



Synthesis of data on mercury in the Great Lakes region: procedures and key findings

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Great Lakes Mercury Project

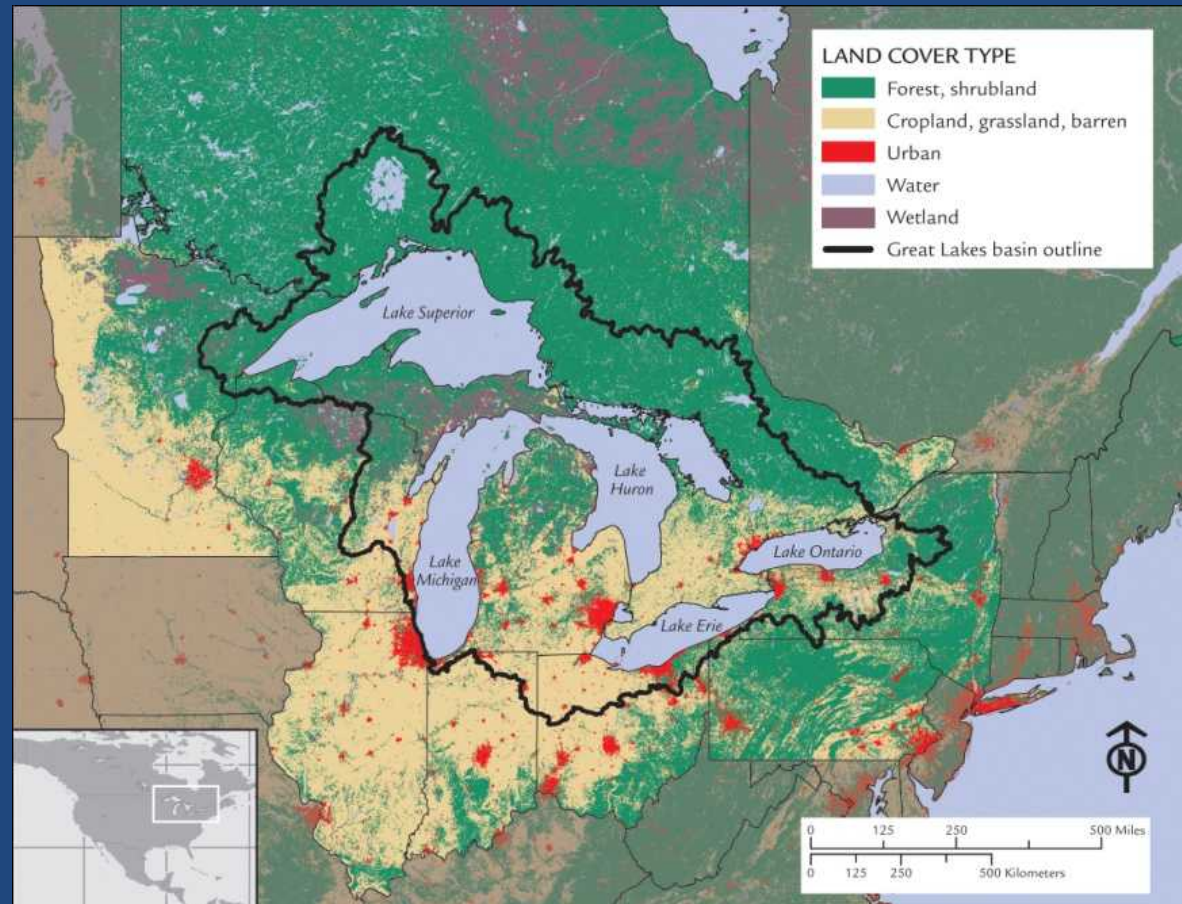
A synthesis: Compiled and analyzed data to address key questions regarding Hg in the Great Lakes region

- **Workshops:** La Crosse (2008), Ann Arbor (2010)
- **Topical workgroups:** Atmospheric deposition, Dated sediment cores, Waters & watersheds, Lower food web, Fish, Wildlife, Policy
- **172 participants from 55 institutions**
 - 9 Federal agencies or programs (3 Canadian, 6 U.S.)
 - 7 state and provincial
 - 24 colleges and universities
 - 15 nonprofit, private sector, and other

Geographic scope – the Great Lakes region

Defined as including

- the 5 Great Lakes
- the 8 G.L. states
- Province of Ontario
- Lake Champlain



Informational products

- 35 refereed papers in two journal issues
Ecotoxicology (vol. 22, no. 7) Bioaccumulation, exposure, risk, and effects in food webs, fish, and wildlife; Monitoring; Policy

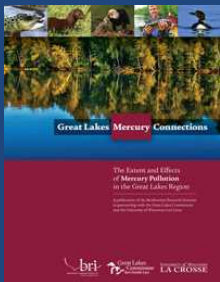


Environmental Pollution (vol. 161)

Spatiotemporal patterns in contamination of physical environment (wet & dry deposition, water, watersheds, sediment cores); some biota



- *Great Lakes Mercury Connections* 40-page summary report



Mercury in the Great Lakes region

- Atmospheric deposition the primary pathway for entry of Hg into regional ecosystems
 - Deposition to forest canopy exceeds wet deposition at most sites, based on litterfall (Risch et al. 2012)
 - Geologic sources generally nil (Woodruff & Cannon)
 - Most Hg from anthropogenic sources (dated cores)
 - Coal-fired power plants: est. 57% of regional anthropogenic Hg emissions in 2005
- Substantial variation in ecosystem sensitivity to Hg

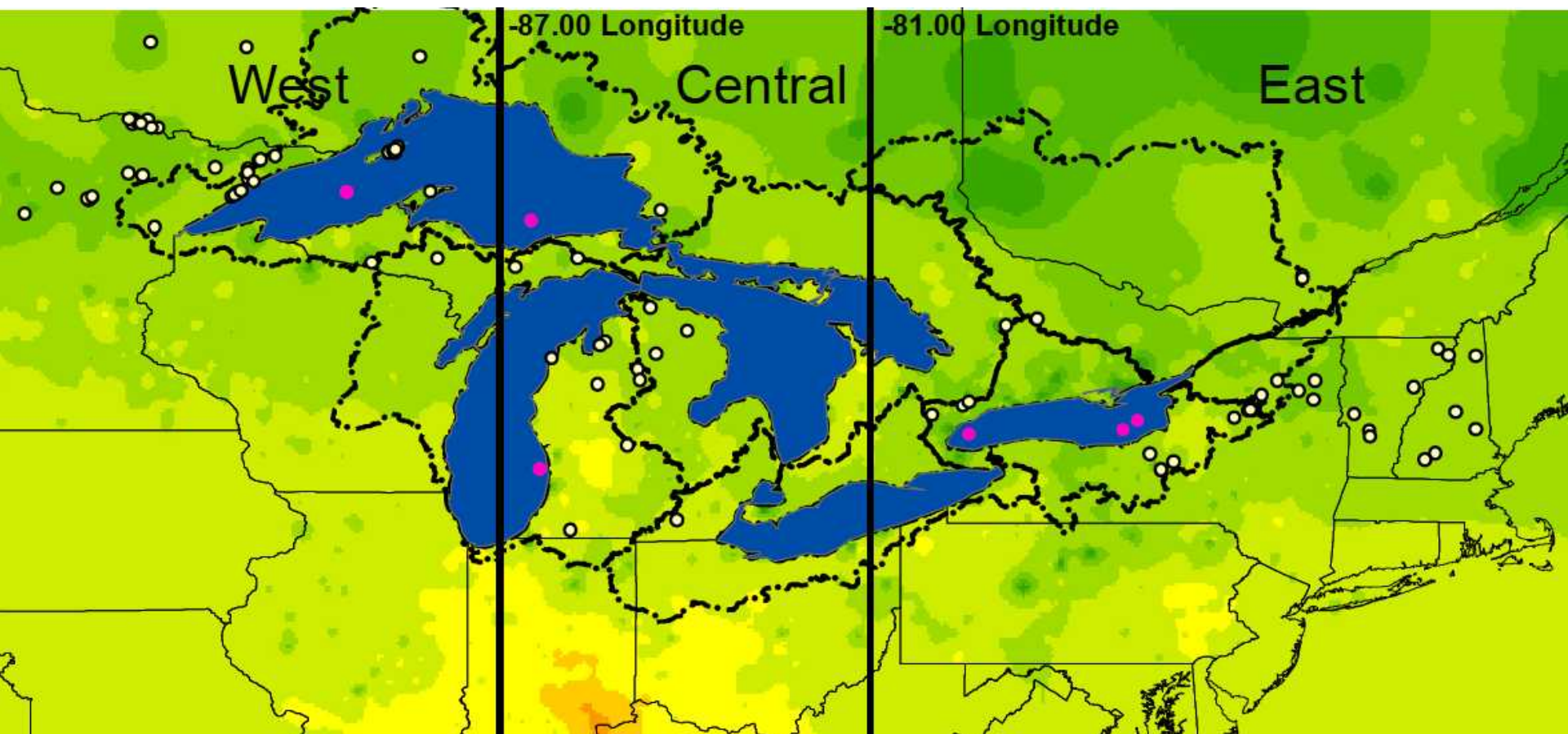
Presentation of Results

- Focus on relevance to policy & management
- Summarized as follows
 - Encouraging news
 - Cause for continuing concern
 - Policy & management implications

Encouraging News

- Early controls on legacy point sources of Hg have greatly reduced localized environmental contamination
- Dated sediment cores from inland lakes show decreasing atmospheric deposition of Hg
- Mercury levels in fish and wildlife have declined in response to controls on Hg sources
- Controls on regional and national emissions have been effective in decreasing Hg levels in biota, even as Asian emissions have increased

Sediment coring sites: Deposition chronology



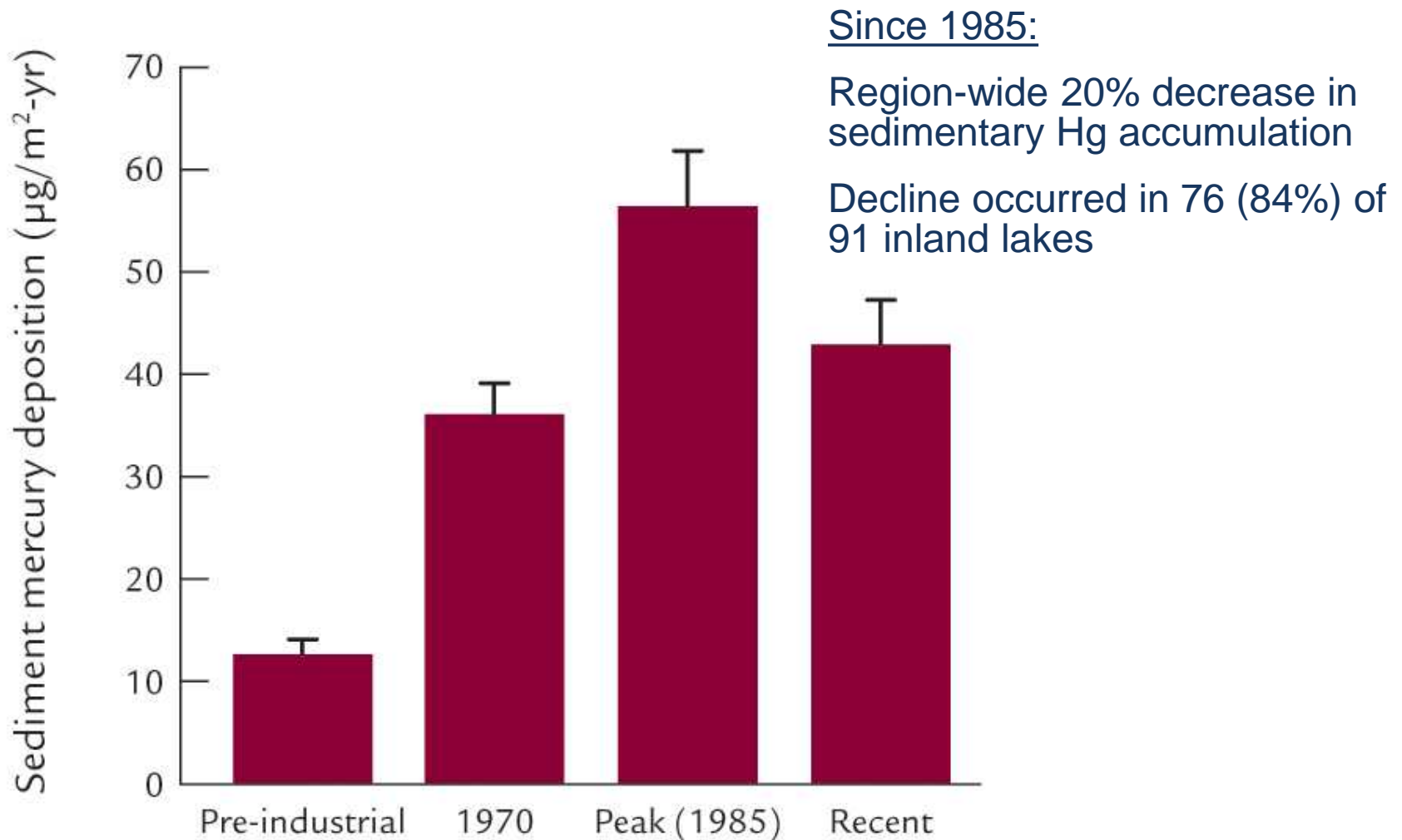
Wet Hg Deposition ($\mu\text{g}/\text{m}^2\text{-yr}$)

Drevnick et al. 2012



0-3
3.01-5
5.01-7
7.01-9
9.01-11
11.01-13
13.01-15
15.01-17
17.01-19
19.01-21
21.01-23

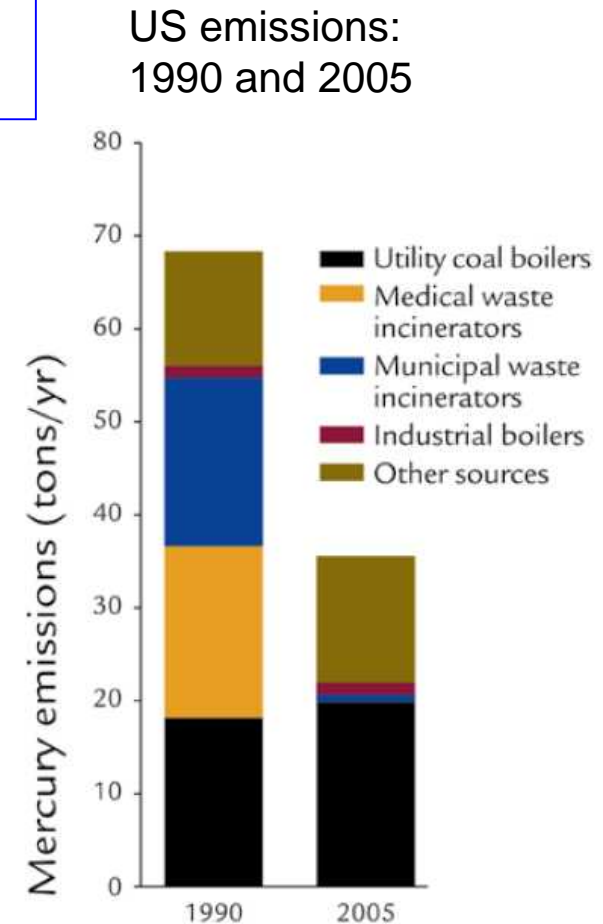
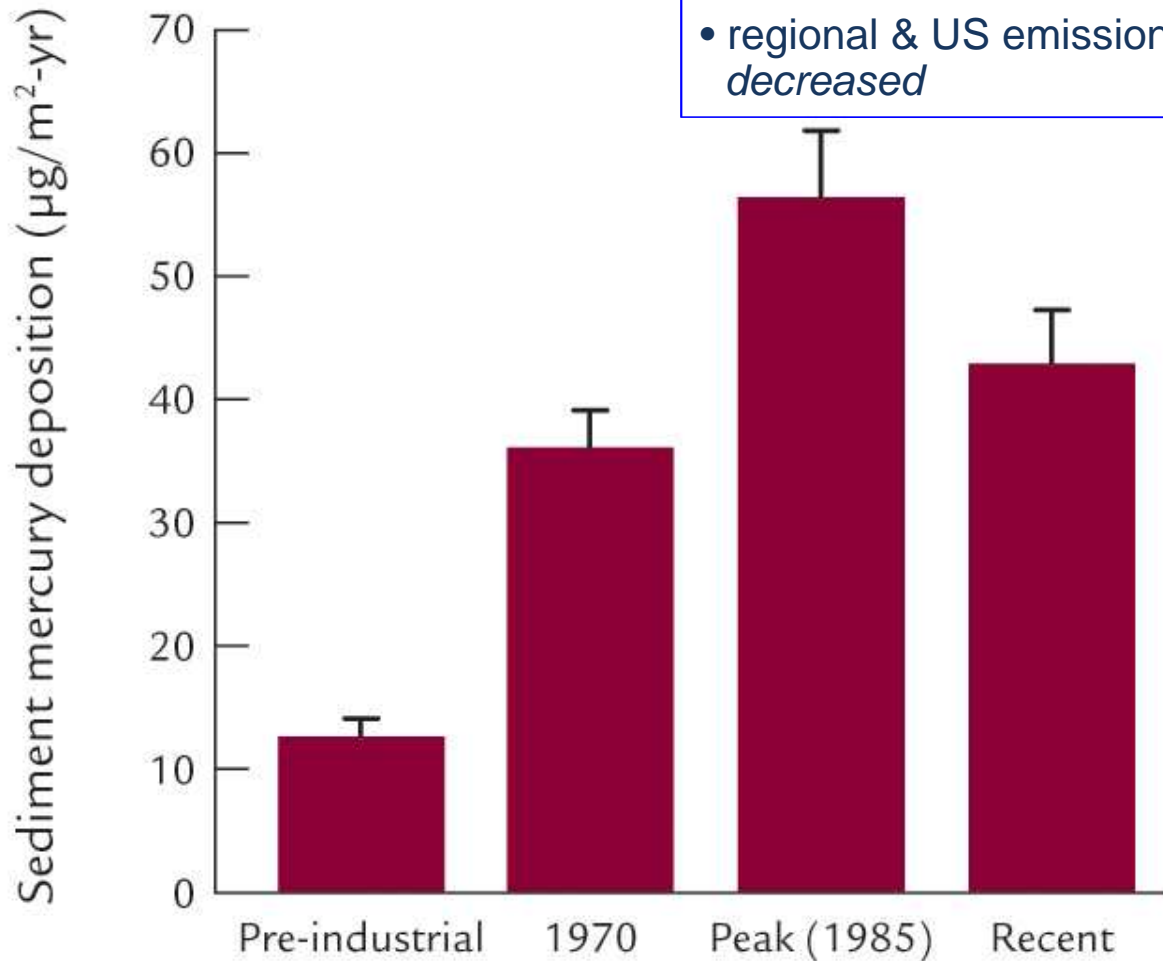
Mercury deposition: **Trends** in dated lake sediments (n = 91 inland lakes in undisturbed watersheds)



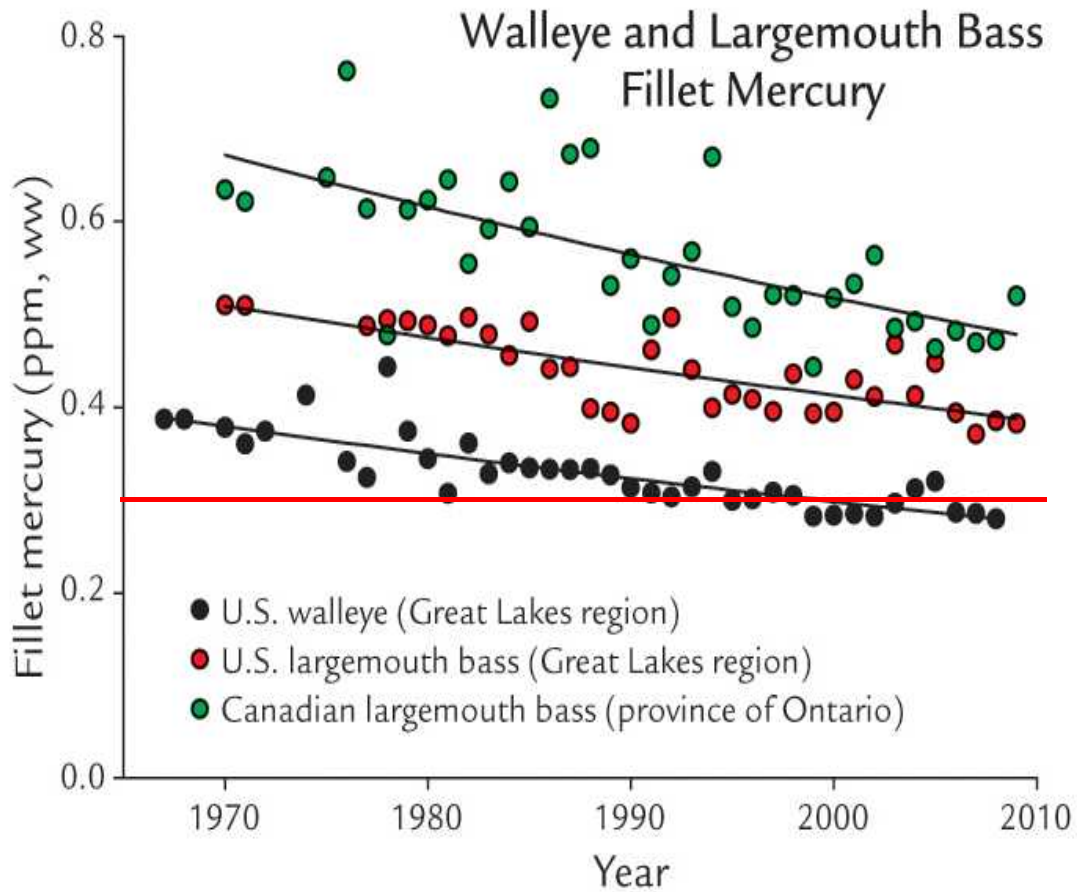
Mercury deposition: **Trends** in dated lake sediments

During this time interval:

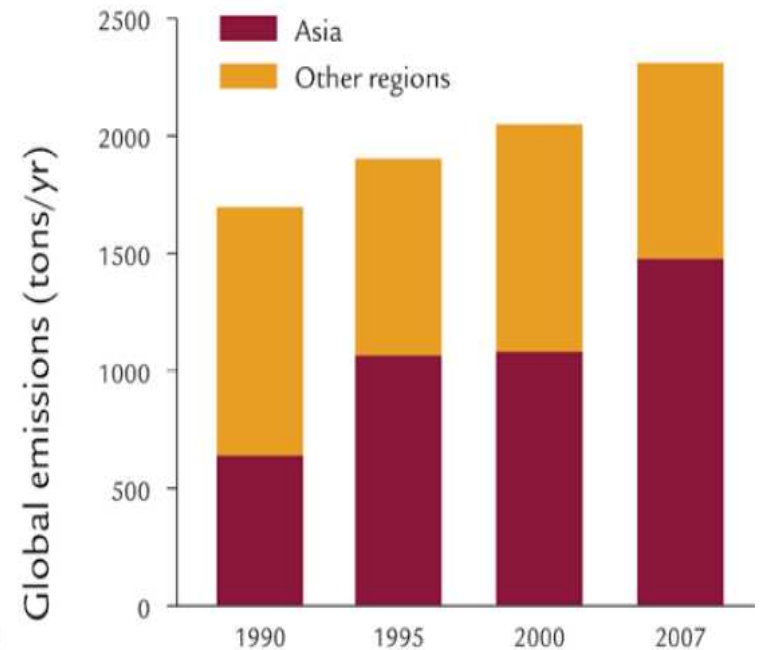
- regional & US emissions *decreased*



Declining mercury levels in fish



Increasing Asian emissions of Hg, 1990 to 2007

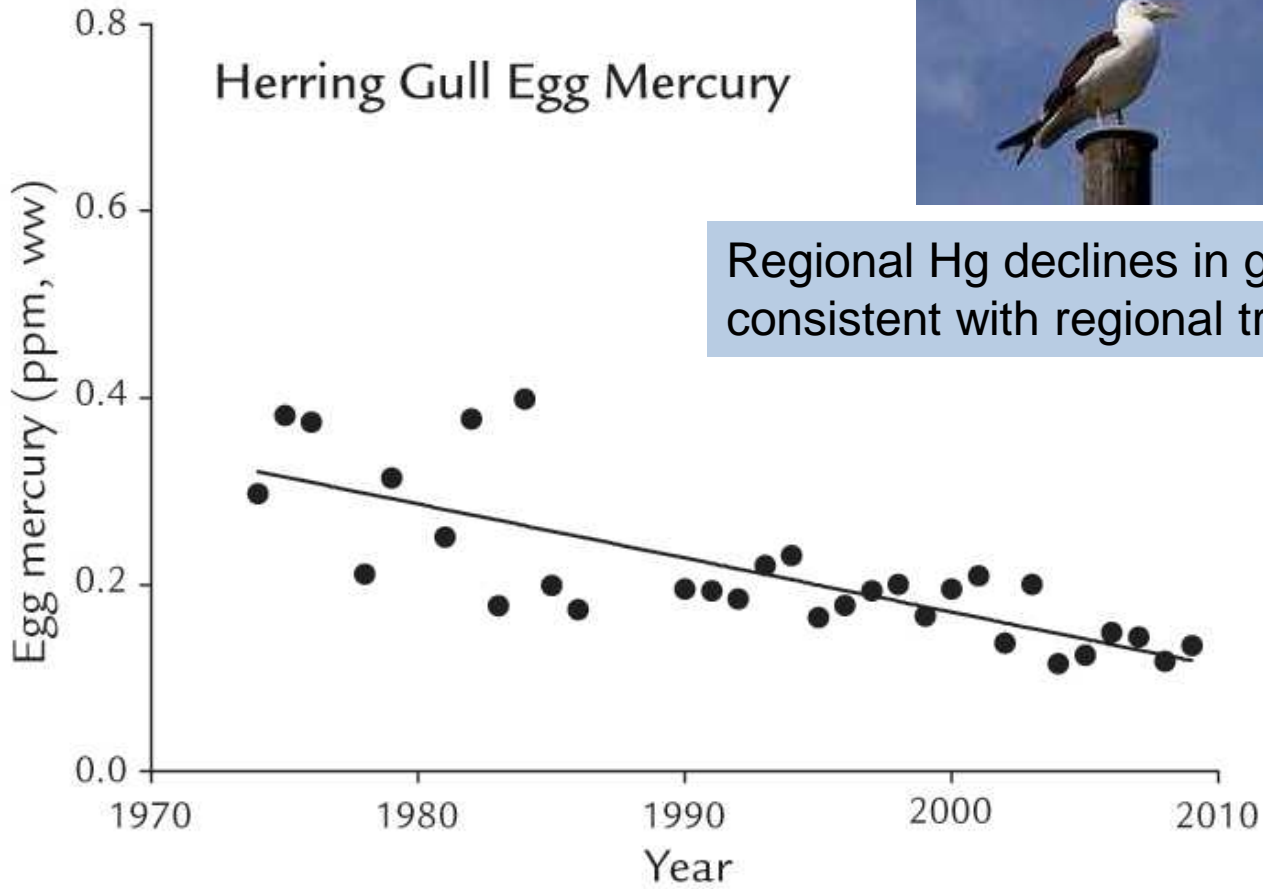


Red line = 0.3 ppm (EPA fish-tissue criterion for MeHg)

Monson et al. 2011

Mercury in herring gull eggs

(Canadian Wildlife Service, 1974-2009)

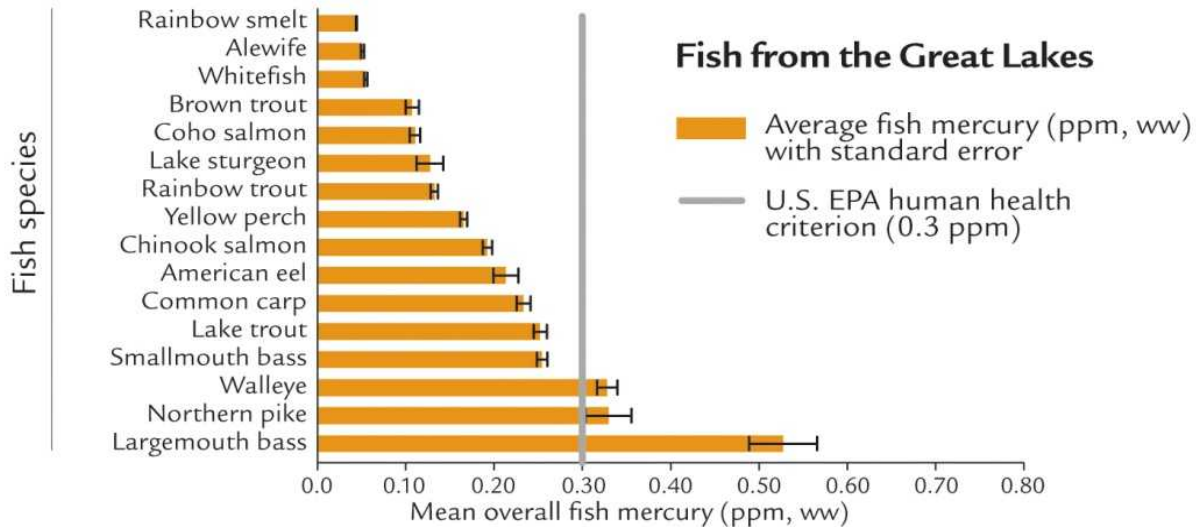
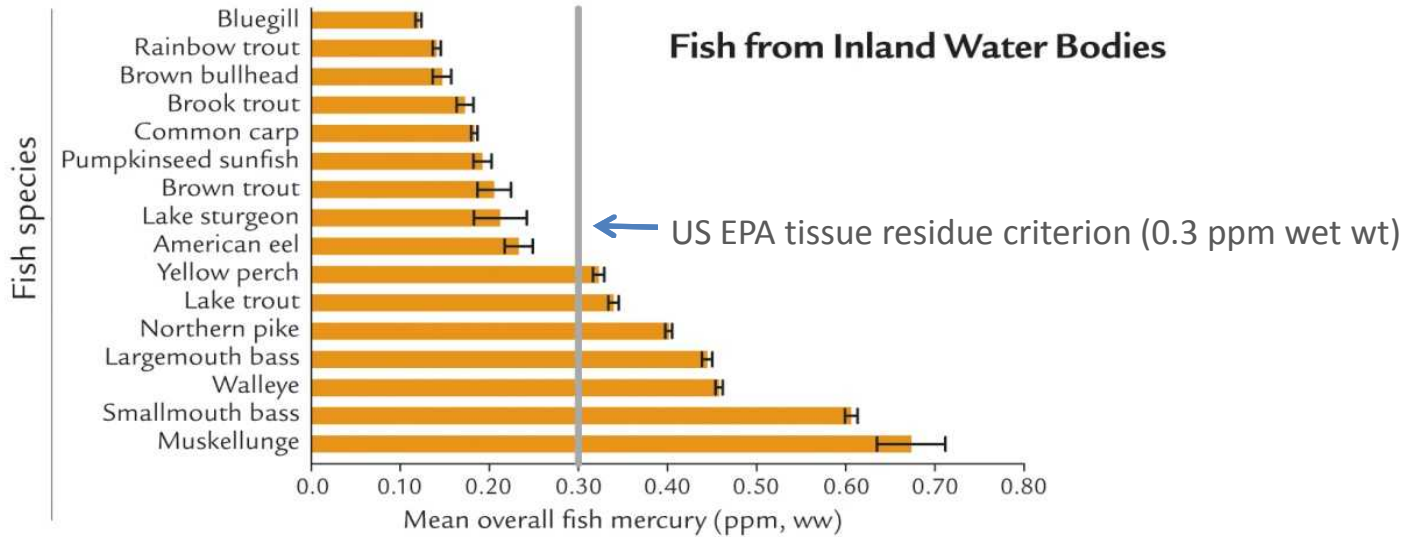


Weseloh et al. 2011

Cause for continuing concern

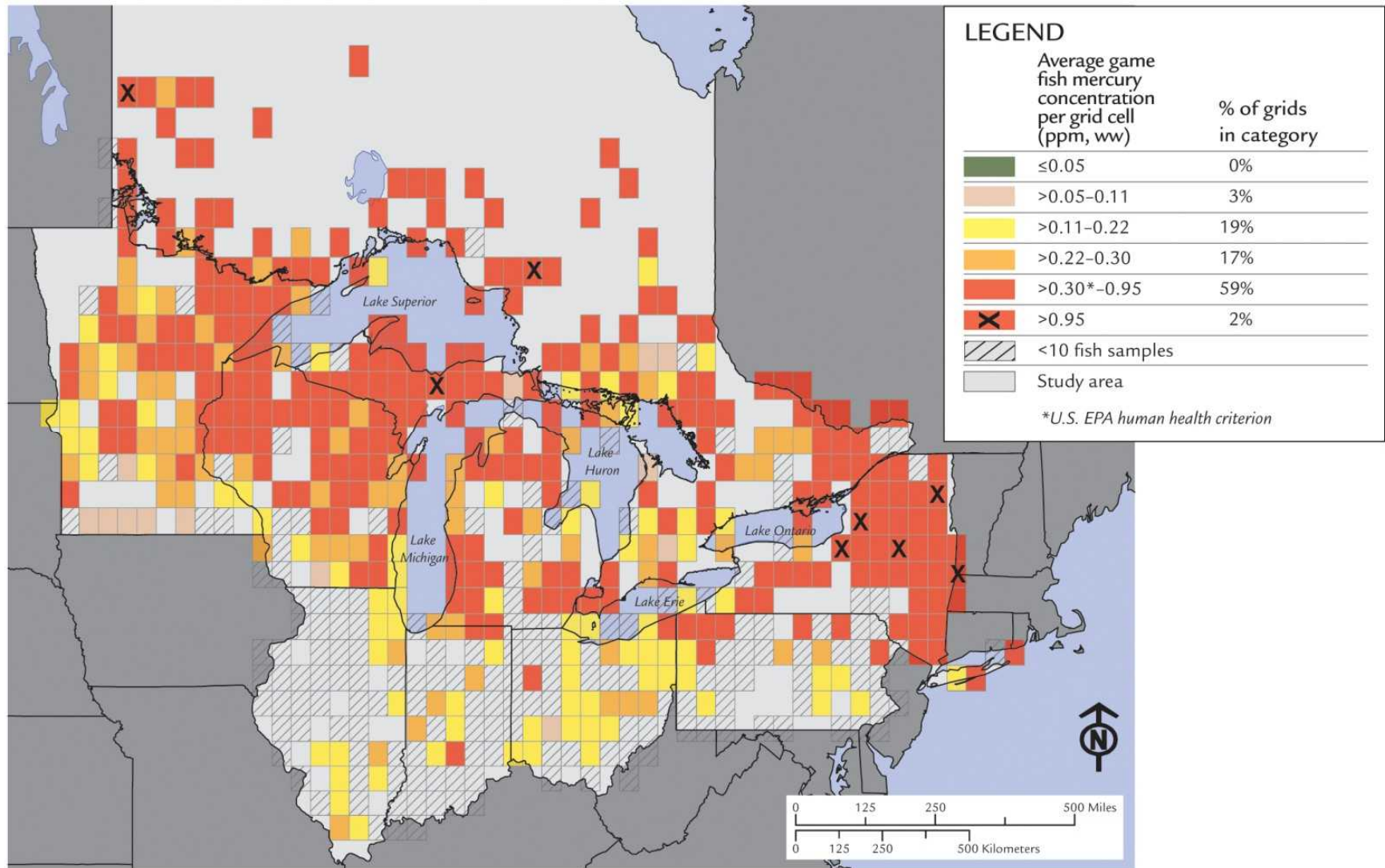
- Hg levels in fish are high in inland waters, where most (~85%) licensed anglers fish, commonly exceeding criteria for protection of human health
- In many inland waters, [Hg] in fish and wildlife exceed thresholds for adverse ecological effects
- High ecosystem sensitivity to Hg in northern parts of the Great Lakes region
- Recent increases or “trend reversals” in [Hg] in some fish and wildlife

Hg in fish fillets: Inland waters > Great Lakes



Evers et al. 2011 (Mercury Connections report)

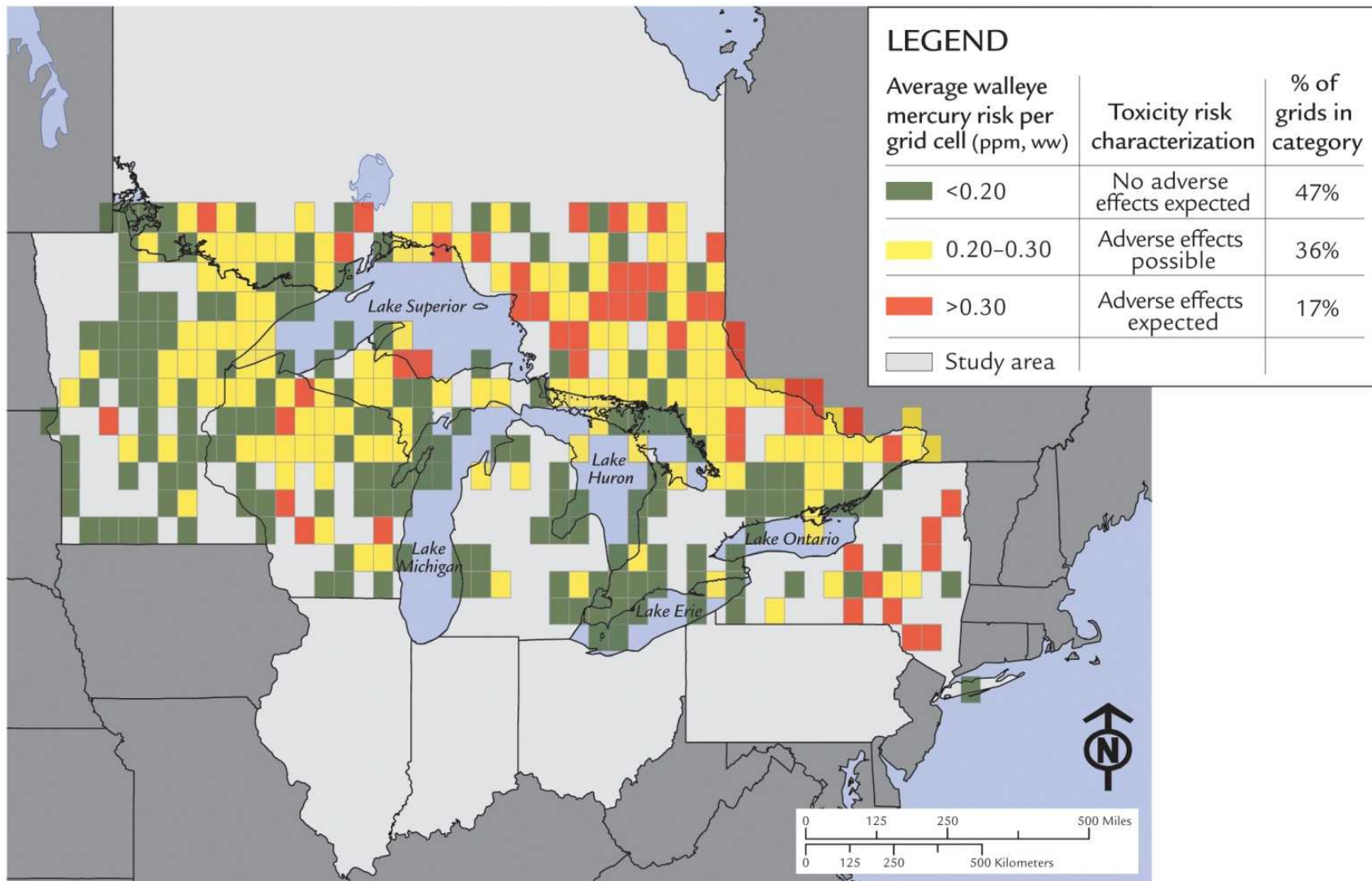
Mercury in fillets of game fish (6 species)



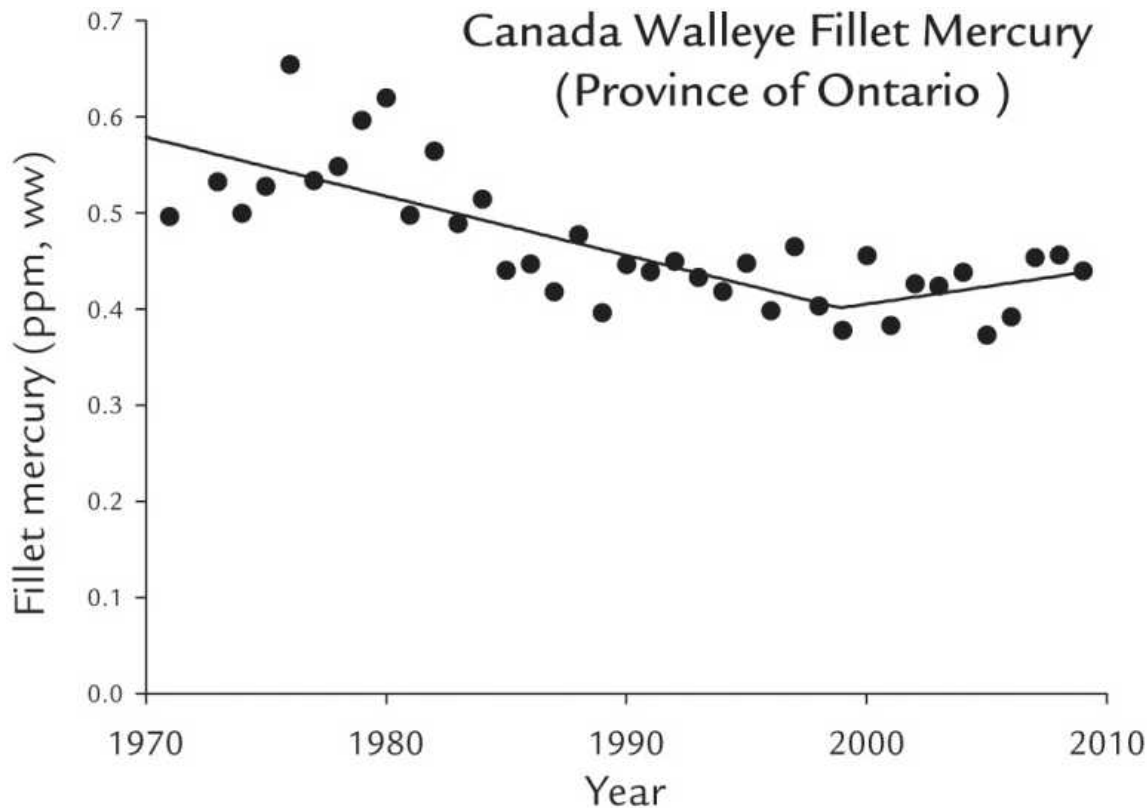
Evers et al. 2011 (compiled from Zanaski et al. 2011, Monson et al. 2011)

Risks to walleye

(based on whole-fish concentrations)



Trend reversals of Hg in fish & wildlife



Other cases in region

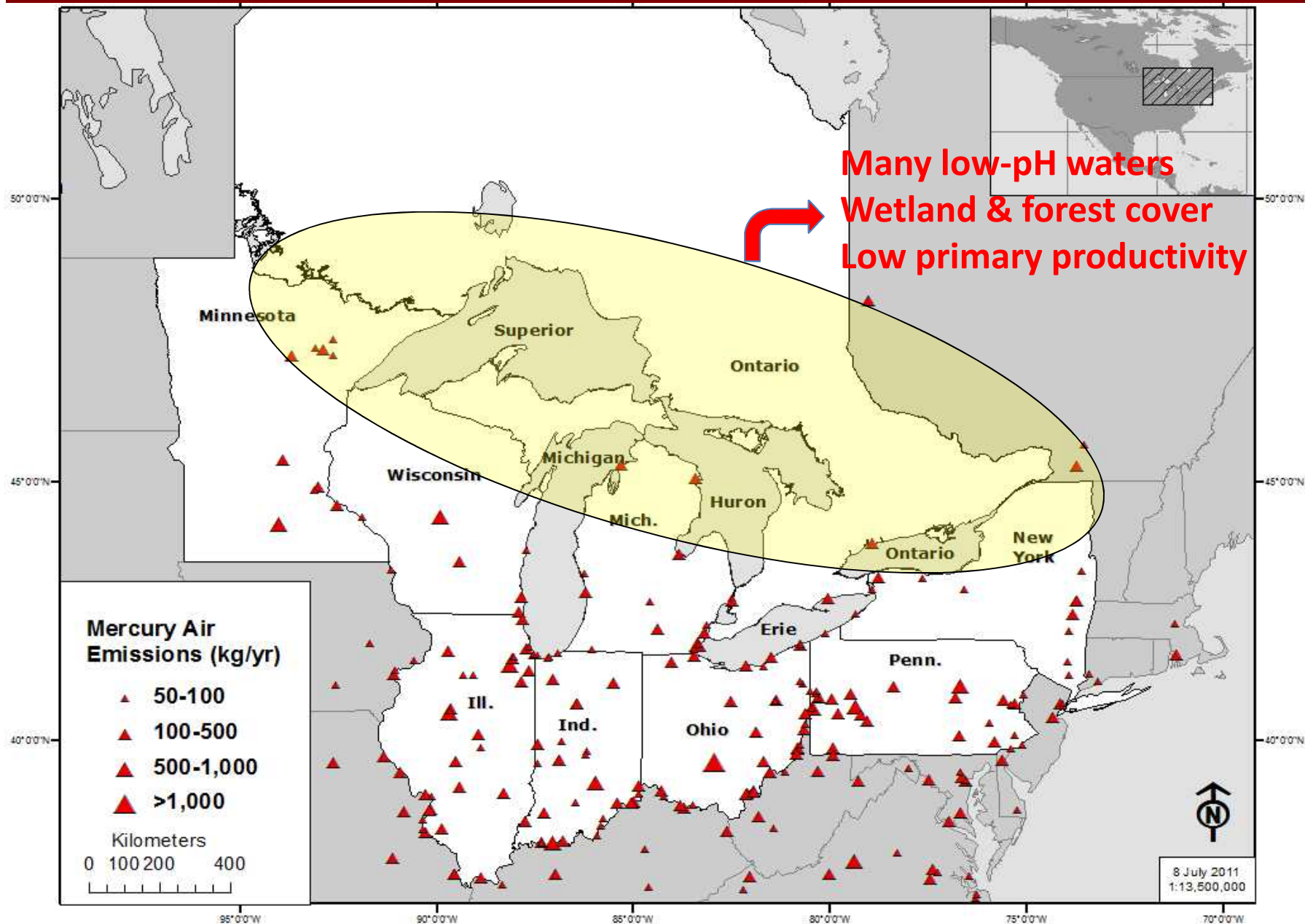
- Common loon (northern WI)
- Walleye & northern pike (MN)
- Walleye (southern WI)
- Walleye (Lake Erie)

Cases elsewhere

- Northern pike (Sweden)
- Yellow perch (N.S., Canada)

Monson et al. 2011

Mercury-Sensitive Watersheds and Water Bodies



Policy & management implications

- Further reductions in Hg emissions are needed, given that Hg levels in fish and wildlife exceed human health criteria and ecological thresholds
- Decreases in Hg emissions from US sources can be reasonably expected to decrease
 - Environmental contamination
 - Biotic exposure to MeHg
 - Associated risks to fish, wildlife, humans

Policy & management implications

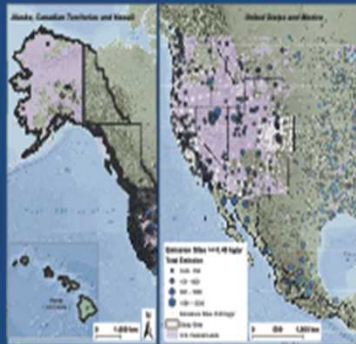
- Need to evaluate trend reversals of [Hg] in biota and identify causal factors & processes
- Monitoring is needed to assess responses to regulatory actions (emission reductions) and other factors that influence bioaccumulation of MeHg
- Communication of risks (and benefits) concerning consumption of fish from regional waters is clearly needed

Keys to Success—Great Lakes Regional Synthesis

- Advance marketing and a strong start
- External funding (GLC-GLAD) and in-kind support
 - Workshops (travel support, venue)
 - Technical support (database mgmt, statistics, GIS)
 - Publications (production, purchase, distribution)
- Early input from resource & environmental managers
- Guidance, communication, facilitation at project level
- Strong work-group leadership and teamwork
- Flexibility & time (an iterative, 3-year process)

Western North America Hg Synthesis

Mercury Cycling, Bioaccumulation, and Risk Across Western North America: A Landscape Scale Synthesis Linking Long-Term Datasets



A new science initiative is taking place between the U.S. Geological Survey, Biodiversity Research Institute, and others to synthesize mercury (Hg) data across Western North America.

The project will examine mercury in biological and abiotic matrices across western landscapes.

From the data synthesis, we will explore the linkages between mercury cycling and land use, biogeochemistry, climate, human health, and public policy.

We encourage participation from those in the mercury research community interested in:

- Contributing Mercury Data
 - Federal, State, Private, and Institutional Data
 - Biotic and Abiotic Data Sets
- Engaging in Data Analysis
 - Temporal and Spatial Trend Analysis
- Manuscript Co-authorship
- Investigating Policy Implications

Those interested in one or more aspects of this project should visit the Western Mercury Synthesis website or contact one of the coordinators listed to the right.

Principal Investigators:

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