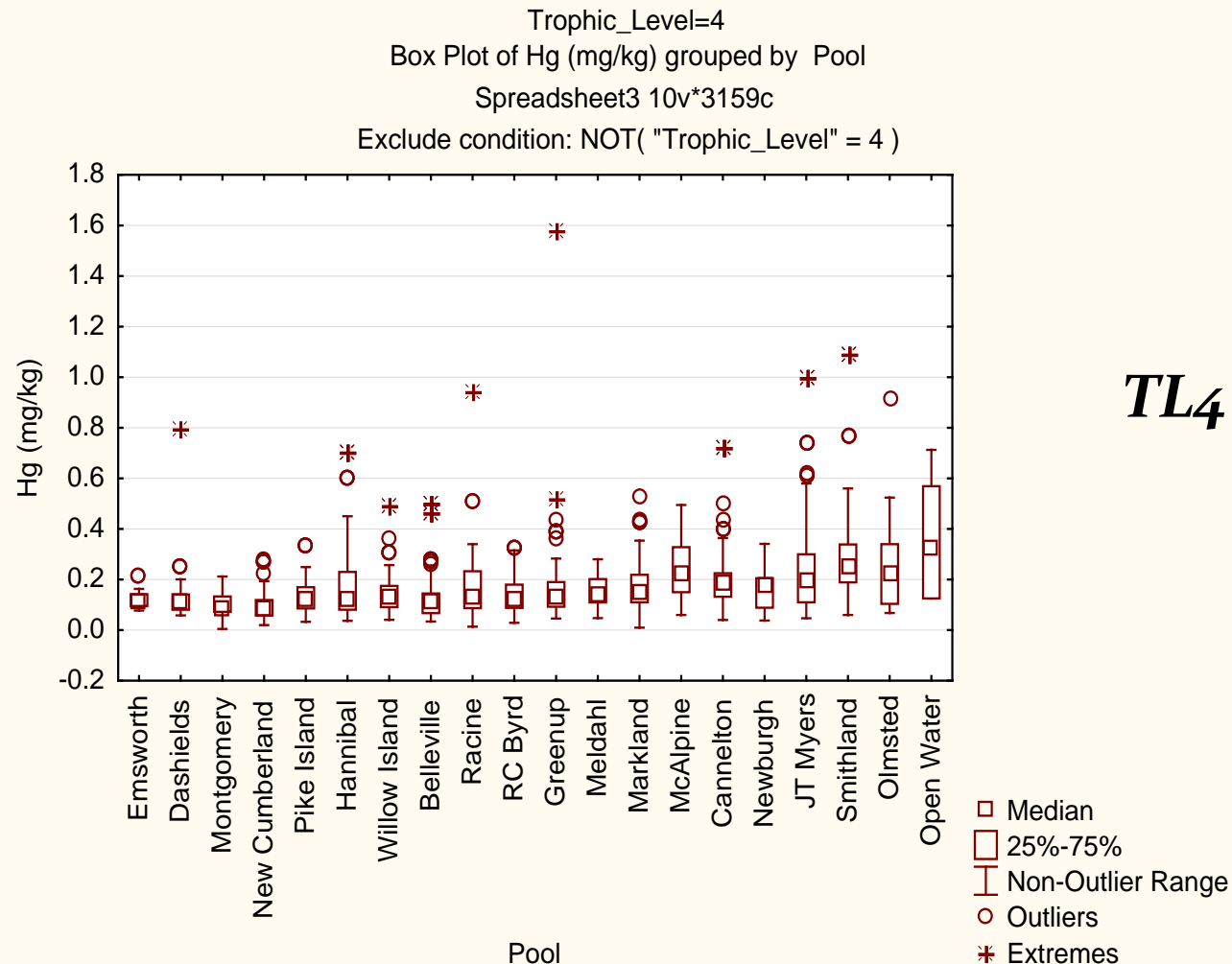




# Total Hg; TL Comparisons - by Pool

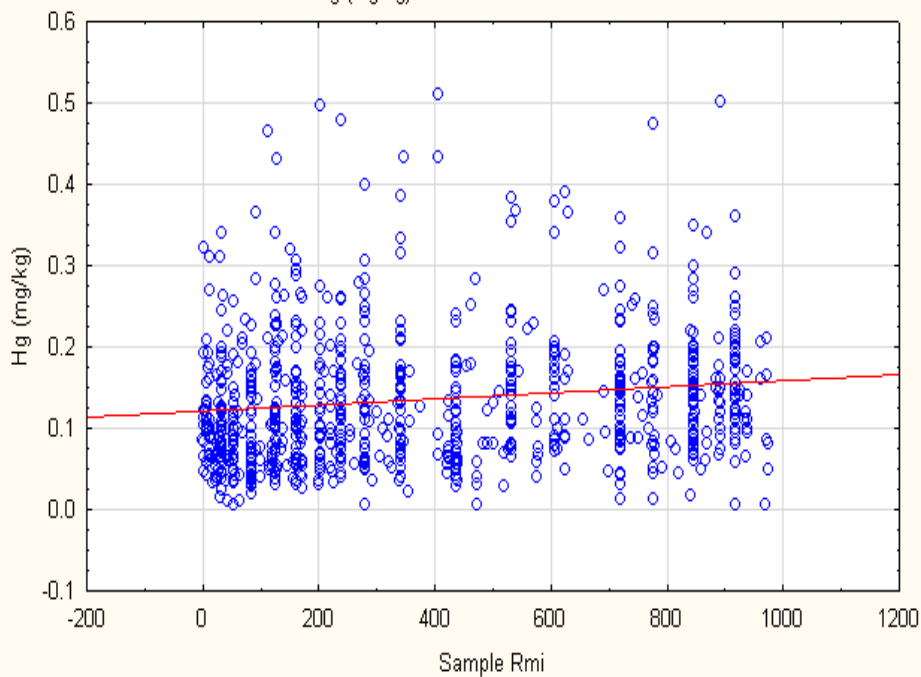


# Total Hg; TL Comparisons - by Pool



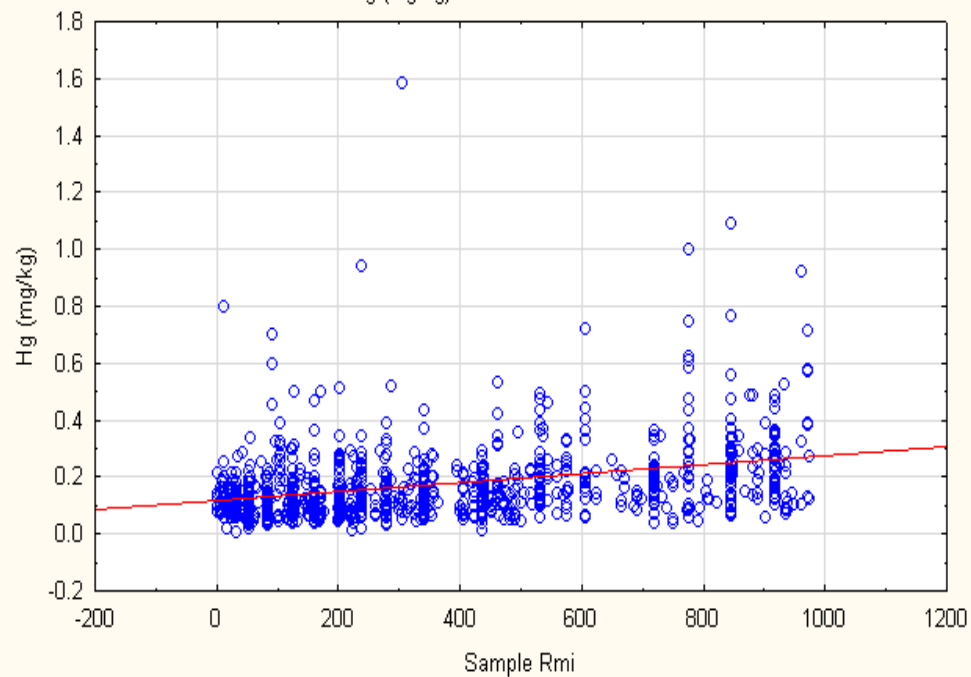
# Total Hg; TL Comparisons - by RMI

Trophic\_Level=3  
Scatterplot of Hg (mg/kg) against Sample Rmi  
Spreadsheet3 10v\*3159c  
Exclude condition: NOT( "Trophic\_Level" = 3 )  
 $Hg \text{ (mg/kg)} = 0.1218 + 3.6359E-5 * x$



**TL<sub>3</sub>**

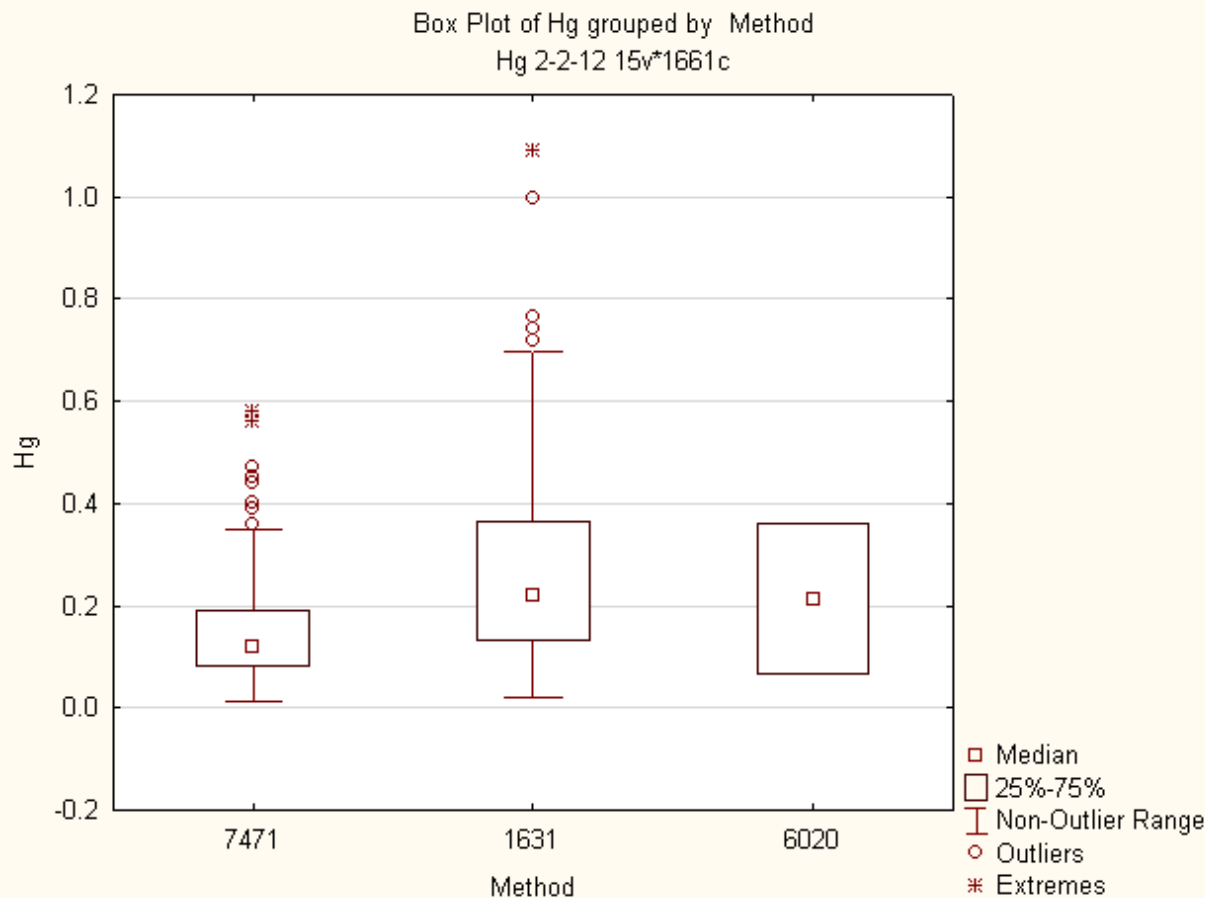
Trophic\_Level=4  
Scatterplot of Hg (mg/kg) against Sample Rmi  
Spreadsheet3 10v\*3159c  
Exclude condition: NOT( "Trophic\_Level" = 4 )  
 $Hg \text{ (mg/kg)} = 0.1189 + 0.0002 * x$



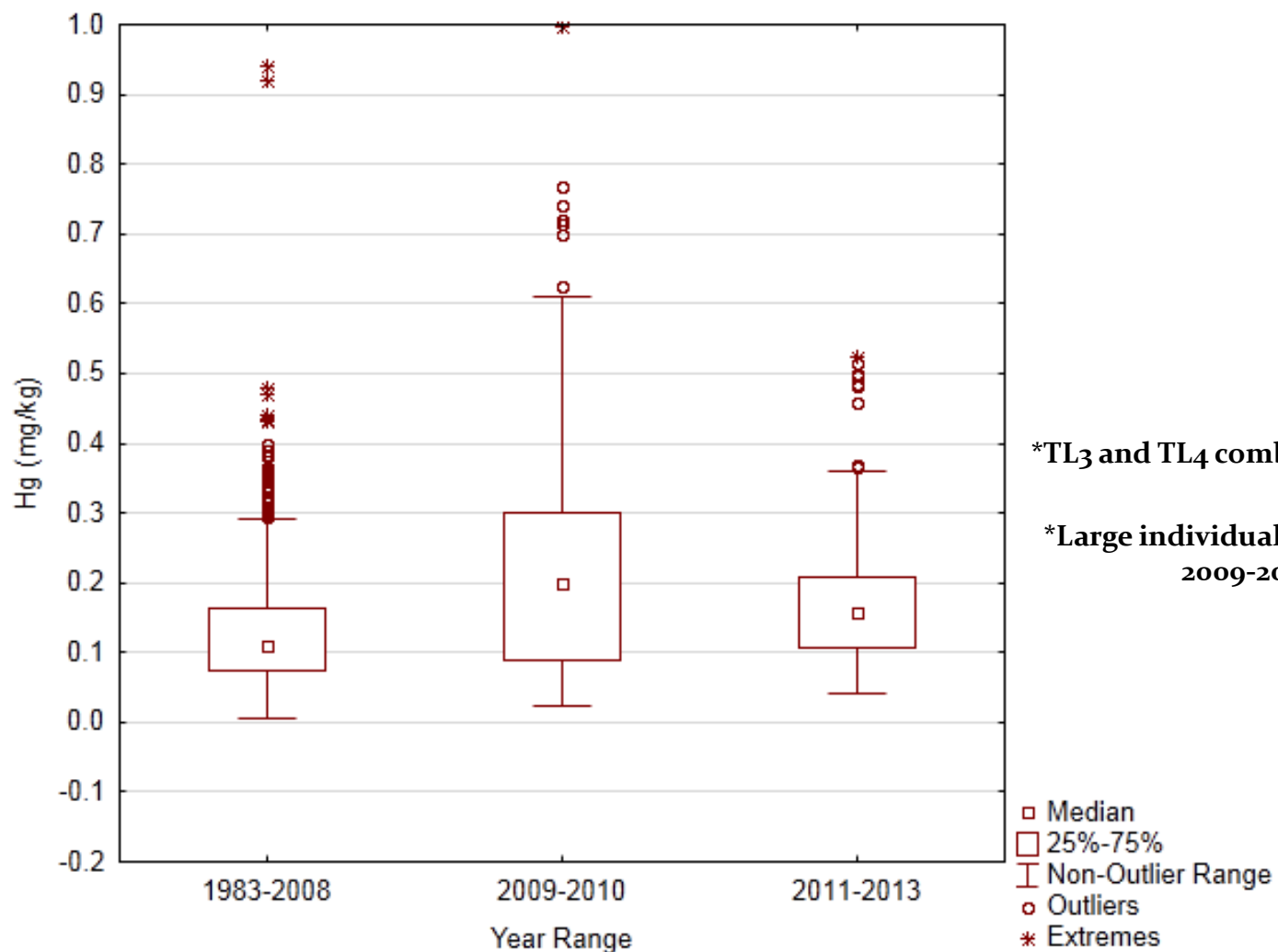
**TL<sub>4</sub>**

# Total Hg; Method Comparisons

In 2009, ORSANCO began adopting the new Hg analysis method EPA 1631 which yields higher values than the previous method, EPA 7471.



# Total Hg; Temporal Comparisons

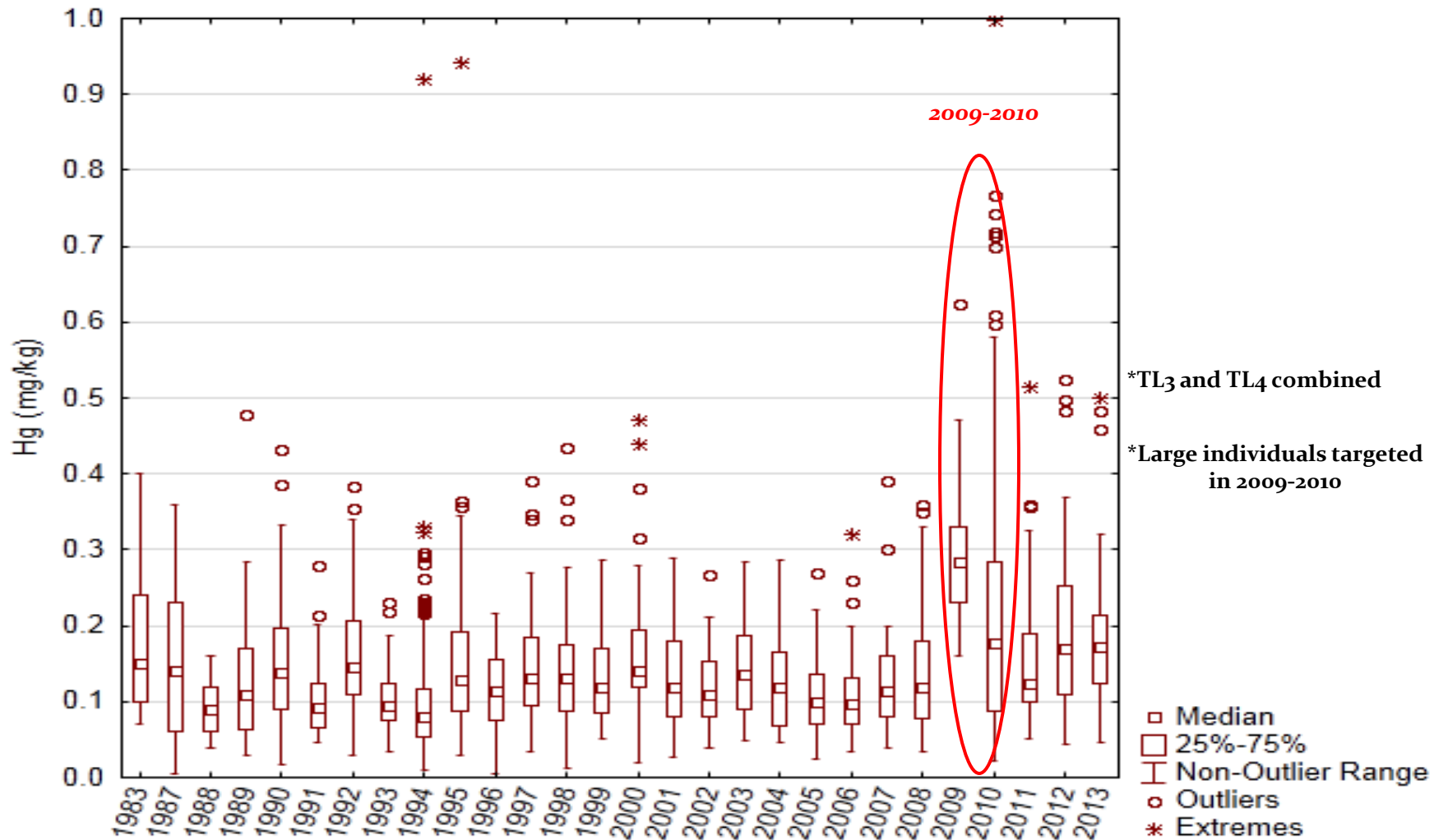


\*TL<sub>3</sub> and TL<sub>4</sub> combined

\*Large individuals targeted in 2009-2010

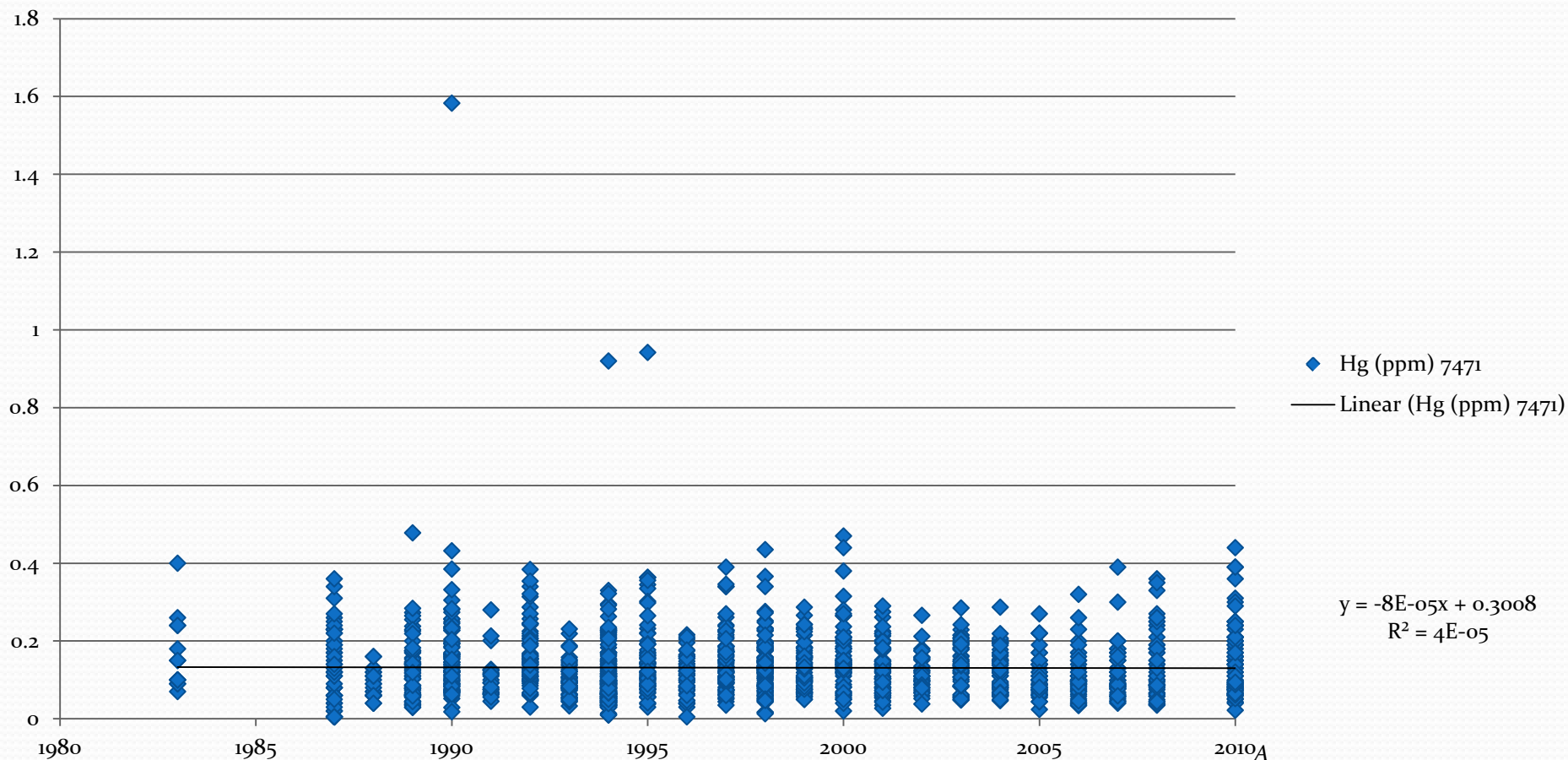


# Total Hg; Temporal Comparisons



# Total Hg; Temporal Comparisons

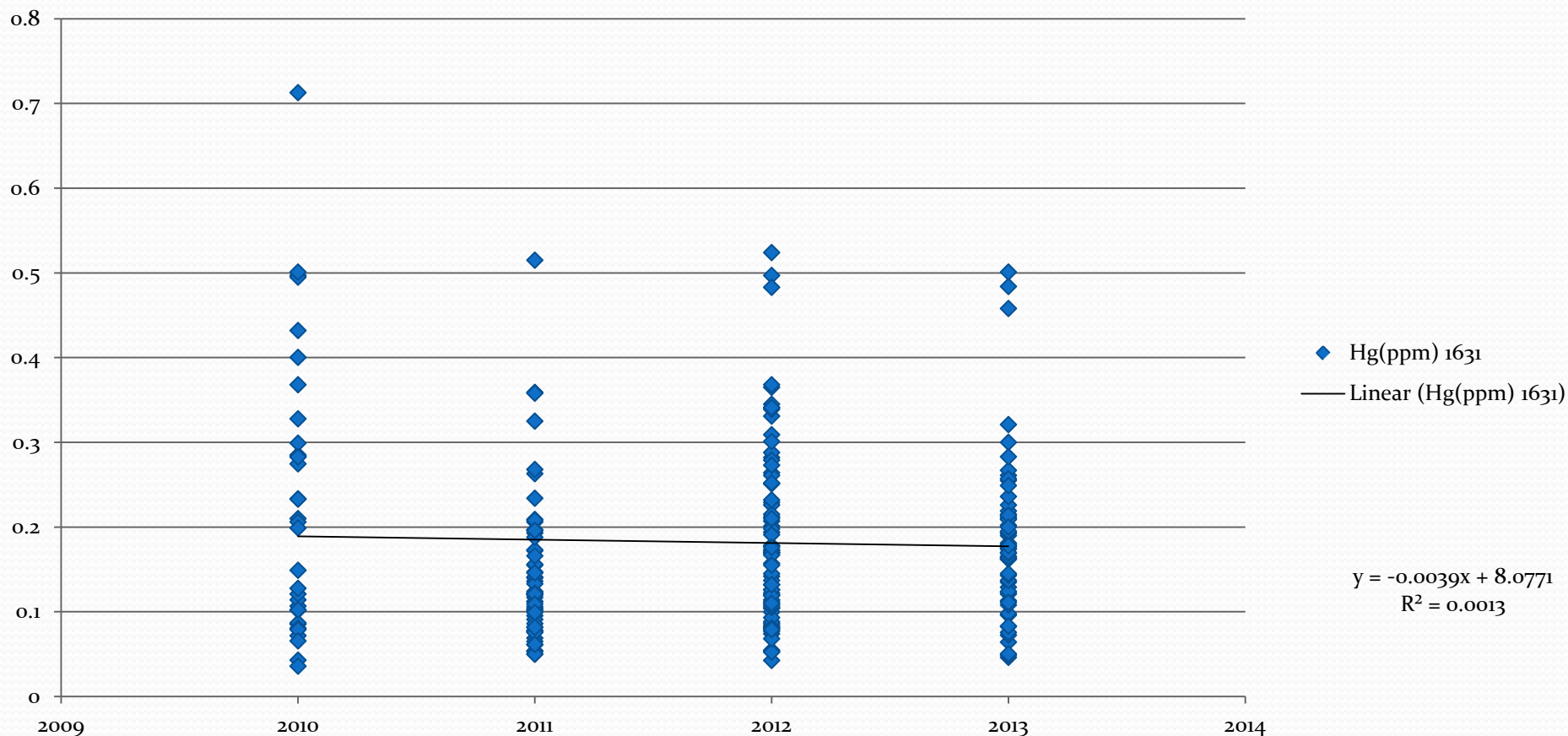
Hg (ppm) 7471



*All TL<sub>3</sub> and TL<sub>4</sub>; by year 1983 – 2008; 2010A*

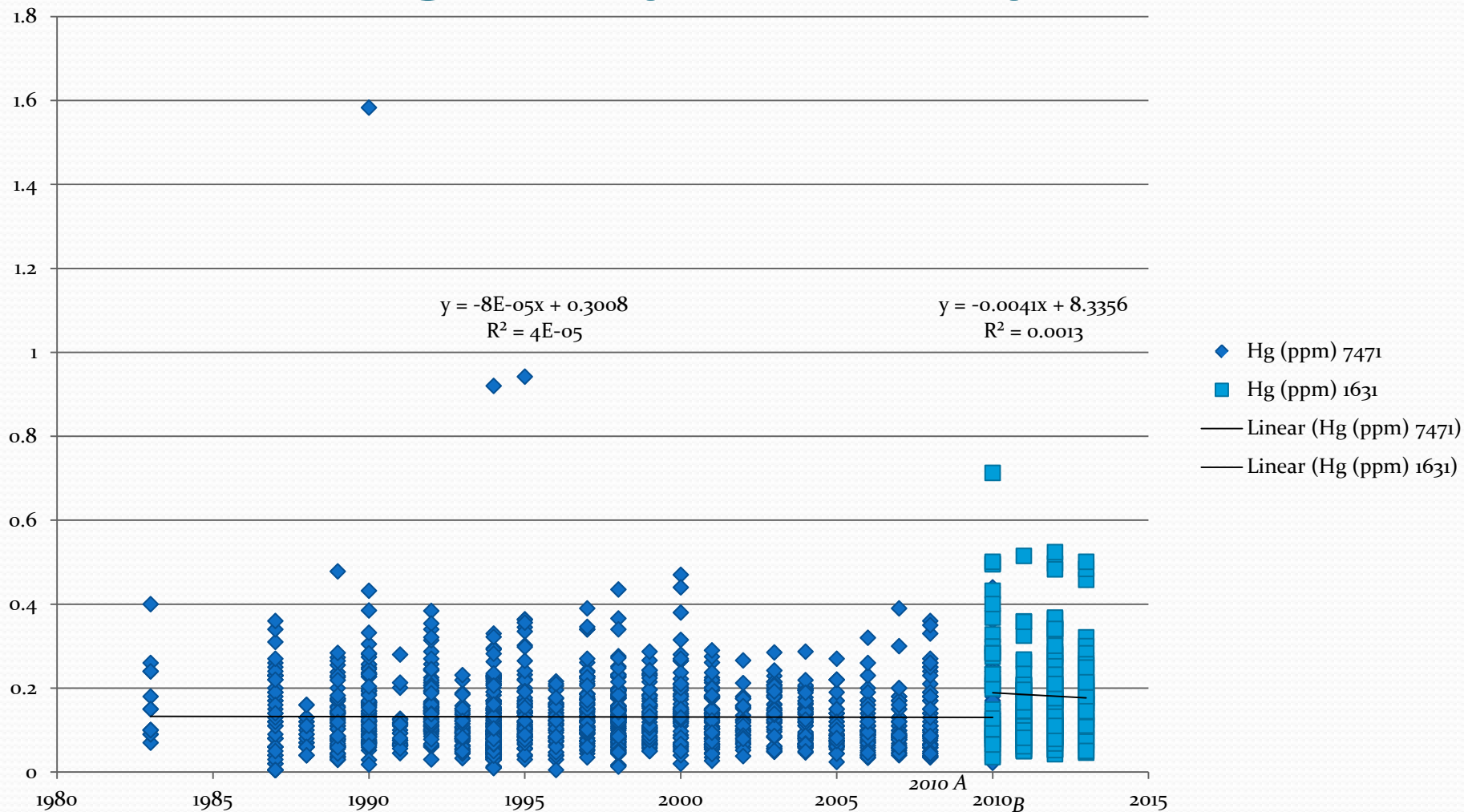
# Total Hg; Temporal Comparisons

Hg (ppm) 1631



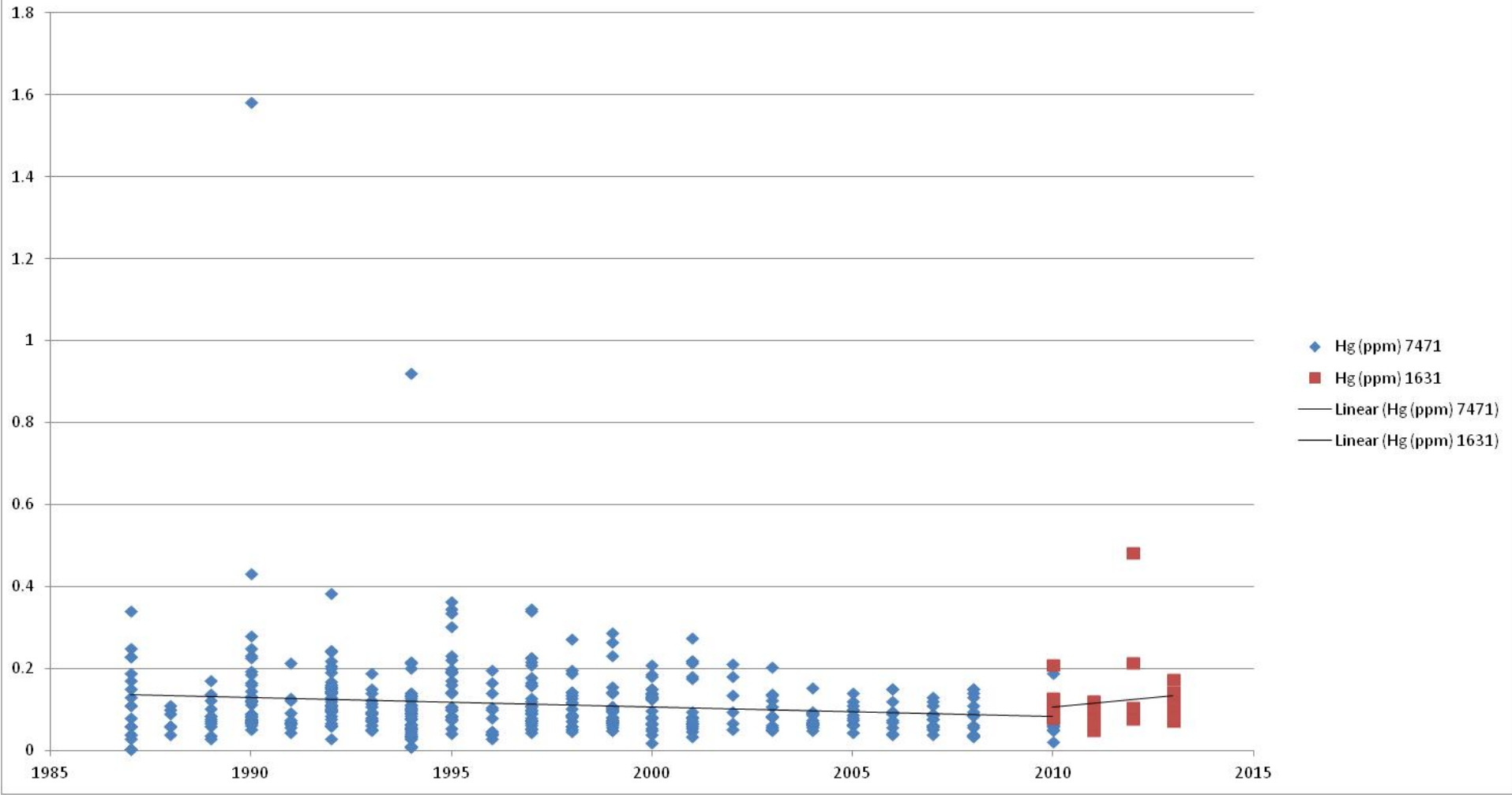
*All TL<sub>3</sub> and TL<sub>4</sub>; by year 2010B - 2013*

# Total Hg; Temporal Comparisons



*All TL<sub>3</sub> and TL<sub>4</sub>; by timeframe*

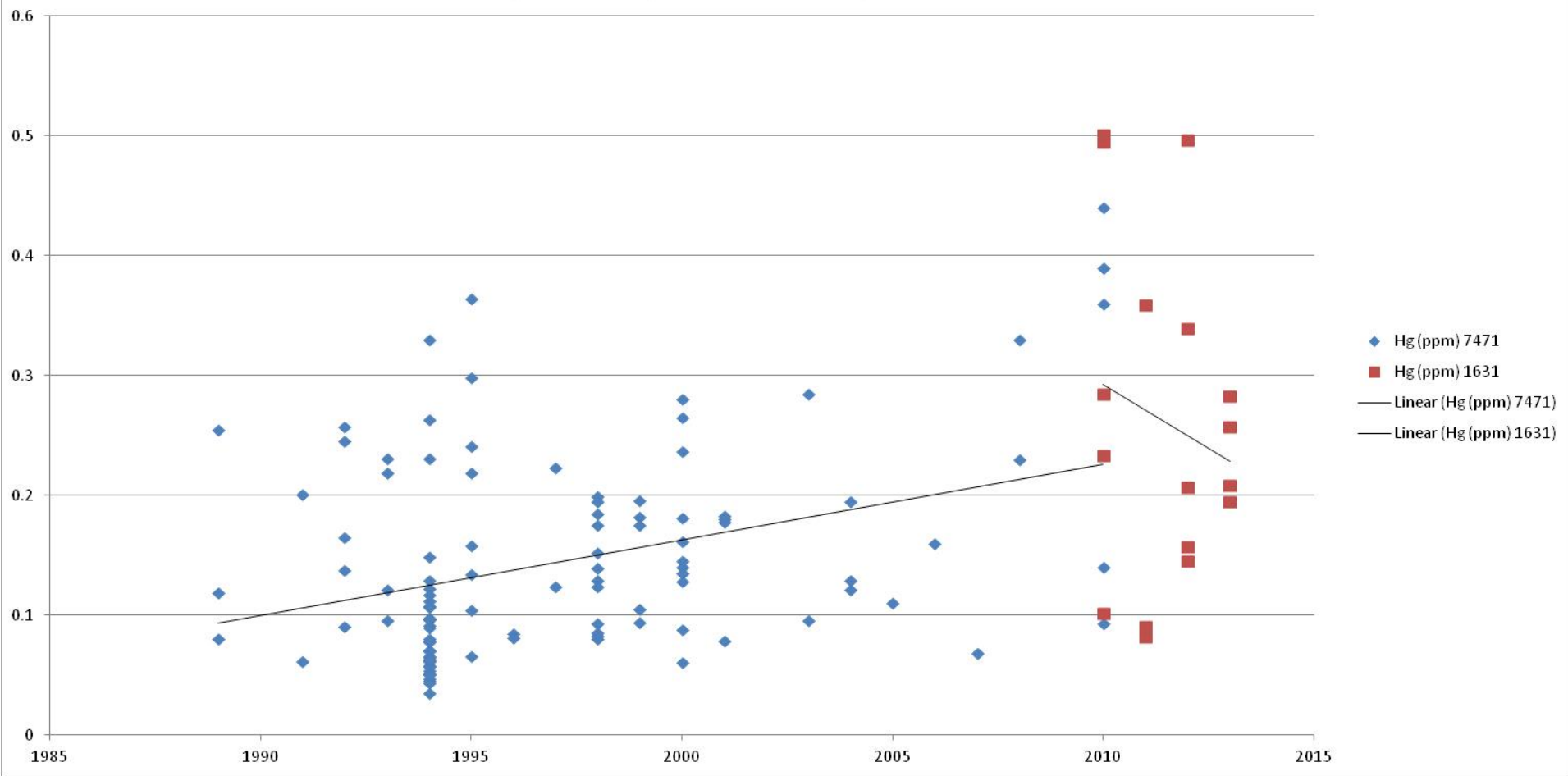
Channel Catfish Hg / Time



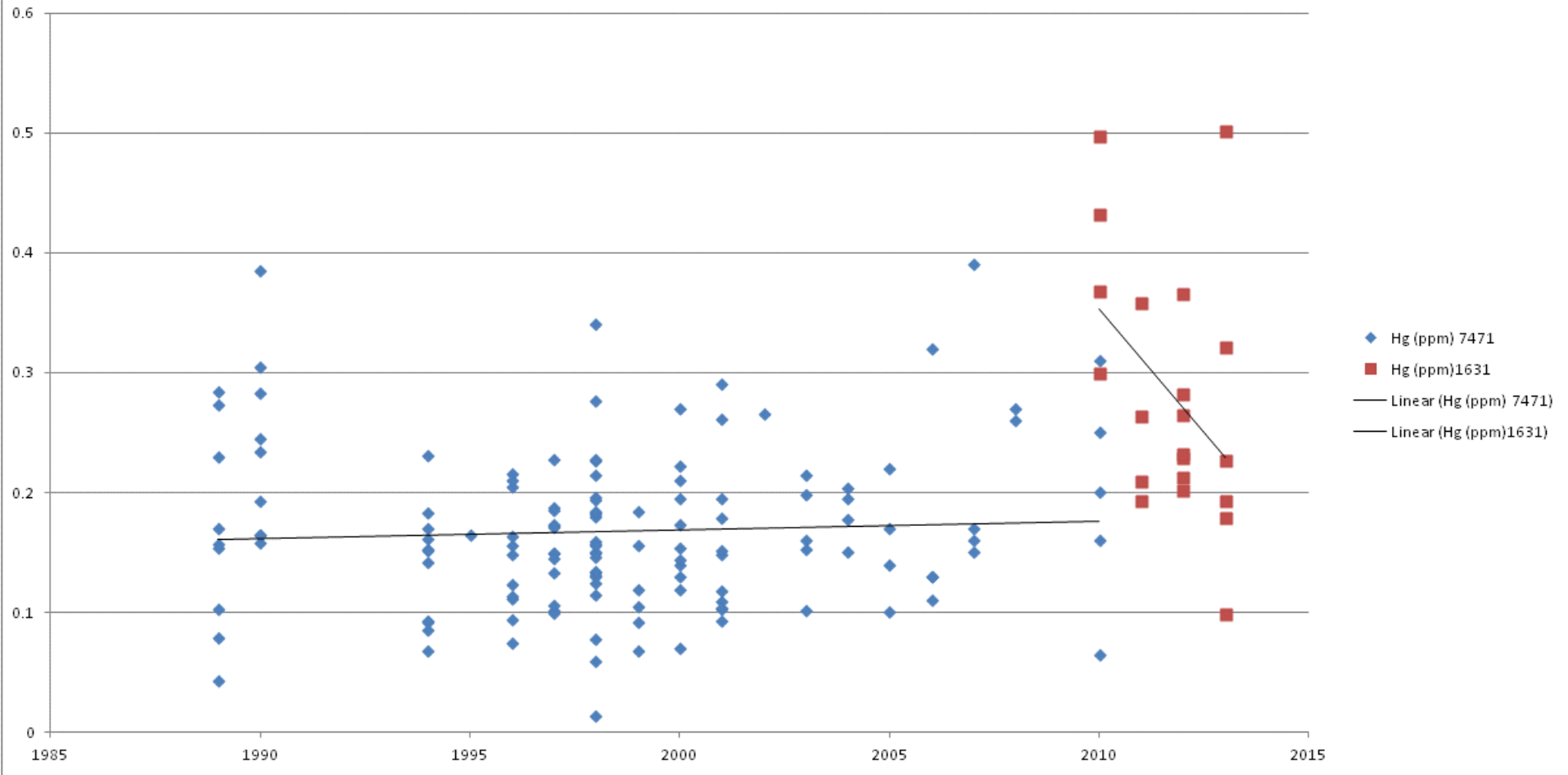




Hybrid / Striped Bass Total Hg / Time



Freshwater Drum Total Hg / Time



# Next Steps

- Appropriately address the issues of the 2009 & 2010 and the 2009 – 2013 datasets and the increased total Hg yields derived from EPA 1631.
- Investigate size standardization and focus on the 13 species for which we have the most data
- Truncate the dataset and determine % increase or decrease over time



# Questions?







ORSANCO electrofishing crew

# Mercury in Ohio River Fish Tissue - Spatial and Temporal Trends; Preliminary Analyses

Rob A. Tewes

Senior Biologist - Ohio River Valley Water Sanitation Commission (ORSANCO)



Hybrid Striped Bass fillets

## INTRODUCTION

The Ohio River Valley Water Sanitation Commission (ORSANCO) is a multi-state pollution control agency formed in 1948 and charged primarily with pollution abatement in the basin, criteria and standard development and issuance, and environmental and biological monitoring. As part of ORSANCO's Biological Programs, the ORSANCO Fish Tissue Program has been collecting fish tissue contaminant data from the Ohio River since the 1980's. The six main stem states (PA, OH, WV, KY, IN, IL) have been using these data to issue risk-based fish consumption advisories since the 1990's. A comprehensive analysis of total mercury (Hg) trends in fish tissue is warranted at this time as recent air emission regulations could ultimately be responsible for directing more Hg into waterways. Additionally, mixing zones for bioaccumulating contaminants of concern, like Hg, are in the process of being eliminated on the Ohio River, potentially affecting permit renewals for many Ohio River dischargers.

## STUDY AREA

The 981 miles of the Ohio River are segmented by high-lift locks and dams that maintain a nine-foot minimum depth for commercial navigation. The navigational pools that lie between these installations served as our study areas. Samples were obtained from randomly selected sites throughout each of the Ohio River's 19 pools as well as from lockchambers.



The Ohio River Basin, navigational pools and major cities.

## SAMPLING METHODS

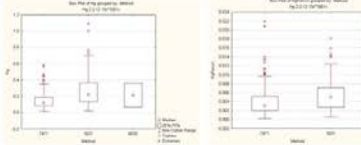
Prior to 1990, ORSANCO fish tissue collection was conducted at annual lockchamber surveys using rotenone. In 1990, ORSANCO began using boat electrofishing as a primary fish collection method. Rotenone surveys were coupled with electrofishing until 2005 when rotenone surveys were discontinued. Fish tissue samples from the Ohio River were pool-specific composites consisting of right-side fillets only (not whole fish) from three-five similarly sized individual fish (smallest at least 75% of total length of largest) of a particular species. Samples primarily consisted of species that were most commonly encountered, caught by anglers or commercial fisherman, and considered to be most commonly consumed by the public. These taxa included primarily but were not limited to:

- Sauger (*Sander canadensis*)
- Channel Catfish (*Ictalurus punctatus*)
- Common Carp (*Cyprinus carpio*)
- Hybrid Striped Bass (*Morone saxatilis* X *chrysops*)
- Freshwater Drum (*Aplodinotus grunniens*)
- Largemouth Bass (*Micropterus salmoides*)



## ANALYTICAL METHODS AND DATA QUALIFICATION

Frozen composite samples were sent to numerous contract laboratories since program inception. Prior to 2009, total Hg concentrations were determined by analysis method EPA 7471 or comparable methods (EPA 6010, EPA 6020, HNO<sub>3</sub>-H<sub>2</sub>O<sub>2</sub>/CVAAS) and reported as parts per million (ppm). In 2009 contract laboratories began using a newer analysis method, EPA 1631. ORSANCO conducted an internal comparison study using split samples to determine the difference in yield between EPA 1631 and EPA 7471 and comparable methods. Samples analyzed using EPA 1631 had an ~20% higher concentration value result than when analyzed using other methods. According to the laboratory, this difference is partly due to more complete sample digestion in the EPA 1631 preparation method than in other analysis techniques. As a means of producing more accurate contaminants data, ORSANCO adopted EPA 1631 in 2010.



Data used in trends analyses were qualified by / restricted to: composited multi-fish fillets from defined species from multiple trophic levels from the Ohio River only, analyzed for total Hg using comparable methods.

## DATA ANALYSIS

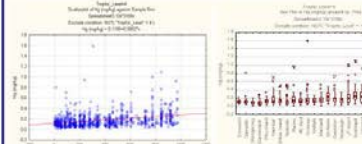
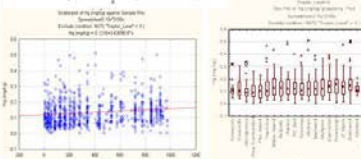
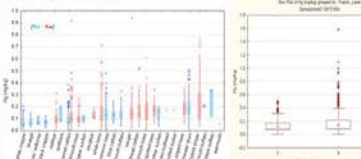
We compiled all fish tissue total Hg data that met the primary qualifications from 1983 to 2013, totaling 2,053 samples (27 taxa). We encountered numerous unique challenges and analysis factors:

- Specific species
- TL assignments
- Varying size classes
- Spatial patterns
- Analysis timeframes
- Analytical method

Additionally, differences in Hg concentration yields between EPA 1631 and previous analysis methods needed to be addressed. For these reasons, our expectations were that initial analyses could reveal multiple endpoints.

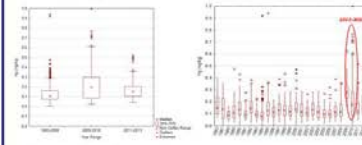
## SPECIES / SPATIAL COMPARISONS

Total Hg concentrations in discrete taxa were compared for all TLs and all years to show Hg concentration ranges across species. Sample data were separated by TL to investigate differing concentration ranges. Data were plotted against Ohio River mile (RMI) to investigate possible spatial concentration ranges.



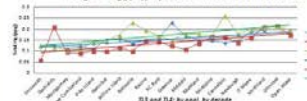
## TEMPORAL COMPARISONS

All data groups were plotted against individual collection year and multiple year ranges to investigate concentration ranges over time. In 2009, ORSANCO fish tissue collections focused primarily on large individuals. Similarly, 2010 collections included large TL4 species (namely Hybrid Striped Bass). In these conditions, coupled with the inherent differences in Hg concentration yields between the analysis methods, trend analysis endpoints may be skewed. Observed total Hg increases since 2009 may be due to targeting larger individuals and analysis method change.

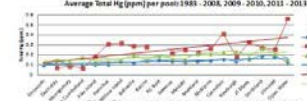


### TL3 and TL4 by adjusted year range

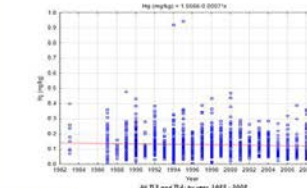
Average Total Hg (ppm) per pool: 1983-1992, 1993-2003, 2004-2013



### Average Total Hg (ppm) per pool: 1983-2008, 2009-2010, 2011-2013



### TL3 and TL4, by pool, by analysis method and collection date timeframes



## NEXT STEPS

Multiple iterations of these analyses have yet to be tested. Moving forward we will determine how to appropriately address the issues of the 2009 & 2010 and the 2009 - 2013 datasets and the increased total Hg yields derived from EPA 1631. Additionally, investigating size standardization and focusing on the 13 species for which we have the most data will streamline the analyses. By accounting for these factors, paring down the dataset and determining % increase or decrease over time, we will be able to better ascertain significant total Hg trends in Ohio River fish tissue.

**ACKNOWLEDGEMENTS** - This project is possible due to the efforts of ORSANCO staff biologists Jeff Thomas and Ryan Argo as well as our seasonal interns. Additional thanks to Jerry Schulte (ORSANCO).



The Ohio River Valley Water Sanitation Commission (ORSANCO)  
Biological and Research Programs





# Proposed Advisory Changes for 2014

- Unit 1 (mi 0 to mi 31.7)
  - Advisories currently under review by PA
  - Channel Catfish <18" changed from Level 5 (DNE) to Level 4 (6meals/ year)
  - White Bass changed from Level 3 to Level 4
  - Walleye and Saugeye changed from Level 4 to Level 3
- Unit 2 (mi 31.8 to mi 203.9)
  - No changes for 2014; require Silver Carp samples
- Unit 3 (mi 204 to mi 846)
  - No changes for 2014; require Walleye and Saugeye, Silver Carp and Bighead Carp samples
- Unit 4 (mi 846.1 to mi 981)
  - Freshwater Drum <14" held at Level 2 as per IL