



New and Emerging Chemical Threats to the Lake Superior Ecosystem

Presented by:

Matt Hudson

Great Lakes Indian Fish and Wildlife Commission

Emerging Contaminants – A Global Issue

- Broadly defined as chemicals that can be detected in the environment but are not typically monitored and are not regulated.
- Examples
 - Pharmaceuticals
 - Personal Care Products
 - Current Use Pesticides
 - Detergents
 - Veterinary Medications



www.contrarianedge.com



<http://www.keefe.com/index.php?p=35>



<http://www.pesticideform.org/article.php?list=tvpe&tvpe=4>

So What's “Emerging?”

- Awareness of environmental presence of chemicals used in society
- Concern about the potential human and ecological health impacts these chemicals are having



Why Now?

- Improvements in analytical techniques and instrumentation has improved detection ability
- We've started looking – the more we look the more we find



Where do these compounds come from?

- Primarily wastewater derived from:
 - Municipal
 - Agricultural
 - Industrial
- sources and pathways



www.wlssd.duluth.mn.us



<http://planteconomics.com/consulting/manufacture/>

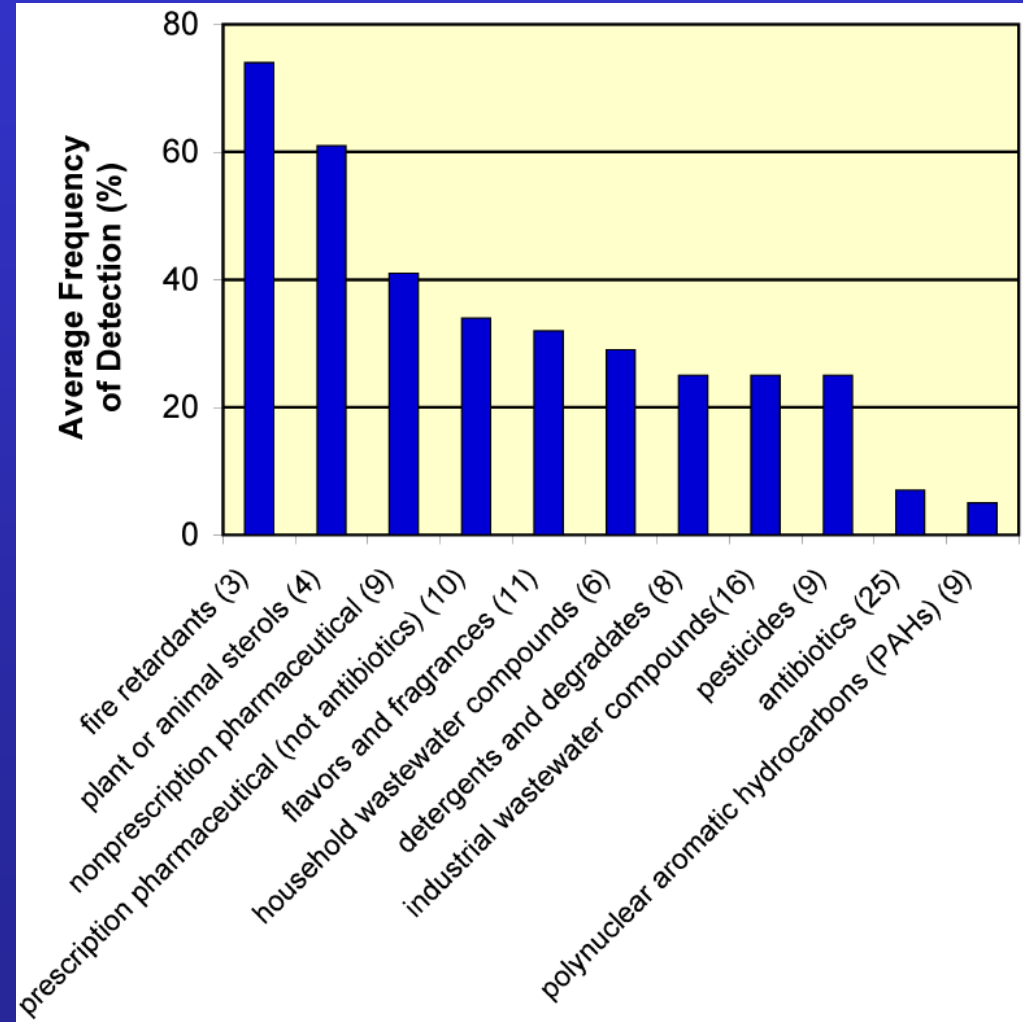


toxics.usgs.gov

Why Are We Concerned?

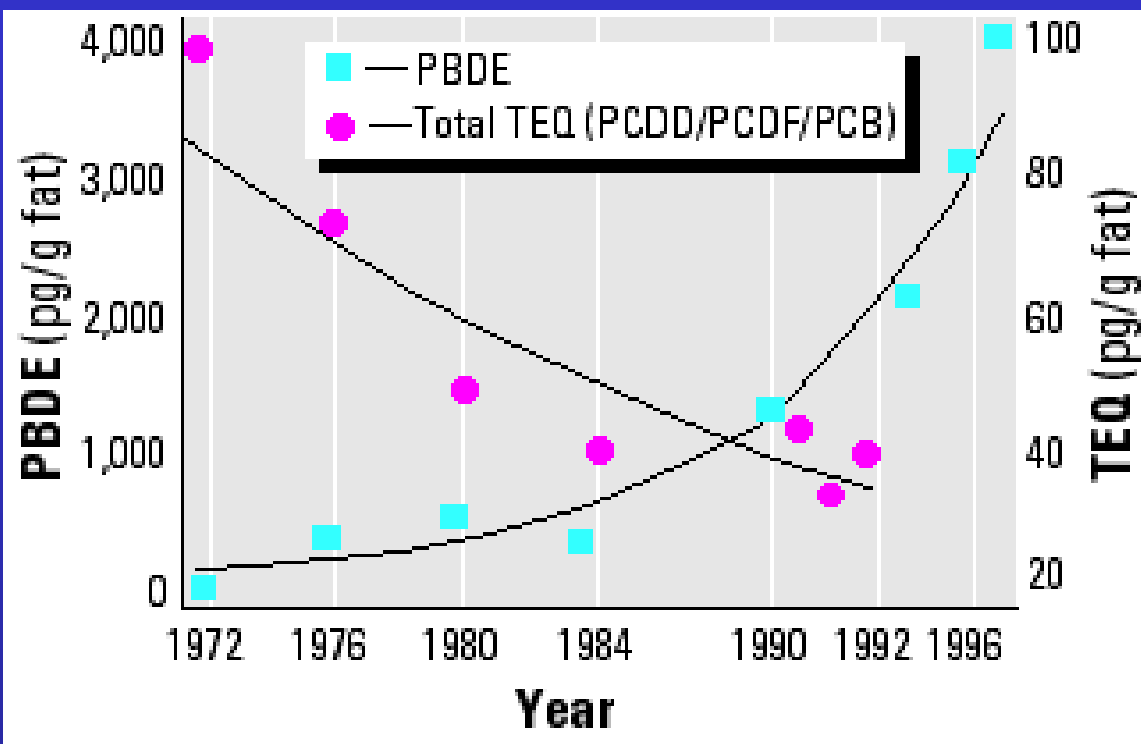
- Scope - About 80,000 TSCA chemicals in commerce

That's a lot of chemicals!



Source: http://toxics.usgs.gov/highlights/tracing_wastewater.html

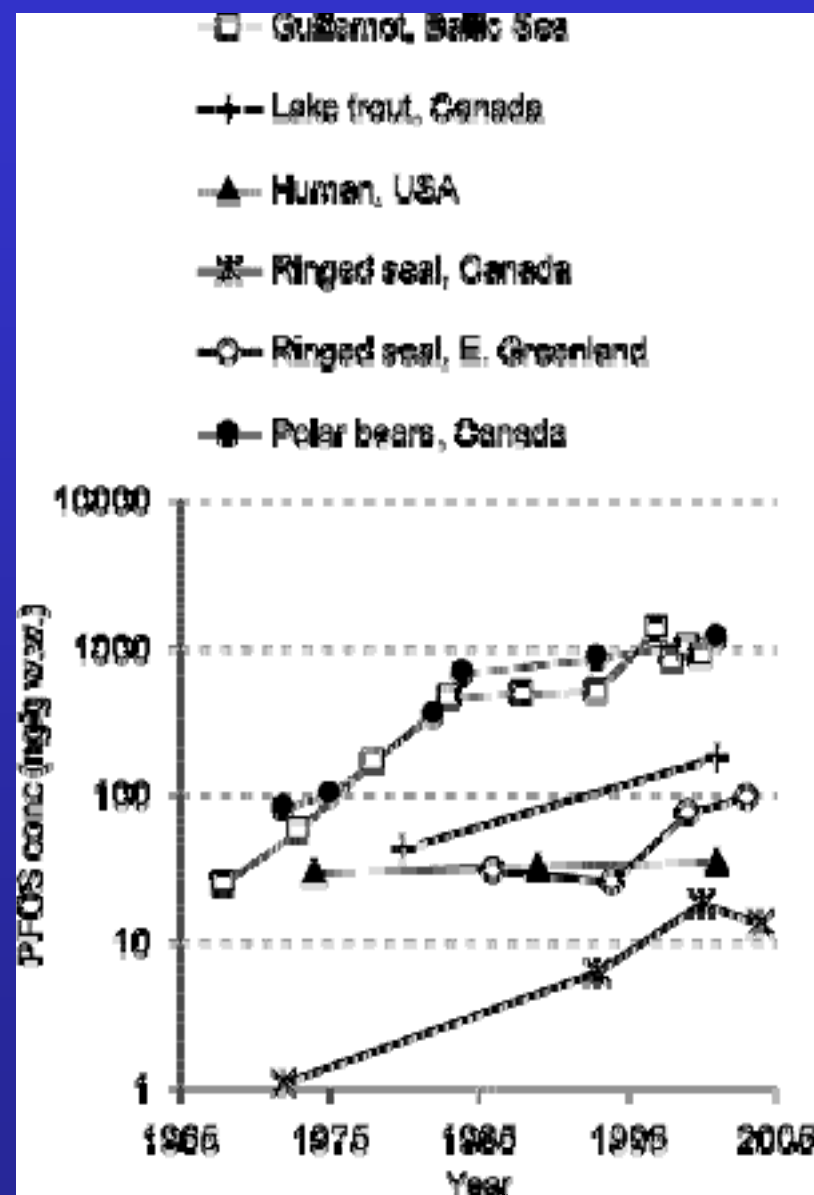
Increasing Concentrations/Global Distribution



Source: Norén and Mieronyté 1998. *Organohalogen Compounds* (35)



http://www.solarnavigator.net/animal_kingdom/mammals/polar_bear.htm



Source: Houde et al. 2006 *ES&T* (40)

Evidence of Environmental Impacts

- Endocrine Disruption
 - Some compounds act like biological hormones and can cause abnormal responses within the endocrine system
- Some Observed Responses
 - Reduced reproductive ability
 - Intersex gonads
 - Antibiotic resistant bacteria
 - Vitellogenin induction
 - Bioaccumulation

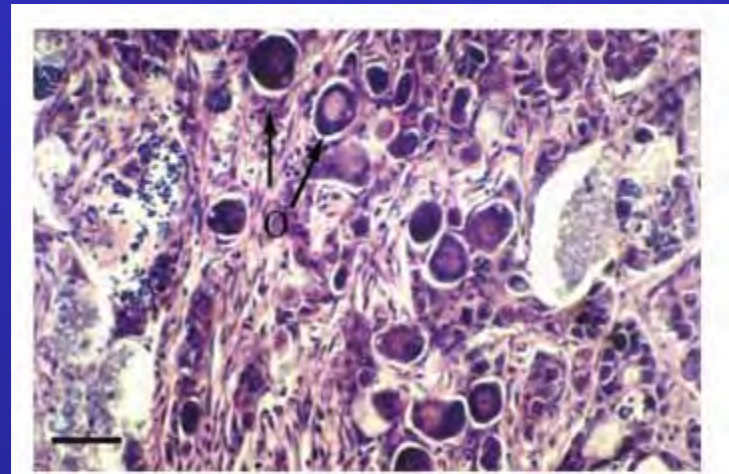


Figure 1. Testis of a male white perch from Cootes Paradise. Numerous primary oocytes (O) are present in the testicular tissue. Hematoxylin and eosin. Magnification, 400 \times ; bar = 30 μ m.

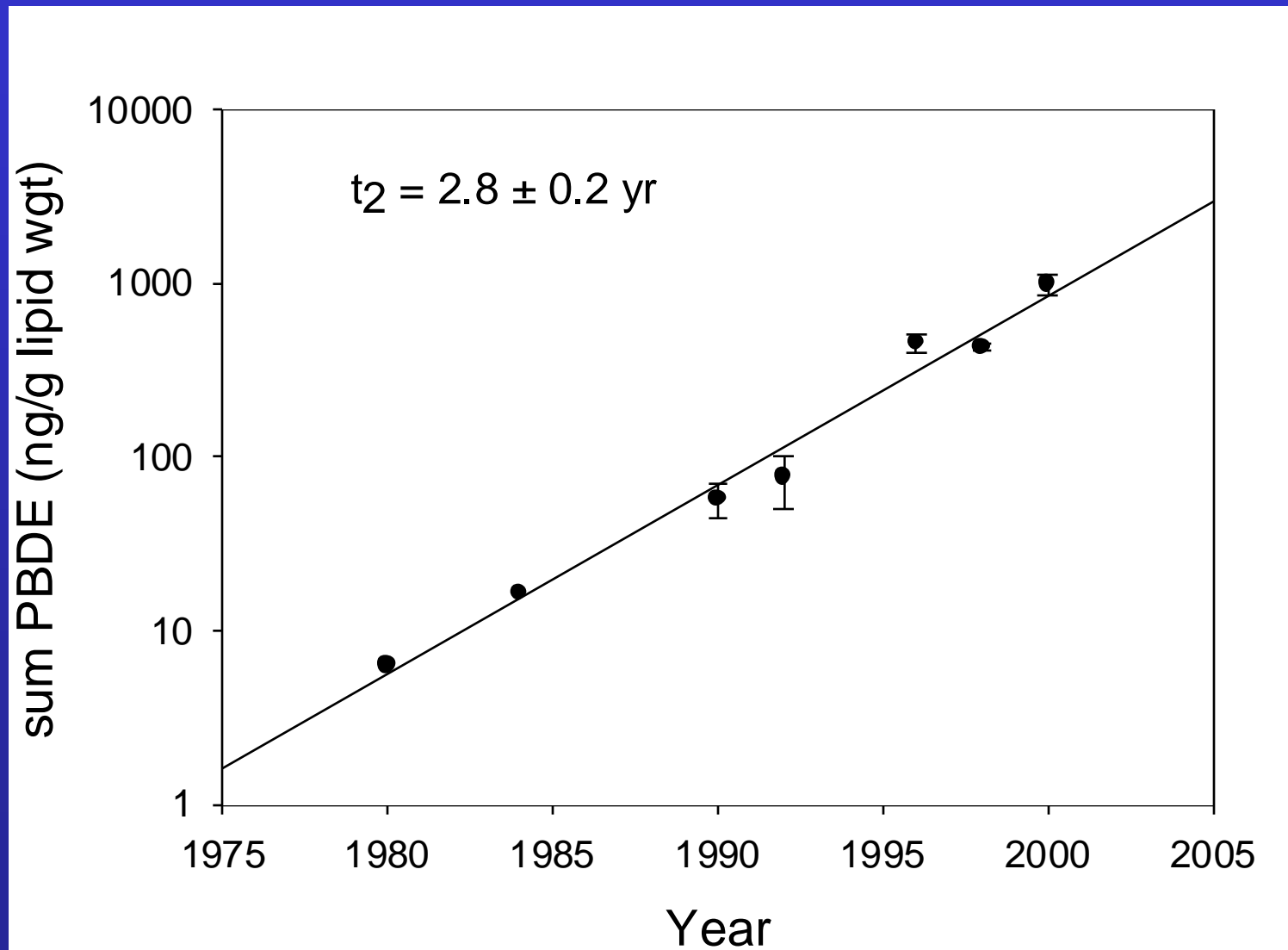
Source: Kavanagh et al. 2004, *EHP* (112)

Key Points So Far

- Sheer number of substances
- Increasing levels of some compounds
- Presence of chemicals but relative lack of information on toxicity
- Potential for endocrine disruption
- Some other related concerns/considerations:
 - Timing of exposure may be as or more important as dose
 - Chemical mixtures
 - Do observed impacts to individuals have population-level impacts?

What's Being Found In Lake Superior?

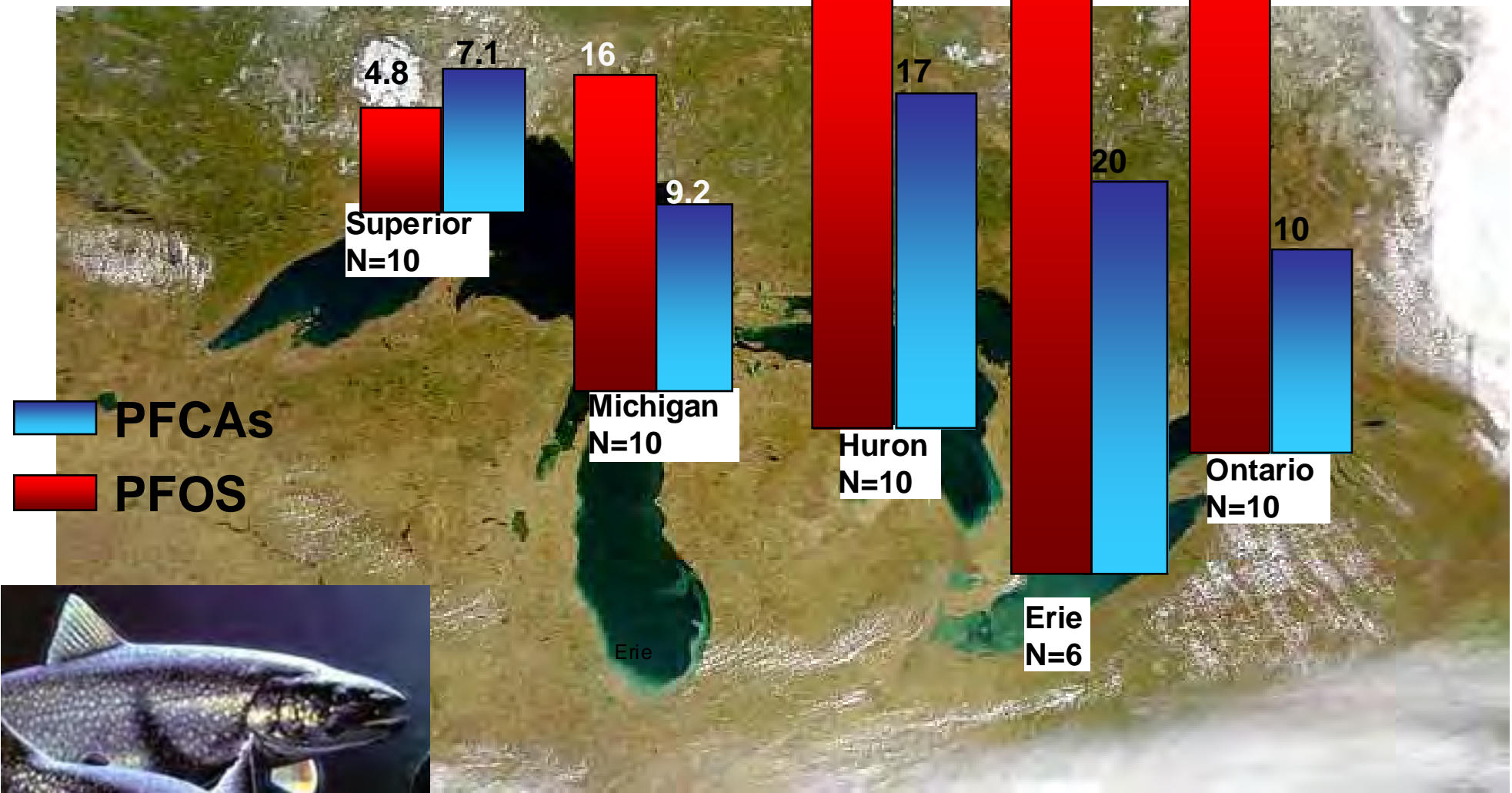
PBDE concentrations in Lake Superior whole lake trout increasing exponentially



Source: Zhu and Hites 2004, *ES&T* (38).

PFOS and PFCAs (ng/g wet wt) are lower in Lake Superior lake trout compared to the other Lakes

(all samples are whole fish; age = 4 yrs collected in 2001) Furdui et al. ES&T 2007



Environment Canada Monitoring Stations 2005



12/17/2007

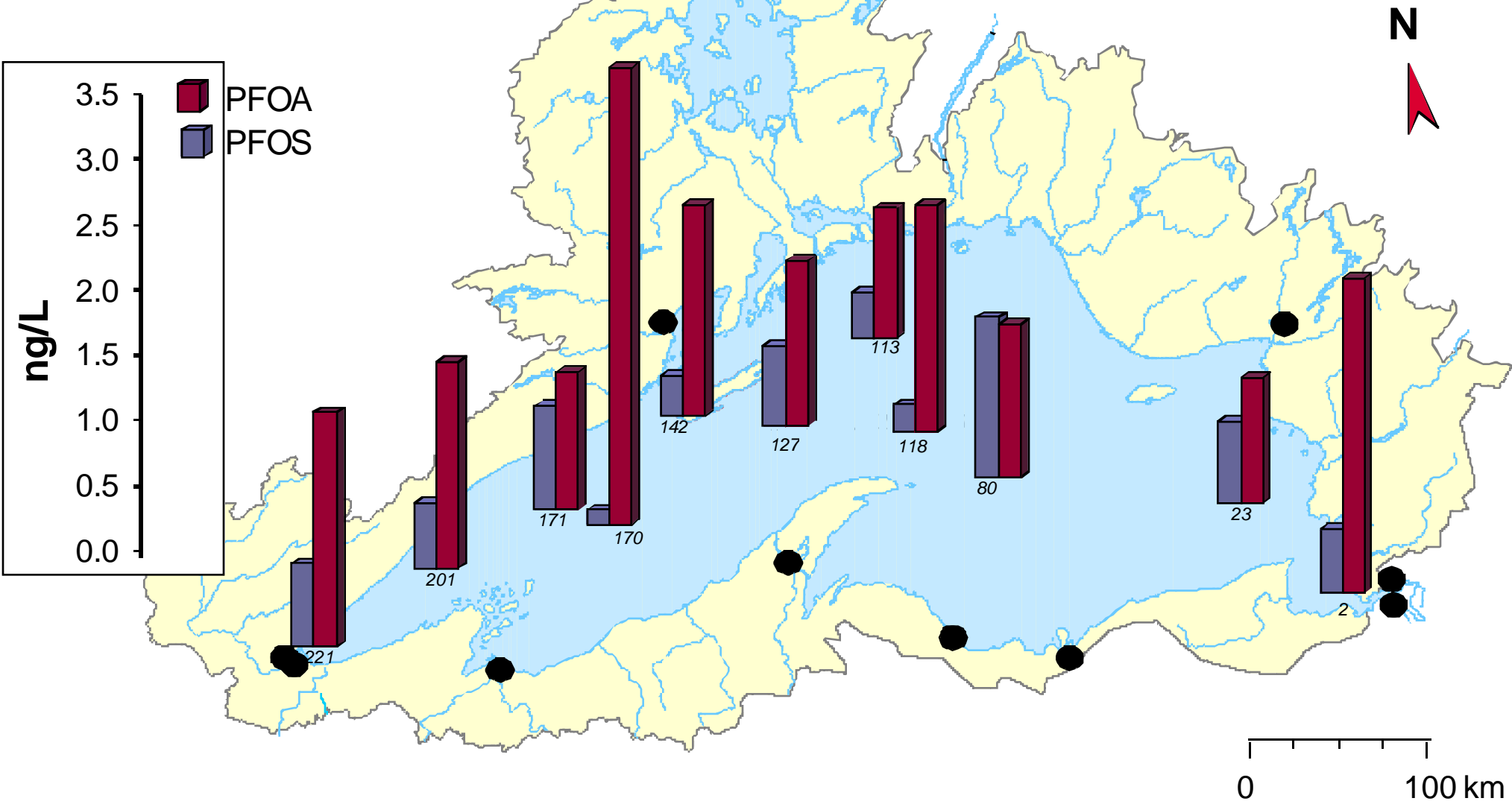


Environment
Canada

Environnement
Canada

Canada

Spatial trends of total PFCAs and PFSA in Lake Superior surface waters, 2005. No significant differences between sites near MWTPs (Duluth, Thunder Bay) and open lake sites

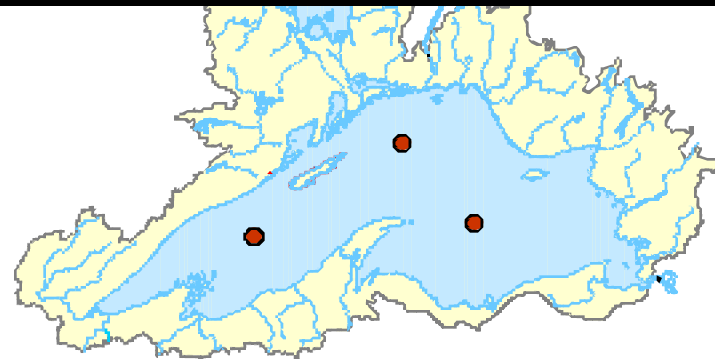


Source: D. Muir, Environment Canada

Concentrations of two major perfluorinated alkyl acids – PFOA and PFOS. PFOA may be increasing

Site	Depth	Year	PFOA	PFOS	Notes
Stn 80	4	2001	0.24		Scott et al. ES&T 2006
	1	2005	0.36	1.14	Scott et al. 2007
	1	09-2005	0.5	0.1	Furdui et al. 2006 unpub
Stn113	4	2001	<0.01		Scott et al. ES&T 2006
	1	2005	0.43	0.29	Scott et al. 2007
	1	09-2005	1.2	0.30	Furdui et al. 2006 unpub
Stn 171	4	2001	0.22		Scott et al. 2005 unpub
	1	2005	0.39	0.70	Scott et al. 2007

Stn 80 = mid-lake east of Keweenaw Peninsula
 Stn 113 = north central – east of Isle Royale
 Stn 171 = central west basin



Source: D. Muir, Environment Canada

Acid Pharmaceuticals

Station:		80	113	169	536
	Detection	may 2005	may 2005	may 2005	fall 2005
Analytes	Limit (ng/L)	Mid-lake			Thunder Bay
		Concentration: ng/L			
Clofibric acid	0.25	nd	nd	nd	nd
Ibuprofen	0.30	nd	nd	nd	nd
Acetaminophen	0.21	nd	nd	nd	nd
Salicylic acid	0.13	nd	nd	nd	nd
Gemfibrozil	0.09	0.17	0.20	0.15	0.34
Fenoprofen	0.02	nd	nd	nd	nd
Naproxen	0.30	nd	nd	nd	nd
Triclosan	0.15	nd	nd	nd	nd
Fenofibrate	0.20	nd	nd	nd	nd
Ketoprofen	0.11	nd	nd	nd	nd
Diclofenac	0.14	nd	nd	nd	nd
indomethacin	0.04	nd	nd	nd	nd

12/17/2007



Significant Management and Policy Questions

- How do you manage so many chemicals?
 - Every person is potentially a source
 - Which ones are really a concern?
- Economic considerations
- Thinking upstream vs. downstream – where are cost and effort best allocated to provide lasting solutions?

Current Chemical Management Strategies

- Chemical by chemical approach
 - Zero Discharge Demonstration Program
 - Great Lakes Binational Toxics Strategy
- Has worked well at reducing “legacy” pollutants like mercury, PCBs and banned pesticides on a relatively short list

Future of chemical design and regulations

- Green Chemistry – several countries including US (DfE program) and Canada
 - the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances (US EPA).
- CEPA 1999 - Canada
 - provides for the assessment and/or management of the environmental and human health impacts of new and existing substances.
- REACH - Europe
 - Goals are to improve environmental and human health protection and improve competitive position of European chemical companies
 - Puts burden of proof for chemical safety on producers rather than government

Management Approaches – Great Lakes

- Development of a Great Lakes relevant list
 - Screening of Env. Canada and US EPA chemical lists has yielded about 400 probable P&B substances
 - Further screening will identify top candidates to be considered for further study and measurement in the Great Lakes region.
- GLBTS
 - Proposal to create Substance and Sector groups
- Lake Superior proposed strategy
 - Would use lists like the above to prioritize monitoring and surveillance chemicals specific to Lake Superior
 - Would focus on pollution prevention activities as a way to prevent releases of potential emerging contaminants
 - Would report and update on these activities through a new section in the biennial LaMP Critical Pollutants updates.

People responding in the Lake Superior Basin

- 2007 Earthkeepers annual Cleansweep focused on pharmaceuticals
 - more than a ton of unwanted pills, powders and liquid medicines collected



<http://www.superiorwatersheds.org/projects.php?id=5>

People responding in the Lake Superior Basin

- City of Thunder Bay HHW Depot allows drop-off of many household products including pharmaceuticals, cleaners, solvents, pesticides
- WLSSD's Medicine Cabinet Clean-Out Day, (10/6/07) collected over 250 pounds of pharmaceutical waste



<http://www.thunderbay.ca/index.cfm?fuse=html&pg=666>



What Can You Do?

- As always, remember the four R's: Reduce, Reuse, Recycle, Repair!
- Take unwanted or expired pharmaceuticals to a clean sweep event - Don't flush them!
- Make your own cleaning products
- Use non-antimicrobial soap
- Select products (cleaners, shampoos, etc.) made from plant-based materials
- Ask at your garden store for less-toxic alternatives to chemical pesticides to control pests
- Read product labels! The words **caution**, **warning** and **danger** indicate that the product's ingredients are harmful

Acknowledgements

- Derek Muir, Brian Scott, Camilla Teixeira, Chris Spencer, Colin Darling, Xiaowa Wang, Aquatic Ecosystem Division, Environment Canada
- Alice Dove, Environment Canada
- Vi Richardson, Environment Canada
- Lake Superior Chemical Committee

THANK YOU!

QUESTIONS??