Shifts in Age of Great Lakes Lake Trout; an interlaboratory comparison

Are they affected by changes in growth as a function in the changing food web?

Authors

- Elizabeth Murphy, U.S. EPA
- William Wellenkamp, Michigan DNR
- Ji He, Michigan DNR
- Thomas Holsen, Clarkson University
- Bernard Crimmins, Clarkson University
- Phillip Hopke, Clarkson University
- James Pagano, SUNY Oswego
- Michael Milligan, SUNY Fredonia
- Ken Miller, Computer Sciences Corporation
- Marian Landon, Computer Sciences Corporation

Disclaimer: The views expressed in this presentation are those of the author(s) and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

What are we here to discuss?

- Observation
  - Persistent organic pollutant concentrations increasing, at some locations, in whole lake trout.
  - Productivity of some of Lakes Huron and Michigan, to some extent, are decreasing.
  - Fish are outside of target age range.
- Interlab Study Purpose
  - 4 year comparison is to gauge accuracy and precision, refine aging rules and techniques, and allow for compositing of GLFMSP samples around a known age.
- Results
  - SOP development
  - Technique refinement
- Next steps

Great Lakes Fish Monitoring and Surveillance Program (GLFMSP)

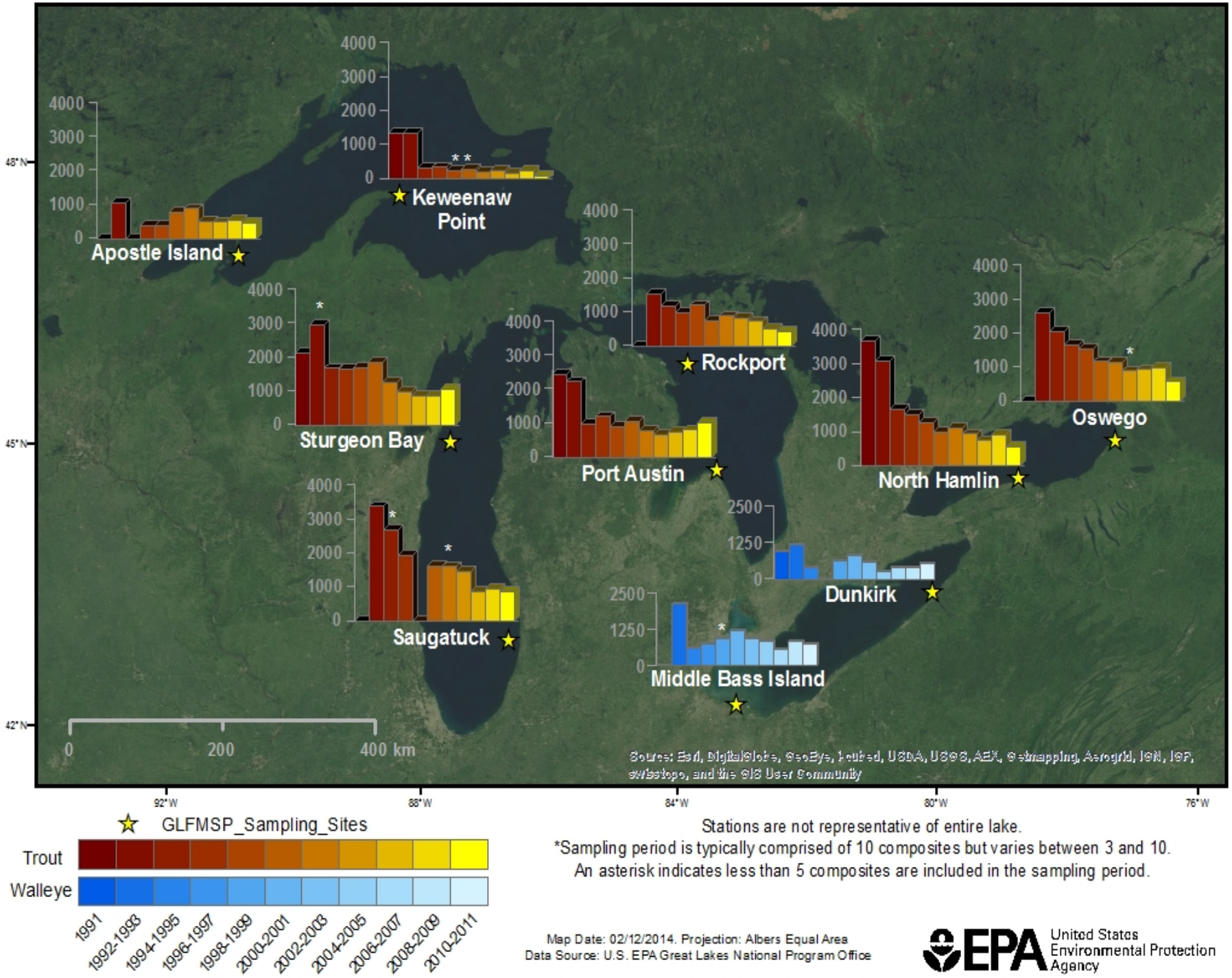
- Chemical monitoring and surveillance program in whole top predator fish
  - Legacy Chemicals
  - Emerging Contaminant Surveillance
- 1970 – present
- Top Predators chosen because they are good integrators
- 2 collection sites per lake, alternating annually
  - Rockport, Lake Huron
  - Port Austin, Lake Huron
- 50 fish per site analyzed as 10 5-fish composites
- Consistent size range, 600 – 700 mm with assumed age (Lake Trout)
- Long-term archive
- Corresponding program in Environment Canada

Observations

- Persistent organic pollutant concentrations increasing, at some locations, in whole lake trout.
- Productivity of Lakes are decreasing.
- Target size fish are older.

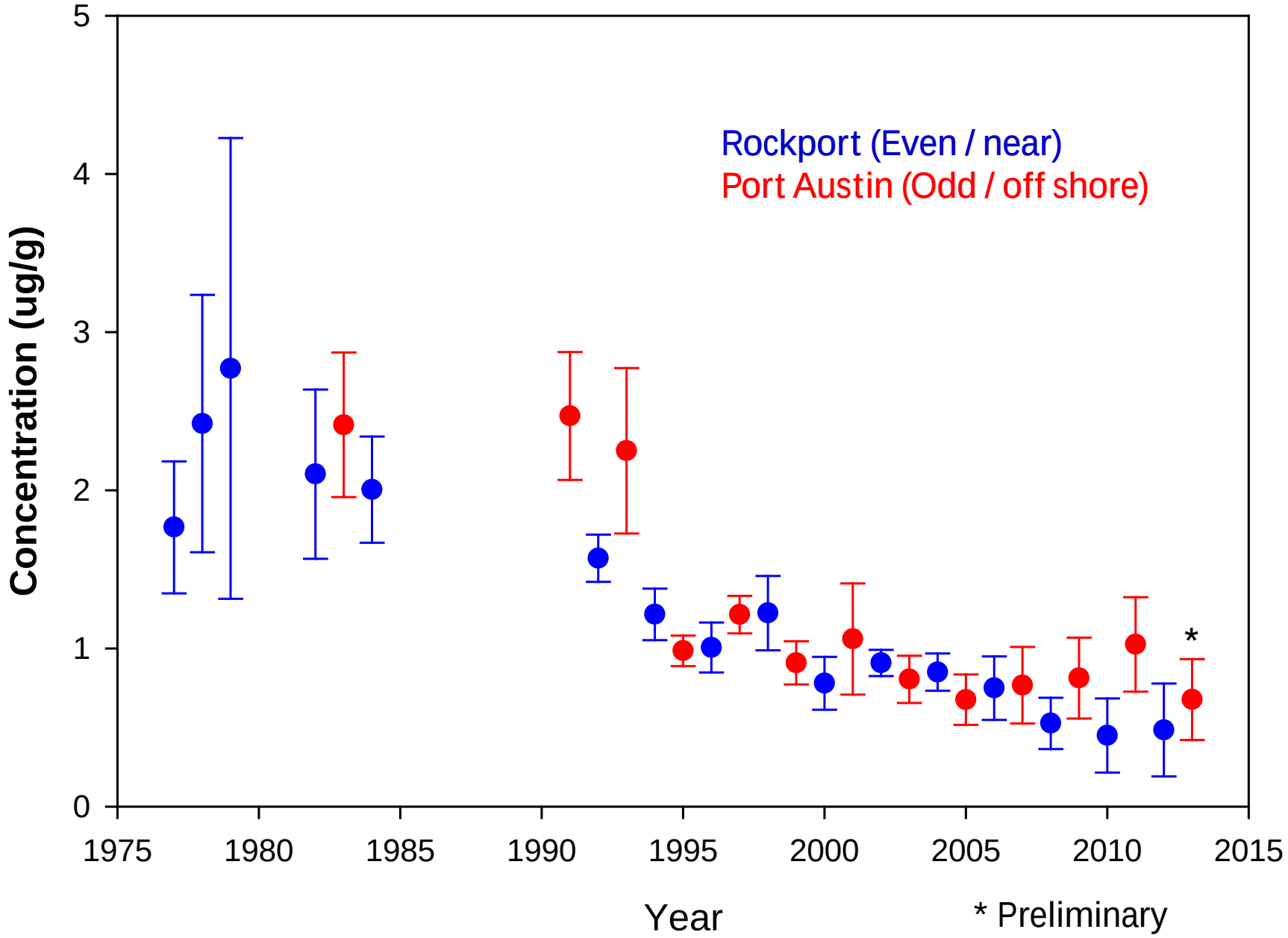
GLFMSP mean ∑ PCB (ppb)

Lake Trout and Walleye 1991 - 2011



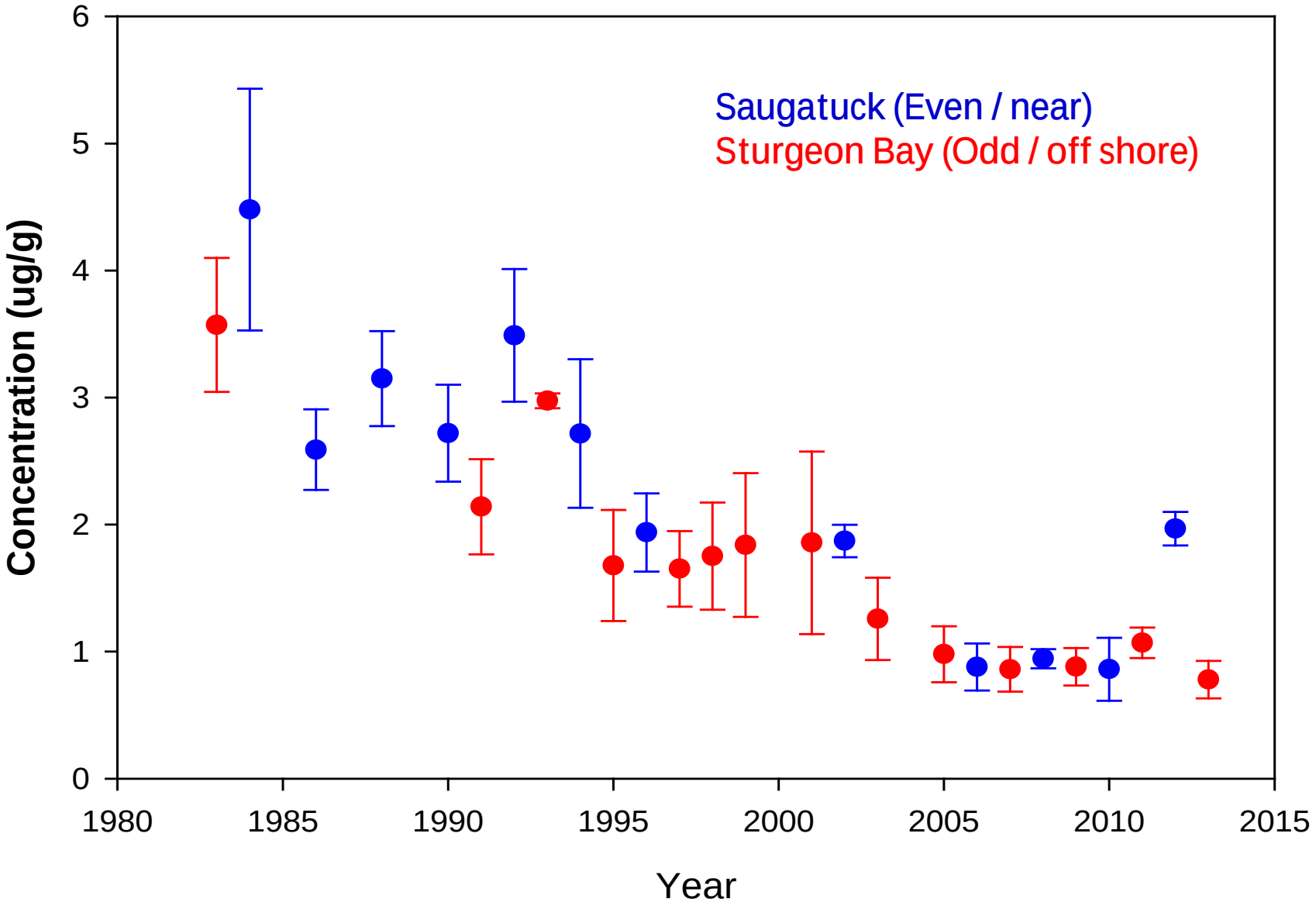
Lake Huron
∑ mean PCBs

Whole Body Lake Trout
1977 - 2013



Lake Michigan ∑ mean PCBs

Whole Body Lake Trout
1982 - 2013



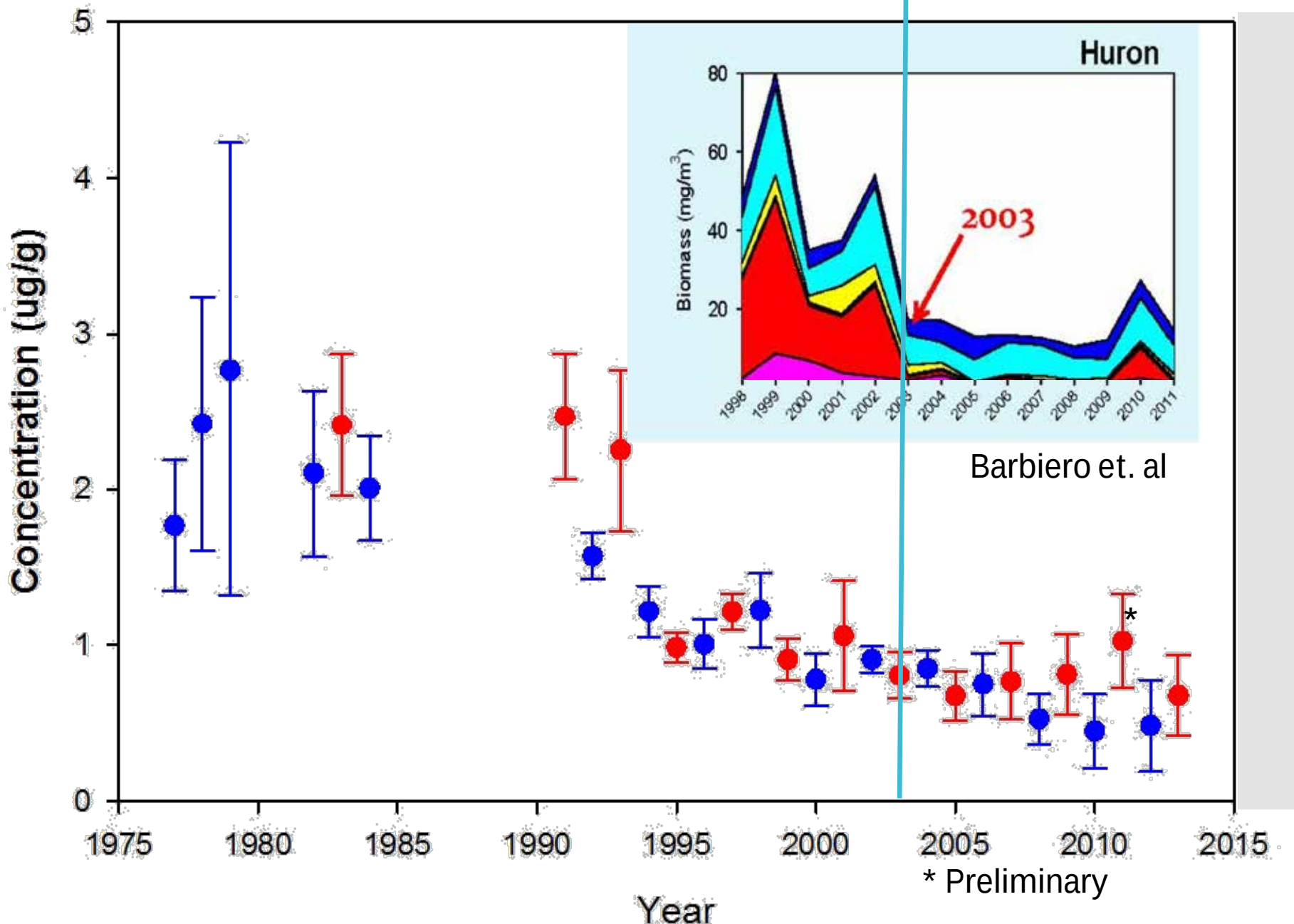
Ecosystem changes in Lake Huron, and glimpse into the future of Lake Michigan

- Decrease in prey species = slower growing lake trout
- Shift in stocked Lake Trout (older) to naturally reproducing wild fish (younger).
- Increased survival rate (longevity) of lake trout from better lamprey and fishing controls – more old fish in the samples.
- Fish in target size ranges are typically found in the nearshore during spring and fall to feed on smelt. Wild fish (generally younger) found in off shore during fall collections.
- Lake shifting from mesotrophic to oligitrophic
  - Mesotrophic lake = intermediate level of productivity
  - Oligotrophic lake = low primary productivity as a result of low nutrient content

Lake Huron
∑ mean PCBs

Whole Body Lake Trout
1977 - 2013

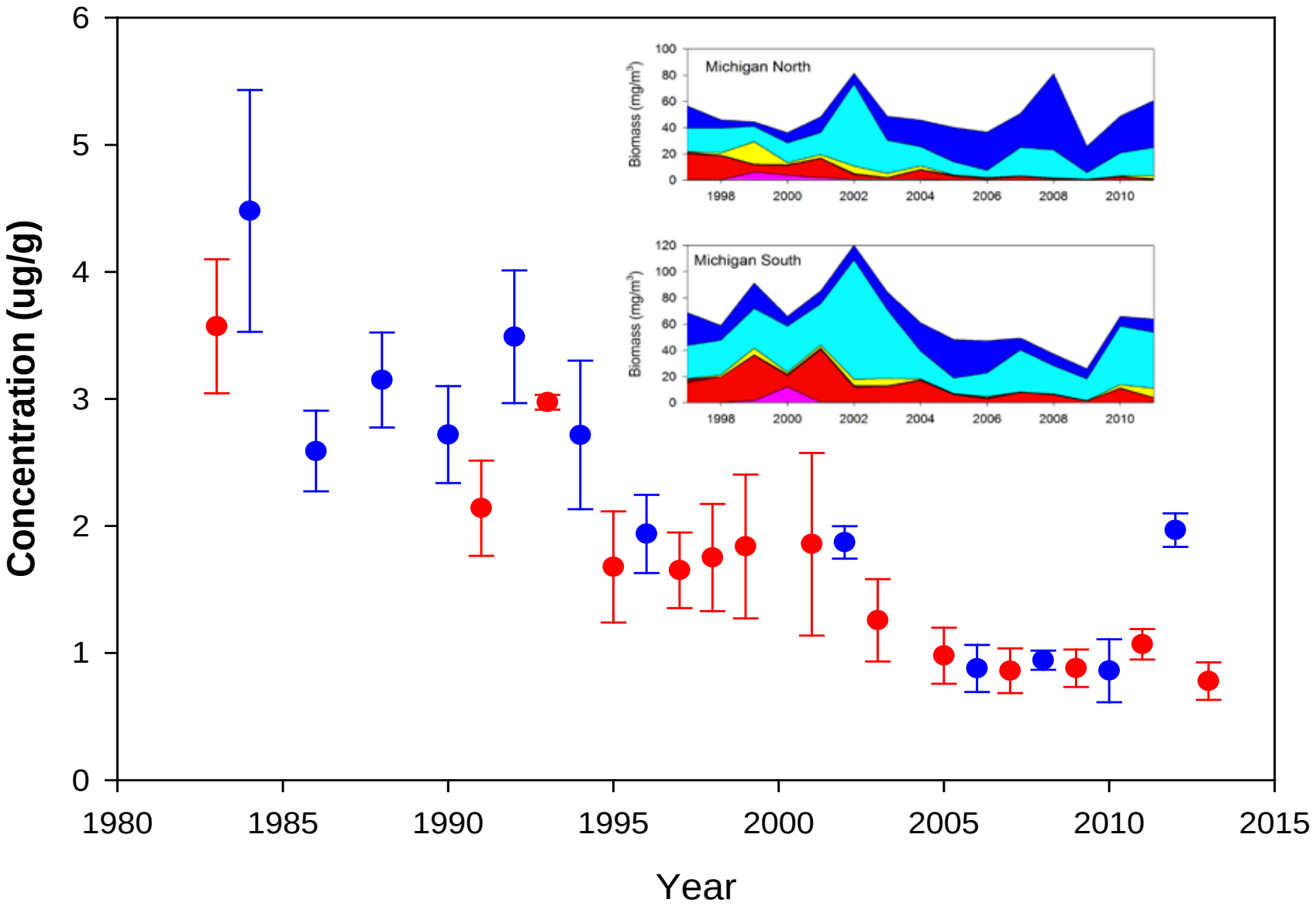
Rockport (Even / near)
Port Austin (Odd / offshore)



Lake Michigan ∑ mean PCBs

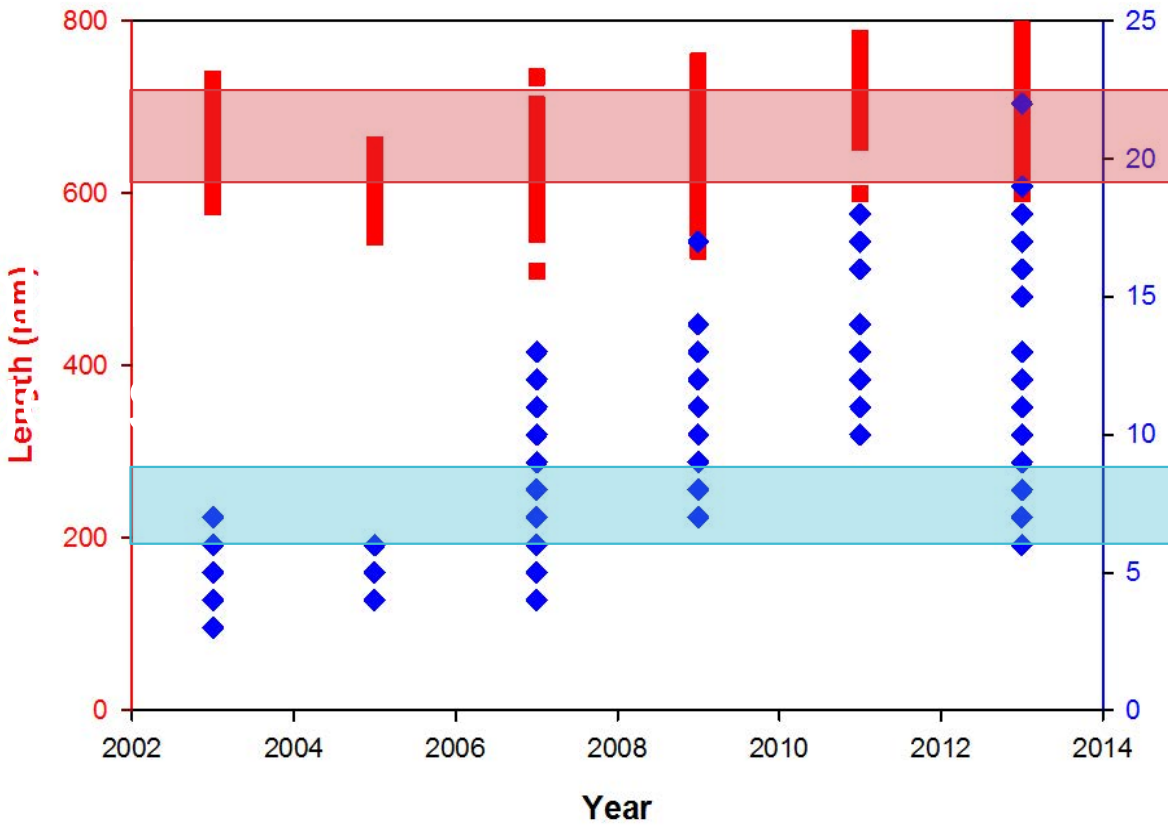
Whole Body Lake Trout
1977 - 2013

Saugatuck (Even / near)
Sturgeon Bay (Odd / offshore)

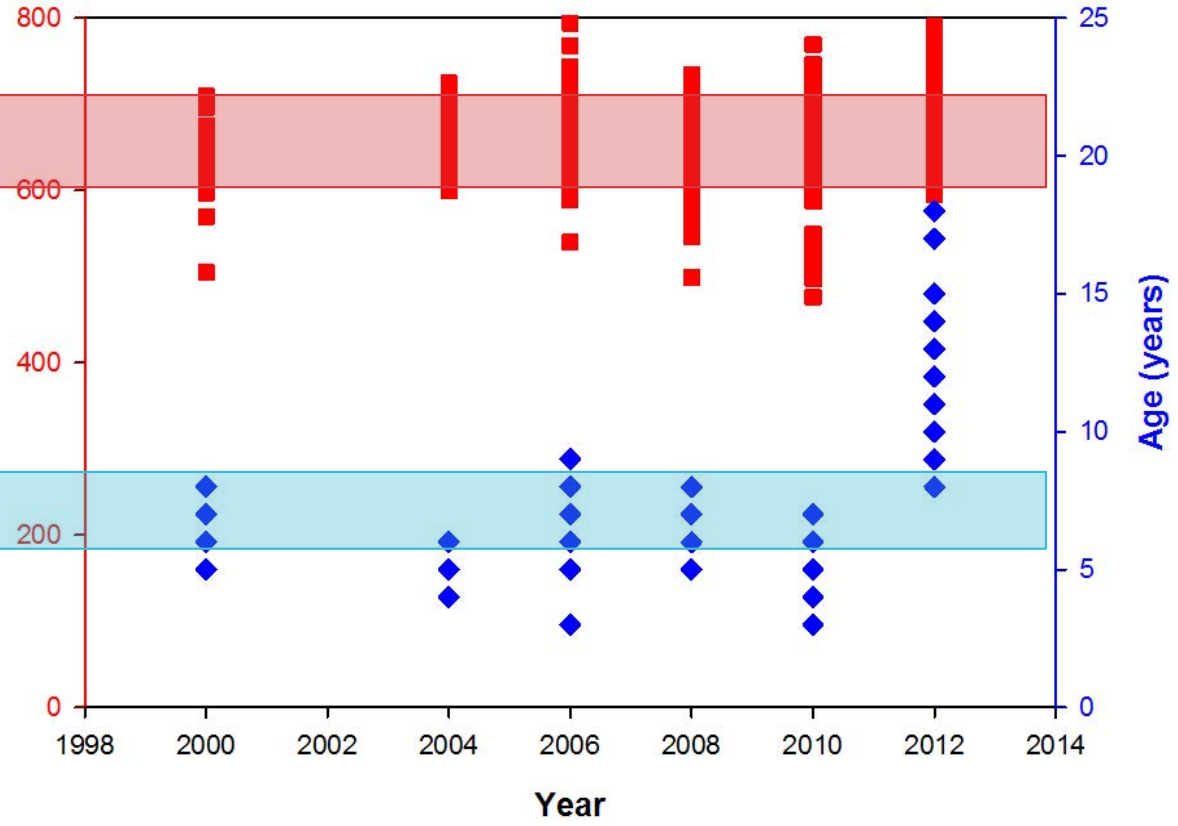


Lake Huron Age vs. Length

Port Austin (odd)



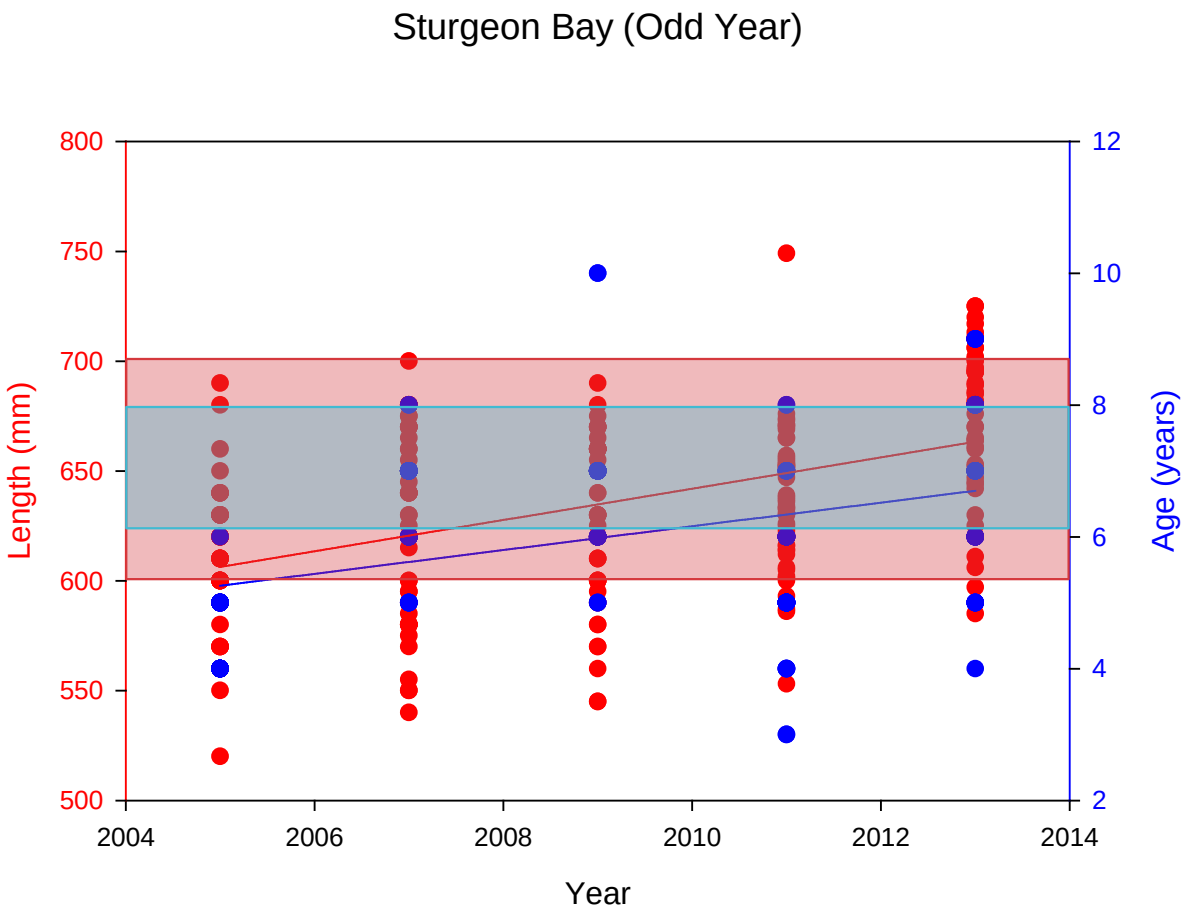
Rockport (even)

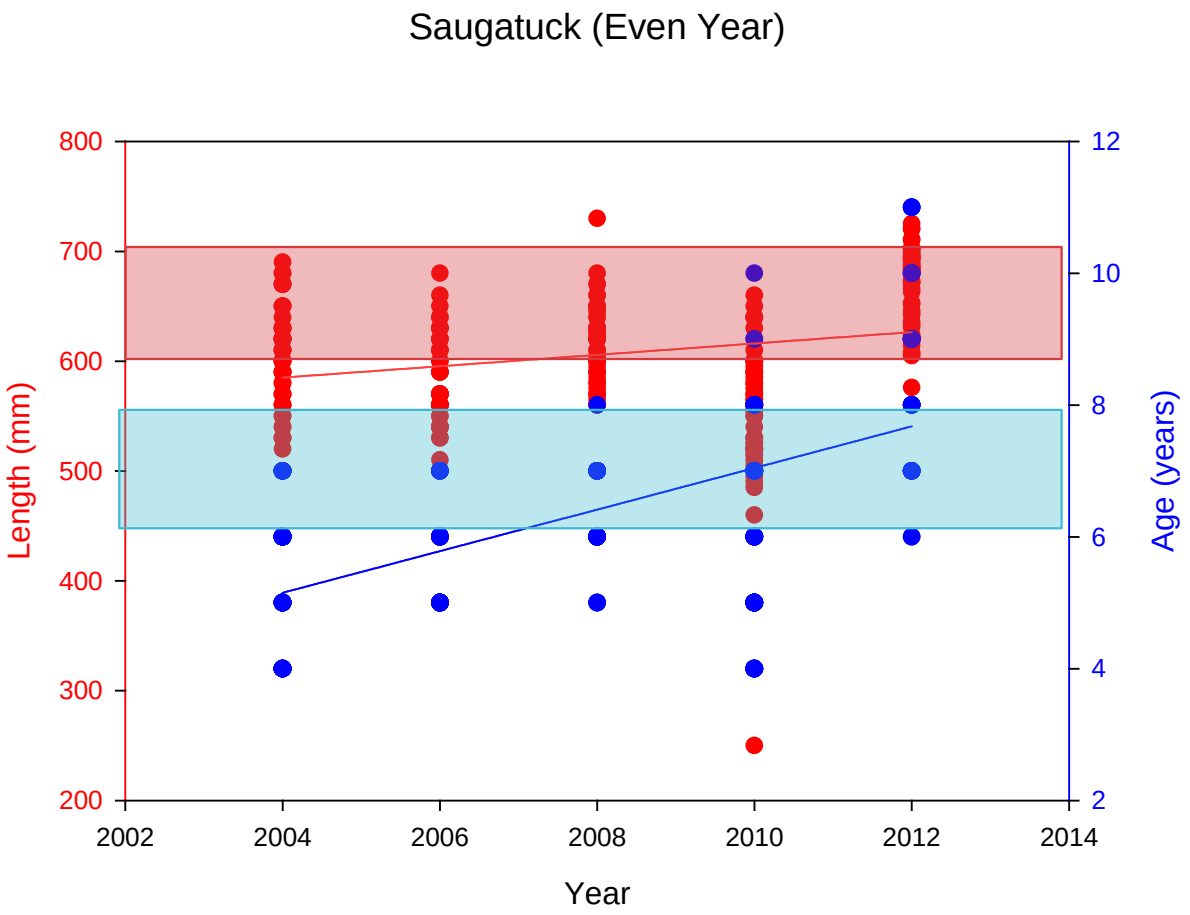


Target Age Range = 6 – 8 years

Target Size Range = 600 – 700 mm

Lake Michigan Age vs. Length





Target Age Range = 6 – 8 years

Target Size Range = 600 – 700 mm

Fish in target size range (600– 700 mm) are getting older

Michigan (600 - 700mm Whole Lake Trout)				
Year	0 - 5	6 - 10	11 - 15	16 - 20
2003	4	16	0	0
2004	12	8	0	0
2005	20	0	0	0
2006	12	8	0	0
2007	4	16	0	0
2008	2	18	0	0
2009	4	16	0	0
2010	12	8	0	0
2011	36	4	0	0
2012	0	40	0	0
2013	1	17	0	0
2014	18	22	7	2

Huron (600 - 700mm) Whole Lake Trout				
Year	0 – 5 years	6 – 10 years	11 – 15 years	16 – 20 years
2003	20	0	0	0
2004	20	0	0	0
2005	20	0	0	0
2006	2	18	0	0
2007	0	20	0	0
2008	0	20	0	0
2009	0	14	4	0
2010	18	2	0	0
2011	0	0	40	0
2012	0	20	12	0
2013	0	11	27	11
2014	0	34	12	4

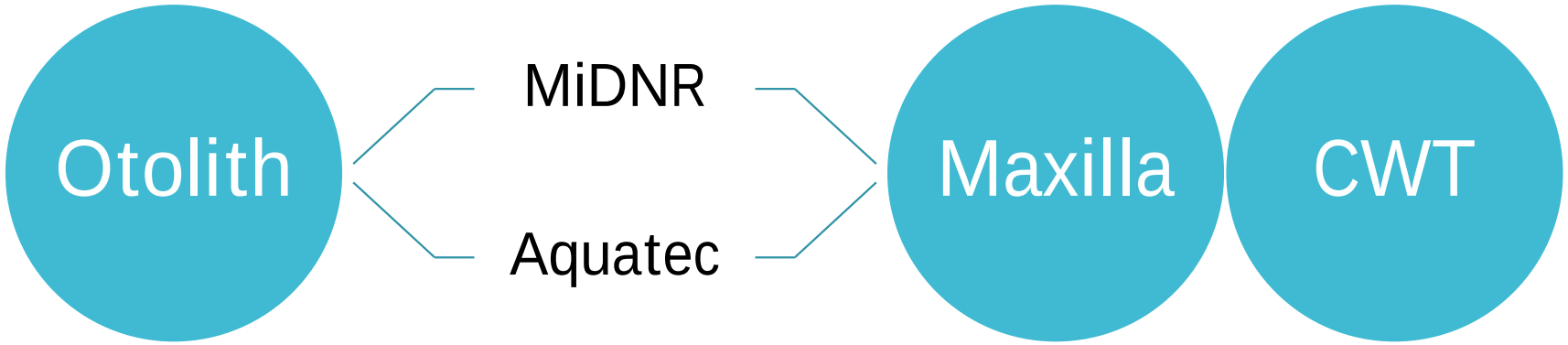
Purpose

- Accuracy
- Precision
- Refine technique
- Develop SOP

Share Photos & structures

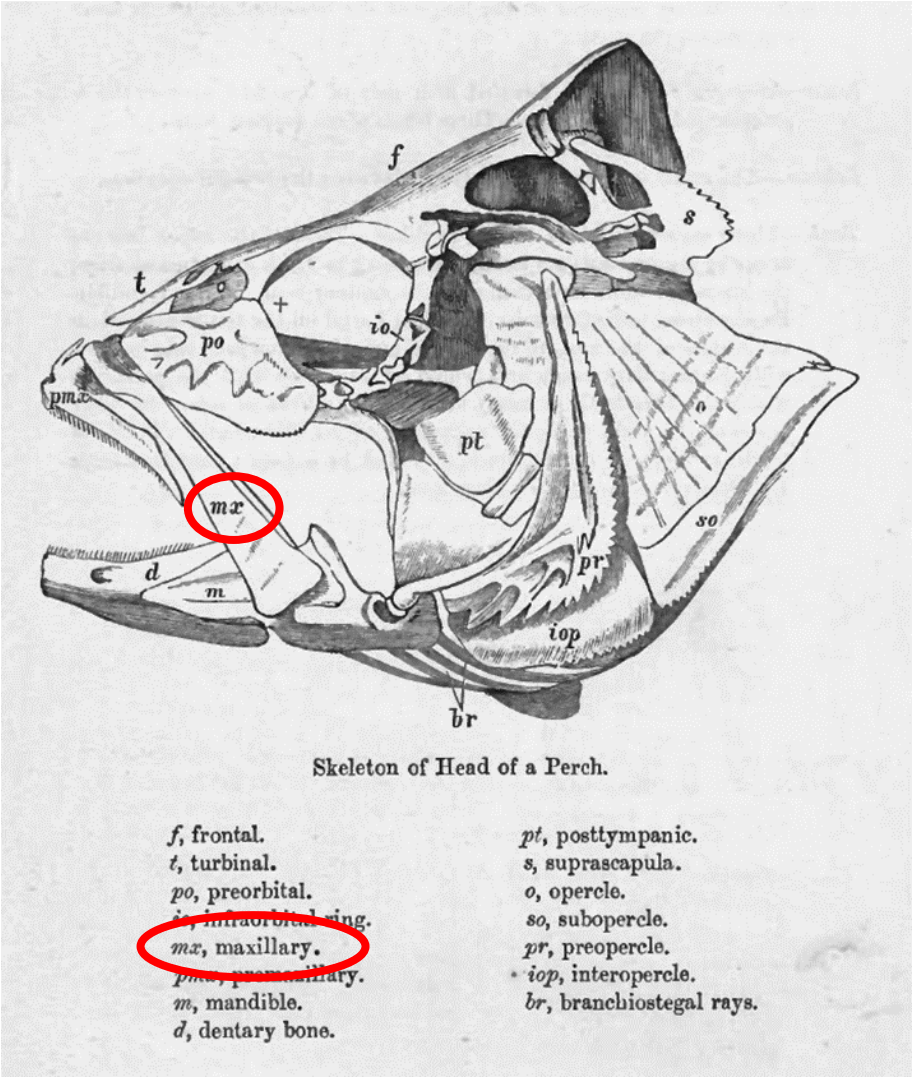
1st year – open read

2nd – 4th year – closed reads



Maxillary bone

The maxilla is a fusion of two bones along the palatal fissure that form the upper jaw in bony fish.



Why / How use them?

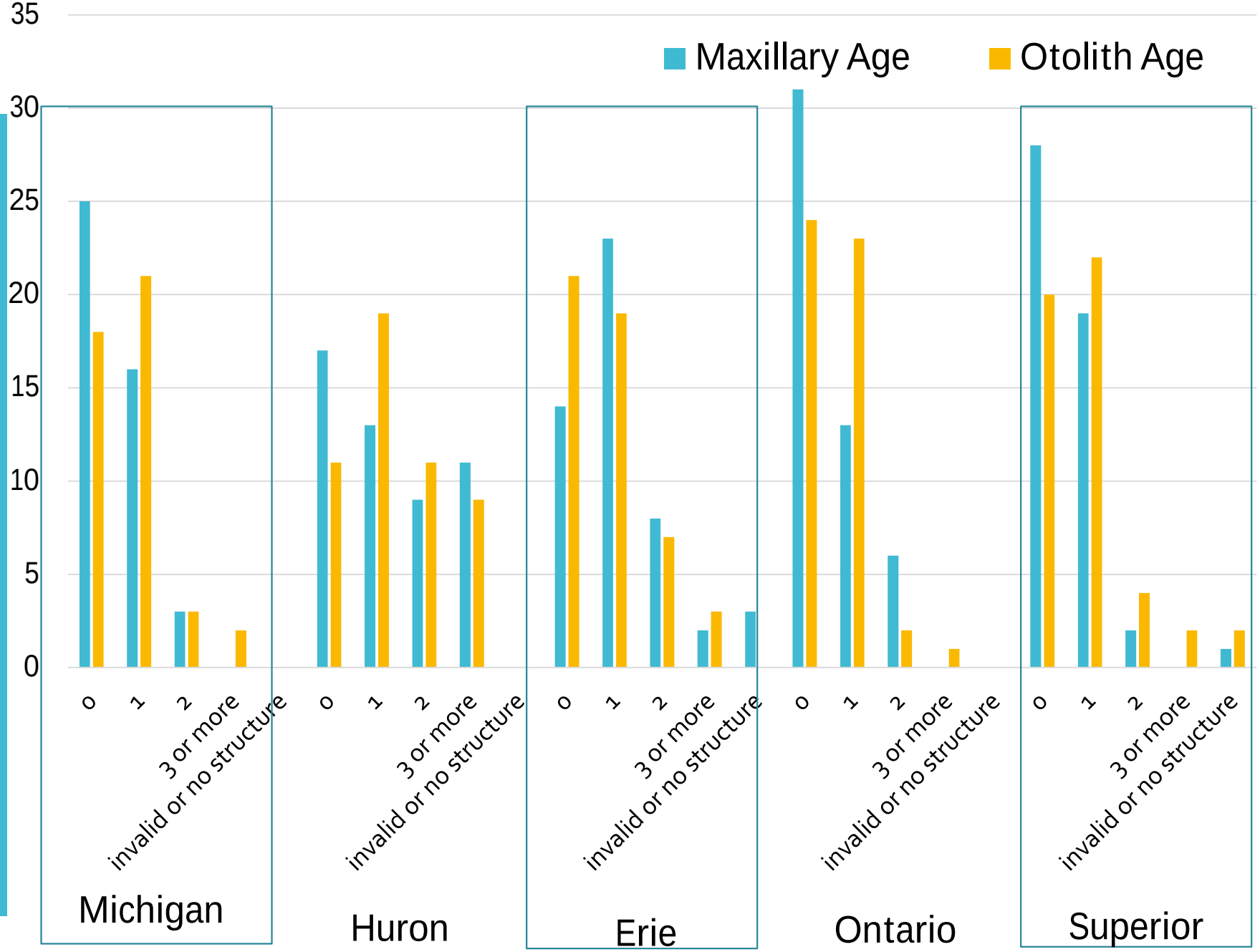
- Count annuli
- Formation driven by growth and food availability.
  - Metabolic demand results in slower growth.
- Accurate and quick to process
- **Limited fluid loss compared to removing otolith**

Results

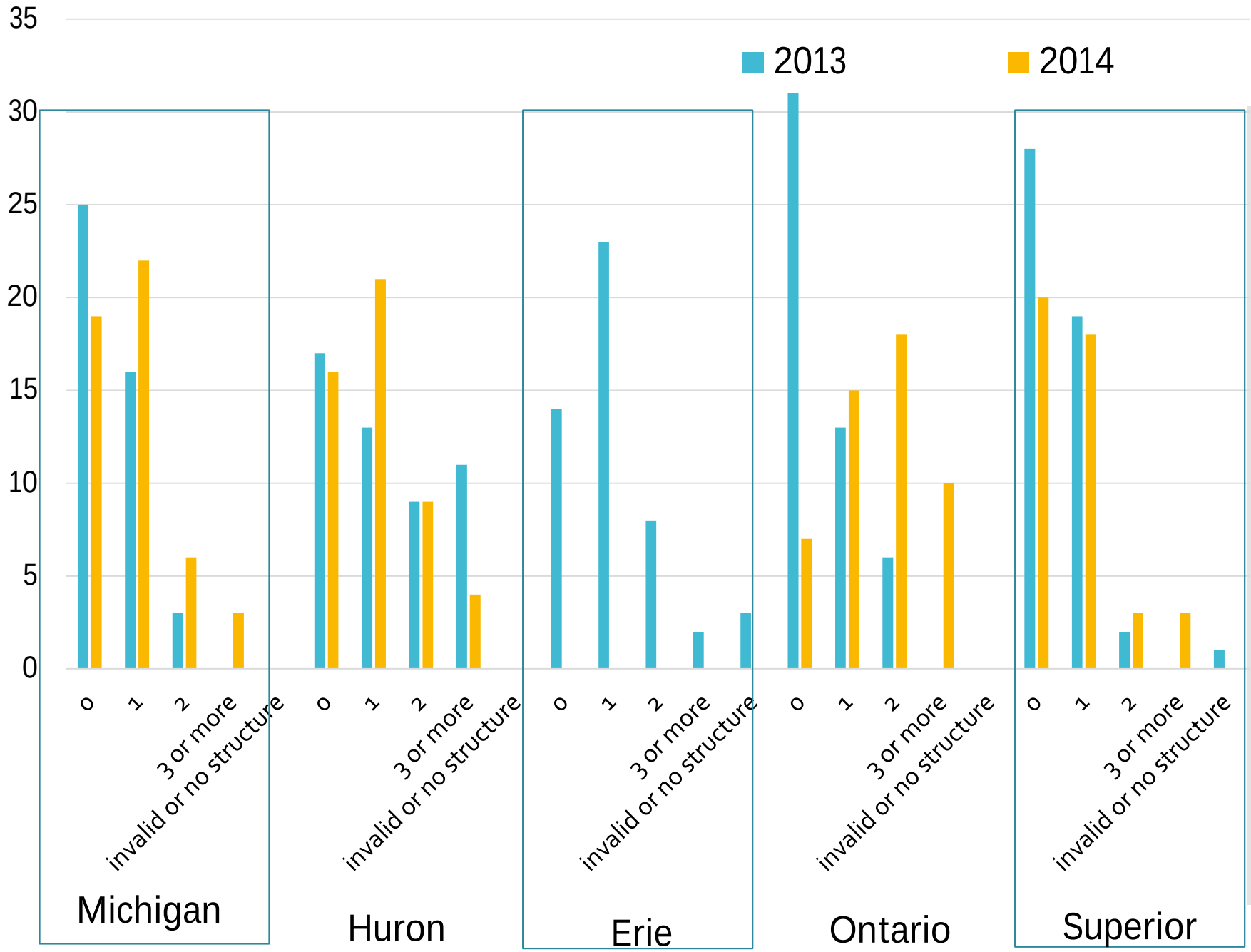
General Findings

- · Maxillary age assessments were comparable between laboratories
- · Year 1 of comparison had most accuracy (open reads)
- · Majority assessments are within 1 year of each other
- · Refinement of technique needs to continue
- · Maxillary SOP development is necessary to improve accuracy
- · Development of photo library for training

Difference in Age (years) by Structure Type 2013



Difference in Age (years) by Year of collection



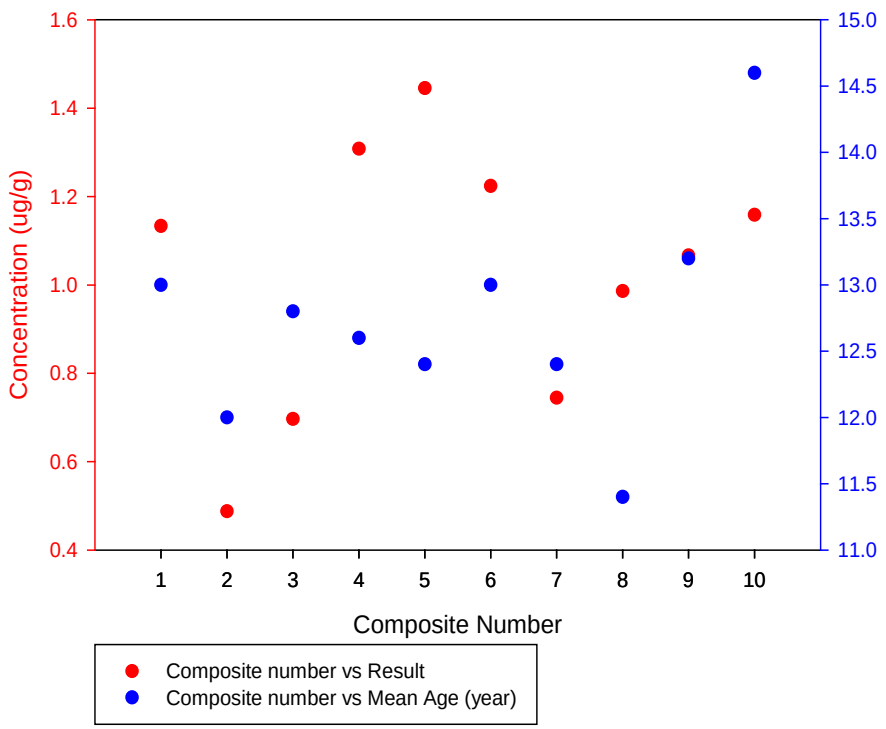
How can the GLFMSP use this information?

Determine next steps & incorporate this information into collection, homogenization, and analysis SOPs to account for increased age.

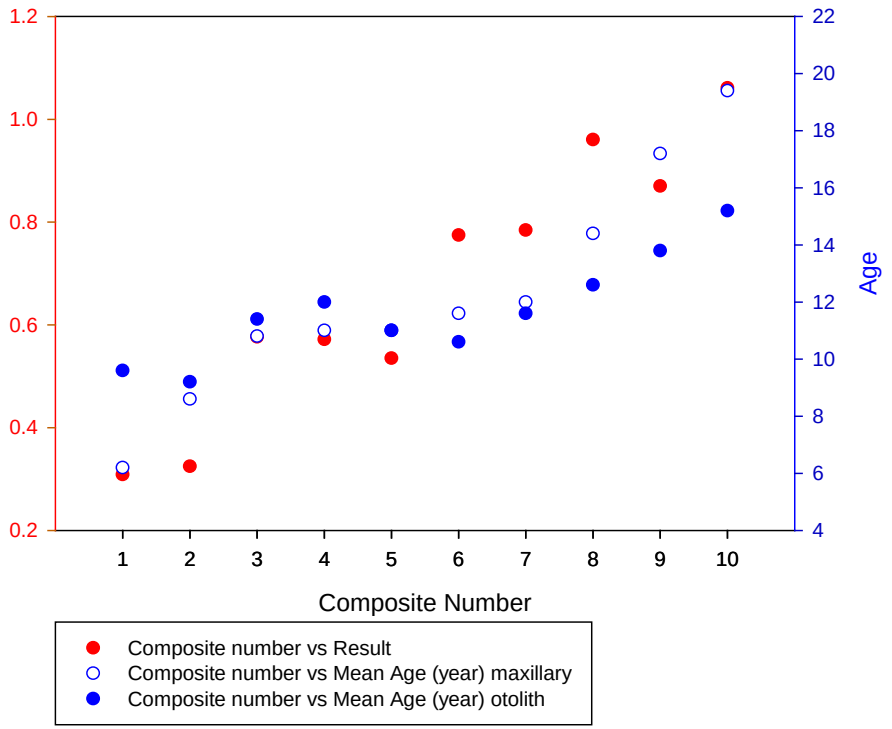
Effect of aging fish prior to compositing

Total PCBs at Port Austin, Lake Huron

Composite by Size - 2011



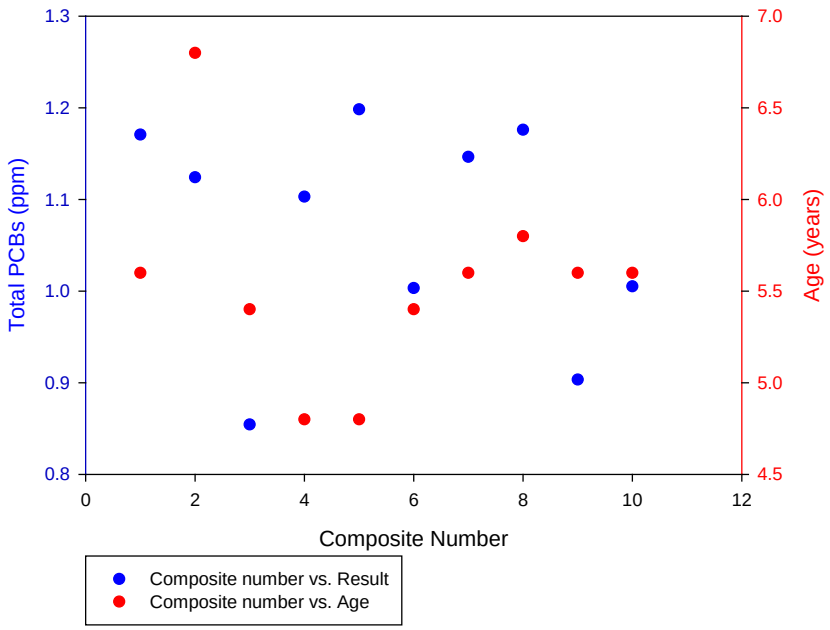
Composite by Age - 2013



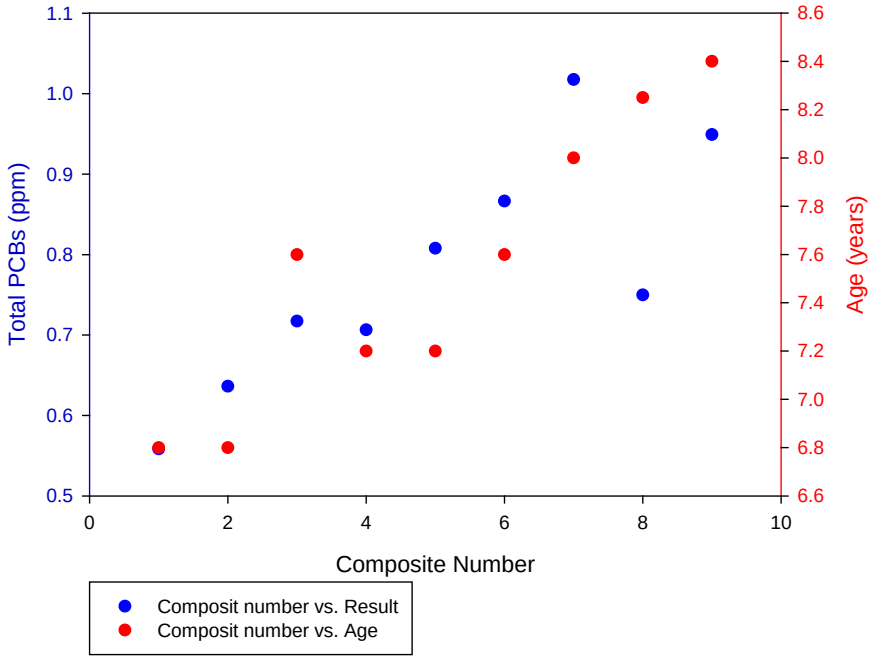
Effect of aging fish prior to compositing

Total PCBs at Sturgeon Bay, Lake Michigan

Sturgeon Bay - 2011



Sturgeon Bay - 2013



Next Steps

- Continue to refine and improve aging assessments
- Continue to explore the relationship between biological condition and chemical concentrations
  - Chlorination levels
  - Effects in other lakes
  - Continue to composite fish around known age
- Determine need to revise collection methodology
  - Size
  - Location
  - Time of year
  - Individuals vs. composites
- Inform decision makers and resource managers of findings
- Help show the success of the Multi Billion Dollar investment of the GLRI

Special Thanks to Jim Johnson

Michigan DNR, retired after 42 years

Thank you & questions

Elizabeth Murphy
Murphy.Elizabeth@epa.gov
312-353-4227