

Lake Michigan: Lake USA



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Lake Michigan Science, Status, Vision

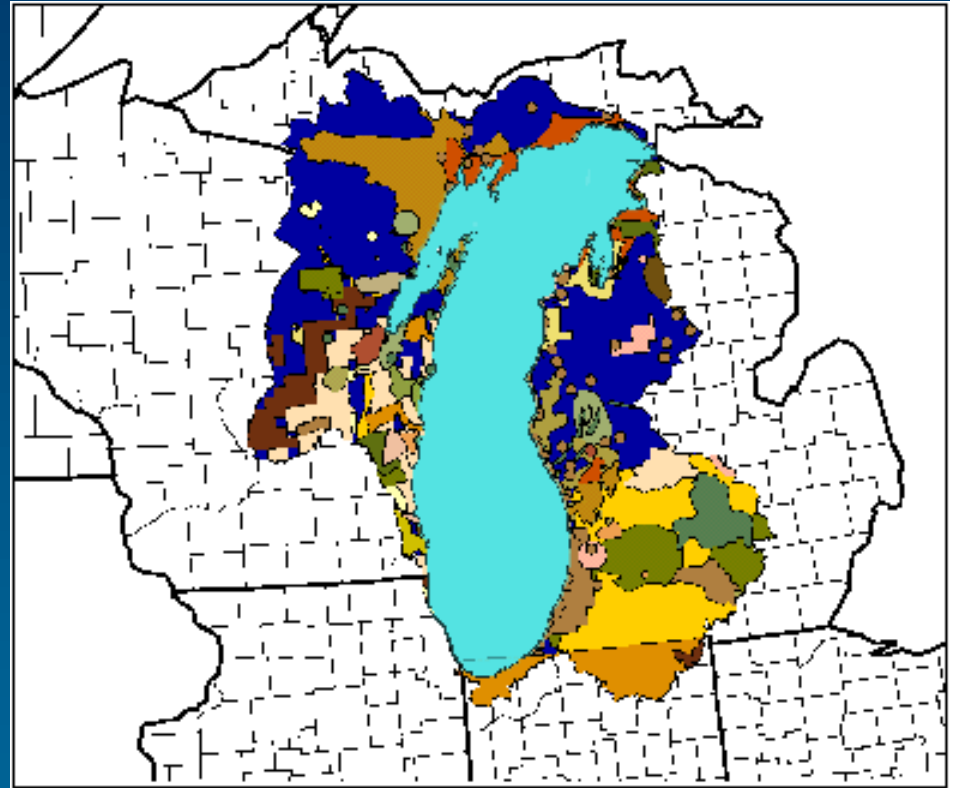
Developed by:

Lake Michigan Mass Balance Study
Great Lakes Fishery Commission



About Lake Michigan

- 2nd largest by volume
- world's largest collection of fresh water dunes
- 40% of Coastal Wetlands, 26% of prime waterfowl (of the Great Lakes)
- 307 miles north to south leading to complex sub-ecosystem mixtures



Lake Michigan Basin's 10 Areas of Concern

- Sediment cleanups at: Waukegan, Manistique, Menominee, Bryant Mill Pond
- Final plans: Indiana Harbor Ship Canal, Sheboygan, Kalamazoo
- Drawing board: Fox River Green Bay, Milwaukee Estuary, Muskegon and White Lakes



Lake Michigan: Current Ecosystem Status

- Overview “an outstanding natural resource of global significance, under stress and in need of special attention”
- Beneficial use impairments presented spatially and temporally
- Cross-walk with LaMP goals

Endpoint Goals

A red lighthouse stands on a rocky island in the ocean. The lighthouse is a tall, cylindrical tower with a black lantern room at the top. The sky is a clear, bright blue. The water is a deep blue, and the rocks are grey and jagged. The lighthouse is the central focus of the image.

- We can all eat any fish
- We can all drink the water
- We can all swim in the water
- Habitats are healthy
- Public access to natural areas
- Sustainable activities

We can all eat any fish

Ecosystem Status:

Impairment

Restrictions on
fish and wildlife
(F/W) consumption

Tainting of F/W
flavor

Spatial

Local

Local

Temporal

Ongoing

Episodic

We can all drink the water

Ecosystem Status:

Impairment

Restrictions on drinking water consumption or taste and odor problems

Spatial

Local

Temporal

Episodic

We can all swim in the water

Ecosystem Status:

Impairment

Beach closings

Spatial

Local

Temporal

Episodic

Habitats are healthy

Ecosystem Status:

Impairment

Spatial

Temporal

Degradation of
F/W populations

Regional

Episodic

Fish Tumors or
other deformities

Local

Episodic

Degradation of
Benthos

Local

Ongoing

Eutrophication or
undesirable algae

Local

Episodic

Habitats are healthy

Ecosystem Status:

Impairment

Degradation of
phytoplankton and
zooplankton

Loss of F/W
habitat

Bird or animal
deformities

Spatial

Lakewide

Lakewide

Local

Temporal

Ongoing

Ongoing

Episodic

Public access to natural areas

Ecosystem Status:

Impairment

Degradation of
aesthetics

Spatial

Local

Temporal

Evolving

Sustainable activities

Ecosystem Status:

Impairment

Restrictions on dredging

Added cost to agriculture or industry

Spatial

Local

Local

Temporal

Evolving

Evolving

Monitoring the Stressors

- Chemical:
 - PCBs/dioxins, Mercury, Pesticides, Nutrients
- Biological:
 - Aquatic Nuisance Species
 - Pathogens (local and exotic)
- Physical:
 - sediments, habitat destruction. Water flow change



About Lakewide Science

- Study: EEGLE, Episodic Events: Great Lakes Experiment
- Timeframe: 1998-9 sampling, currently modeling
- Stressors: tracking a massive spring plume of fine clay and sediments up to 12 miles wide by 200 long
- Question: Is it Nutrients? Pollutants?

About Human Health Science

- Study:
 - ATSDR - Great Lakes Human Health Effects Research Program
 - States annual fish monitoring
- Stressors: persistent toxic chemicals
- Question: current data for fish advisories



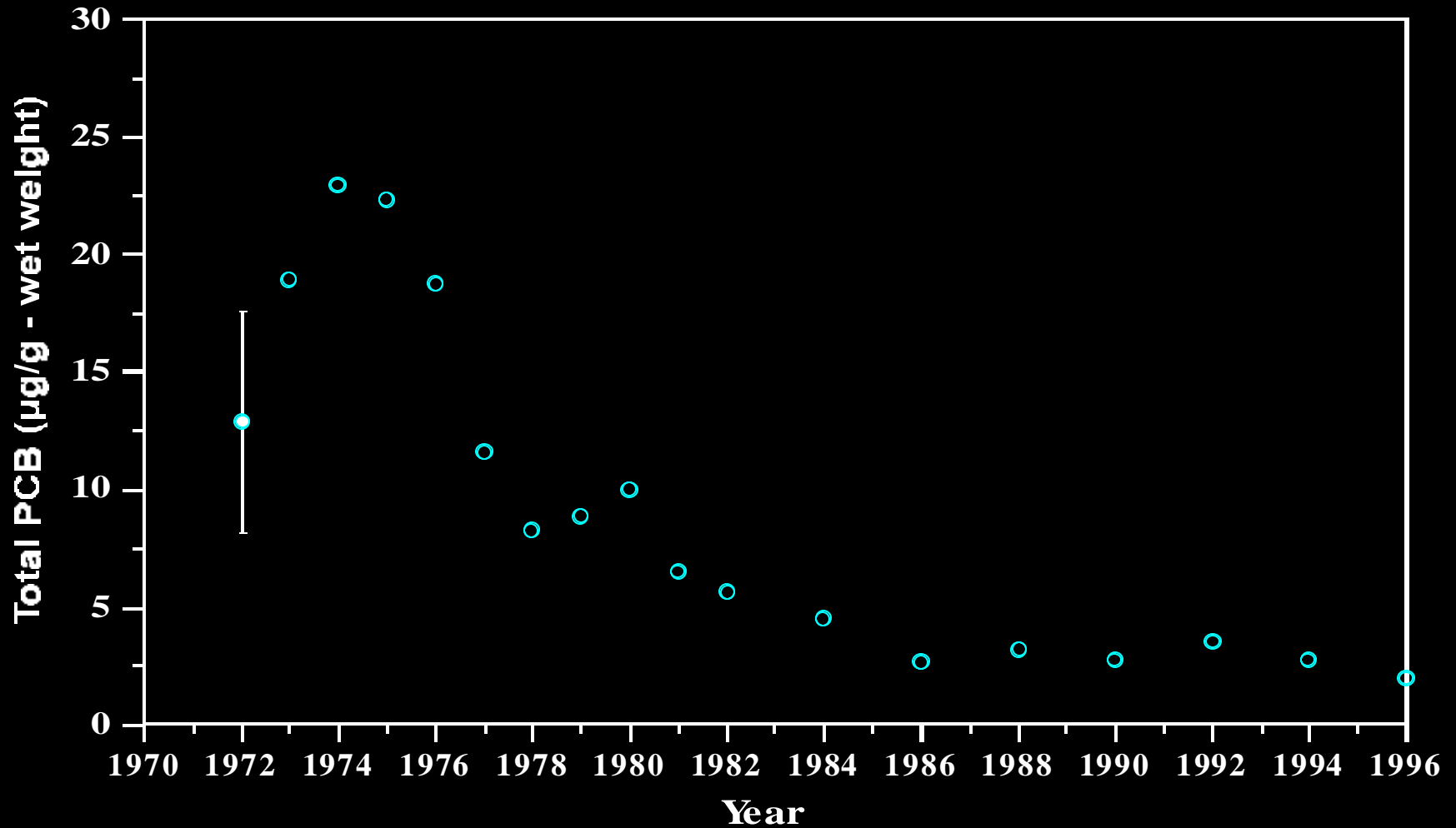
About Lakewide Science

- Study: LMMB, Lake Michigan Mass Balance Study
- Timeframe: sampling 1994-5, currently modeling
- Stressors: PCBs, Mercury, Atrazine, Transnonachlor
- Question: Route of these contaminants into, through and out of the ecosystem?

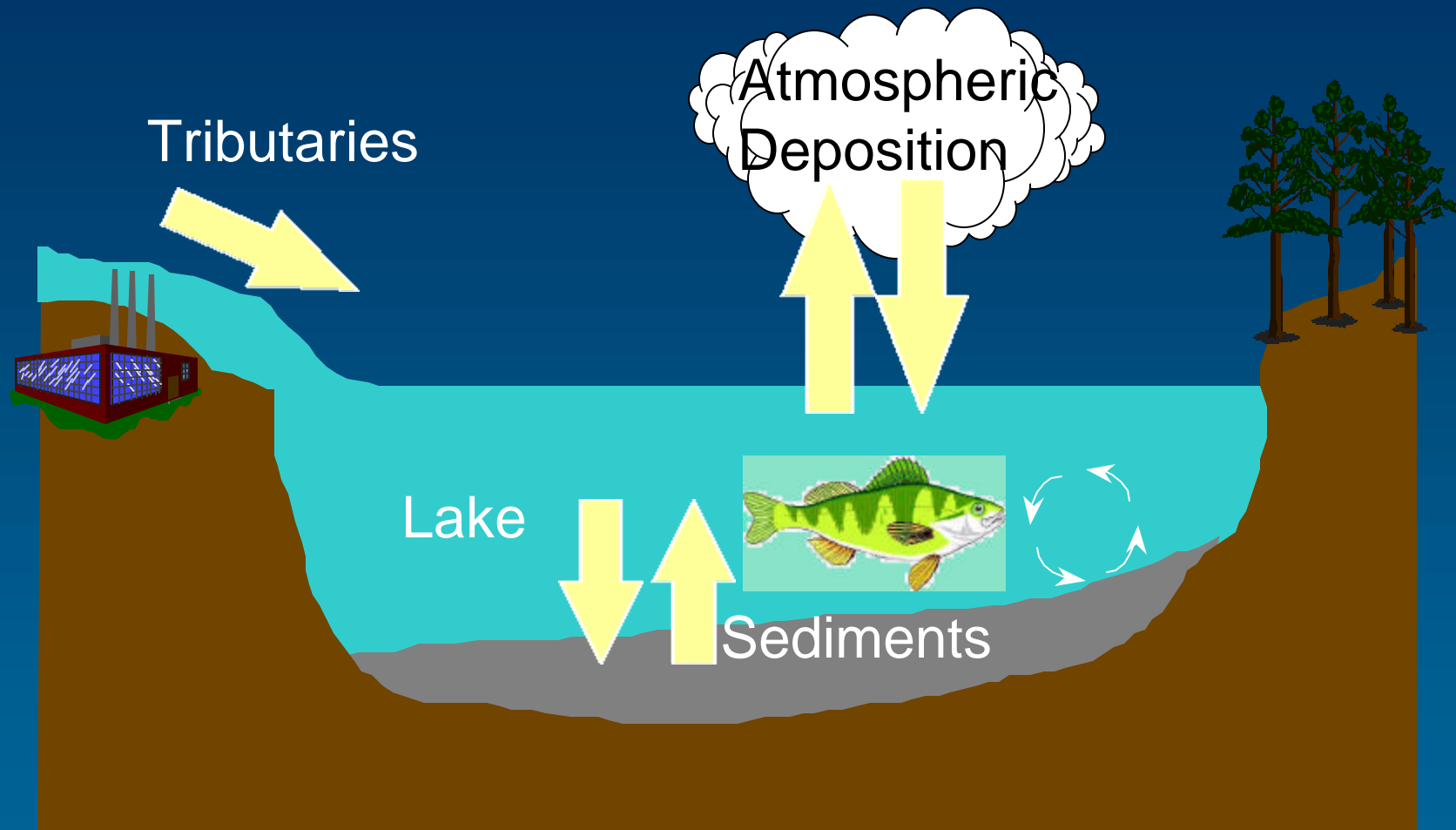


Total PCB Concentrations in Lake Michigan Lake Trout

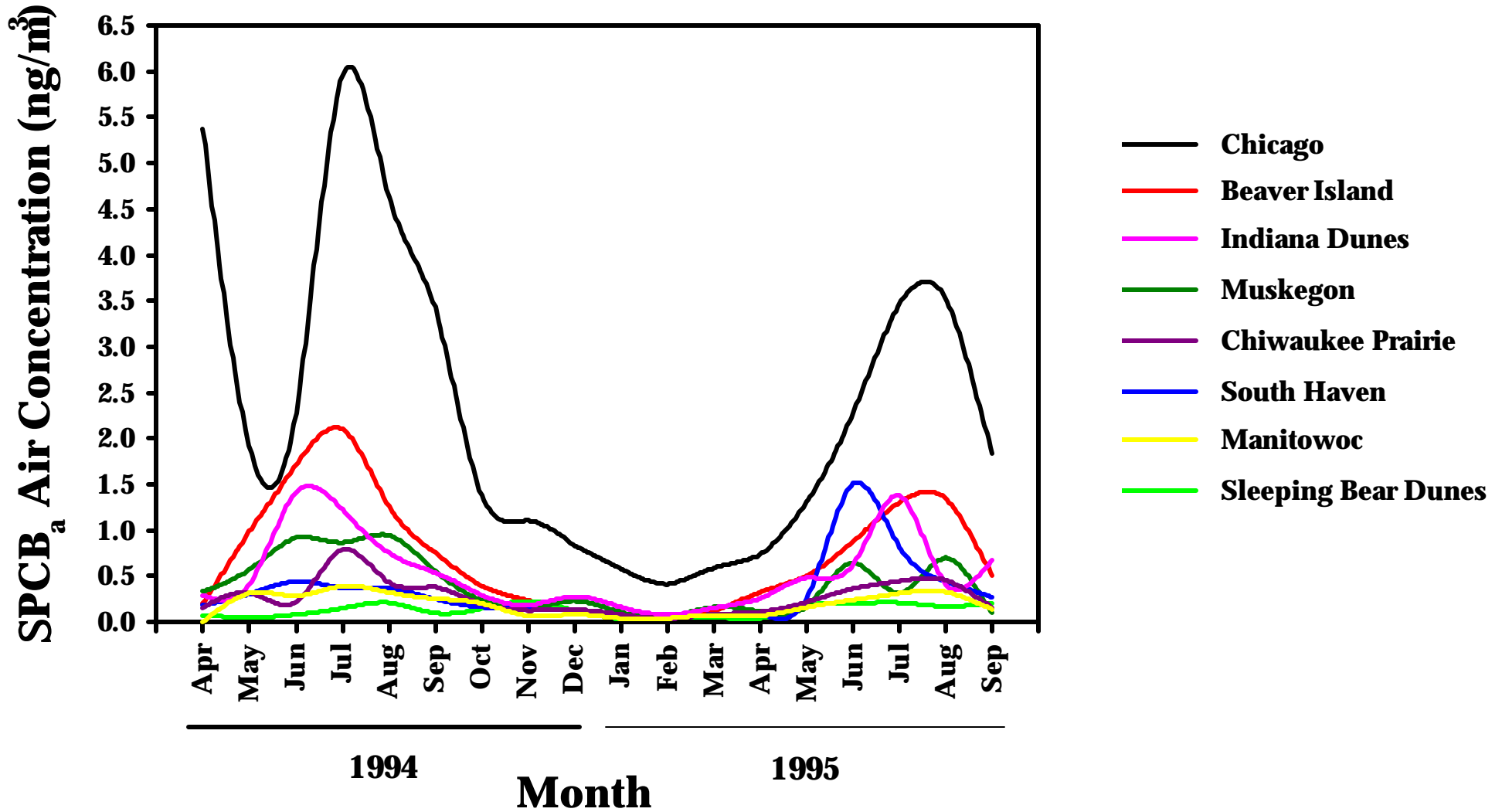
Error bars = 95% confidence limits



"Sources" of Toxics to Lake



Air Concentration Summary

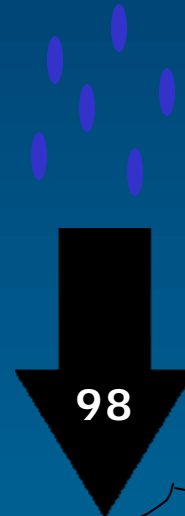


PCB loadings for Lake Michigan (kg/yr)

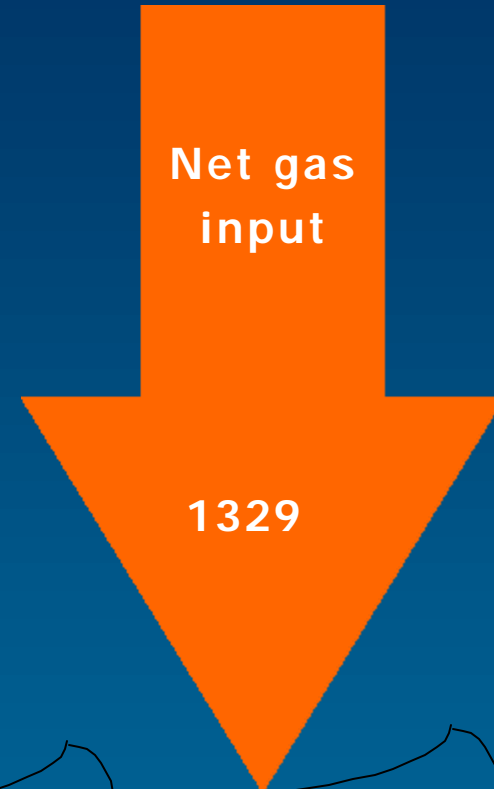
Dust, aerosols and
particulates
(Dry deposition)



Rain and snow
(Wet deposition)



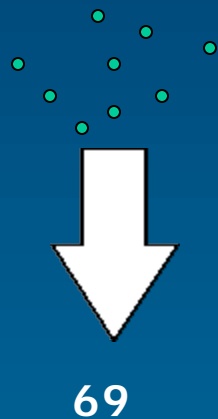
Net gas
input



$$\begin{aligned} \text{Atmospheric Loading} &= 109 + 98 + 1329 - 0 \\ &= 1536 \text{ kilograms per year} \end{aligned}$$

Mercury Loadings for Lake Michigan (kg/yr)

Dust, aerosols and
particulates
(Dry deposition)



Rain and snow
(Wet deposition)



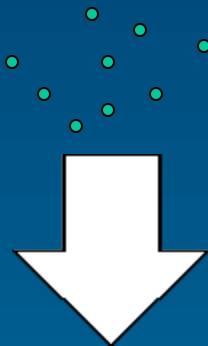
Almost equal
input and output



$$\begin{aligned}\text{Atmospheric Loading} &= 69 + 614 + 506 - 460 \\ &= 729 \text{ kilograms per year}\end{aligned}$$

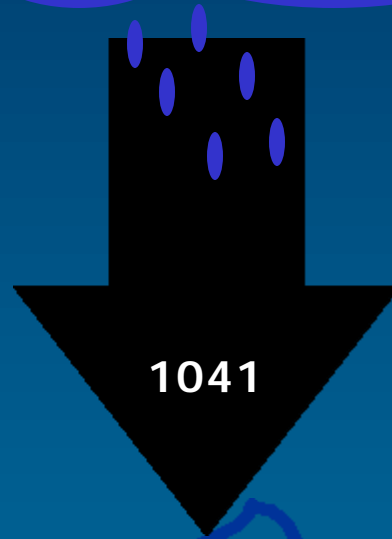
Atrazine loadings for Lake Michigan (kg/yr)

Dust, aerosols and
particulates
(Dry deposition)



208

Rain and snow
(Wet deposition)



1041

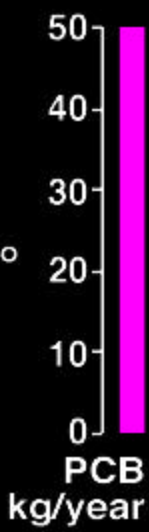
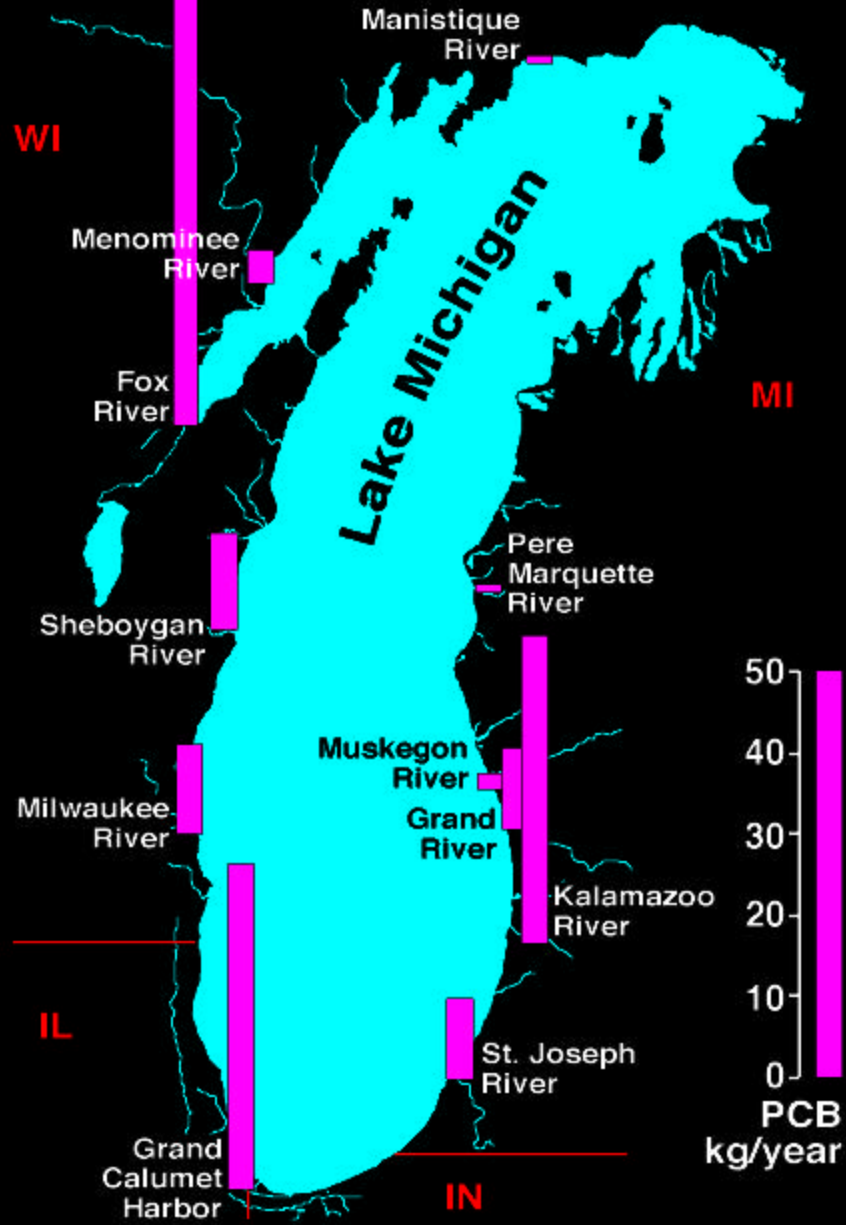
Net gas input



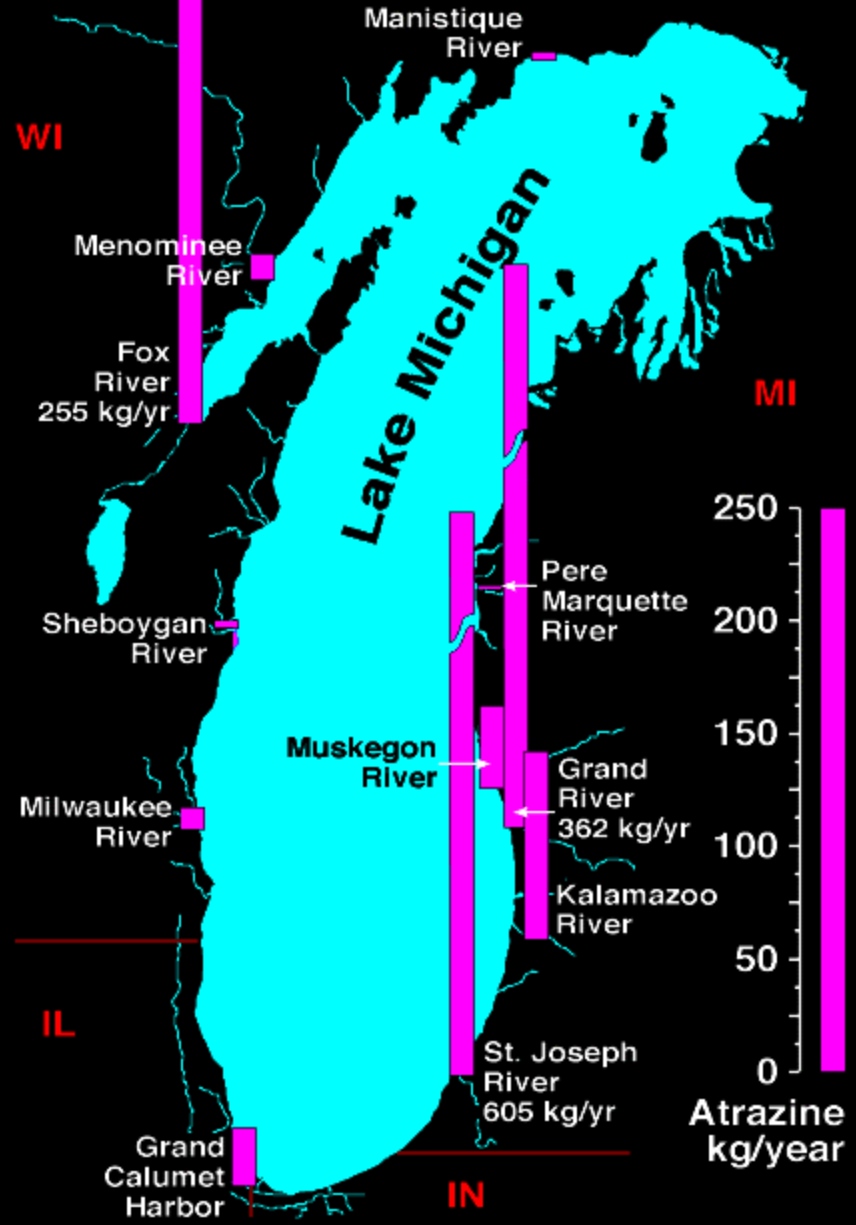
445

$$\begin{aligned}\text{Atmospheric Loading} &= 208 + 1041 + 445 - 0 \\ &= 1694 \text{ kilograms per year}\end{aligned}$$

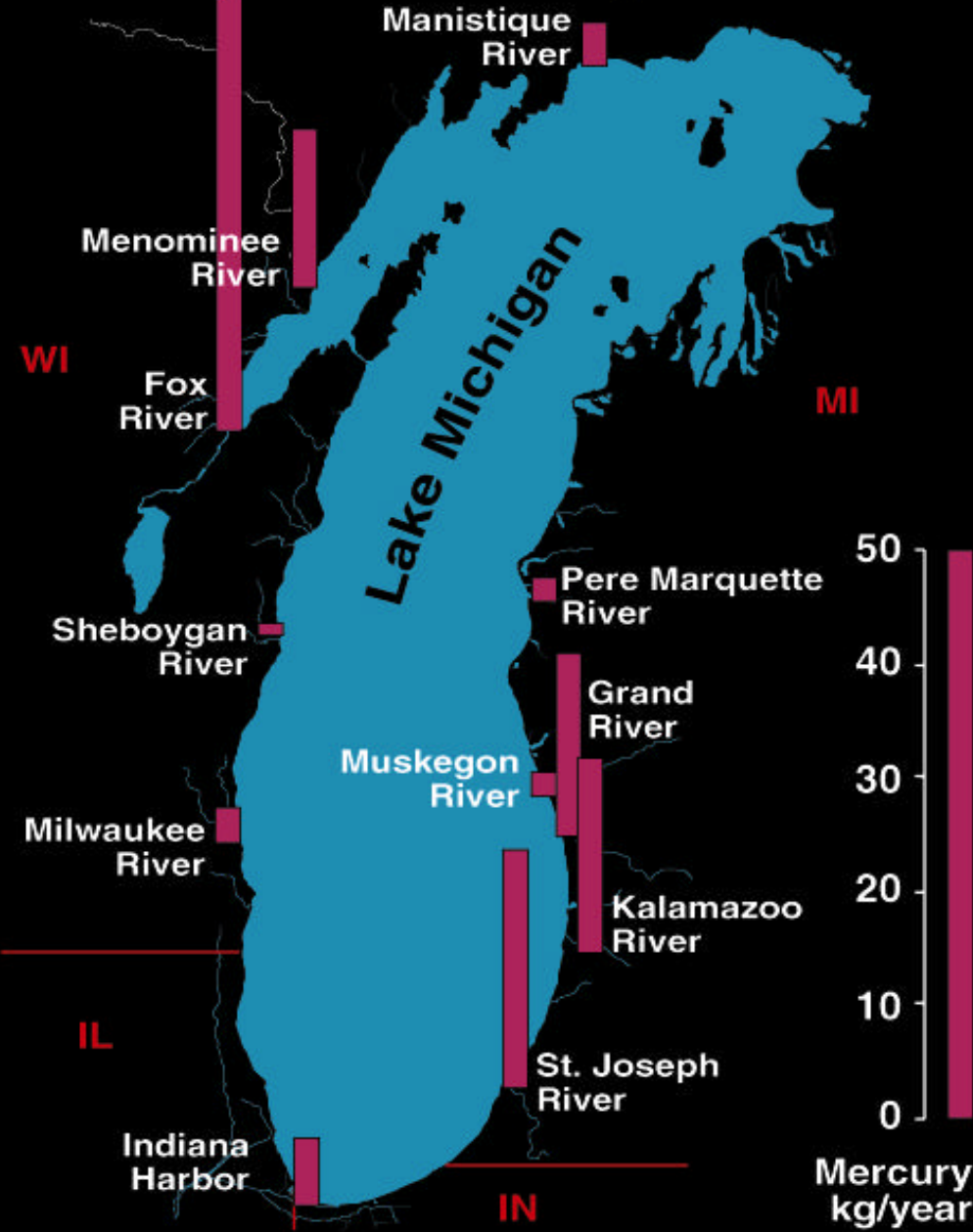
PCB Loads (kg/year) to Lake Michigan from Major Monitored Tributaries, 1994



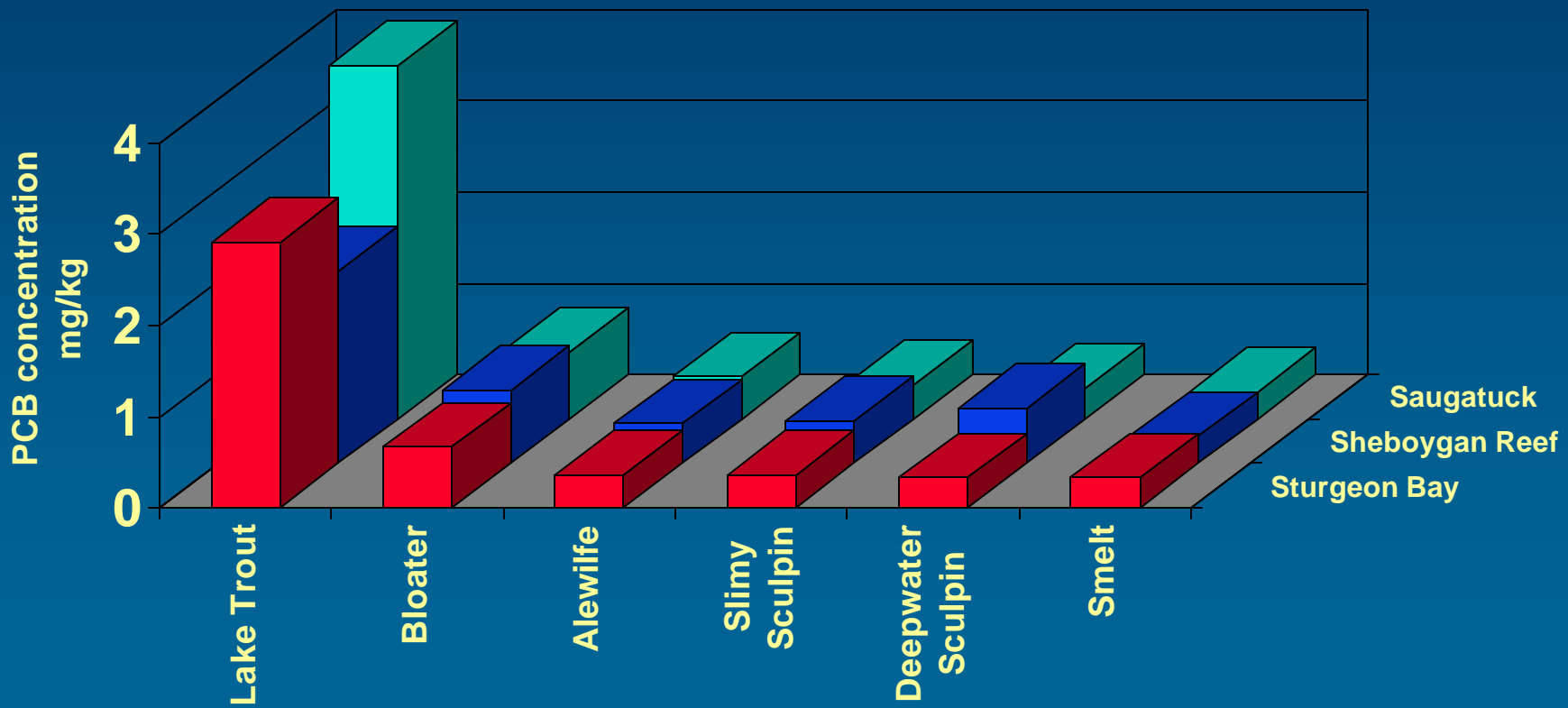
Atrazine Loads (kg/year) to Lake Michigan from Major Monitored Tributaries, 1995



Lake Michigan Major Tributary Mercury Loads, 1995



LMMB Biota: PCBs in Predator and Forage Fish



Causes and Sources

A photograph of a beach scene. In the foreground, a large, intricate sandcastle sits on the sand. In the middle ground, three people (two adults and a child) are standing near the water's edge, looking out at the ocean. The background shows waves breaking on the shore under a bright sky.

- Man's imprint on the land sprawl, endangered species, runoff, incinerators large and small
- Lake Michigan Monitoring Coordinating Council (LMMCC) formed to address indicators in coordinated effort

Goal and Vision

- *“To restore and protect the integrity of the Lake Michigan ecosystem through collaborative, place-based partnerships.”*
- **To create** *“a sustainable Lake Michigan ecosystem that ensures environmental integrity and that supports and is supported by economically viable healthy human communities.”*

Acknowledgements

- Agency for Toxic Substances and Disease Registry
- Chippewa-Ottawa Treaty fishery Management Authority
- Grand Traverse Band of Ottawa and Chippewa Indians
- Great Lakes Fishery Commission
- Illinois Environmental Protection Agency

Acknowledgements

- Indiana Department of Environmental Management
- Michigan Department of Environmental Quality
- Oneida Tribe, Wisconsin
- US Army Corps of Engineers
- US Department of Agriculture, NRCS

Acknowledgements

- US Environmental Protection Agency
- US Fish and Wildlife Service
- US Geological Survey
- Wisconsin Department of Natural Resources