Current (2008-12) distribution and body burden of monitored contaminants in Lake Trout and Walleye in the Great Lakes

Daryl McGoldrick; Environment Canada

Elizabeth Murphy; United States Environmental Protection Agency

State of Lake Michigan Conference 2015 Travers City, Mi

Environment Canada Environnement Canada

EPA United States Environmental Protection Agency

Beth and Daryl's "Top 40" terrible, nasty, horrible to good bad things in Great Lakes fish

Daryl McGoldrick

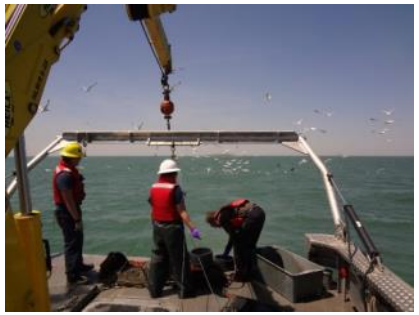
Elizabeth Murphy

State of Lake Michigan Conference, Traverse City, Mi

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.*

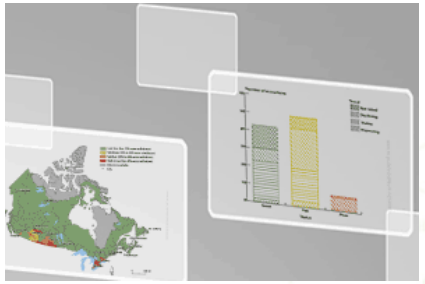
Outline

1 Fish Contaminant Monitoring in the Great Lakes



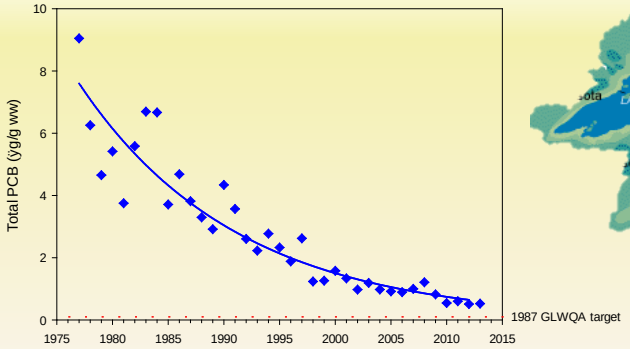
2 Current status of contaminant burden of Great Lakes fish

3 Future monitoring; challenges to assessing condition



Contaminant monitoring in Great Lakes

- Monitoring and surveillance established to assess impairment of the ecological quality of the Great Lakes and trends in concentration of pollutants in fish



Environment Canada Environnement Canada

EPA United States Environmental Protection Agency

Fish Contaminants Monitoring and Surveillance

Great Lakes– 1977 to present

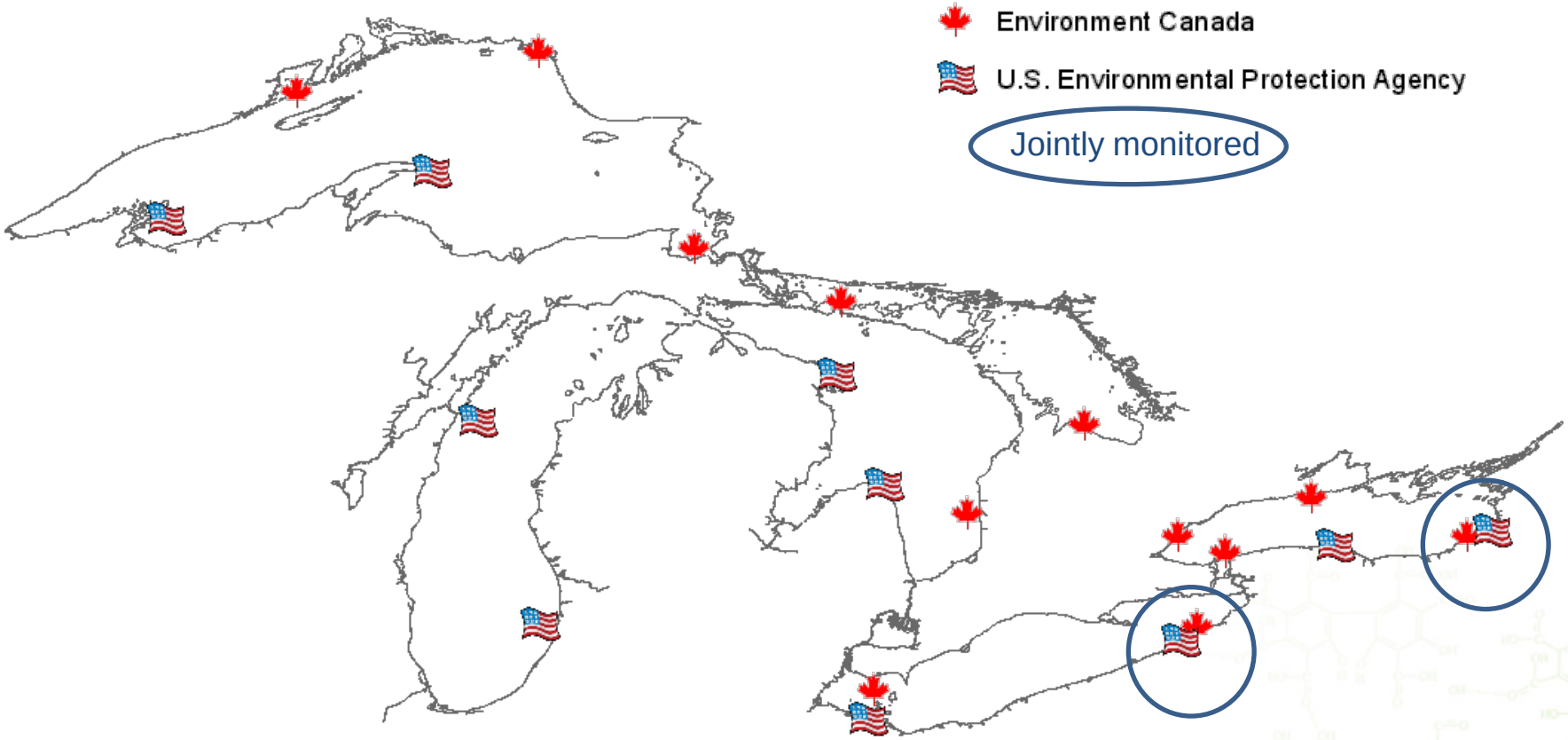
Environment Canada

- 12 permanent monitoring stations
- samples collected @ 10 stns/year in each lake bordering Canada
- Contaminants measured in 10-25 individual Lake Trout or Walleye per station
- Some contaminants measured in 5 composite samples of rainbow smelt per station
- Top predator selected by age (4 to 6 years)

US EPA

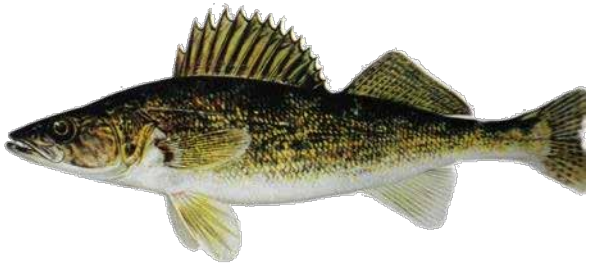
- 10 permanent monitoring stations
- samples collected @ 5 sites/year, one in each Great Lake
- Aim to collect 50 top predators per station each year
- Collect based upon size
- Analyze as composites
- Analysis as cooperative agreement

Monitoring Network



Target biomonitors

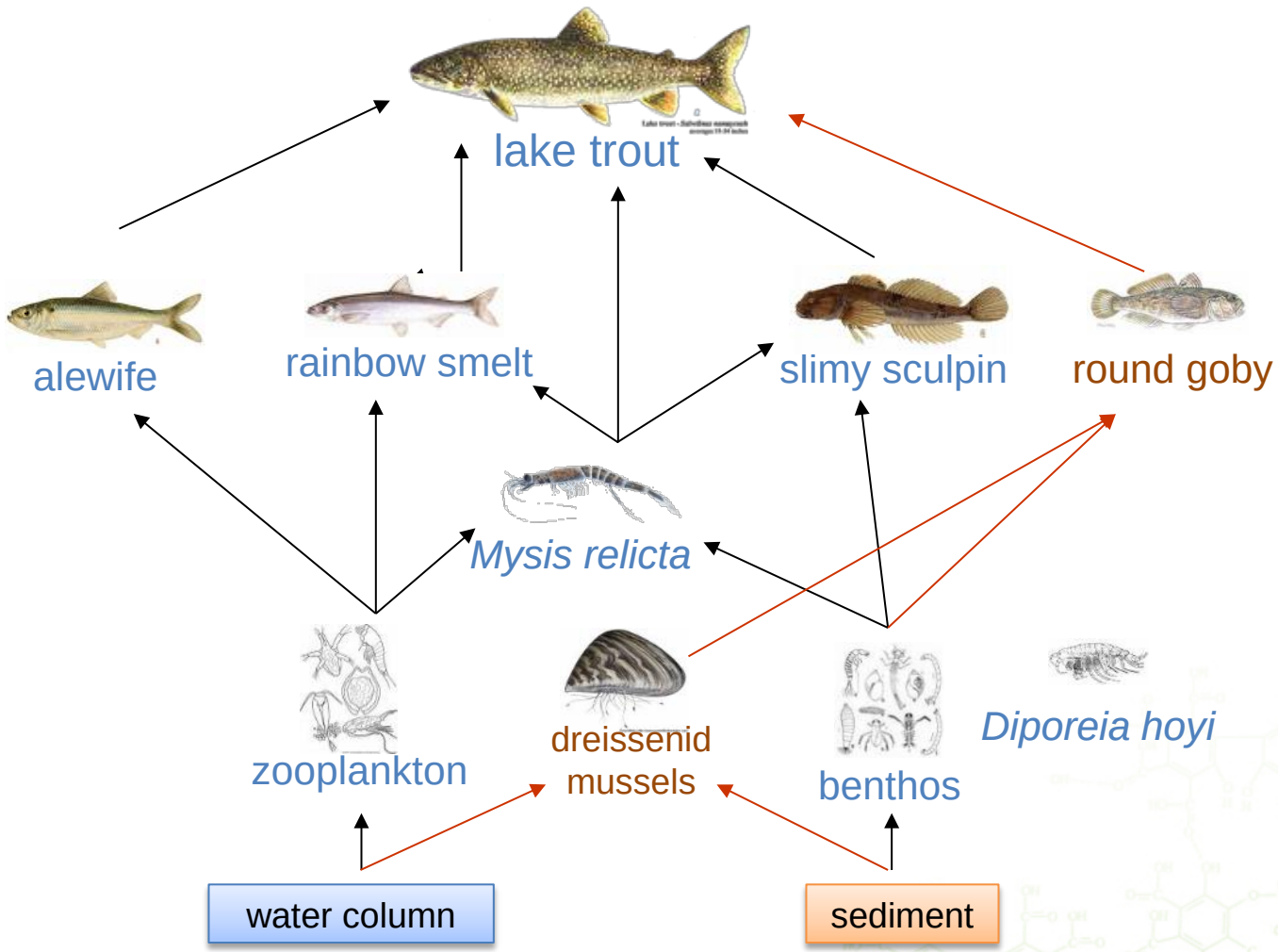
Lake Trout
(Salvelinus namaycush)



Walleye (Sander vitreus)

- Top pelagic predators
- Well studied
- High lipid content
- Wide ranging and long lived
  - spatial and temporal integrators of contamination
- Accumulate elevated contaminant levels relative to their environment and prey
- Present across the monitoring network

Food Web *(simplified)*



What we do…

- Annual **goal oriented** monitoring as well as focused adaptive surveillance activities for contaminants of concern and emerging issues at all or a subset of the monitoring stations. Specific environmental indicators measure whether or not the goals are being achieved

Monitoring

PCBs / OCs

PBDEs

PFOS

Siloxanes

Metals

Surveillance

OPFRs

Chlorinated alkanes

Other flame retardants

Antioxidants

Current Status - contamination

- Monitoring for 38+ years
- Focus shifting from “legacy” POPs to “newer” classes of contaminants
- Many compounds have been added in recent years
- Perspective?

Summarized all data contained in EC and US EPA databases for contaminants in fish from 2008-2012

The Top 40 list (2008-12)

Organic contaminants + Hg

- Detection >10%

Some compounds were grouped

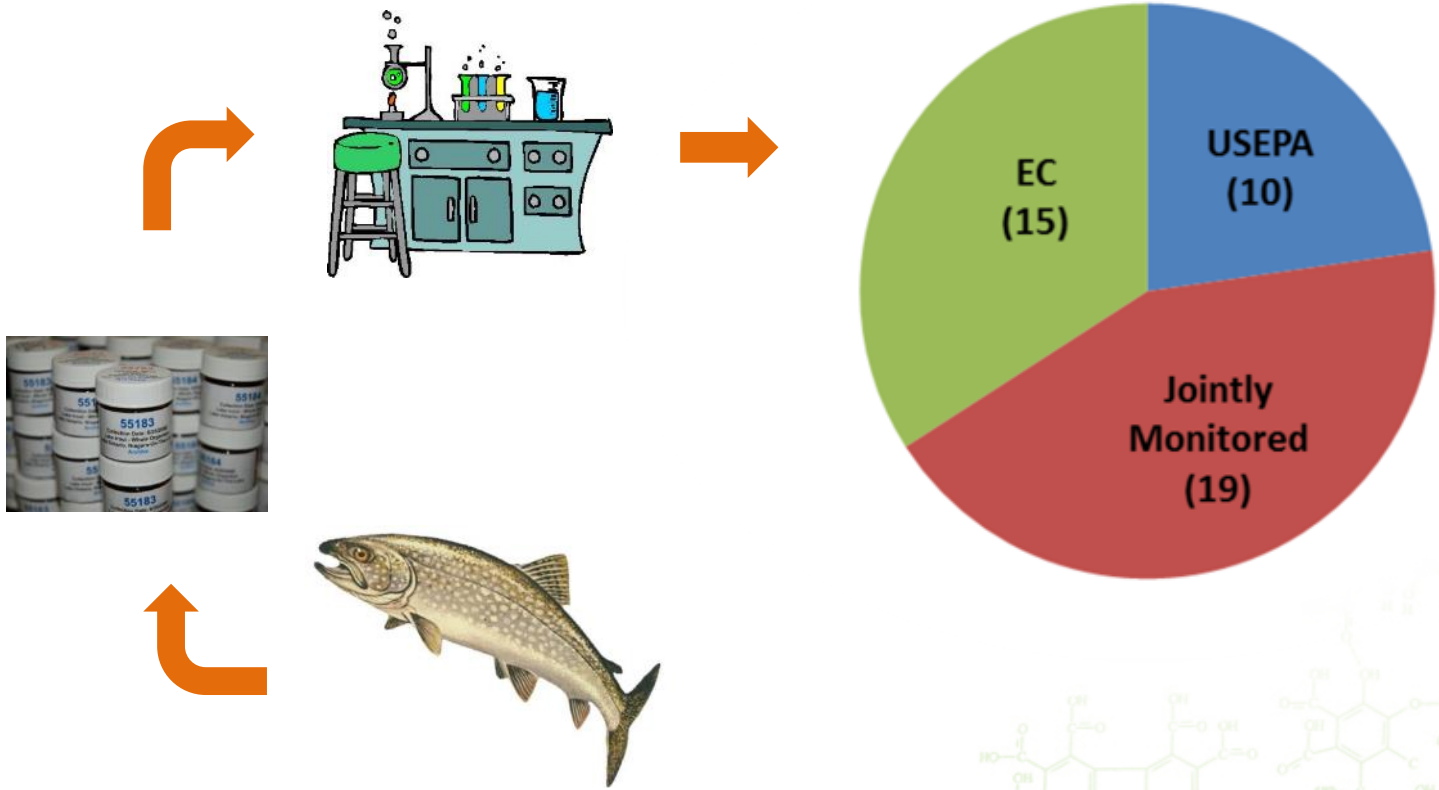
- Homologue sums (PCBs, PBDEs)
- Total Chlordane, DDT, HCH, Endosulfan

5 year arithmetic mean

- Kaplan-Meier estimates if NDs
- Wet weight concentrations

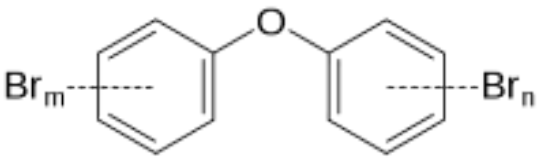
The Top 40 list (2008-12)

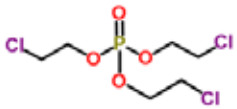
- We were left with 44 compounds and/or groupings measured in GL fish by EC and USEPA

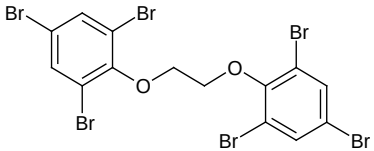


Caveats

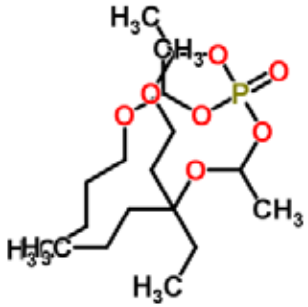
- All contaminants presented are the result of targeted analyses
- Concentrations only – not weighted for toxicity or effects
- All contaminants were not measured at all locations

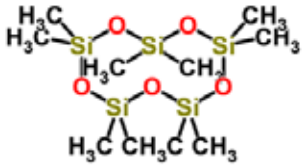

O
Br m
Br n

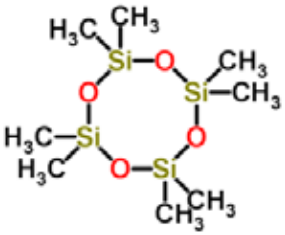

O
Cl
O
P
O
Cl
O
Cl

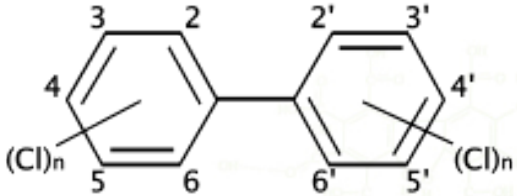

Br
Br
Br
O
O
Br
Br
Br

THE "TOP 40"

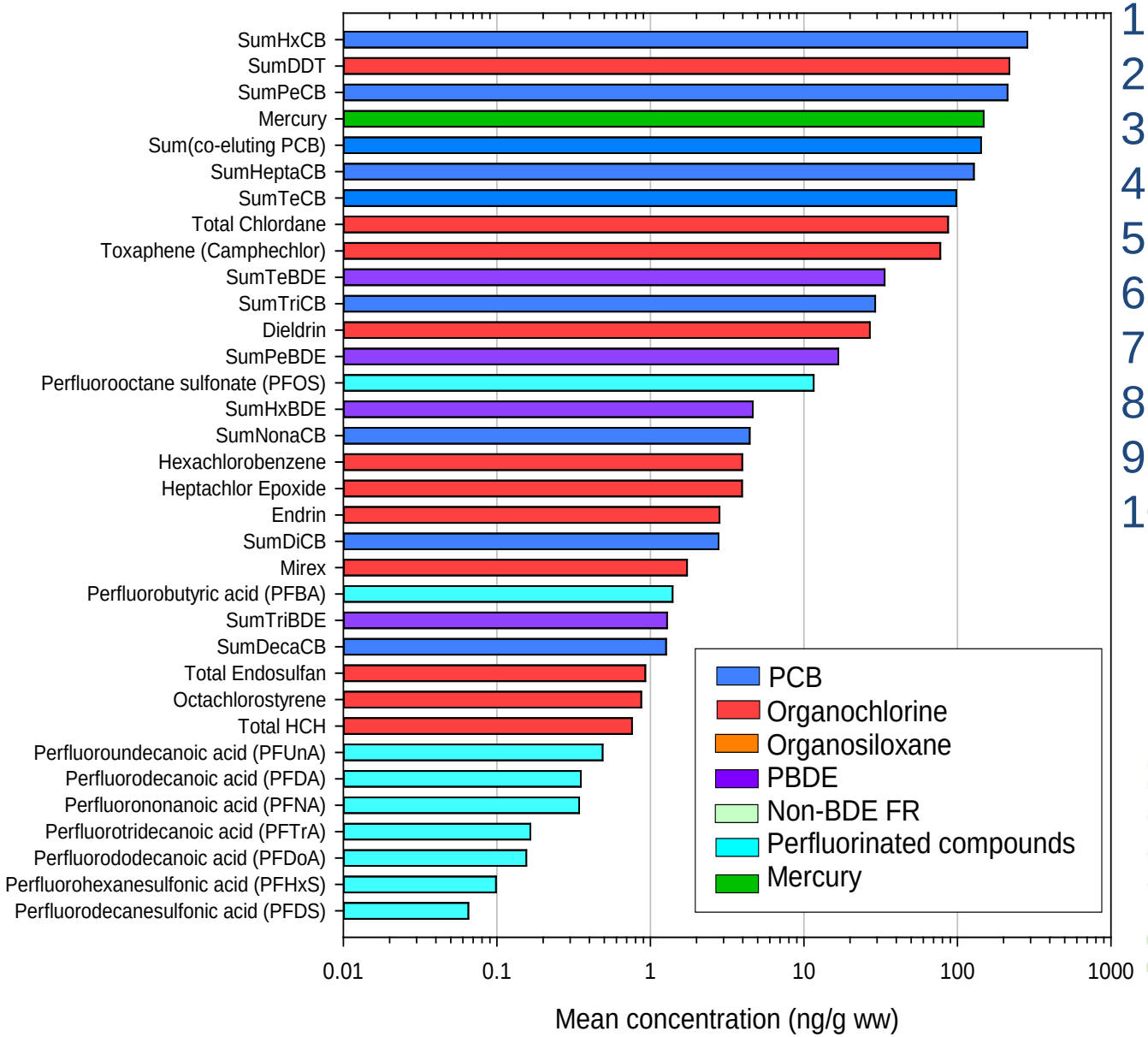

H3C
CH3
O
P
O
O
O
O
O
O
CH3
H3C
H3C


H3C
H3C
Si
O
Si
O
Si
CH3
CH3
H3C
CH3
O
Si
O
Si
O
H3C
CH3
C
CH3


H3C
CH3
Si
O
CH3
Si
CH3
O
H3C
Si
O
H3C
O
Si
CH3
CH3

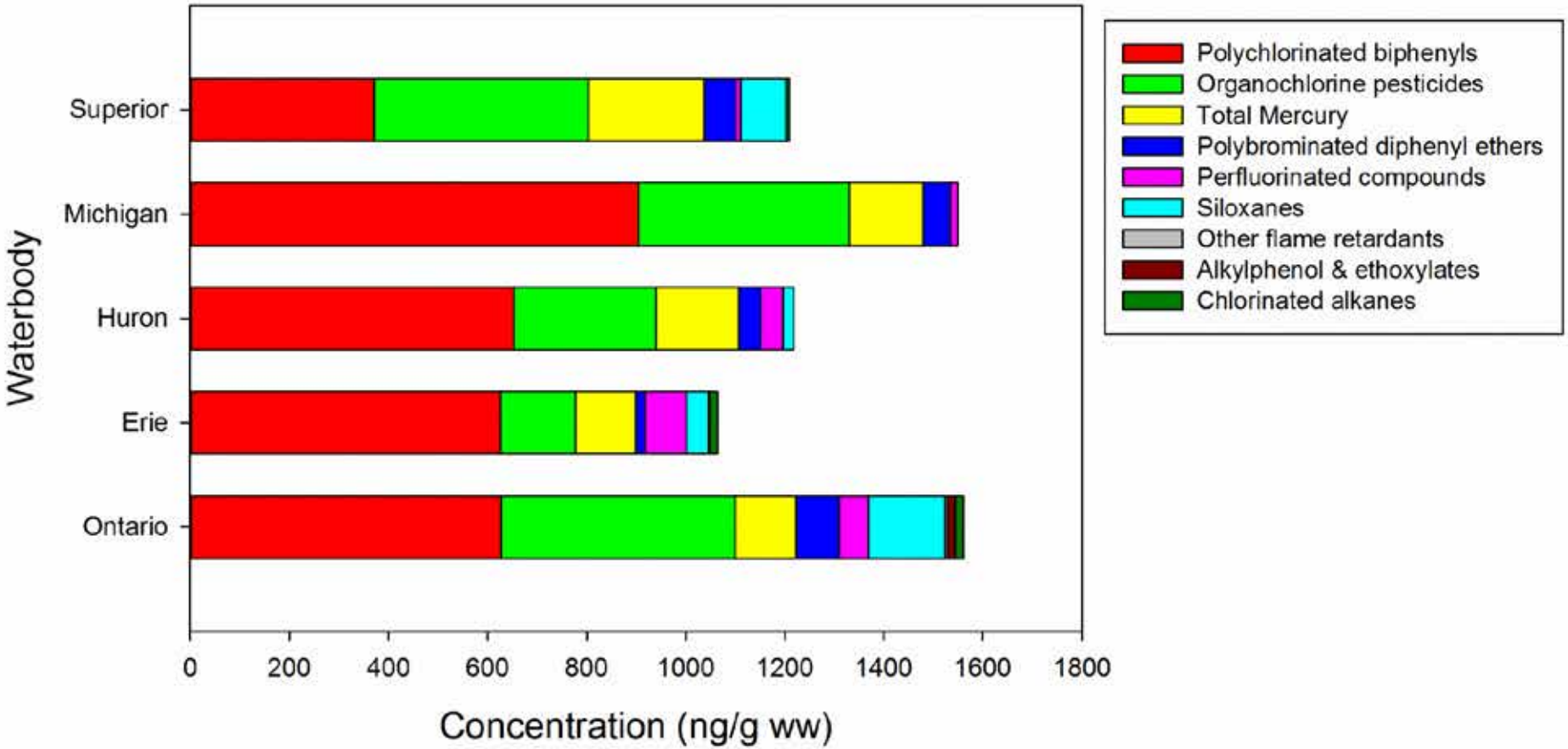

3
2
2'
3'
4
4'
(Cl)n
(Cl)n
5
6
6'
5'

Lake Michigan – Top 36 (USEPA only)

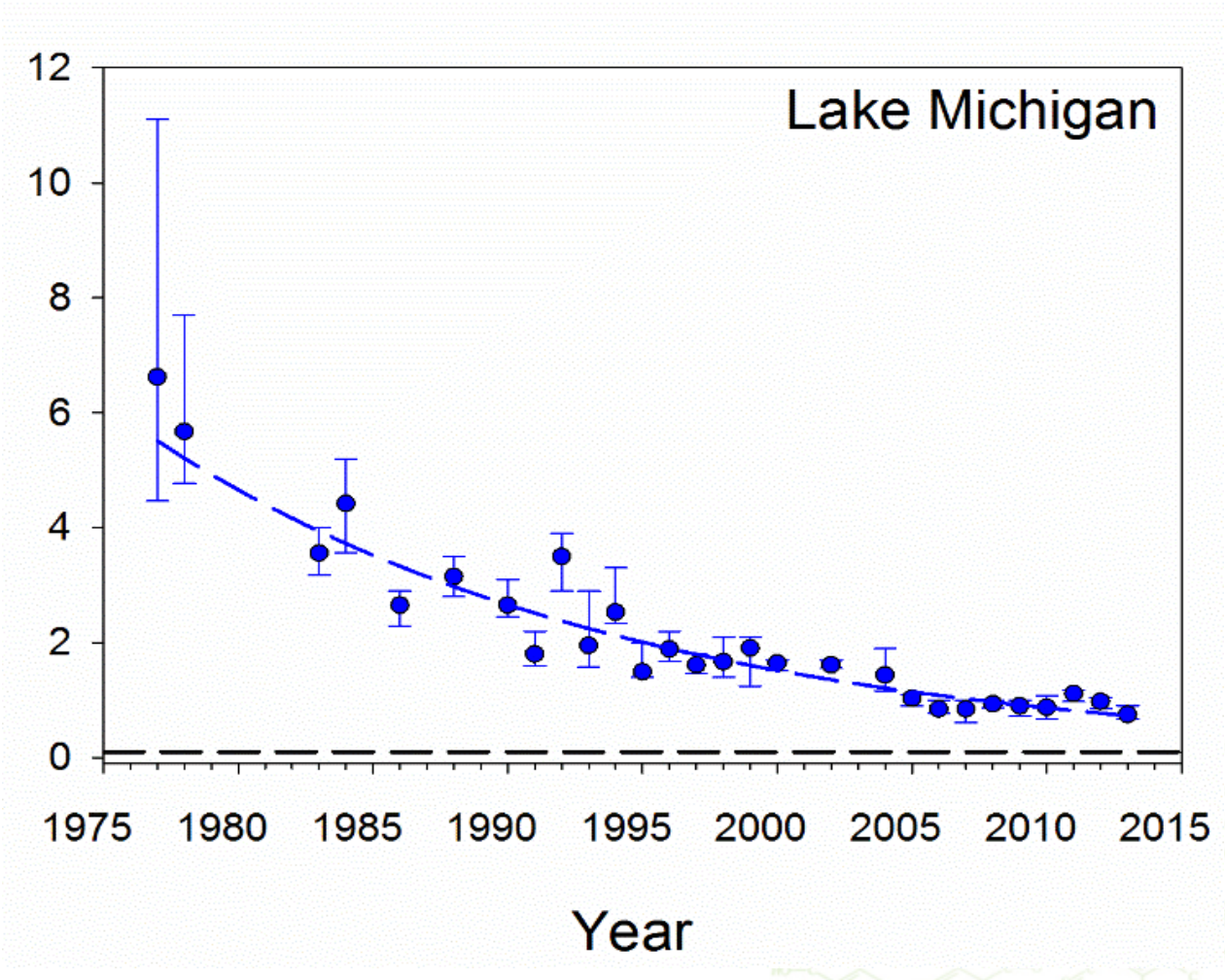


1. HexaCB
2. DDT & metabolites
3. PentaCB
4. Mercury
5. Co-eluting PCBs
6. HeptaCB
7. TetraCB
8. Chlordanes
9. Toxaphene
10. TetraBDE

Basin Wide Body Burden Contribution

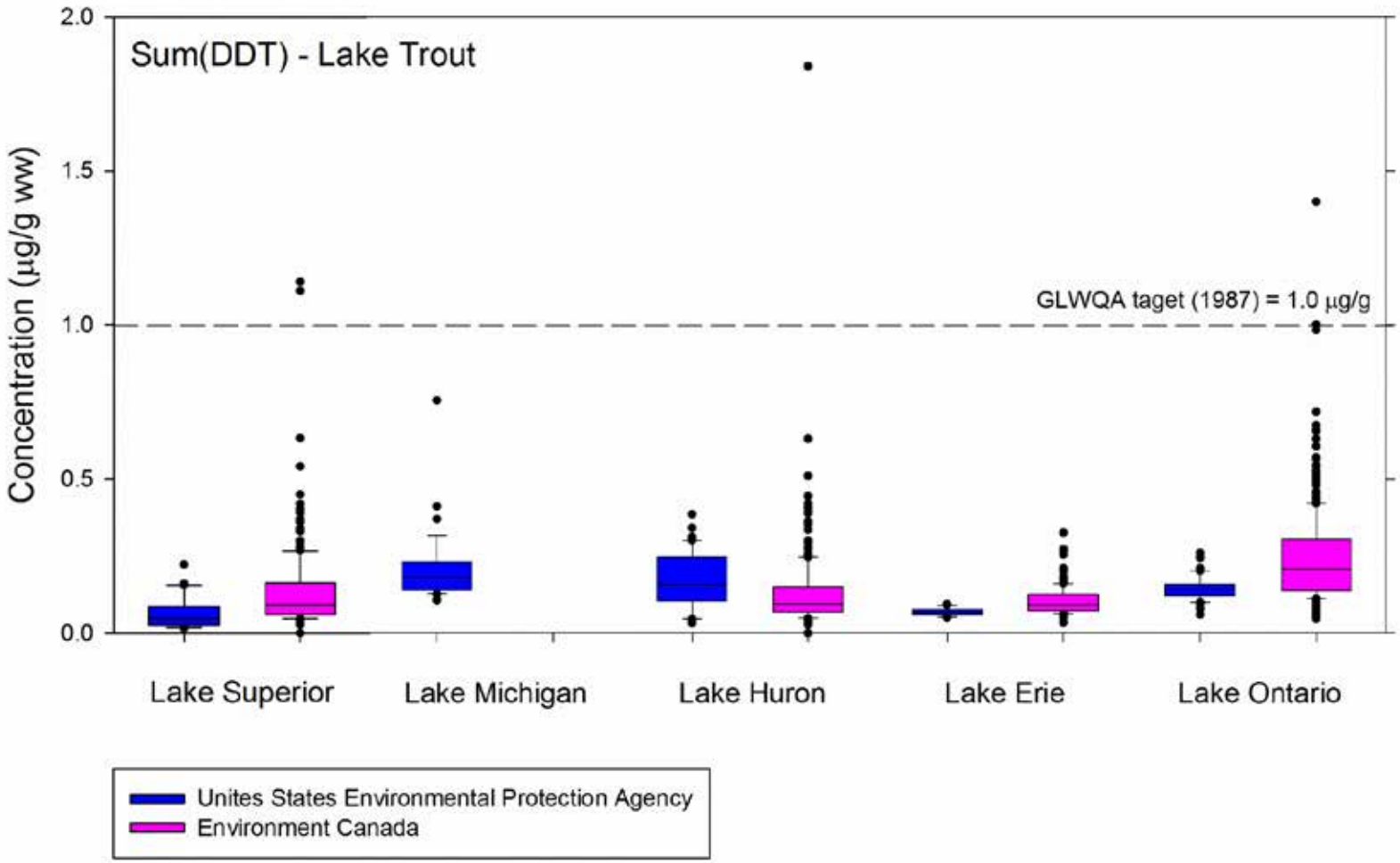


Lake Michigan – Total PCBs (ppm) Whole Lake Trout

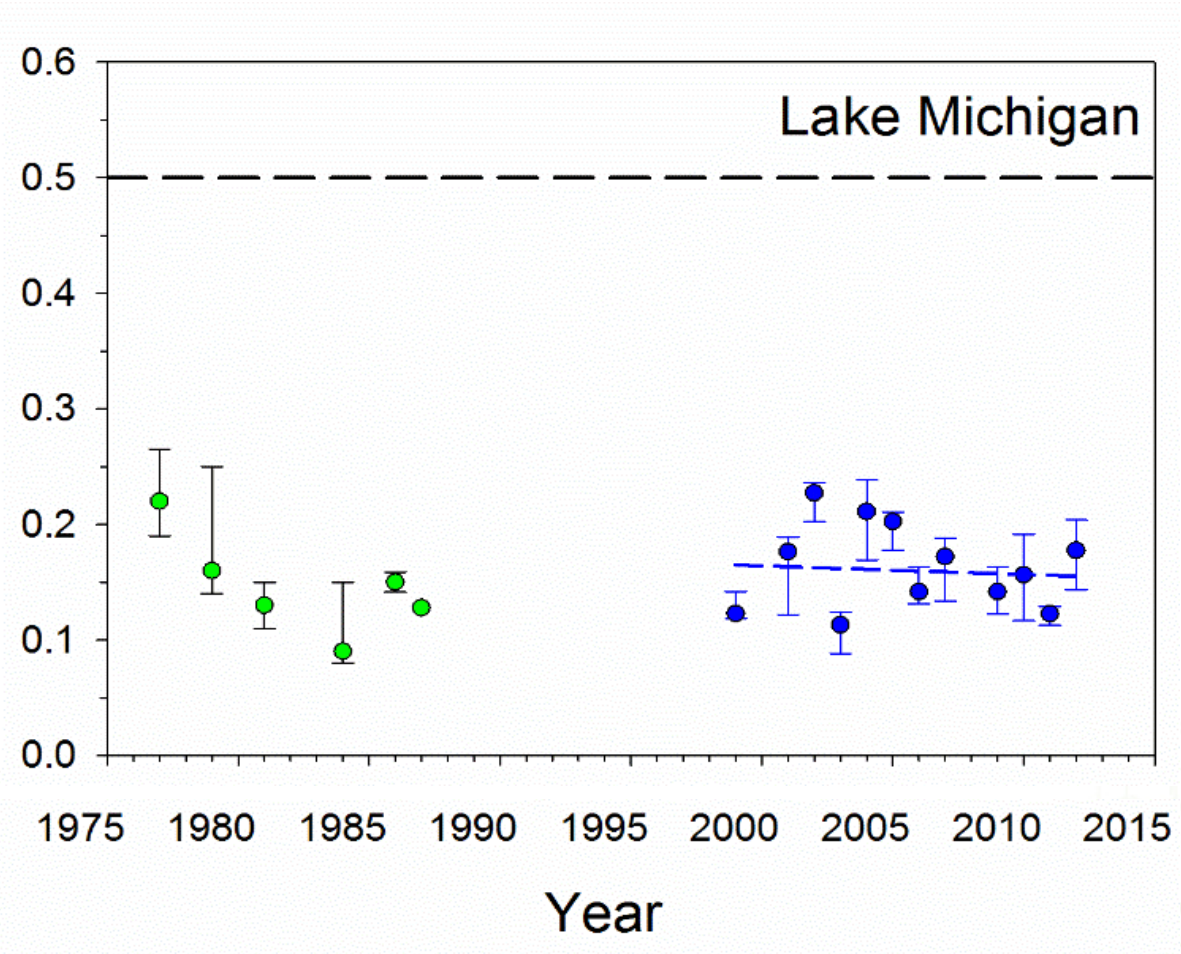


Environment Canada
U.S. Environmental Protection Agency
GLWQA Guideline (1987)

Lake Michigan – Total DDT (ppm) Whole Lake Trout



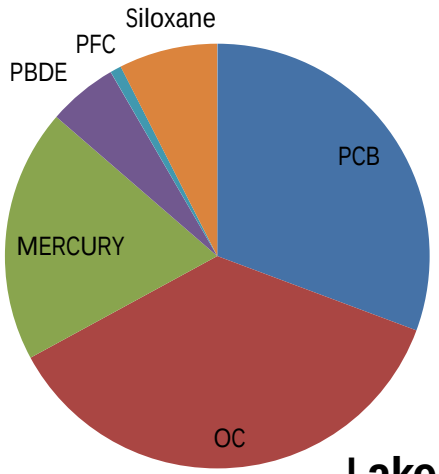
Lake Michigan – Total Hg (ppm) Whole Lake Trout



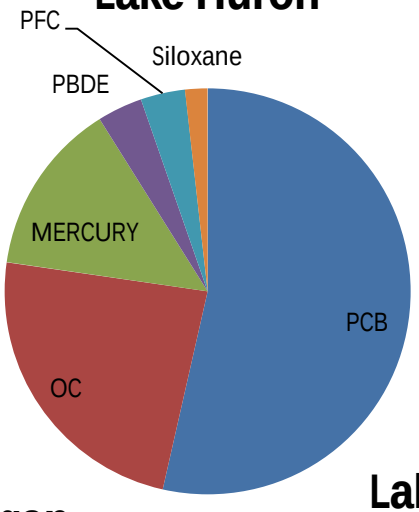
Environment Canada
U.S. Environmental Protection Agency
GLWQA Guideline

Basin-wide summary

Lake Superior

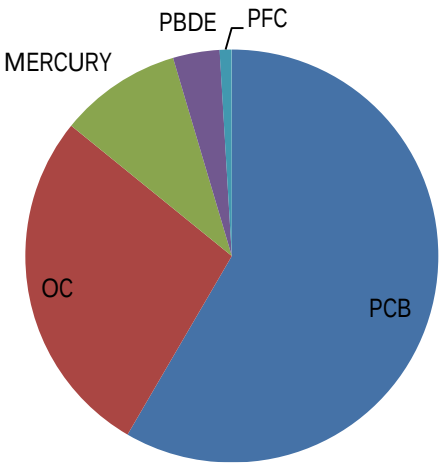


Lake Huron

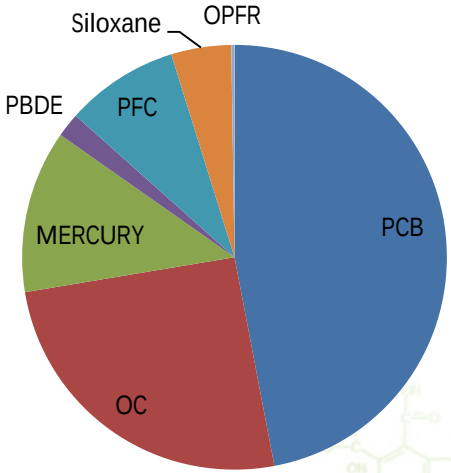


On a mass basis - "Legacy" compounds dominate body burdens of fish in the GLB

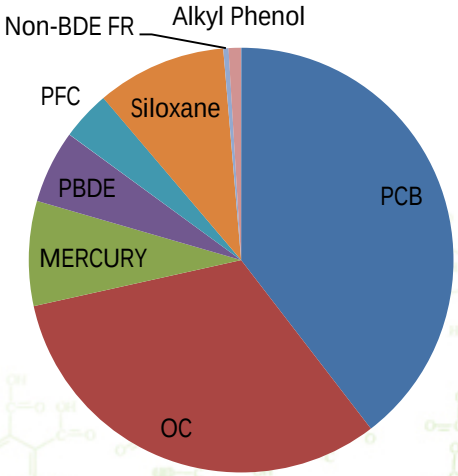
Lake Michigan



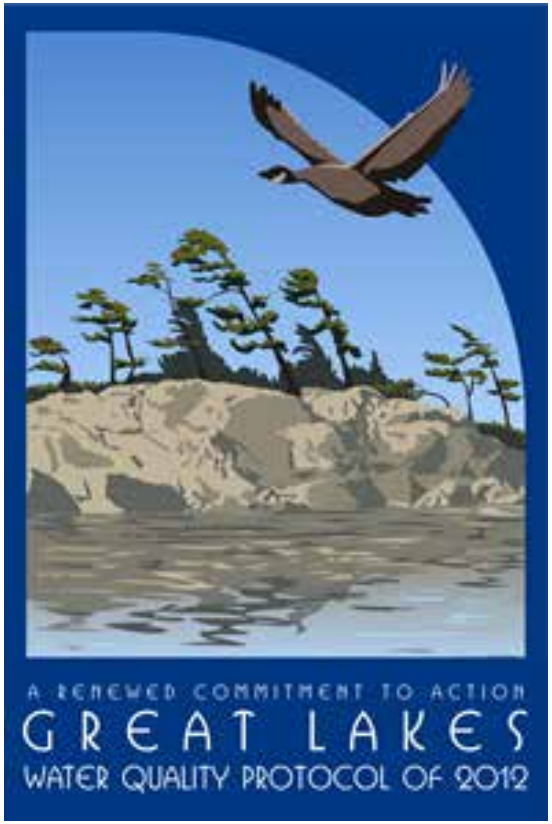
Lake Erie



Lake Ontario



Binational reporting – Great Lakes

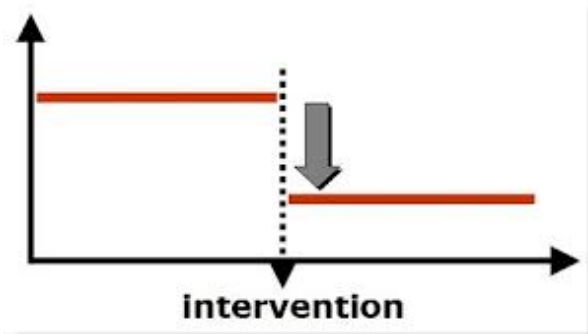


Toxic Chemicals in Great Lakes Whole Fish

- EC and USEPA have collaboratively co-authored this indicator since the inception of SOLEC (1994)
- Relates current contaminant burden of various contaminants of concern **relative to environmental objectives or guidelines**

Indicators – the questions

Are conditions improving in response to action?



Are current conditions causing harm?

Challenges to assessing condition

With sufficient data it is relatively simple to say whether conditions are improving, deteriorating, or are stable.

However, without effect based thresholds/objectives, it is difficult to answer the question of whether observed concentrations are likely to cause harm

Challenges to assessing condition/status

- Most abundant contaminants in fish

Contaminant	Guideline/Target	Source
Total Mercury	0.50 µg/g ww	GLWQA (1987)
Toxaphene	Virtual Elimination[1]	CEPA, 1999
Total PCBs	0.10 µg/g ww	GLWQA (1987)
DDT + metabolites	1.0 µg/g ww	GLWQA (1987)
D5 (siloxane)	Not regulated	-
Total Chlordane	Virtual Elimination[1]	CEPA, 1999
TetraBDE	44 ng/g	FEQG wildlife diet (Gov't of Canada)
PFOS	4.6 ng/g	FEQG mammalian diet (Gov't of Canada)
Mirex	Substantially absent	GLWQA (1987)
Dieldrin	Virtual Elimination[1]	CEPA, 1999

[1]applies to sources/inputs

Challenges to assessing condition/status

- Proposed Chemicals of Mutual Concern (Annex 3)

Contaminant	Guideline/Target[1]	Notes
Total PCBs	0.10 µg/g ww	GLWQA (1987)
Nonylphenol and Ethoxylates	-	-
Total Mercury	0.50 µg/g ww	GLWQA (1987)
PBDEs	120, 88, 1, 420 ng/g ww	FEQG fish tissue (tri, tetra, penta, hexa) (Gov't of Canada)
HBCD	-	-
Chlorinated alkanes (paraffins)	-	-
PFCs	44 ng/g (PFOS only)	FEQG wildlife diet (Gov't of Canada)
Bisphenol A	-	Not detected in fish (prelim studies)

[1]for whole body burden in fish (if existing)

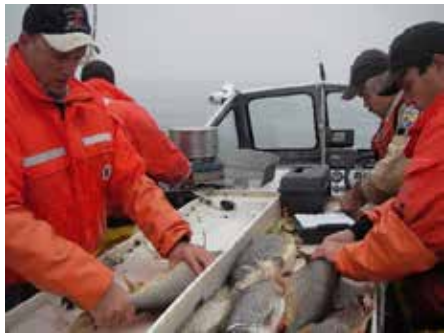
Summary

- Body burden of fish in Great Lakes dominated by PCBs, OC pesticides and mercury
- Informative for assessing chemicals of concern
- The ranking highlights certain compounds where the development of binational environmental objectives would be beneficial
- We have data and we share…

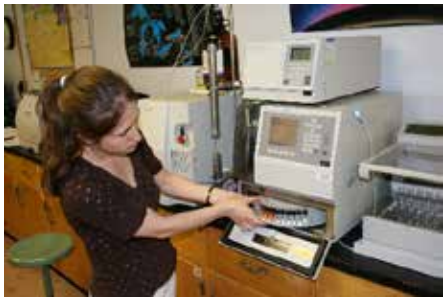
Questions?

Fish Contaminants Monitoring and Surveillance

Daryl McGoldrick
Environment Canada
Daryl.McGoldrick@ec.gc.ca
905-220-1173



Great Lakes Fish Monitoring and Surveillance Program



Beth Murphy
U.S. Environmental Protection Agency
Murphy.Elizabeth@epa.gov
312-353-4227

Environment Canada Environnement Canada

EPA United States Environmental Protection Agency