



# Mercury, Arsenic and Selenium in White Bass fillet caught in the Allegheny and Monongahela Rivers near Pittsburgh PA; Comparisons with store-bought fish from Canadian Lake Erie

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Volz et al.,2007; APHA Conference: <http://www.pitt.edu/~cdv5/>

# Why should we be concerned about toxic metals, metalloids and elements in White Bass (*Morone chrysops*)

- The white bass is a freshwater, temperate member of the bass family Moronidae. They range throughout the central USA, west of the Appalachians into the Great Lakes and in the riverine systems in the Ohio and Mississippi river valleys.
- White bass are a favorite sports fishing species and schools of white bass feeding on shad generate considerable excitement amongst both semi-subsistence and recreational anglers.
- River-caught white bass are excellent table fare. Since an angler can literally catch a hundred at a time if spooning within a school, large quantities are eaten at fish fries and are stored in the freezer for future consumption.
- There now exist commercial fisheries for white bass in Canadian Lake Erie. These fish are sold in fish markets in Pittsburgh PA, other cities within the USA and in Canada.

# Initial Hypothesis

- Mercury (Hg), arsenic (As), and selenium (Se) levels in white bass fillet (in mg/kg wet weight) will be higher from specimens taken near legacy Iron and Steel pollution sites on the Monongahela River than from the less industrially impacted Allegheny River site, even though both are in the same river pool system.
- Hg, As and Se levels in white bass fillet will be higher in river-caught samples from the Pittsburgh Pool, due to legacy pollution and nearby power plants and municipal pollution sources, than white bass commercially sold in the market and branded as Canadian Lake Erie in origin.

## Objective A:

To determine if white bass fillet concentrations of mercury, arsenic and/or selenium vary by locations of catch, within the Pittsburgh Pool.



## Objective B:

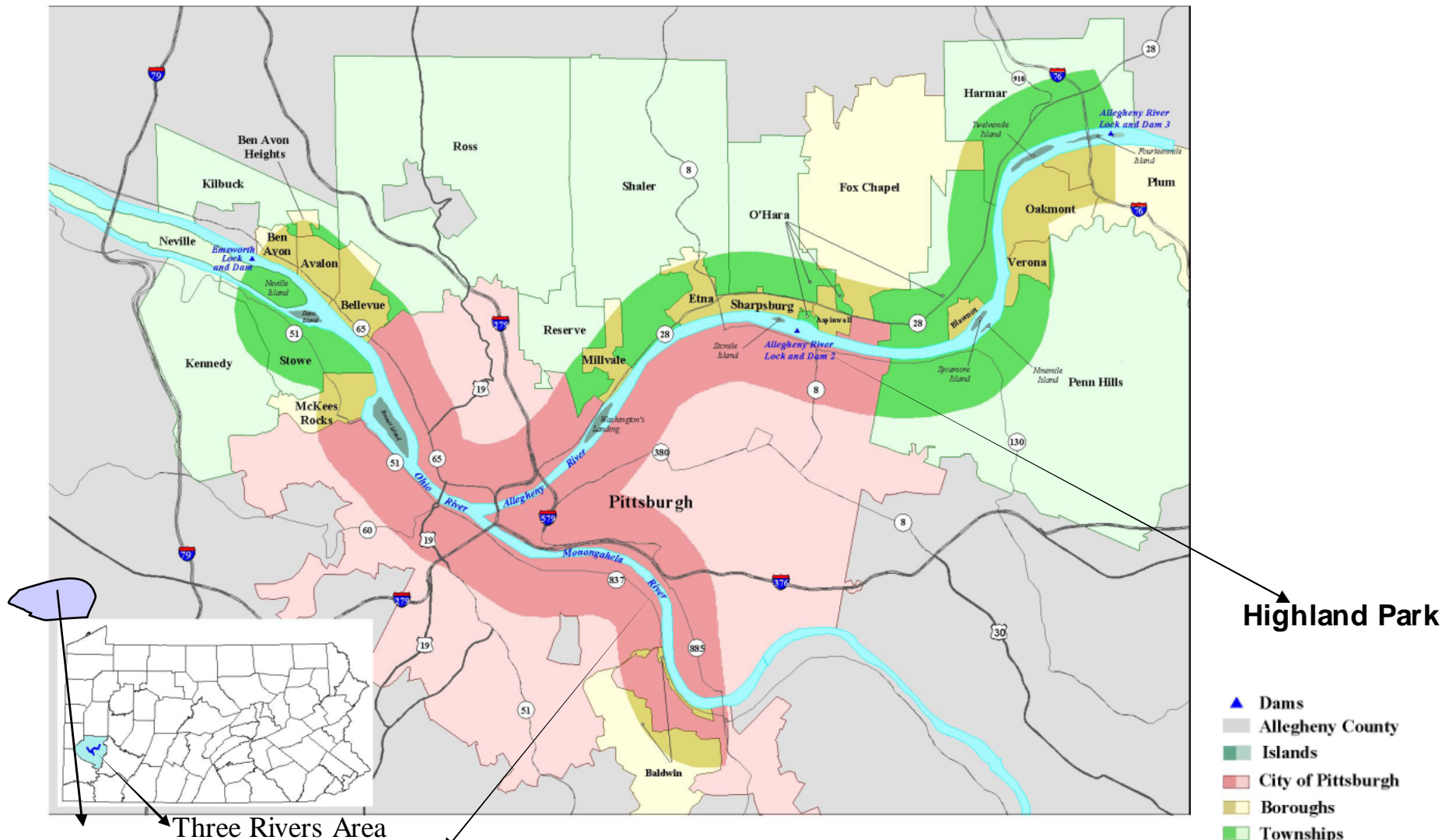
To determine if mercury, arsenic and/or selenium concentrations in white bass fillet vary between river caught and store-bought fish (Canadian Lake Erie).

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# Locations of White Bass Catch Near Pittsburgh and Store Bought in Lake Erie



Approximate range of Store Bought-Lake Erie fish, relative to Pittsburgh, Pennsylvania

Monongahela River near the U. S. Steel Edger Thompson Works

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# Methods

White bass were caught by rod and reel method using a Community Based Participatory Research approach. Local anglers were recruited to catch fish. White bass could not be caught at Point State park in the Pittsburgh Pool and at Kittanning Dam on the Allegheny, presumably because these habitats are not conducive to permanent resident fish populations.

The geo-coordinates of all fish collection locations were determined on a Garmin, GPS Map 60CSx device and were used in ArcView 9.2 map production.

10-35 white bass were caught at each location and 10 white bass were store-bought-coming from Canadian Lake Erie.

0.5 gram of white bass fillet was microwave digested in nitric acid. As and Se were analyzed by collision cell ICP-MS with calibration by the method of standard additions. Mercury was analyzed by isotope dilution cold vapor ICP-MS.

Data were log-transformed and analyzed by ANOVA with Tukey post hoc tests using SPSS 15.0.



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## Descriptive Statistics, Mercury (Hg) Concentrations in Fish Fillet by Catch Location and in Store Bought Fish

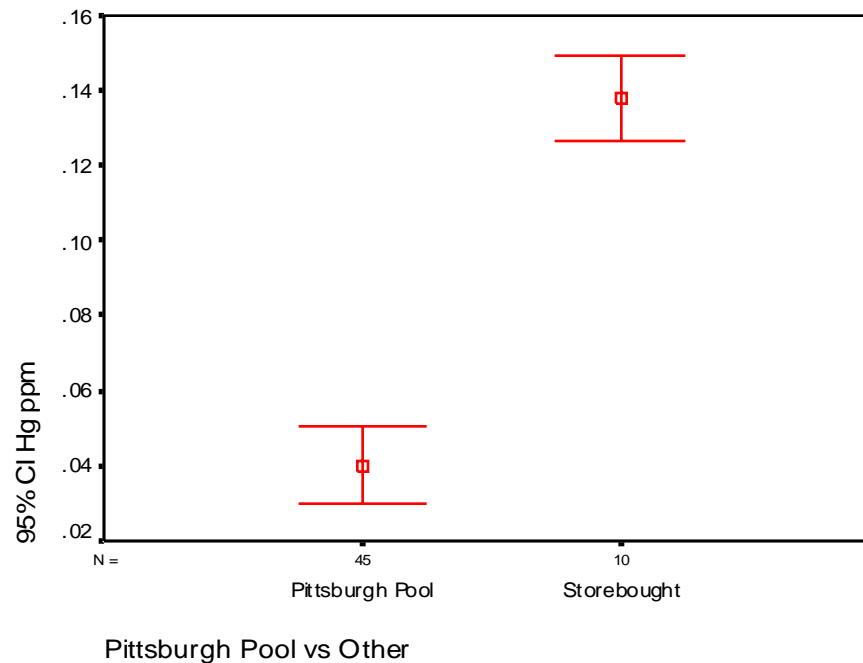
| Catch Location  | n  | Mean Concentration<br>mg/kg*<br>95% CI of the Mean | Median Concentration<br>mg/kg<br>Range |
|---|----|--|--|
| Pittsburgh Pool-<br>Monongahela River at<br>Braddock Dam    | 10 | 0.041<br>0.025-0.067                               | 0.033<br>0.026-0.081                   |
| Pittsburgh Pool-<br>Allegheny River at<br>Highland Park Dam | 35 | 0.034<br>0.031-0.037                               | 0.033<br>0.021-0.070                   |
| Store Bought- Caught<br>in Canadian Lake Erie               | 10 | <b>0.137</b><br>0.126-0.148                        | <b>0.134</b><br>0.118-0.163            |

\*mg/kg is equivalent to ppm, all samples are by wet weight.

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# 95% Confidence Interval of the Mean Mercury Concentration (ppm) in White Bass Fillet from the Pittsburgh Pool vs Store-bought (Canadian Lake Erie)



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## Descriptive Statistics, Arsenic (As) Concentrations in Fish Fillet by Catch Location and in Store Bought Fish

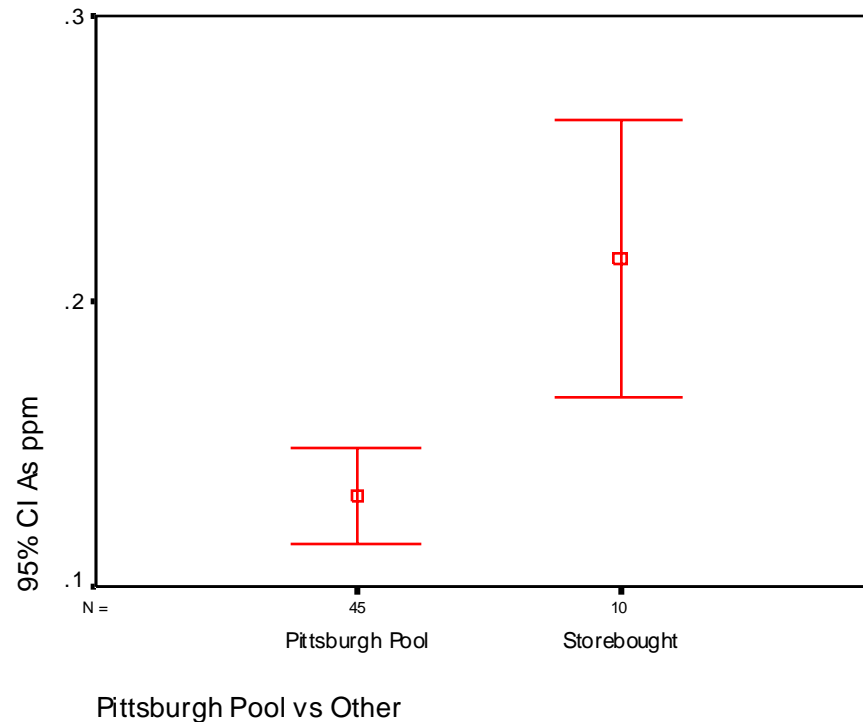
| Catch Location  | n  | Mean As<br>Concentration mg/kg*<br>95% CI of the Mean | Median As Concentration<br>mg/kg<br>Range |
|---|----|---|---|
| Pittsburgh Pool-<br>Monongahela River at<br>Braddock Dam    | 10 | 0.111<br>0.079 - 0.156                                | 0.112<br>0.049 - 0.194                    |
| Pittsburgh Pool-<br>Allegheny River at<br>Highland Park Dam | 35 | 0.126<br>0.111 - .143                                 | 0.119<br>0.071 - <b>.359</b>              |
| Store Bought- Caught<br>in Canadian Lake Erie               | 10 | <b>0.206</b><br>.165 -.257                            | <b>0.202</b><br><b>.127 - .361</b>        |

\*mg/kg is equivalent to ppm, all samples are by wet weight.

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# 95% Confidence Interval of the Mean Arsenic Concentration (ppm) in White Bass Fillet from the Pittsburgh Pool vs Store-bought (Canadian Lake Erie)



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## Descriptive Statistics, Selenium (Se) Concentrations in Fish Fillet by Catch Location and in Store Bought Fish

| Catch Location  | n  | Mean Concentration Se<br>mg/kg*<br>95% CI of the Mean | Median Se Concentration<br>mg/kg<br>Range |
|---|----|---|---|
| Pittsburgh Pool-<br>Monongahela River at<br>Braddock Dam    | 10 | 0.547<br>0.444 - 0.674                                | 0.574<br>0.334 - 0.780                    |
| Pittsburgh Pool-<br>Allegheny River at<br>Highland Park Dam | 35 | 0.570<br>0.508 - 0.640                                | 0.541<br>0.376 - 0.739                    |
| Store Bought- Caught<br>in Canadian Lake Erie               | 10 | <b>1.01</b><br>0.865-1.177                            | <b>1.11</b><br>0.670 - 1.20               |

\*mg/kg is equivalent to ppm, all samples are by wet weight.

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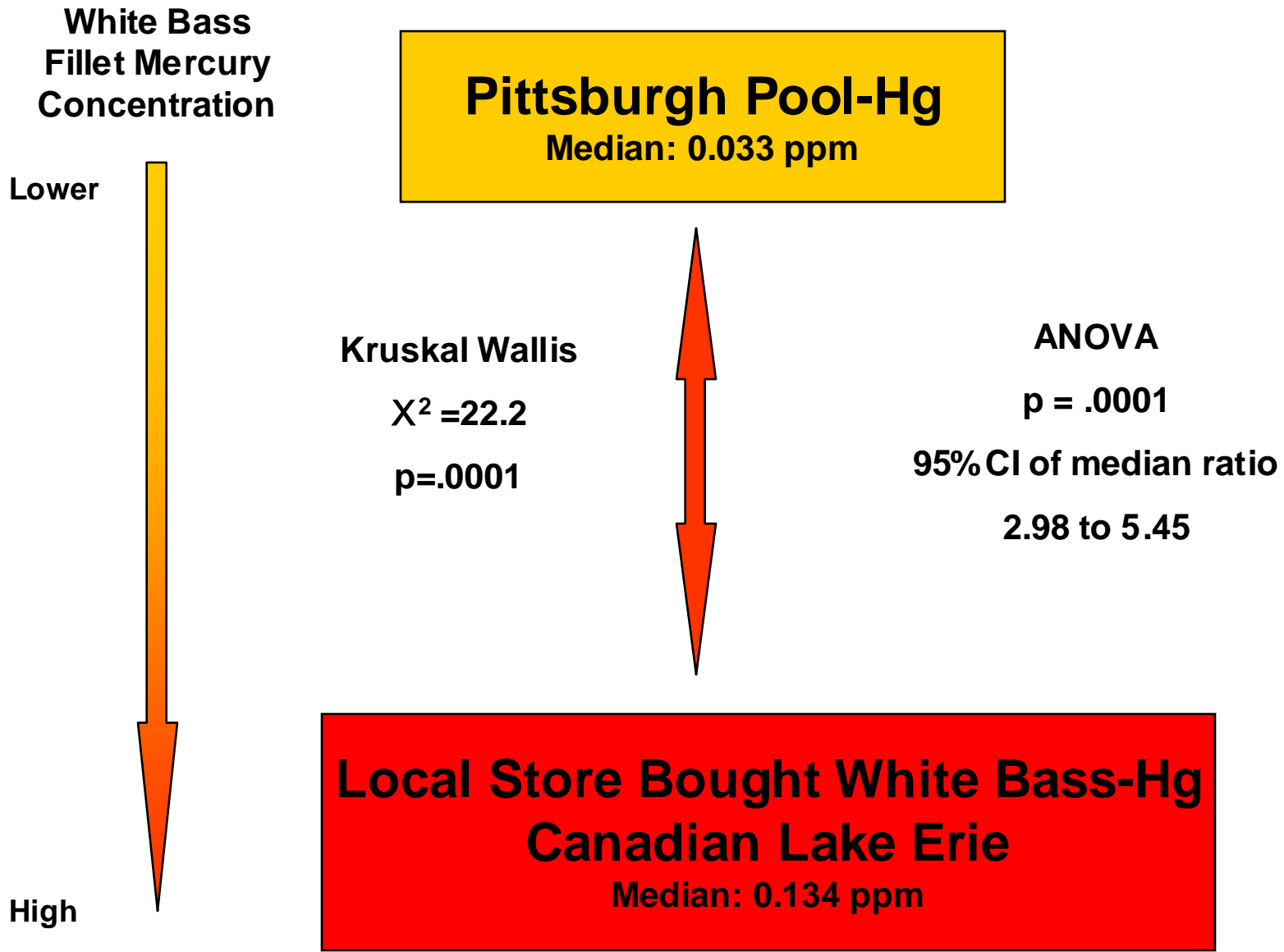


# White Bass, ANOVA Tukey Post Hoc Comparisons



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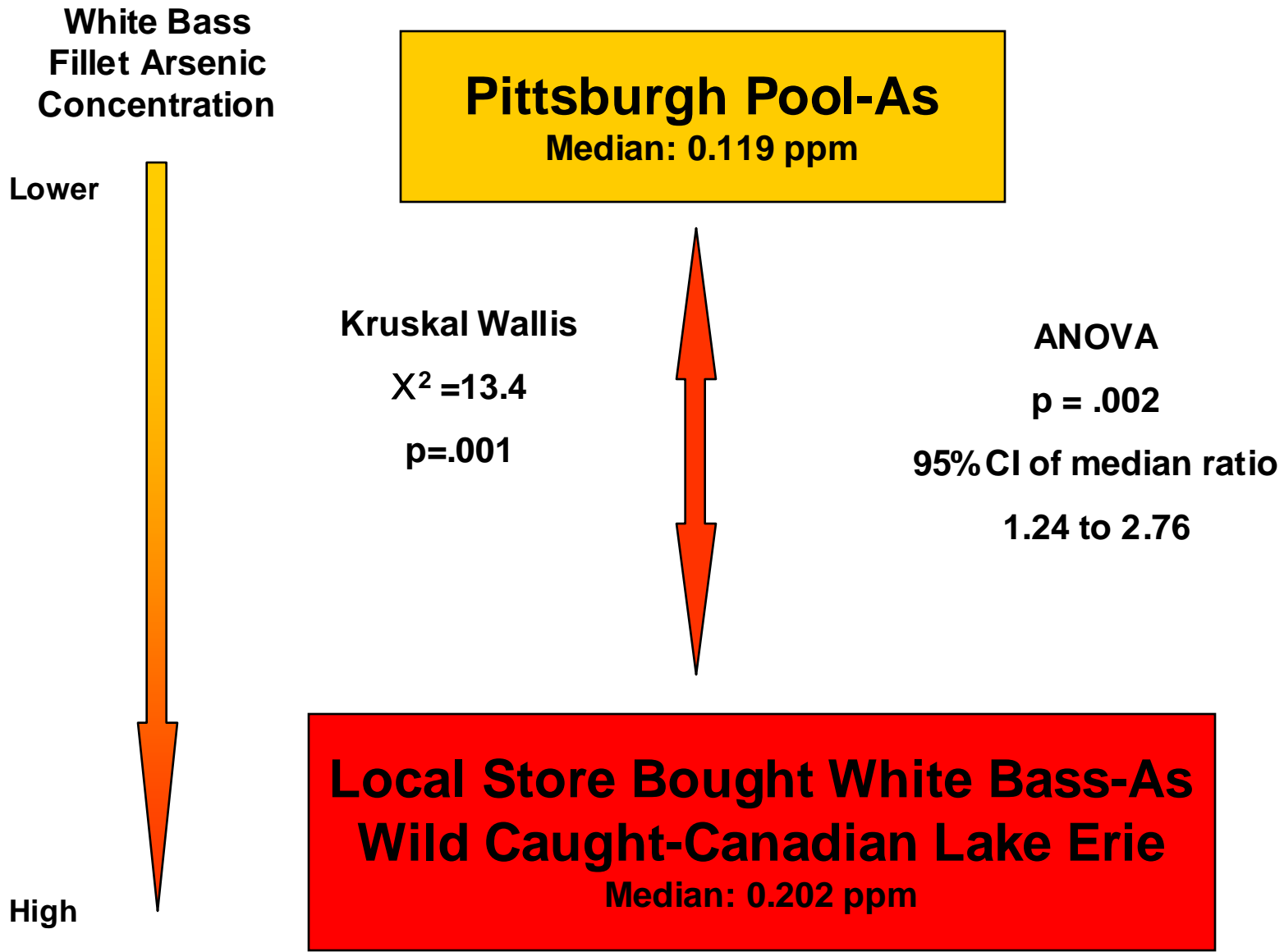




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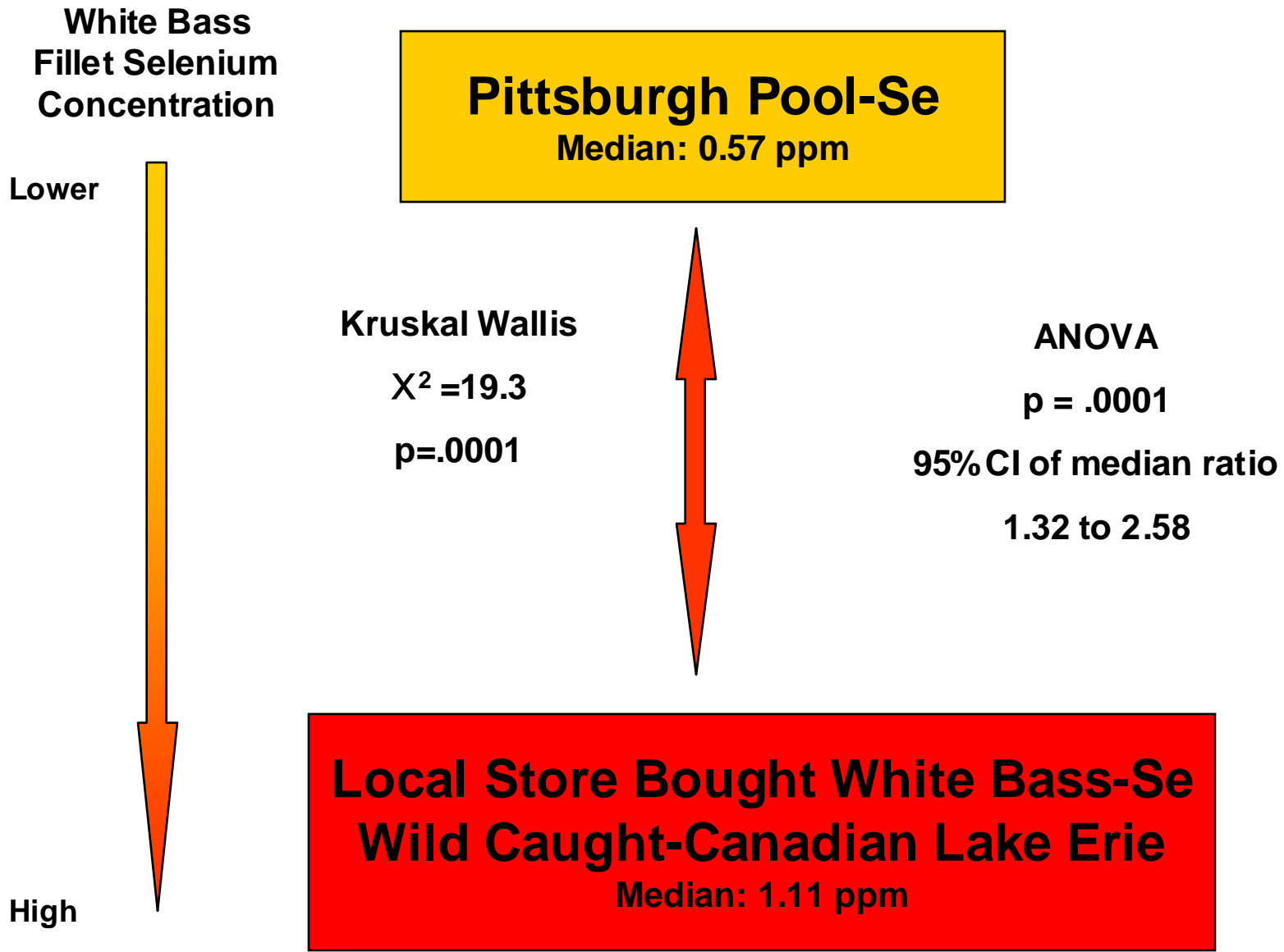






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# Conclusions

- We reject our hypothesis that there is a significant difference in Hg, As and/or Se levels in fillet tissue of white bass from legacy contaminated areas of the Monongahela River compared to the less industrially impacted Allegheny River site, within the Pittsburgh Pool.
- ✓ The Pittsburgh Pool may be considered a locked water system due to the lock and dam system, which essentially makes a lake around Pittsburgh including portions of the Allegheny, Monongahela and Ohio Rivers.
- ✓ Pollution discharged into the Pittsburgh Pool from industrialized sources and sewer overflows may have become somewhat evenly distributed throughout the water body-especially over time.
- ✓ Fish caught at each location within the Pittsburgh Pool may range throughout the pool. This is especially true for white bass which travel in large schools and congregate near dams where the dissolved oxygen level is maximized.

# Conclusions

- We reject our hypothesis that river-caught fish have less Hg, As and/or Se than commercially sold market fish. Store-bought fish had 4.1, 1.7, and 1.9 times the median Hg, As, and Se levels found in river-caught fish, respectively.
- ✓ The store-bought fish from Canadian Lake Erie were significantly larger than the river-caught fish, which helps explain why there is more bioconcentrated Hg and Se in Lake Erie caught fish.
- ✓ The ecological habitat and food chain for riverine and Lake Erie (big lake) white bass is considerably different. There is a more complex food chain in the Great Lakes compared to the Upper Ohio River drainages, this includes more trophic levels in the lake system and with them- more opportunity for bioaccumulation and contaminant magnification.

# Public Health Implications



- Location, location, location-just as in real estate the location of fish catch can help us to make informed hypothesis regarding the contaminants-toxic metals and metalloids, elements and even persistent organic pollutants that may be in fish tissue.
- Lake Erie has received immense legacy pollution assaults from our industrial cities including Detroit, Toledo, Cleveland, Buffalo and Windsor, Canada. There is ongoing deposition of power plant air and water emissions directly into Lake Erie and into its watershed.

•This study raises concern regarding the safety of the commercial freshwater fish market in the USA. Consumers of market fish do not understand the risks associated with ingestion of fish from particular fisheries and the FDA needs to test more fish samples more frequently to assure food safety.

•Increasing quantities of farm-raised and wild-caught freshwater fish enter the USA fish market from our international trading partners. More strenuous assessment of fish contaminants are required to keep the health risks from ingestion of contaminated fish at acceptable levels.

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