



Hudson River Fish Program Data Update

Long-Term Monitoring – Fish – 2022 Update



- Purpose: Track post-dredging recovery of fish in the Upper Hudson River (also includes collection of fish in a portion of the Lower Hudson River)
- EPA currently conducting five-year review and doing a comprehensive evaluation of the fish data collected through 2021. Therefore, information presented in this presentation is preliminary
- Last update – June 2021 CAG meeting (fish data through 2020)
- Fish collection status
 - 2022 data collection underway
 - Spring – sport fish (complete)
 - Fall – pumpkinseed and forage fish (in progress)
- EPA oversees fish collection, processing and laboratory analyses
- DEC also collects Hudson River fish – data are used by EPA as they are provided

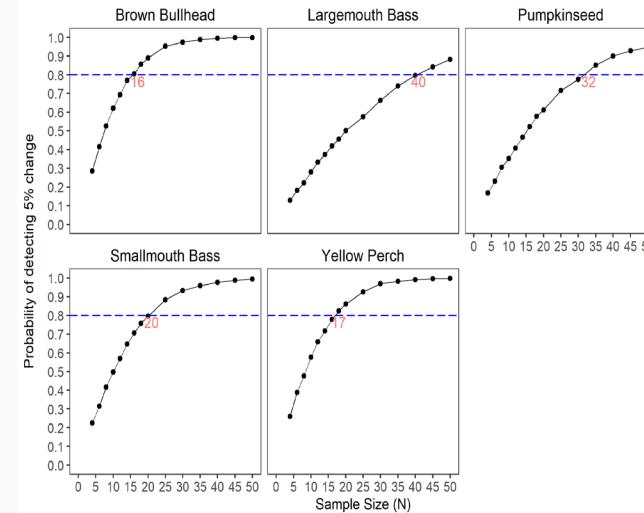
2021 Fish Program – Refinement/Improvement



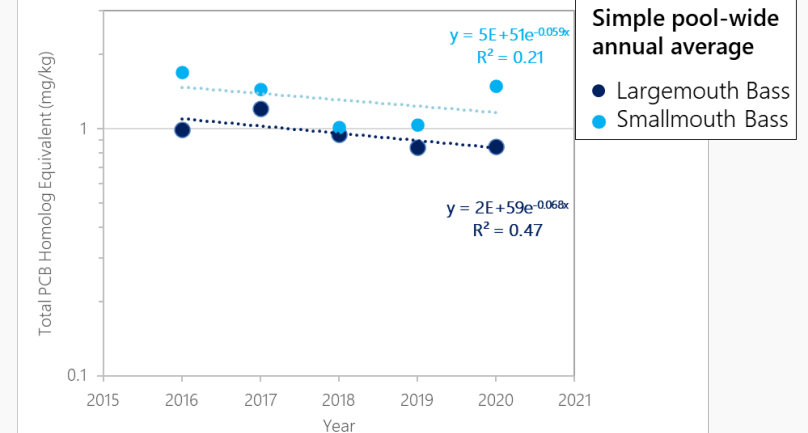
EPA considerations – program adjustments

- Program is transitioning from scopes designed for monitoring during dredging to monitoring post-dredging recovery
- Ability to detect 5% annual rate of decline in PCBs over 10 years
 - Number of fish tissue samples needed
 - Reach, river section, species
- How to reduce uncertainty/variability in program
 - Consistency in species collection and substitutions
- How the data will be used for long-term monitoring
 - Background
 - Forage fish
 - Reaches 1-4

Power analysis results for RS 1: TPCB_{HE} Wet Weight

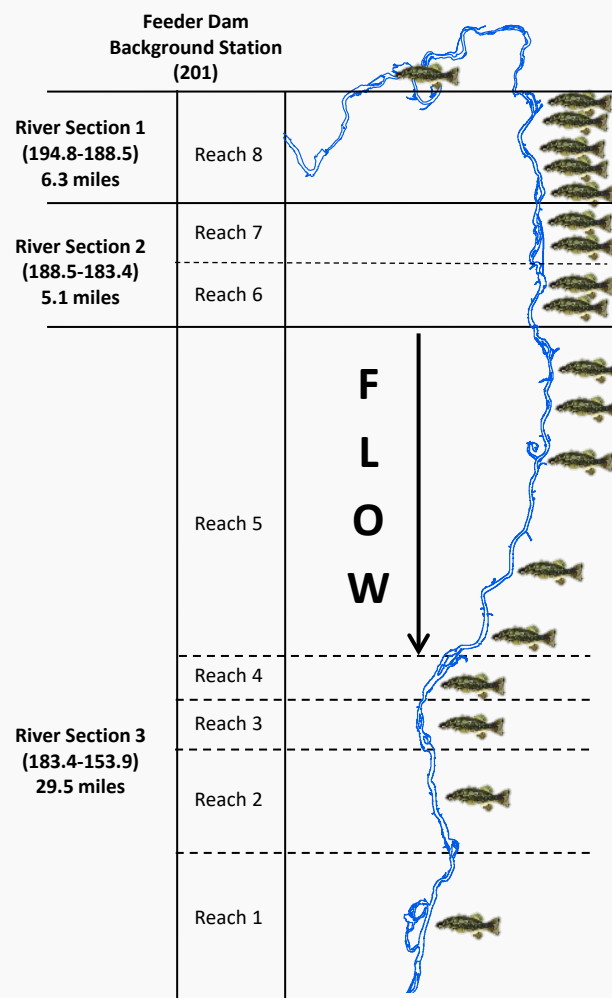


Largemouth Bass and Smallmouth Bass Trends in RS 1





Upper Hudson Locations and Species



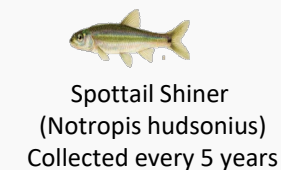
2021 Spring Collection Totals:

256 Sport Fish Fillet Samples



2021 Spring Fall Collection:

161 Whole Body Pumpkinseed Samples



Note

- Pumpkinseed are collected every 5 years in Reaches 4 to 1
- Sport fish and pumpkinseed are collected every 3 years at the Feeder Dam

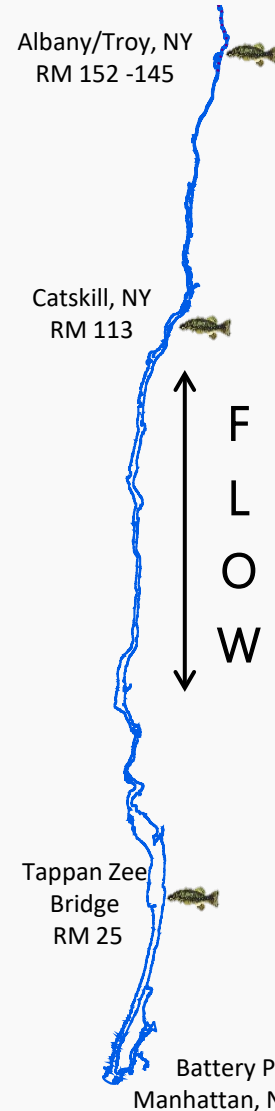
Fish Monitoring Program (cont.)



Hudson River Fish Program
Monitoring Station



Lower Hudson River Locations and Species



2021 Spring Collection Totals:

165 Sport Fish Fillet Samples



Striped Bass
(*Morone saxatilis*)



Smallmouth Bass
(*Micropterus dolomieu*)



Yellow Perch
(*Perca flavescens*)



White Perch
(*Morone americana*)



Brown Bullhead
(*Ameiurus nebulosus*)



Channel Catfish
(*Ictalurus punctatus*)

2021 Fall Collection Totals (Albany/Troy only):

20 Whole Body Pumpkinseed Samples



Pumpkinseed
(*Lepomis gibbosus*)

Fish Program (cont.)



- Key considerations of the program:
 - Primary data evaluation as described in Record of Decision; species-weighted averages by river section compared to:
 - 0.4 mg/kg – target- protective based on half-pound fish meal every two months (in 5 years post dredging - 2020)
 - 0.2 mg/kg – target - protective based on half-pound meal every month (16 years post dredging - 2032)
 - 0.05 mg/kg - goal - protective based on half-pound fish meal every week
 - Ongoing evaluation by EPA (species, station, river reach, lipid-normalized) considering trends over time
 - Continued consistent data treatment
 - Consistency in PCB Aroclor identification and quantitation by Method 8082
 - Regular use at defined frequency of more-detailed congener analysis by Method 1668 (5% of samples - alternating years)
 - Coordination with NYSDOH - data needs for fish advisory considerations
 - National Institute of Standards and Technology (NIST) standard samples analyzed to monitor precision over time
 - Sample material (fish tissue) known to be well mixed - consistent in concentration over many years
 - Analyses over time compare well for the NIST 1946 and NIST 1947 (certified fish tissue)

- Other data considerations:
 - Fish exposure to PCBs
 - Varies by species
 - Can be highly localized
 - Available prey (what fish feed on seasonally and year differences)
 - Other factors (size, age ...)
 - Lipid-normalized concentrations (adjusted for fat content in fish)
 - Varies year to year
 - Wet weight concentrations (NYS standard fillet)



Upper Hudson Species-Weighted Average Calculation

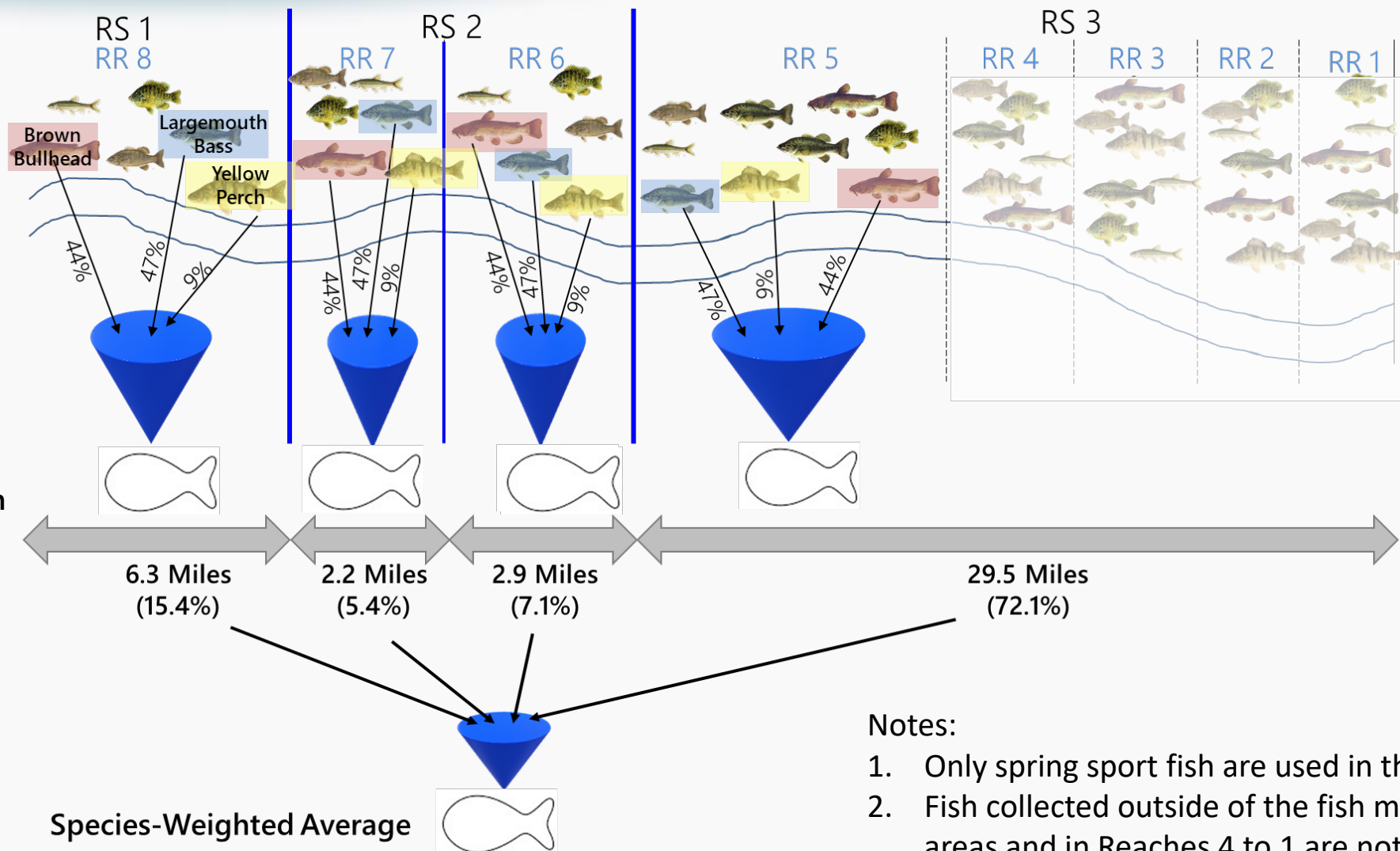


Average PCB concentration by species

Species weighting based on typical angler catch

Species-Weighted Average by River Section or River Reach

River Section or River Reach weighting proportional to length



Notes:

1. Only spring sport fish are used in the calculation
2. Fish collected outside of the fish monitoring areas and in Reaches 4 to 1 are not included in the calculation



Upper River

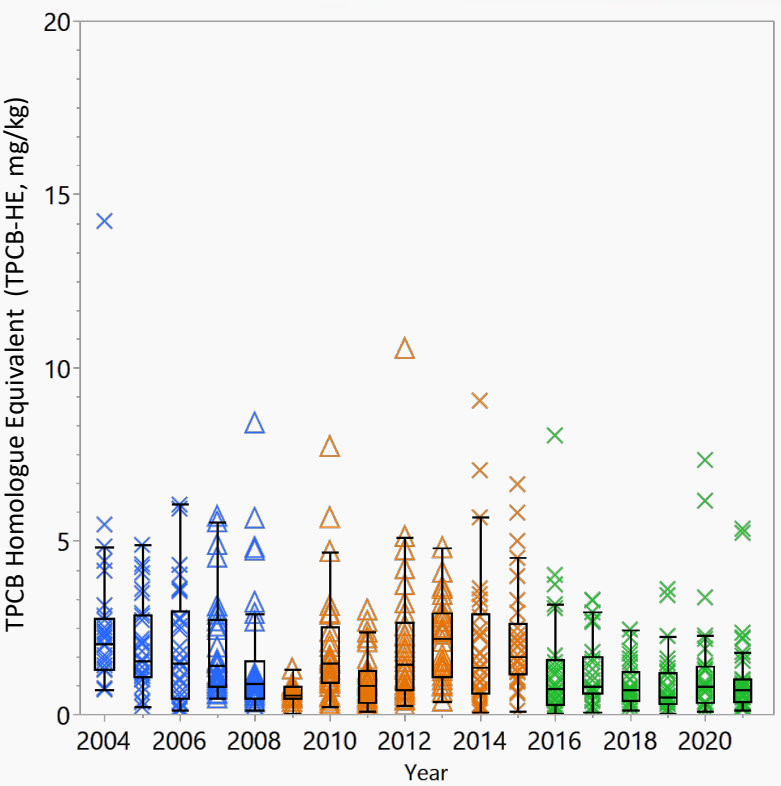
Sport Fish - Fillet

- Sequential by species
- Alternating wet weight and lipid-normalized

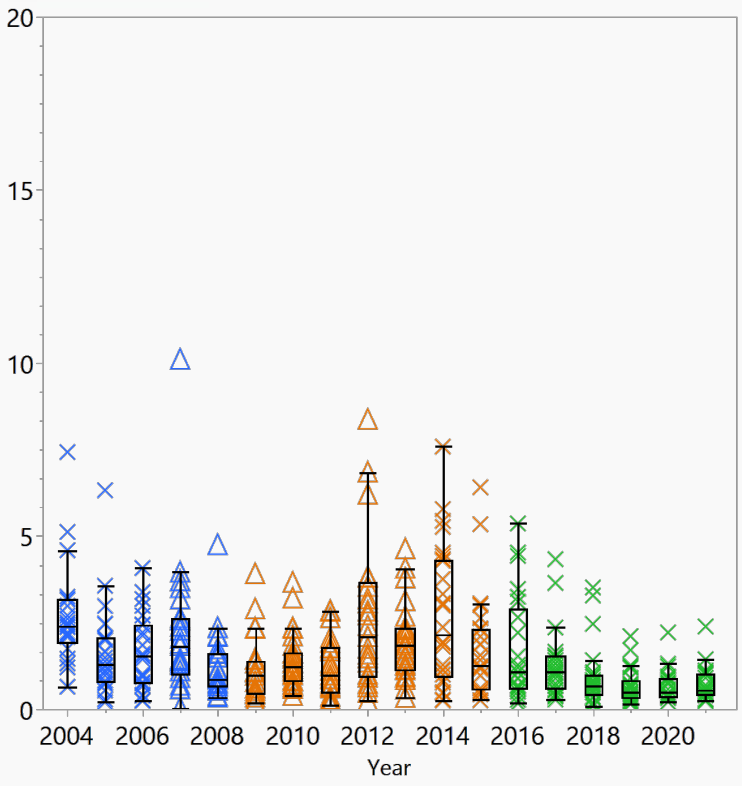
Black Bass (Largemouth and Smallmouth) – Wet Weight Linear Scale



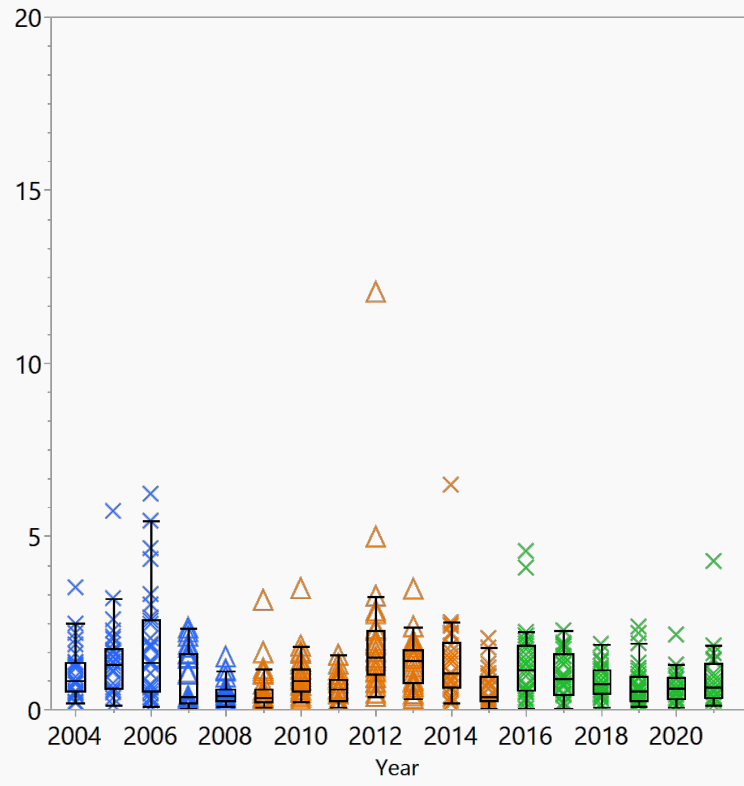
River Section 1



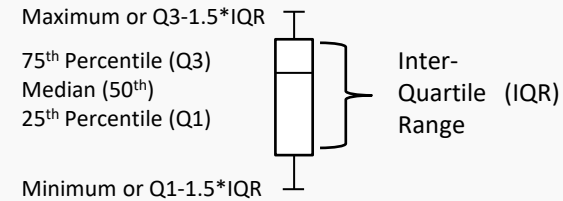
River Section 2



River Section 3



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)
- × Standard Fillet
- △ Rib-out Fillet

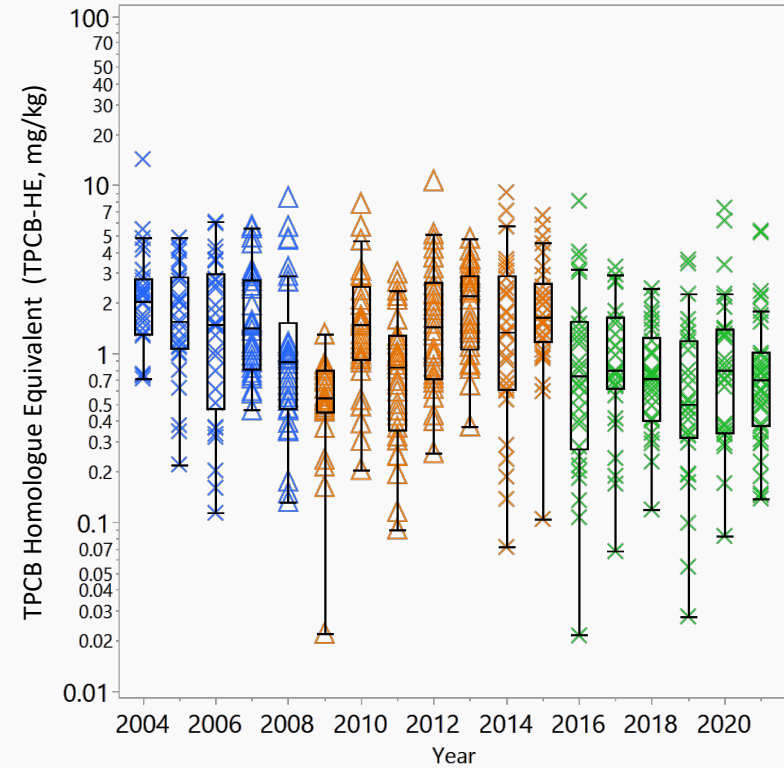


Note: Only fish collected from the designated monitoring stations are included in these plots

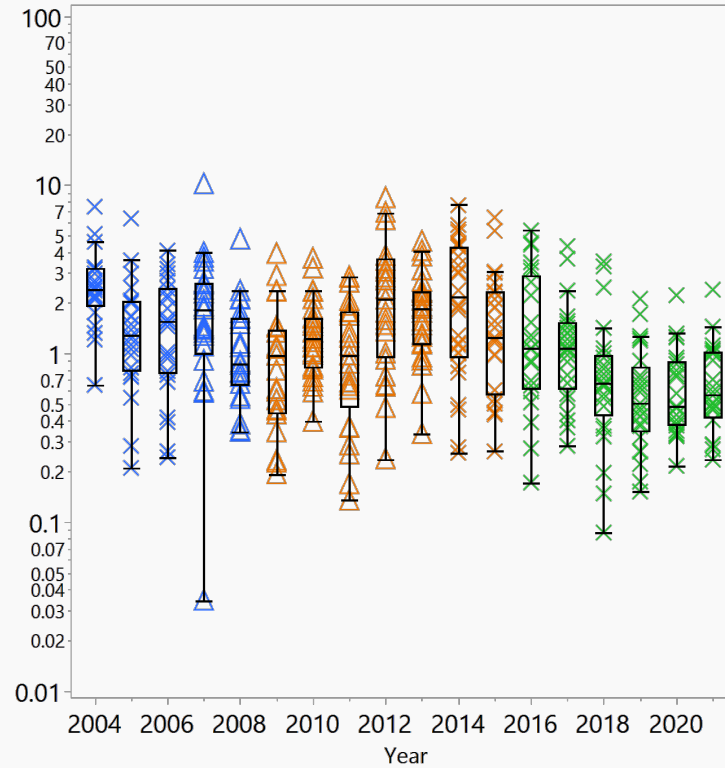
Black Bass (Largemouth and Smallmouth) – Wet Weight



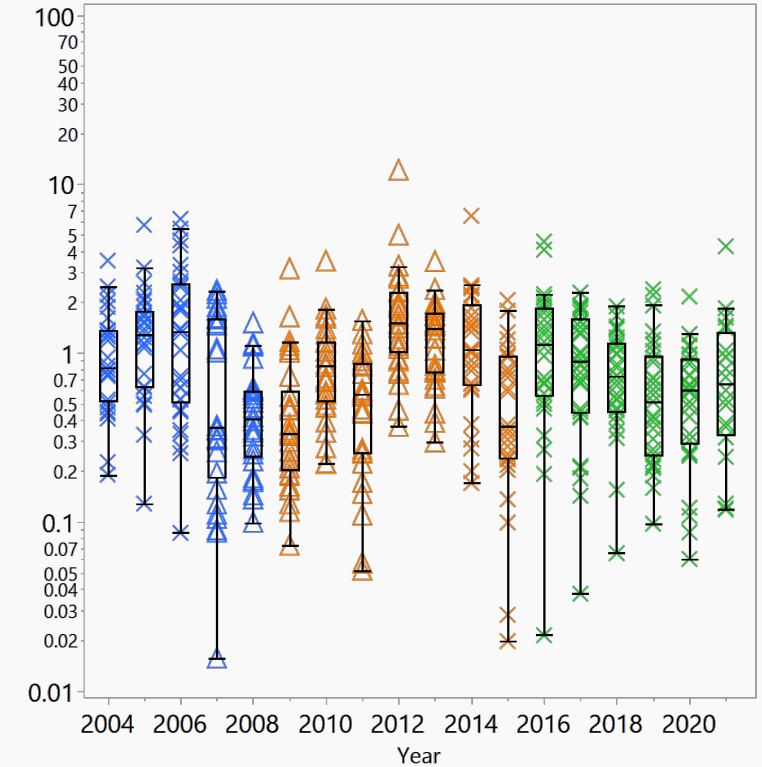
River Section 1



River Section 2

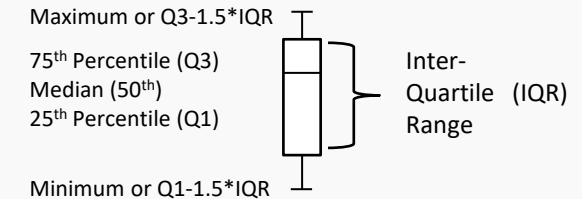


River Section 3



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)

- × Standard Fillet
- △ Rib-out Fillet



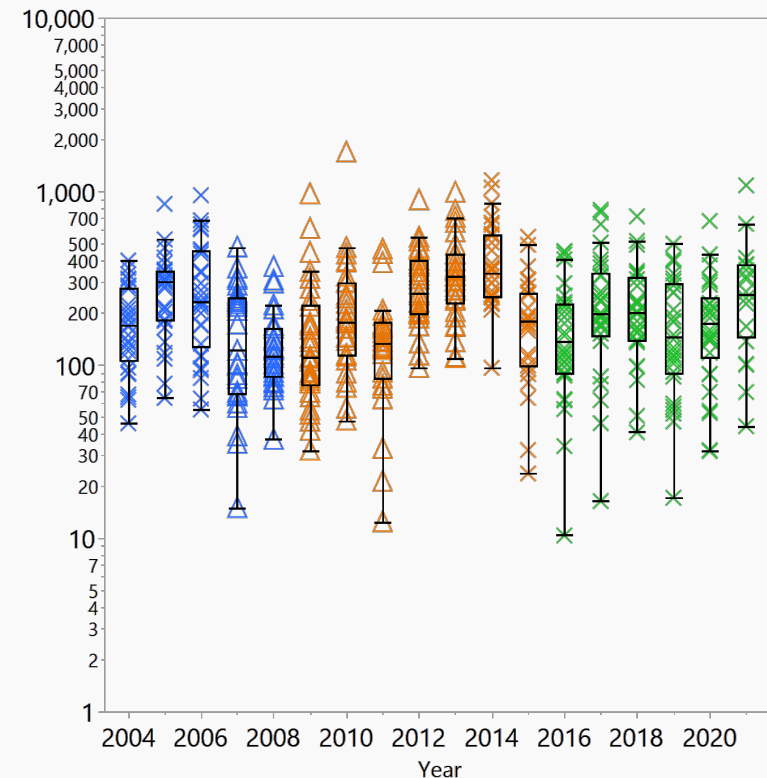
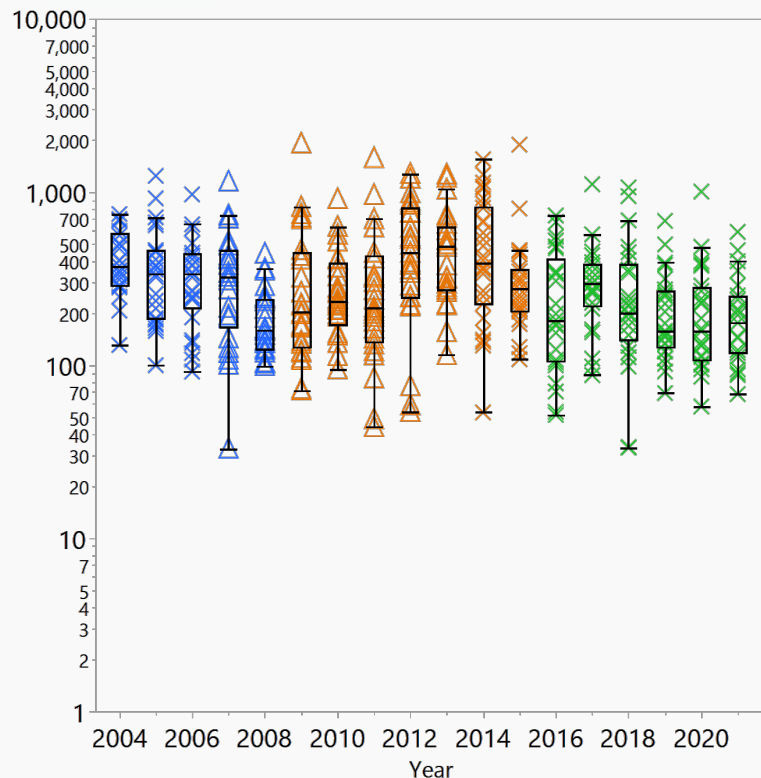
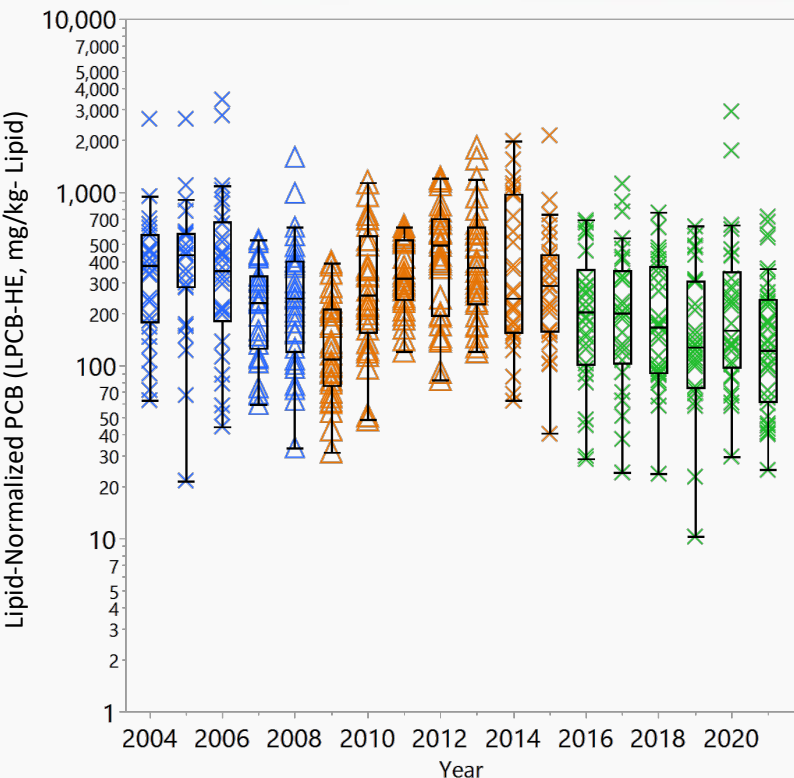
Black Bass (Largemouth and Smallmouth) – Lipid-Normalized



River Section 1

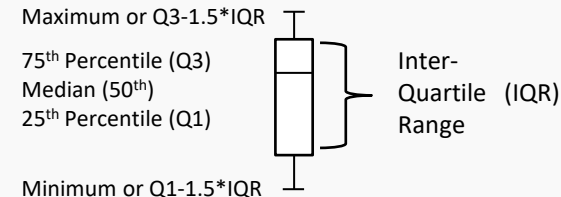
River Section 2

River Section 3



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)

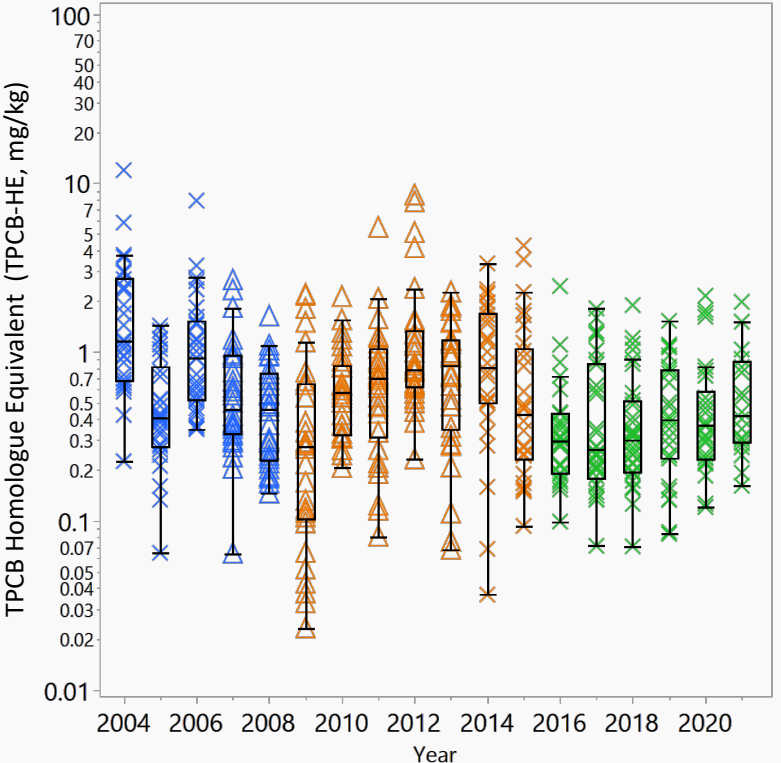
- × Standard Fillet
- △ Rib-out Fillet



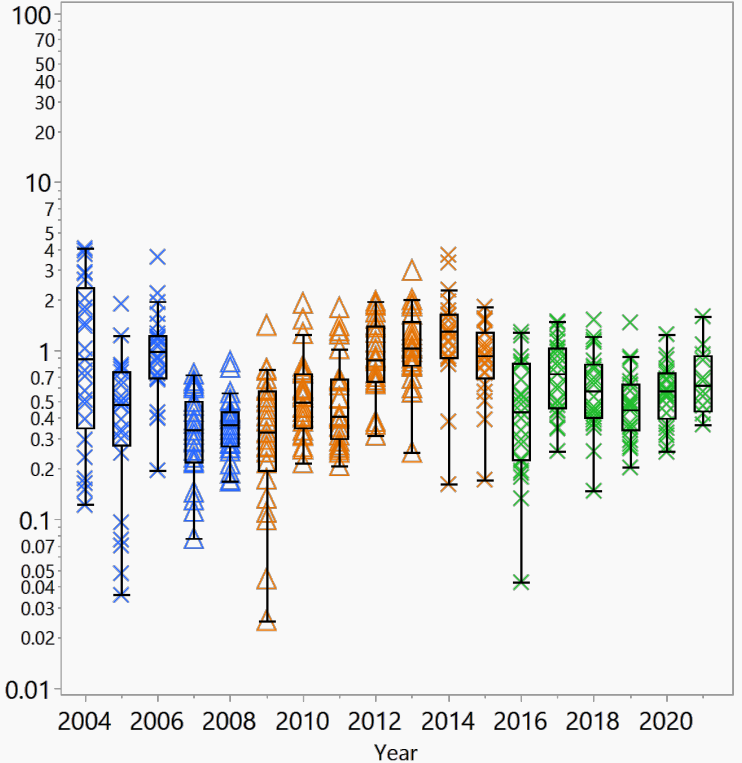
Yellow Perch – Wet Weight



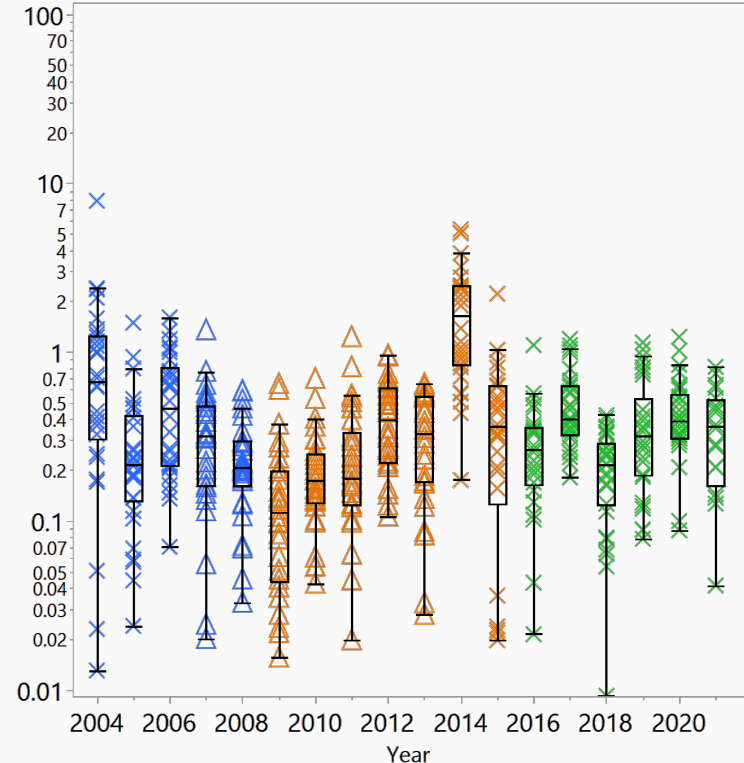
River Section 1



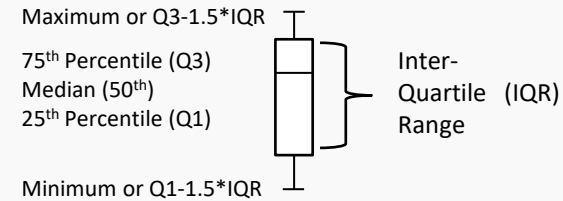
River Section 2



River Section 3



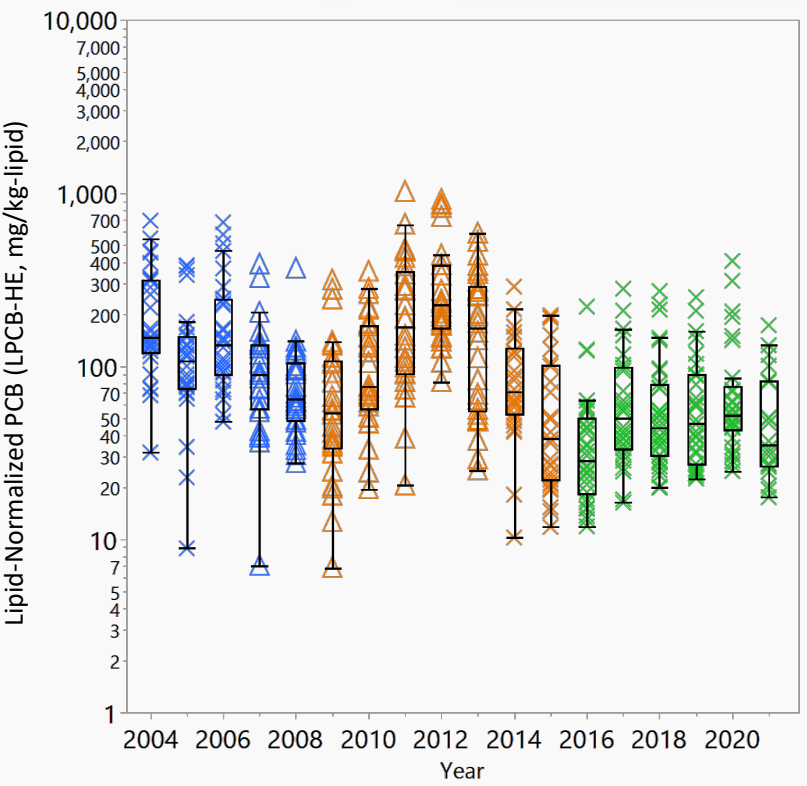
- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)
- × Standard Fillet
- △ Rib-out Fillet



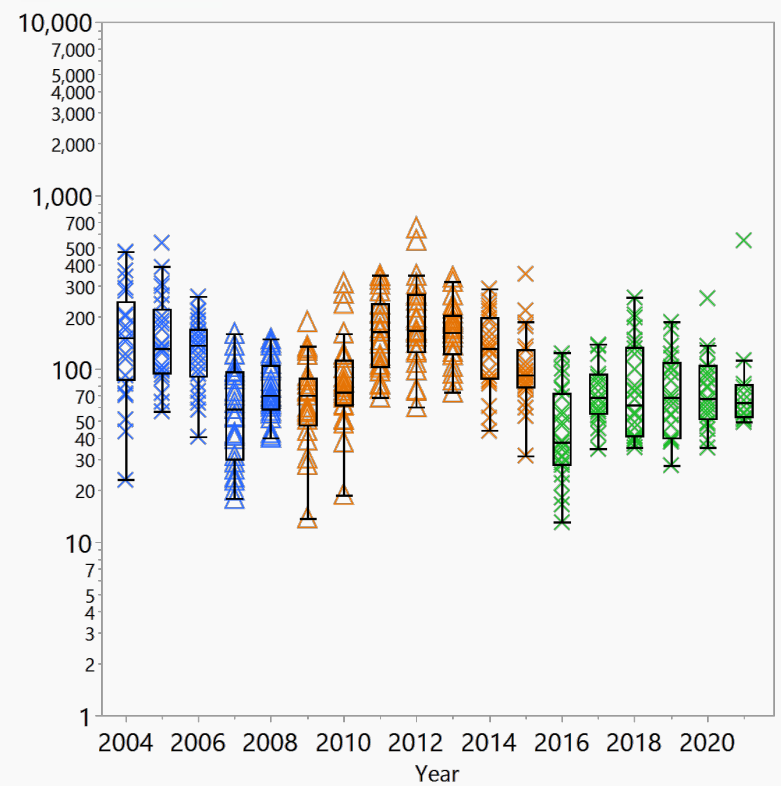
Yellow Perch – Lipid-Normalized



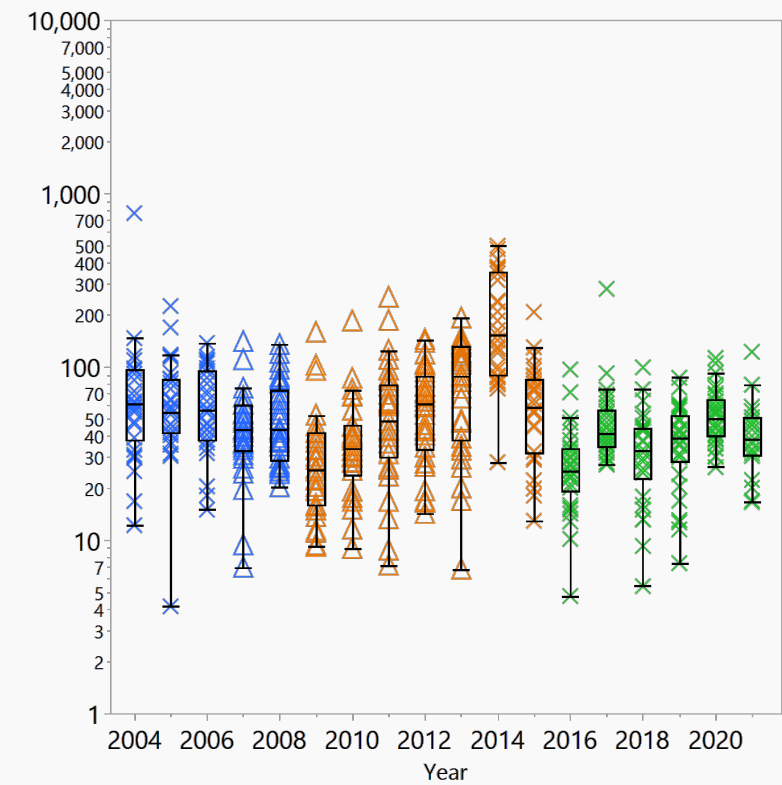
River Section 1



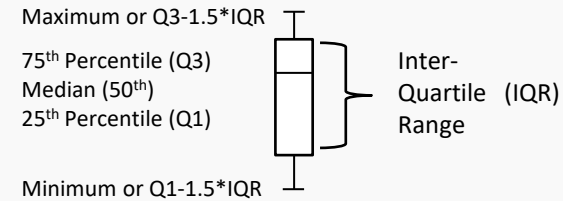
River Section 2



River Section 3



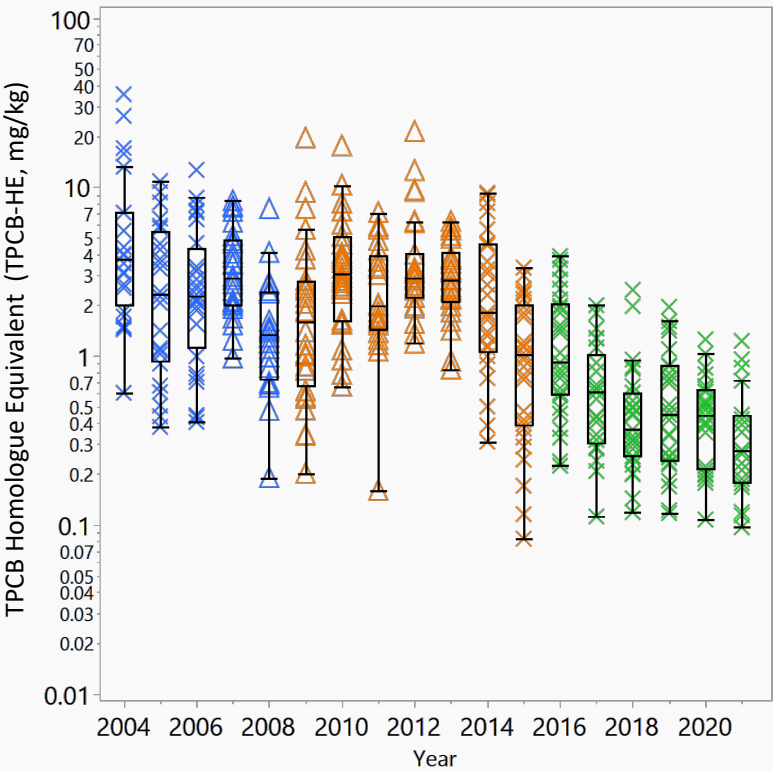
- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)
- × Standard Fillet
- △ Rib-out Fillet



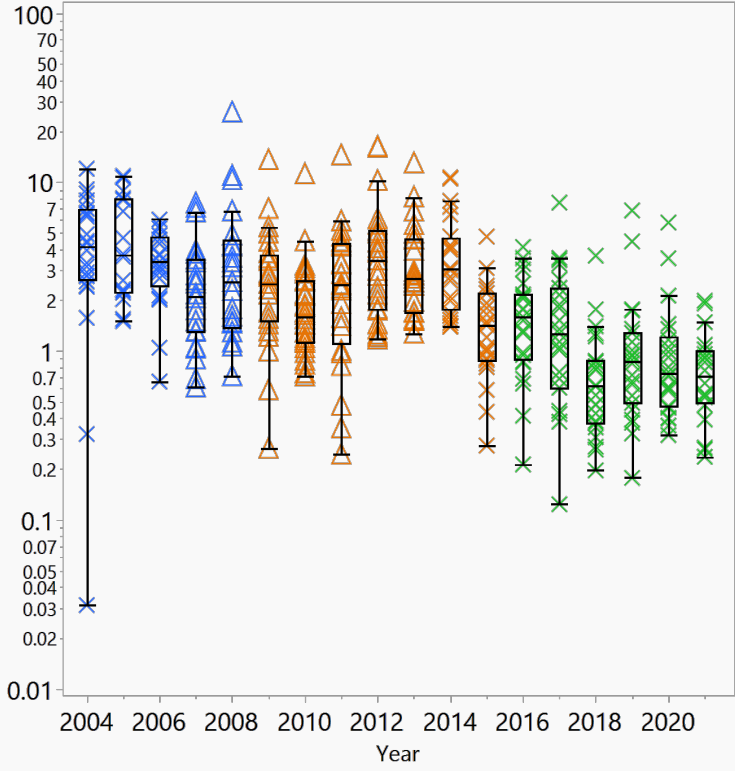
Brown Bullhead – Wet Weight



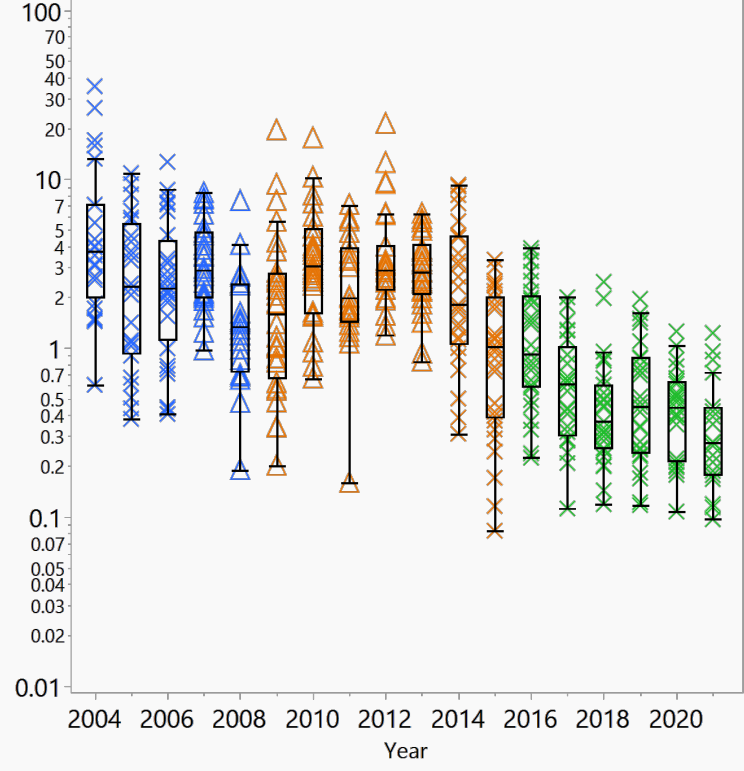
River Section 1



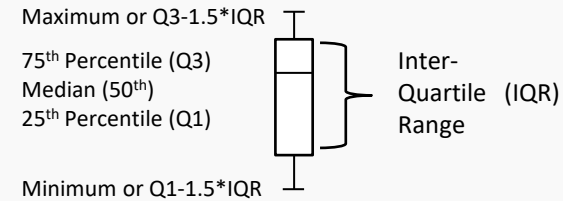
River Section 2



River Section 3



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)
- × Standard Fillet
- △ Rib-out Fillet

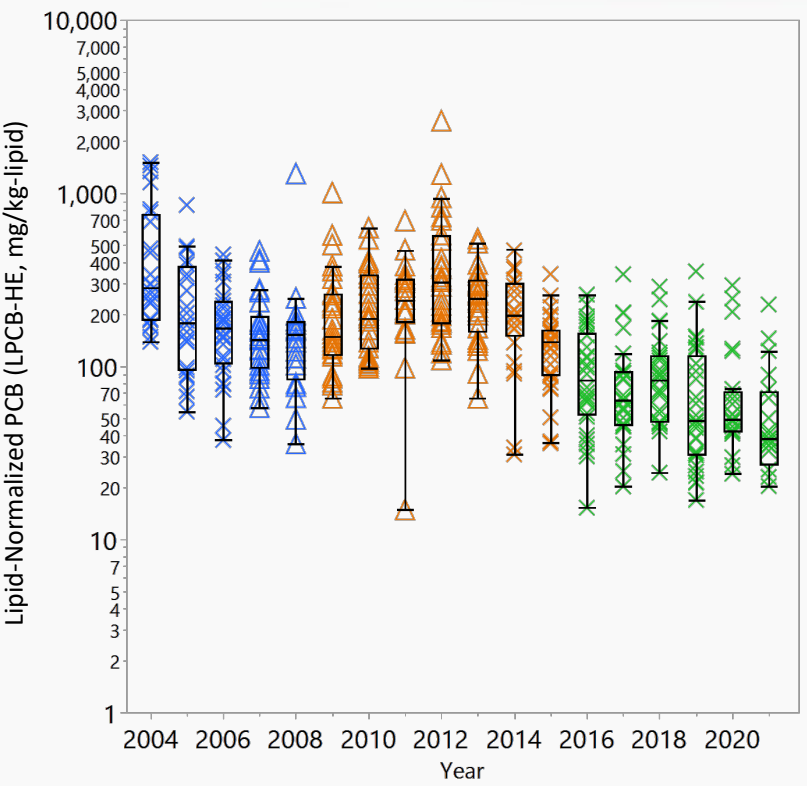


Note: Only fish collected from the designated monitoring stations are included in these plots

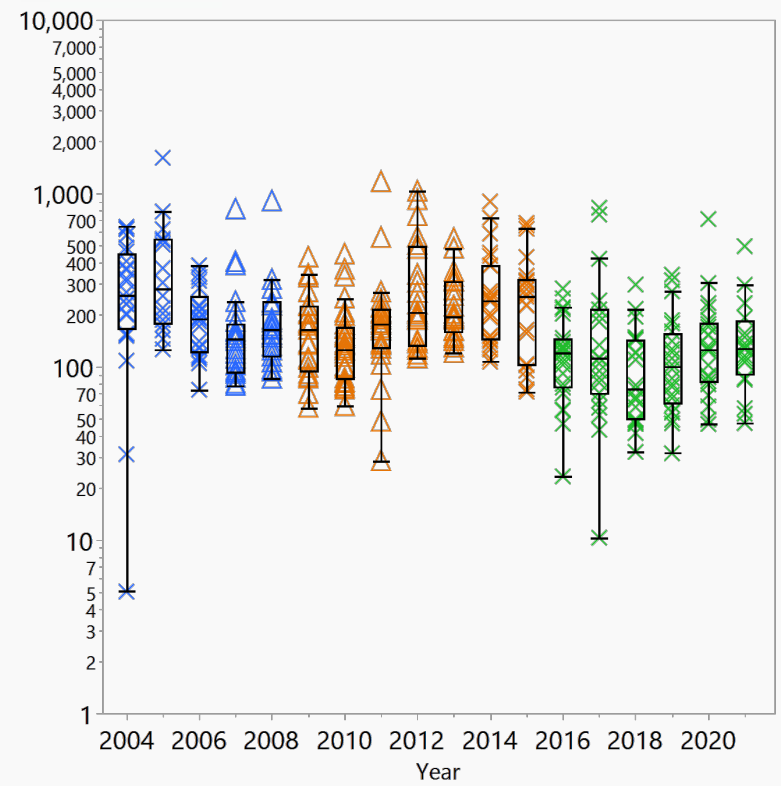
Brown Bullhead – Lipid-Normalized



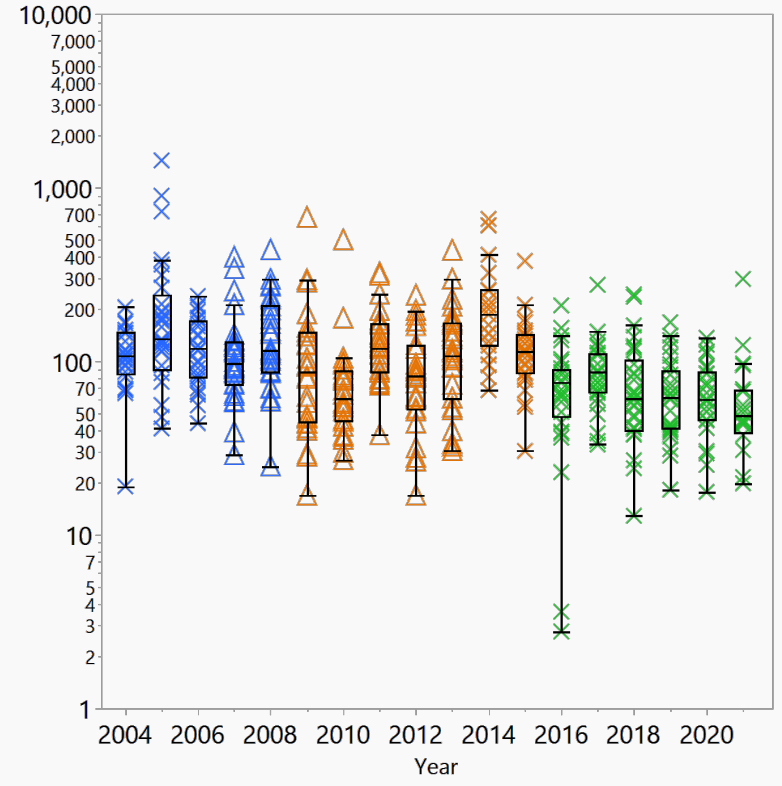
River Section 1



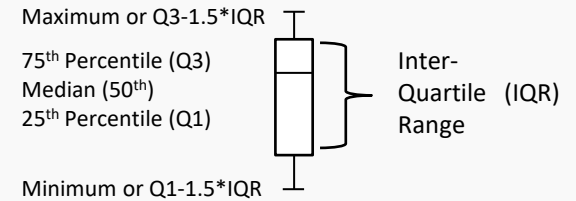
River Section 2



River Section 3



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)
- × Standard Fillet
- △ Rib-out Fillet



Note: Only fish collected from the designated monitoring stations are included in these plots

Hudson River TPCB-HE Species-Weighted Average over Time



2004-2021 Total PCB_{HE} Species-Weighted Averages by River Section (wet weight, mg/kg)

Monitoring Period	Year	Upper River Average		River Section 1		River Section 2		River Section 3	
		River Section 1-3 Mean	Confidence Limit	River Section 1 Mean	Confidence Limit	River Section 2 Mean	Confidence Limit	River Section 3 Mean	Confidence Limit
Baseline (Pre-Dredge) Monitoring Period (BMP)	2004	2.3	2.0 - 2.7	4.9	3.5 - 6.4	3.8	3.2 - 4.4	1.5	1.2 - 1.9
	2005	2.1	1.9 - 2.3	2.3	1.8 - 2.9	3.0	2.3 - 3.7	1.9	1.7 - 2.1
	2006	3.1	2.8 - 3.5	2.3	1.9 - 2.8	2.4	2.2 - 2.7	3.4	3.0 - 3.9
	2007	2.0	1.8 - 2.2	2.7	2.3 - 3.2	2.5	2.1 - 3.0	1.7	1.4 - 2.0
	2008	1.2	0.99 - 1.3	1.5	1.2 - 2.0	2.5	1.8 - 3.5	0.86	0.68 - 1.0
Dredging (2009, 2011-2015) Remedial Action Monitoring Program (RAMP)	2009	1.2	1.0 - 1.4	1.7	1.3 - 2.2	2.0	1.6 - 2.6	0.99	0.78 - 1.2
	2010	1.4	1.2 - 1.8	2.9	2.4 - 3.6	1.7	1.3 - 2.2	1.1	0.84 - 1.5
	2011	1.4	1.2 - 1.6	1.9	1.6 - 2.1	2.0	1.6 - 2.5	1.2	0.95 - 1.4
	2012	1.9	1.7 - 2.2	3.5	2.8 - 4.3	3.4	2.8 - 4.0	1.3	1.1 - 1.7
	2013	1.7	1.6 - 1.9	2.4	2.1 - 2.6	2.7	2.3 - 3.2	1.4	1.2 - 1.6
	2014	2.2	1.9 - 2.5	2.4	1.9 - 2.9	3.3	2.8 - 3.9	2.0	1.6 - 2.4
	2015	1.1	0.98 - 1.3	1.6	1.4 - 1.9	1.7	1.4 - 2.0	0.93	0.73 - 1.2
OM&M Monitoring (on-going)	2016	1.3	1.1 - 1.4	1.4	1.1 - 1.9	2.1	1.8 - 2.4	1.1	0.93 - 1.3
	2017	0.89	0.80 - 0.98	0.96	0.79 - 1.1	1.4	1.2 - 1.8	0.78	0.67 - 0.88
	2018	0.72	0.64 - 0.79	0.73	0.61 - 0.87	0.90	0.72 - 1.1	0.68	0.58 - 0.78
	2019	0.71	0.59 - 0.83	0.77	0.60 - 0.97	0.97	0.75 - 1.3	0.65	0.50 - 0.80
	2020	0.63	0.56 - 0.71	0.86	0.64 - 1.2	0.95	0.75 - 1.2	0.52	0.46 - 0.60
	2021	0.71	0.59 - 0.86	0.72	0.58 - 0.90	0.77	0.66 - 0.89	0.70	0.53 - 0.90

Notes:

- Individual species are averaged by collection station and then averaged together by River Section.
- Reach and River Section fish tissue PCB concentrations are weighted by species. Black bass = 47%, bullhead = 44%, yellow perch = 9%.
- Upper Hudson River average is weighted by both species and river reach length. Reach 8: = 6.3 miles (15.4%); Reach 7 = 2.2 miles (5.4%); Reach 6 = 2.9 miles (7.1%); and Reach 5 = 29.5 miles (72.1%). Fish sampling stations in Reaches 4-1 are not currently included in the calculation set. Fish samples from monitoring stations in Reach 5, which is 14 miles long, are used to represent all 29.5 miles of River Section 3. Fish data were not available for Reach 7 in 2008.
- Dredging was not performed in 2010 so that a planned peer-review of the project could be convened for the purpose of refining the selected remedy.
- The samples from 2007-2013 are rib-out fillets, all other data are from NYSDEC standard fillet samples.
- 95% confidence limits on the mean are calculated using a bias-corrected and accelerated (BCA) bootstrap method.

Upper Hudson River Species-Weighted Average over Time

– Combined River Sections 1, 2 and 3



Legend

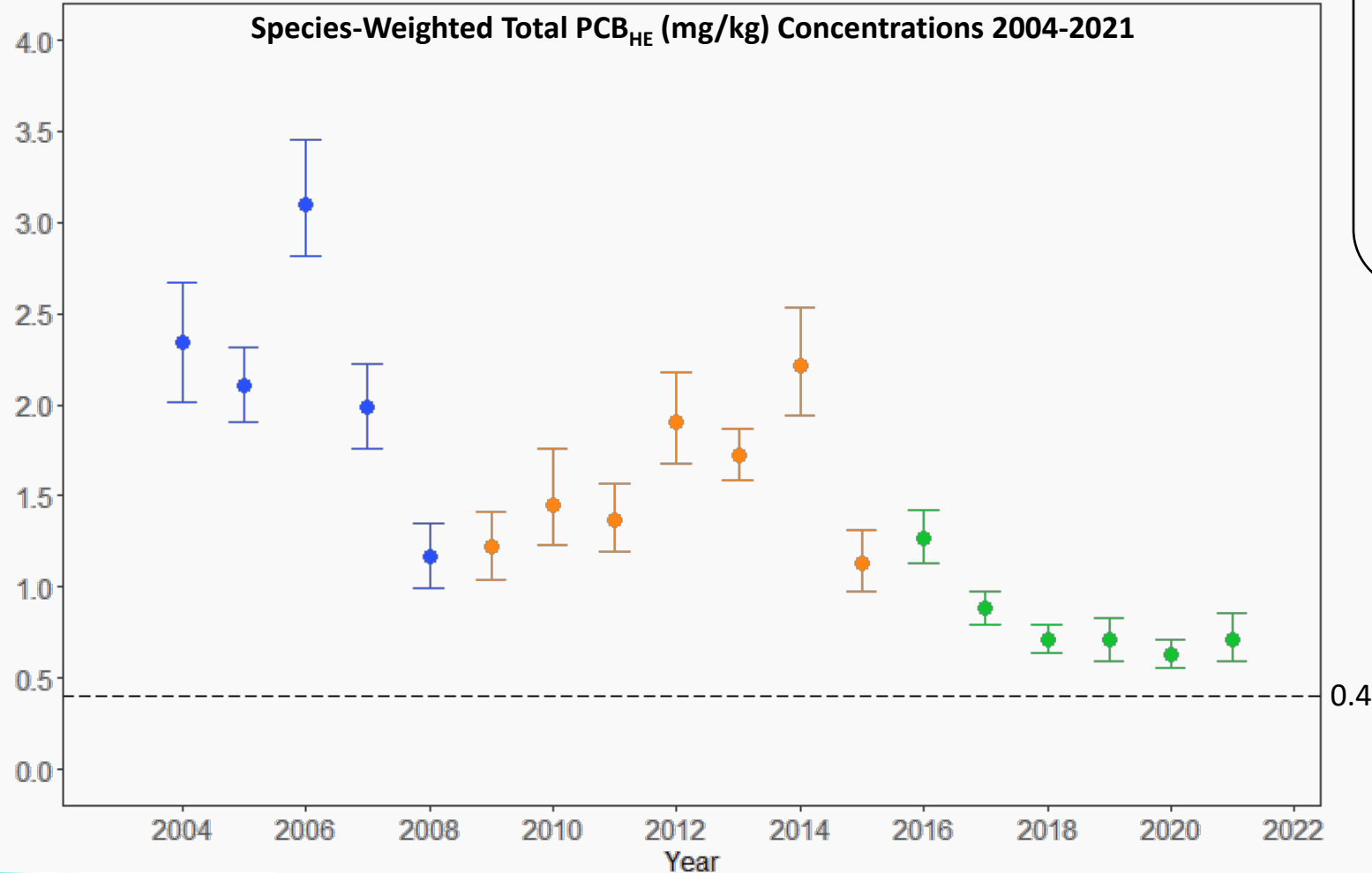
● Before Dredging
(2004-2008)

● During Dredging
(2009-2015)

● After Dredging
(2016-2021)

— Upper Conf Limit
● Mean
— Lower Conf Limit

Total PCB Homologue Equivalent
(mg/kg-wet weight)



Notes

1. Individual species are averaged by collection station and then averaged together by River Section.
2. River Section fish tissue PCB concentrations are weighted by species. Largemouth and smallmouth bass = 47%, brown bullhead = 44%, yellow perch = 9%.
3. Upper Hudson River average is weighted by both species and river section length. River Section 1 = 6.3 miles (15.4%); River Section 2 = 5.1 miles (12.5%); and River Section 3 = 29.5 miles (72.1%). Fish sampling stations in Reaches 4-1 are not currently included in the calculation set. Fish samples from monitoring stations in Reach 5, which is 14 miles long, are used to represent all 29.5 miles of River Section 3. Fish data were not available for Reach 7 in 2008.
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6. 95% confidence limits on the mean are calculated using a bias-corrected and accelerated (BCA) bootstrap method.

Upper River

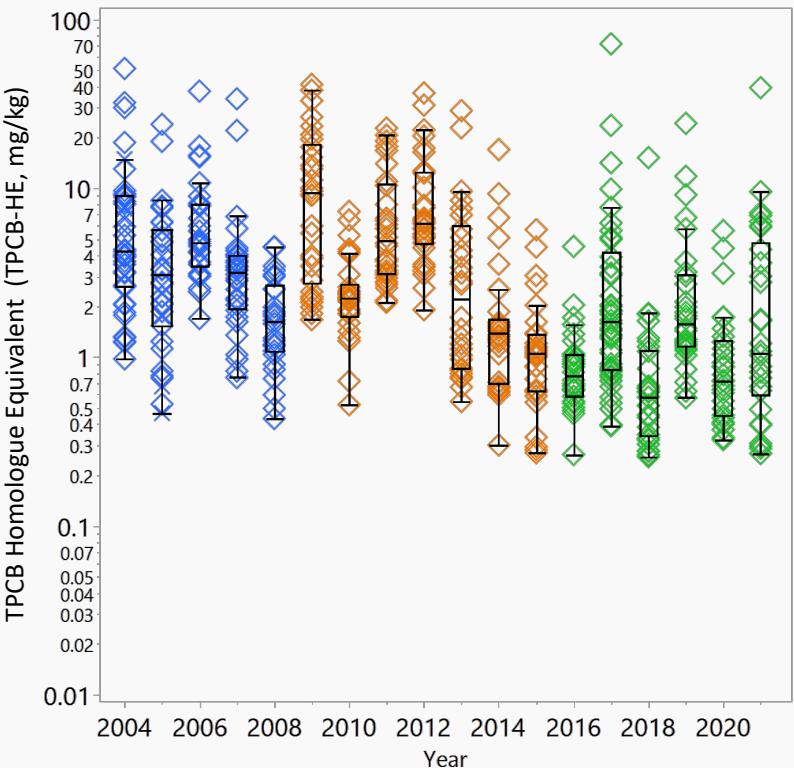
Pumpkinseed – Whole Body

- Alternating wet weight and lipid-normalized

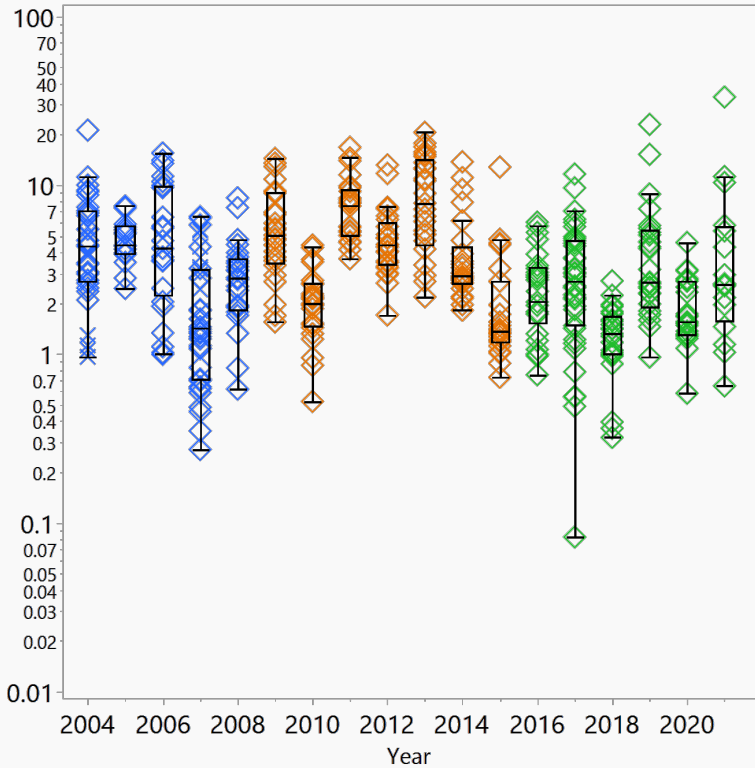
Pumpkinseed – Wet Weight



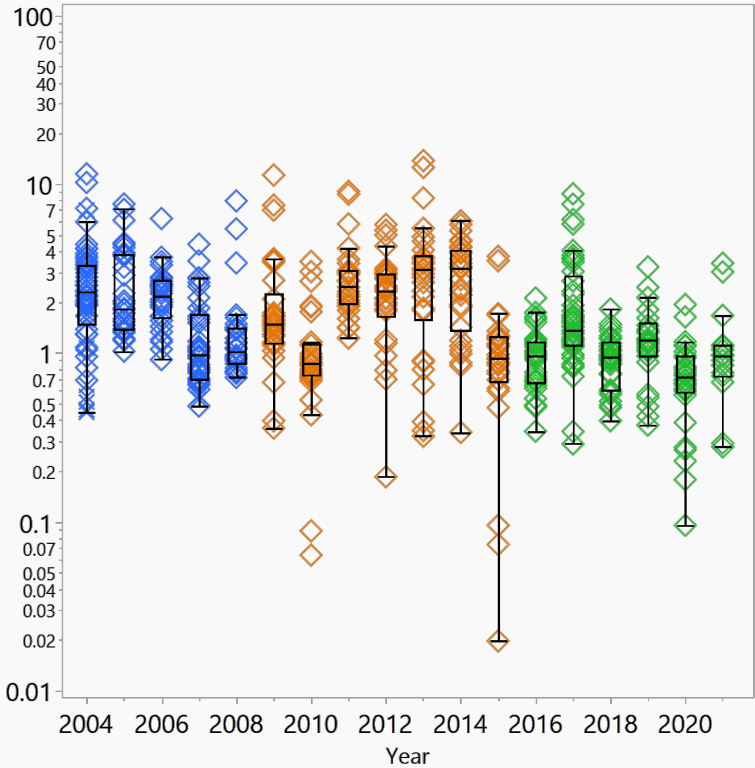
River Section 1



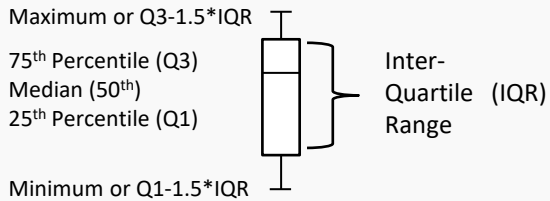
River Section 2



River Section 3



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)
- Whole Body
- Standard fillet



Note: Only fish collected from the designated monitoring stations are included in these plots

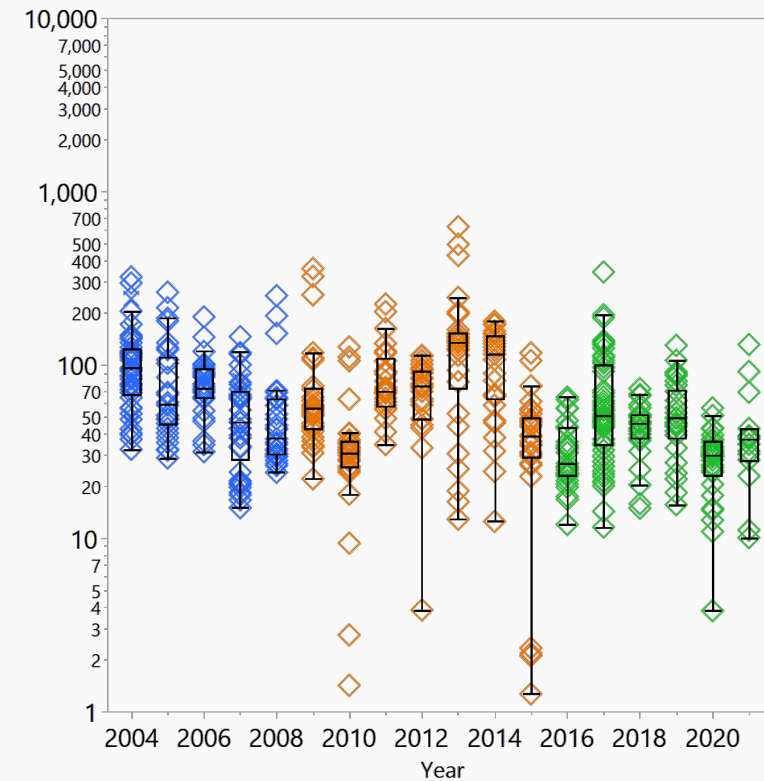
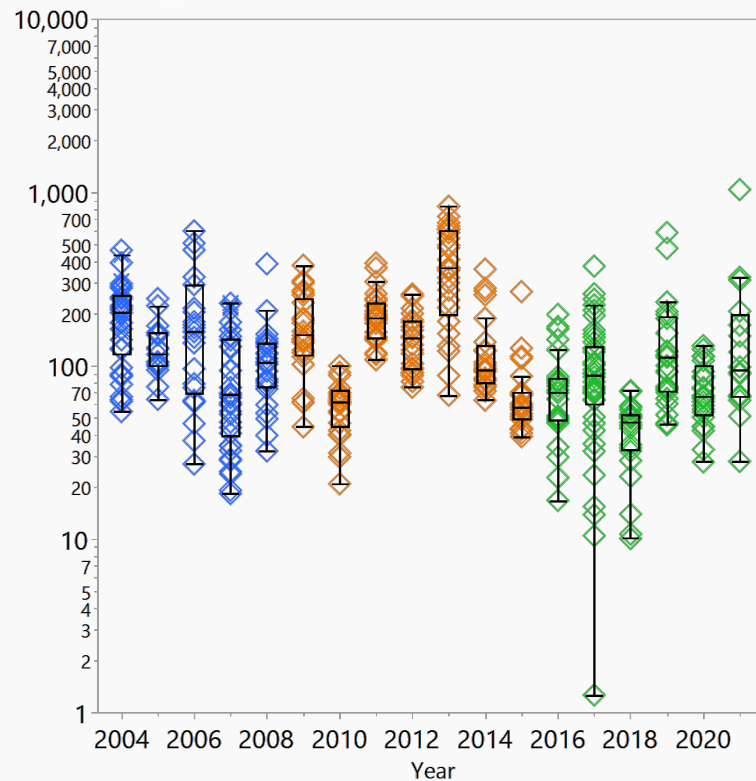
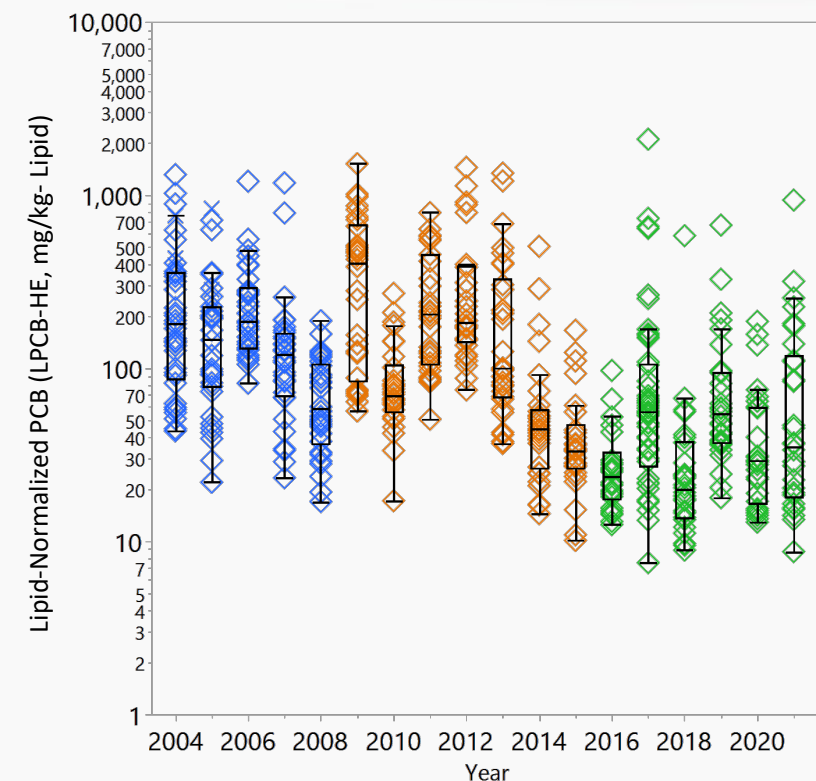
Pumpkinseed – Lipid-Normalized



River Section 1

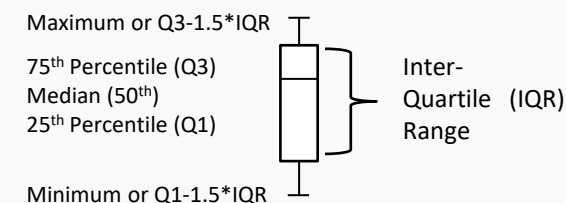
River Section 2

River Section 3



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)

- ◇ Whole Body
- × Standard fillet



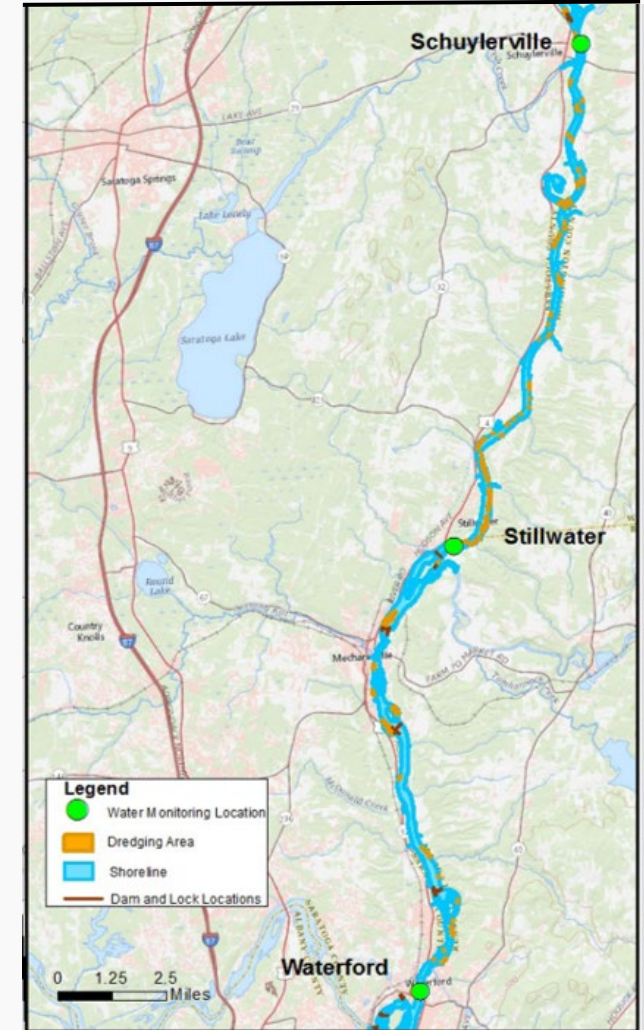
Upper Hudson River Fall 2021 Fish Collection - Reaches 4 to 1



2021 Fall Fish: Reaches 4 - 1

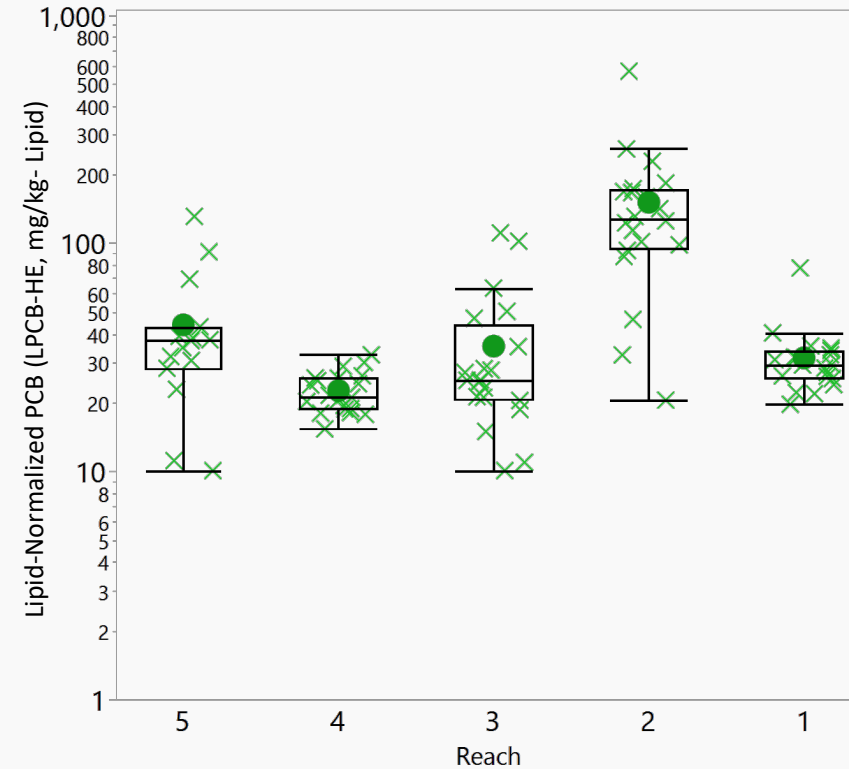
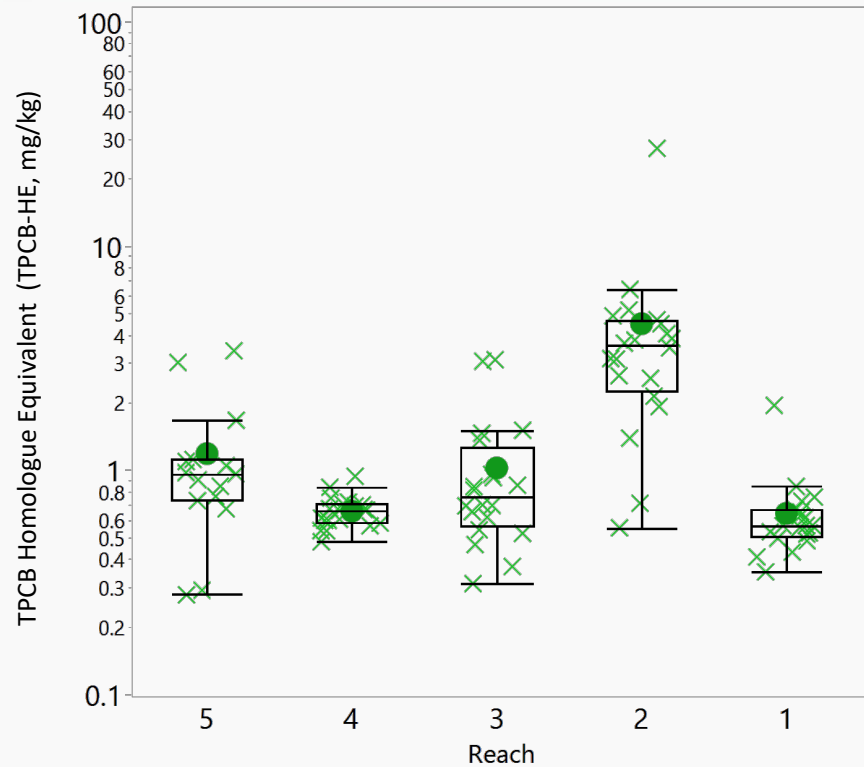


- Purpose: Evaluate whether PCB fish tissue levels in these reaches are consistent with the average Reach 5 fish tissue PCB concentrations
- Samples collected 2021, 9/1 - 9/2
- Targets: 80 pumpkinseed from Reaches 4 to 1, collectively



Pumpkinseed Comparison

- Reach 5 vs Reaches 4-1 in 2021
- Wet Weight and Lipid Normalized



2021 data only

× 2021 Whole Body Samples
● Mean by River Reach

Maximum or $Q3 + 1.5 \times IQR$
75th Percentile (Q3)
Median (50th)
25th Percentile (Q1)
Minimum or $Q1 - 1.5 \times IQR$

Inter-Quartile (IQR)
Range



Lower River

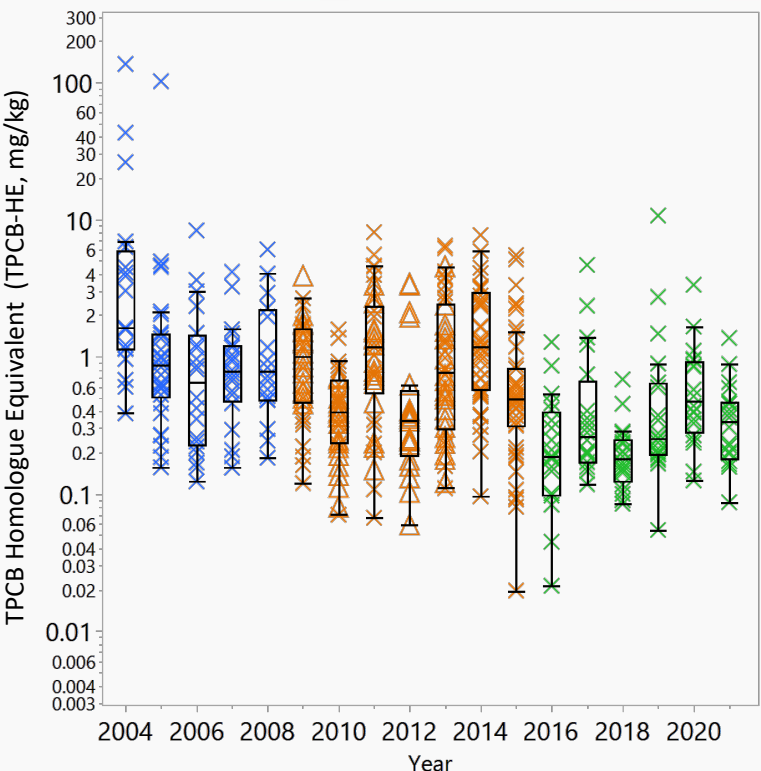
Sport Fish - Fillet

- Sequential by species
- Alternating wet weight and lipid-normalized

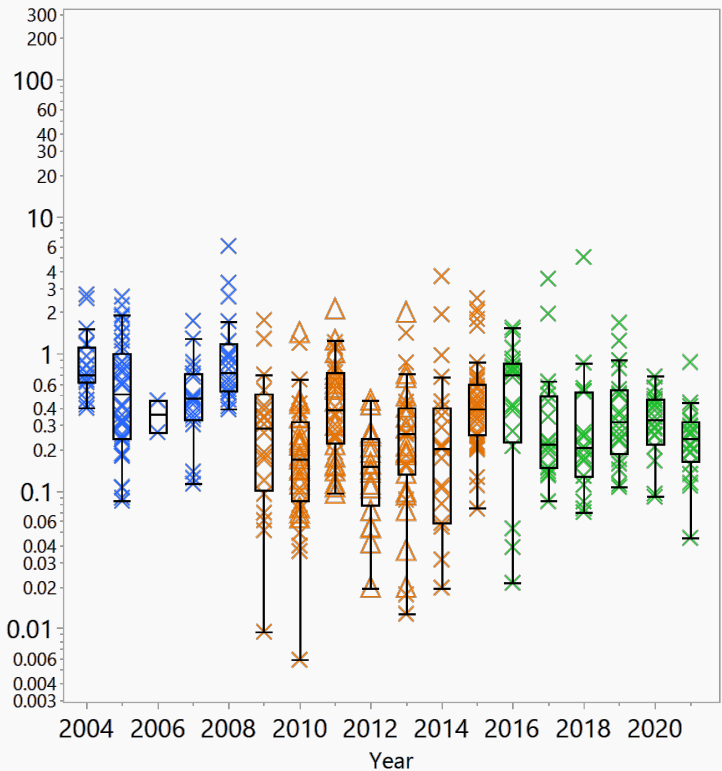
Striped Bass – Wet Weight



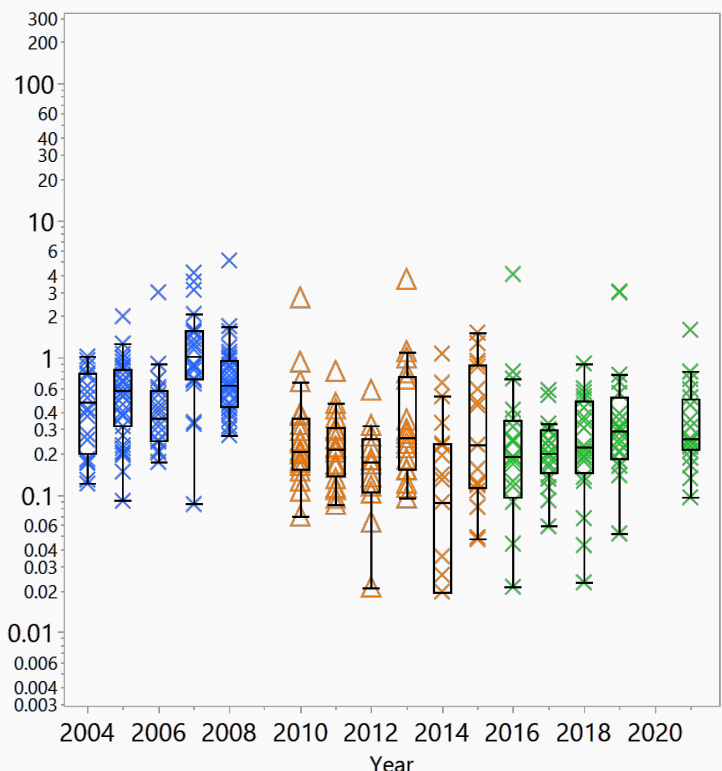
Albany/Troy (RM154)



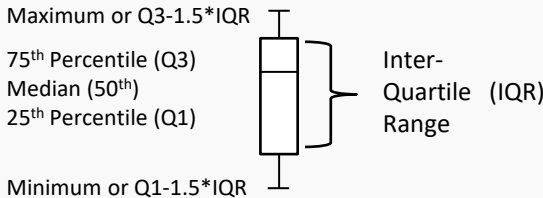
Catskill (RM113)



Tappan Zee (RM27)



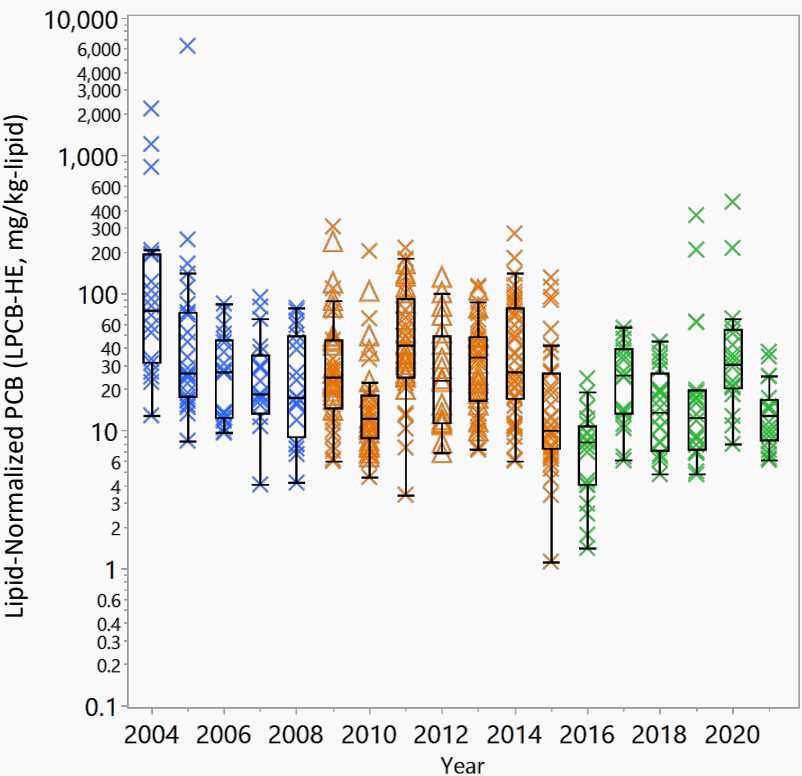
- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)
- × Standard Fillet
- △ Rib-out Fillet



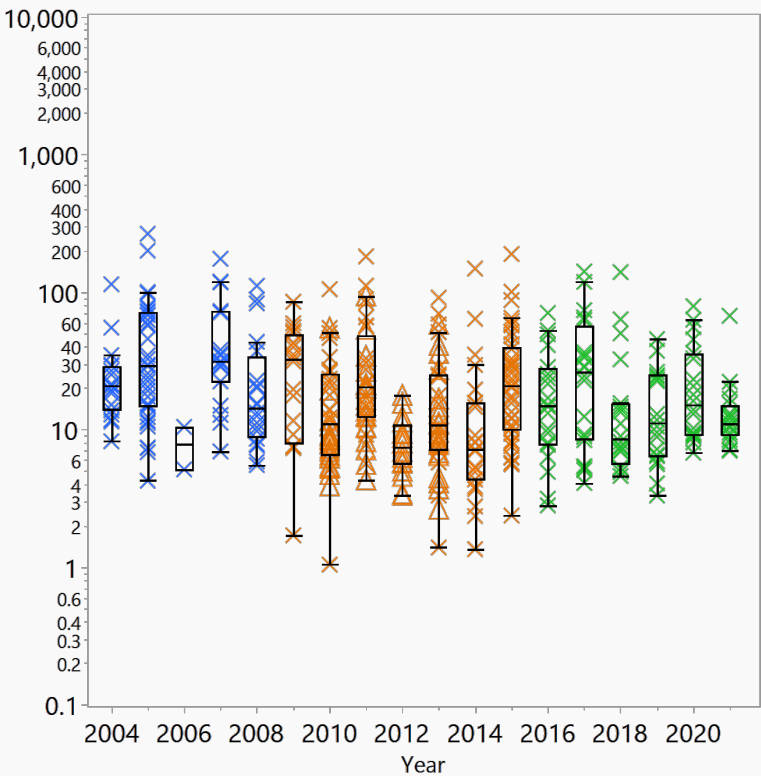
Striped Bass – Lipid-Normalized



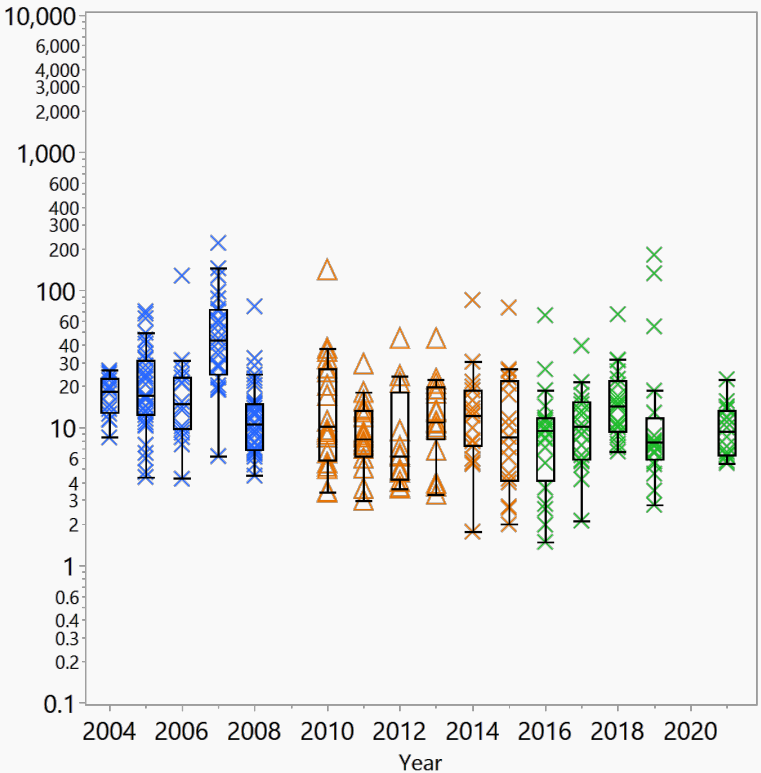
Albany/Troy (RM154)



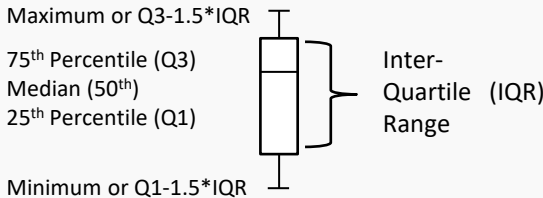
Catskill (RM113)



Tappan Zee (RM27)



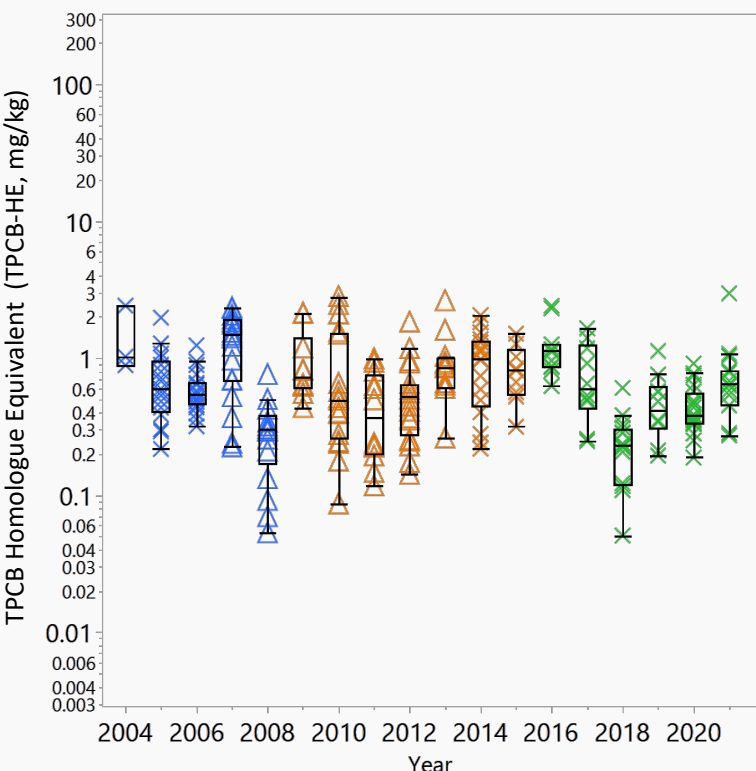
- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)
- × Standard Fillet
- △ Rib-out Fillet



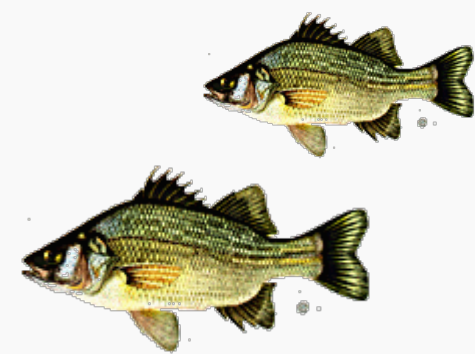
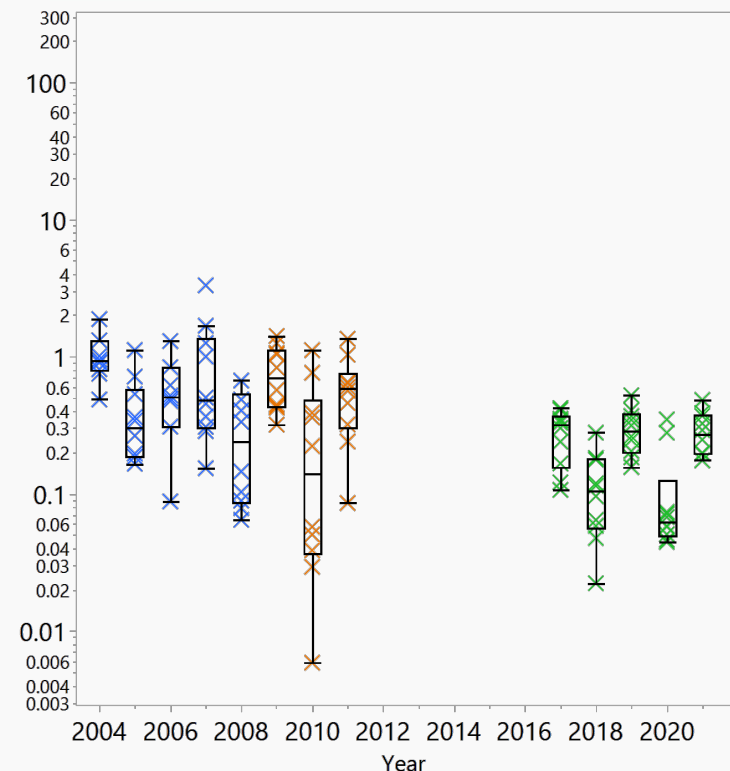
White Perch – Wet Weight



Albany/Troy (RM154)

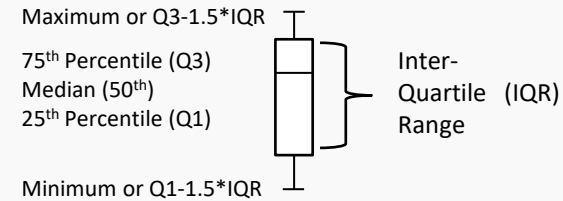


Catskill (RM113)



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)

- × Standard Fillet
- △ Rib-out Fillet

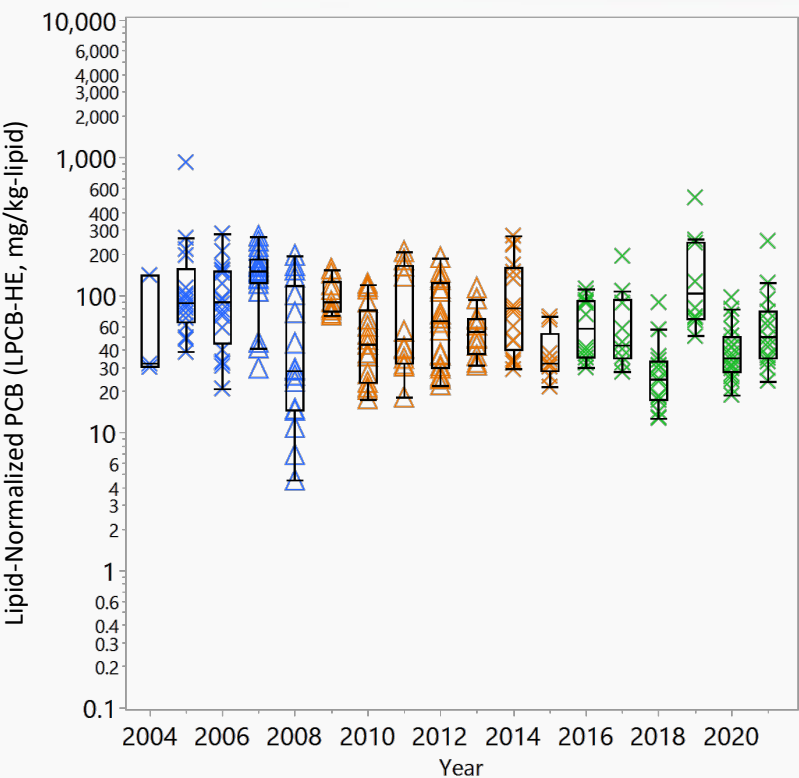


Note: Only fish collected from the designated monitoring stations are included in these plots

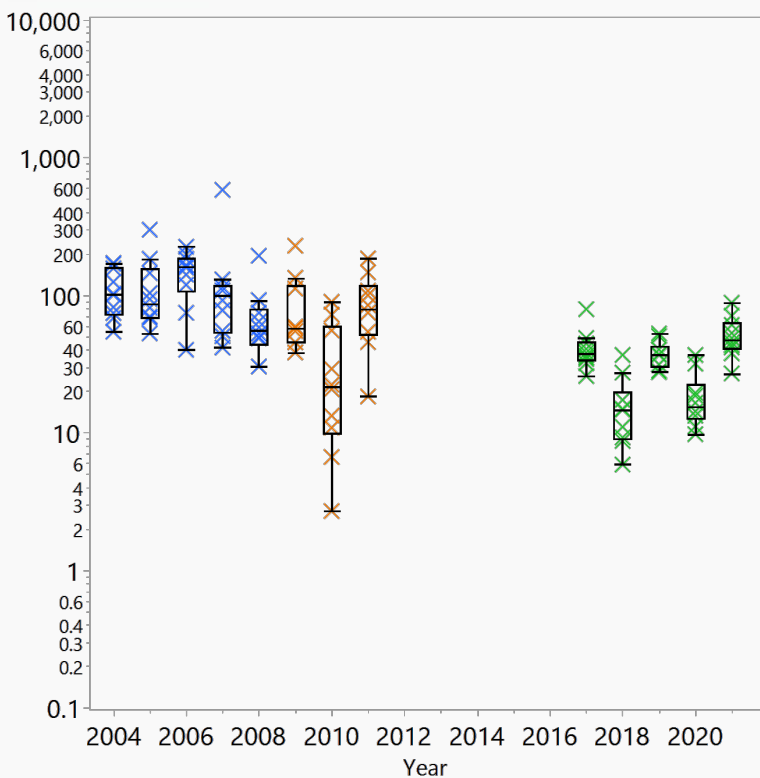
White Perch – Lipid-Normalized



Albany/Troy (RM154)

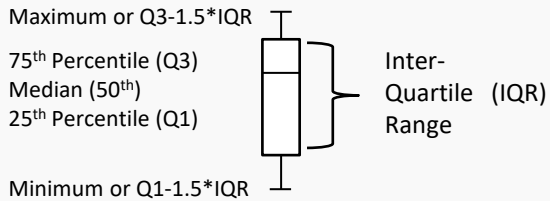
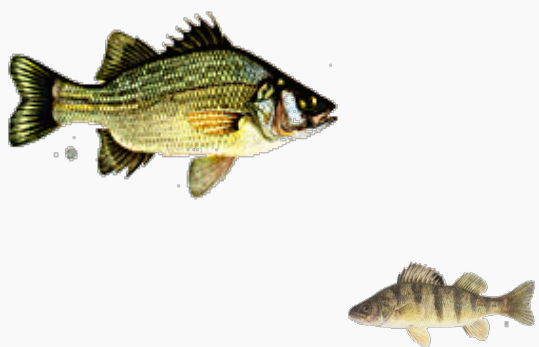


Catskill (RM113)



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2021)

- × Standard Fillet
- △ Rib-out Fillet



Note: Only fish collected from the designated monitoring stations are included in these plots



- This is a preliminary evaluation; a more detailed analysis is being conducted as part of the five-year review
- PCB concentrations in fish have recovered from dredging impacts and are now generally below baseline conditions
- Analysis of NIST standards shows good precision through several years of use – improved program
- EPA (in consultation with DEC/DOH) is continuing its oversight of fish collection, processing and laboratory analysis
- The number of years needed to assess trends will be evaluated further in the five-year review
 - As expected, data is noisy
 - As noted in the last five-year review, as many as 8 or more years of post-dredging fish data may be needed – we now have 6 years of data – further analysis of trends will be conducted in the ongoing five-year review.
- Historical data show that recovery varies from year to year (as expected)

Summary and Next Steps – Fish Program Upper Hudson River (cont.)



- 2022 fall fish data collection is underway (spring fish data is being analyzed by the lab)
- EPA is finalizing the long-term monitoring fish collection scope
 - GE's associated work plan is under review and EPA/DEC are discussing comments
- EPA is planning to expand fish sampling in Lower Hudson as part of the new Lower River Investigations
- EPA will incorporate data from DEC into EPA's analysis (as they are provided to EPA)
- EPA will continue close coordination with DEC and DOH on the Upper and Lower Fish Programs

Questions?

