Mercury Impaired Waters & TMDL Process

Marcia T.Willhite
Bureau of Water
Illinois Environmental Protection Agency

Water Quality Standards

- Water quality criteria sufficient to protect the designated uses
  - Criteria are elements of State W.Q. standards, expressed as constituent concentrations level (numeric value), or narrative statements, representing the quality of water that supports a particular use. When criteria are met, W.Q. will generally protect the designated use.
- An antidegradation policy consistent with 40 CFR Part 131.12

Water Quality Standards

- Use designations
  - ✓ Aquatic Life
  - ✓ Swimming
  - ✓ Drinking Water
  - ✓ Recreation
  - ✓ Agricultural
  - ✓ Industrial

Clean Water Act Section 303(d) Requires States to…..

- Identify waters which are not meeting applicable water quality standards/designated uses
- Establish priority ranking for those waters taking into account the severity of pollution and the uses to be made of such waters
- Target waters for the development of TMDLs

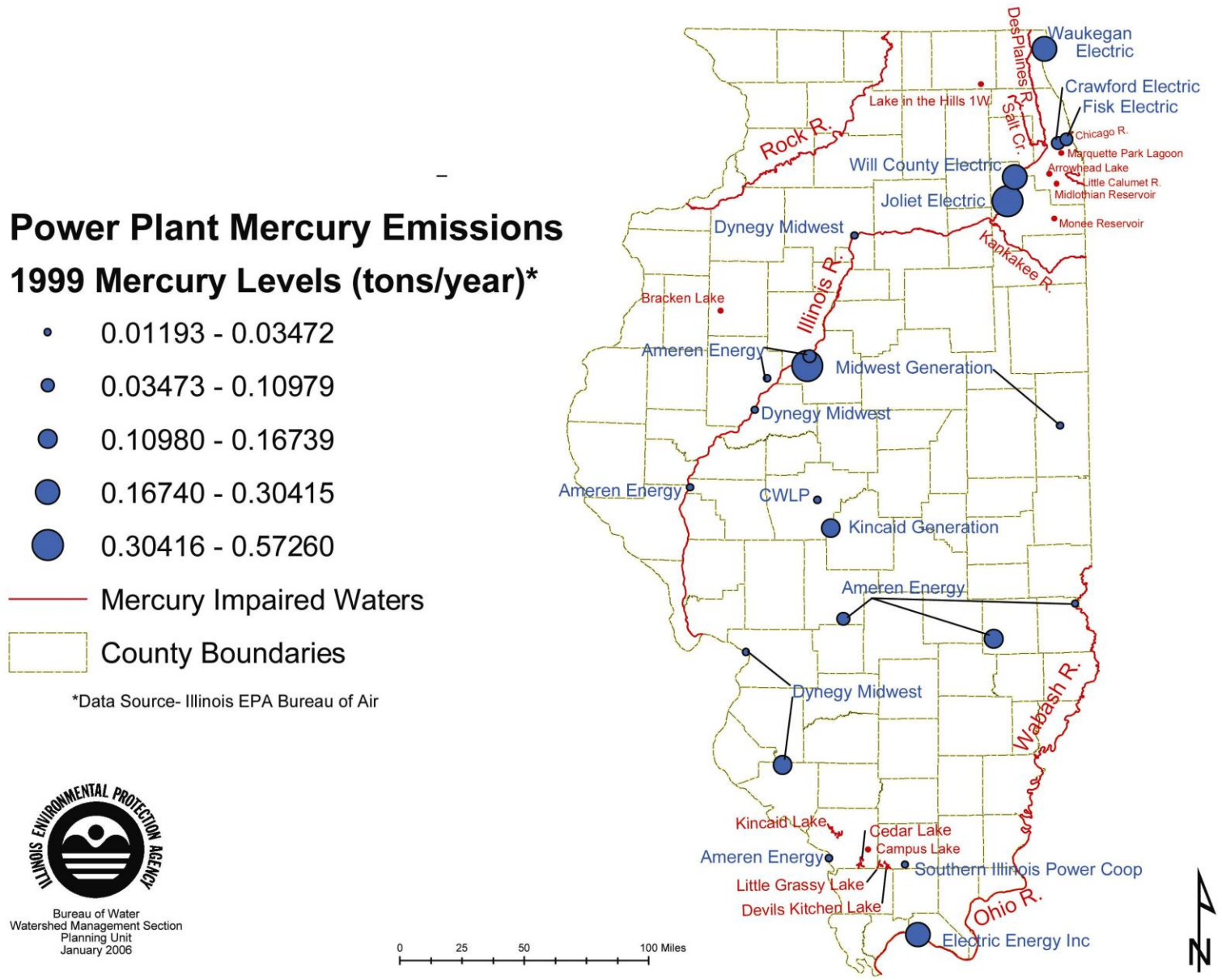
What Waters Have To Be On The 303(d) List

- Waters for which assessments of less than full support based on recent chemical, physical and biological data
- Waters previously listed on approved 303(d) Lists
- Waters with sport fish consumption advisories
- Waters impaired by NPS only

Use Assessment

- Statewide fish consumption advisory
  - no more than 1 meal per week based on mercury and PCB
- Waterbody specific advisory
  = not supporting

Mercury Impaired Waters and Power Plant Emissions



What is a TMDL?

- A TMDL determines the greatest amount of loading that a water can receive without violating Water Quality Standards/Designated Uses

TMDL Components

TMDL = WLA + LA + MOS + SV

- WLA = Waste Load Allocation (Point Source)
- LA = Load Allocation (Nonpoint and Natural Background Sources)
- MOS = Margin of Safety (Scientific Uncertainty & Future Growth)
- SV = Seasonal Variation

Determining Loading

- Easy for point sources
  (concentration x flow)
- Usually need to model loading from non-point sources
  - characterize runoff
    based on land use, soil characteristic, topography
  - GWLF, SWAT

Loading from Atmospheric Deposition

- Monitoring
  - Mercury Deposition Network
    - used in Georgia TMDLs
    - low coverage
    - wet deposition only
  - Dry deposition monitoring
  - Episodic

Loading from Atmospheric Deposition Cont'd

- Sediment cores
- Modeling
  - photochemical, chemical transport, global-scale cycling
  - source – receptor
  - results confusing

Endpoint

- Typically the numeric water quality standard or some numeric surrogate

- Calculate load reduction needed to meet water quality standard

Challenge for Mercury

- Endpoint of interest for mercury is level in fish tissue
- How does loading to water translate to bioaccumulation in fish?

Different Approaches

- Water column level designed to protect against bioaccumulation
  - 12 ppt (1986 national criterion)
  - 1.7 – 7.4 ppt (Methodology for Deriving Ambient Water Quality Criteria for Protection of Human Health, EPA 2000)
  - confounder – monitoring data shows low correlation

Different Approaches Cont'd

- Modeling
  - Everglades Mercury Cycling Model
  - Predicted 1:1 relationship between atmospheric deposition input and tissue accumulation

Final Challenge: Implementation

- Traditional contributors to water impairment come from within watershed
- Implementation stays within watershed
- Mercury from atmospheric deposition – sources can be outside watershed, state, nation

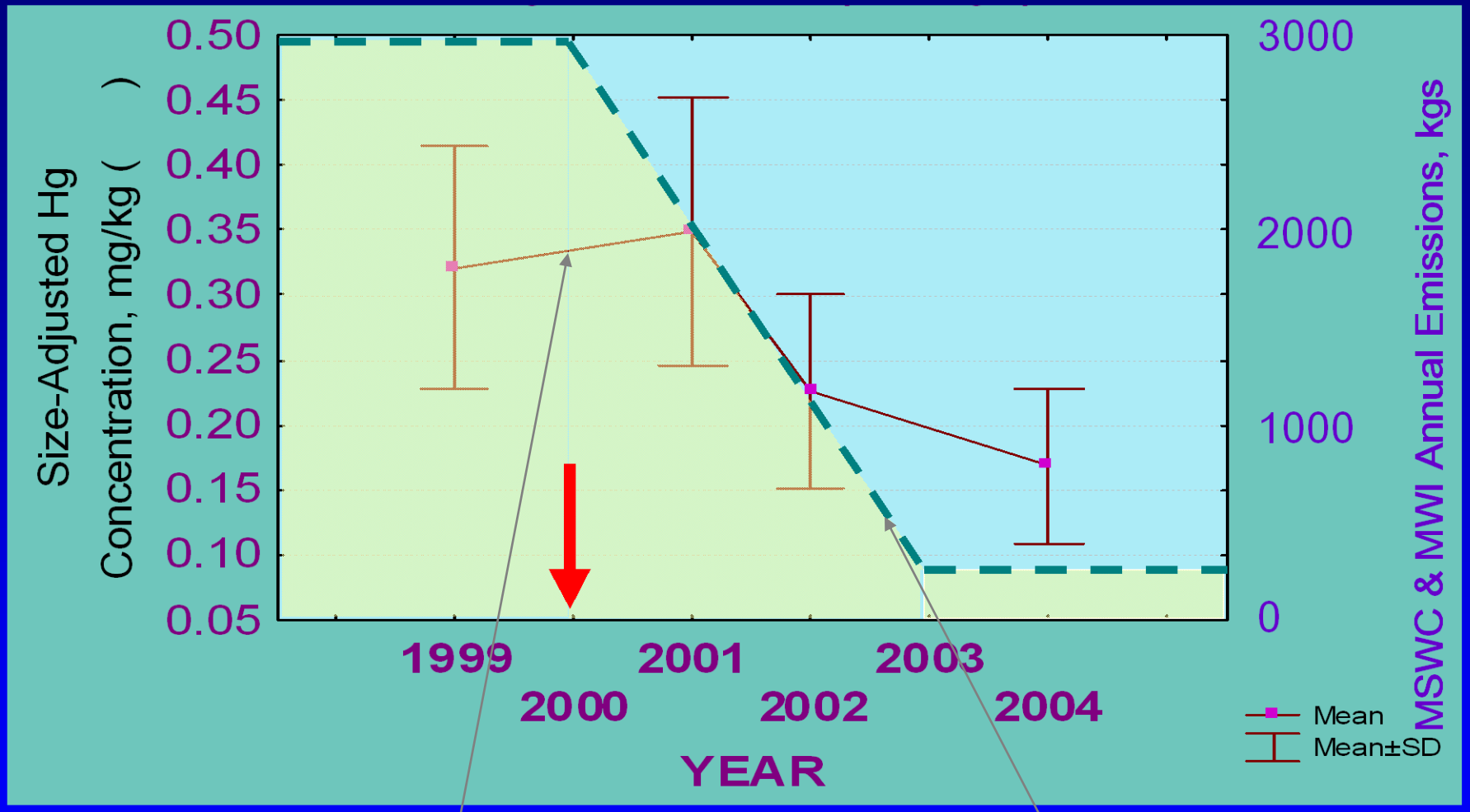
First Challenge:

- Understanding loading for a particular waterbody = clearer picture of importance of local, regional & global sources of atmospheric deposition at that location

Mercury Trends

Recent Data From Florida
& Elsewhere

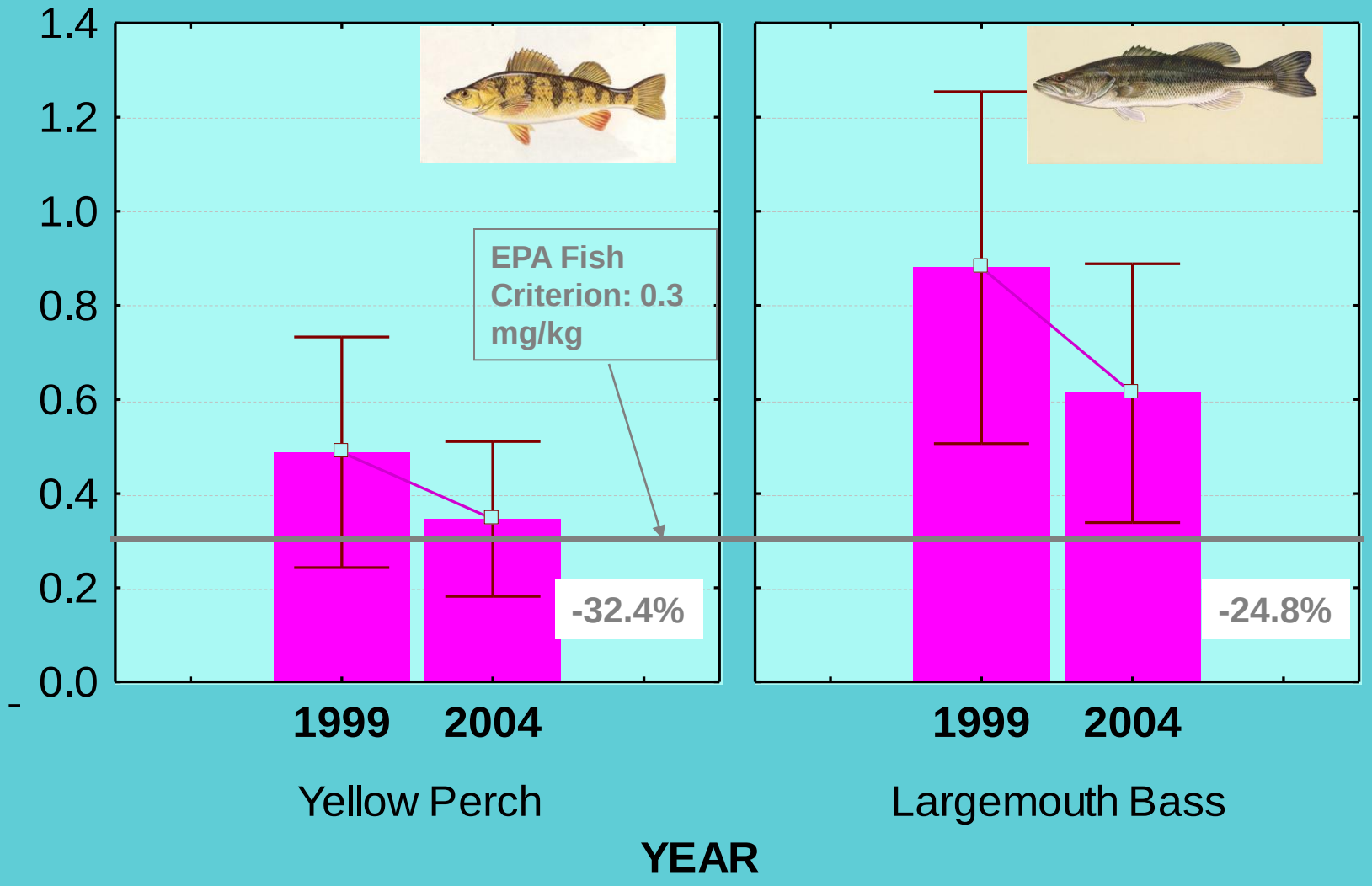
Representative Fish Tissue Mercury and Incinerator Emissions Changes Versus Time in NE MA.



Fish Hg

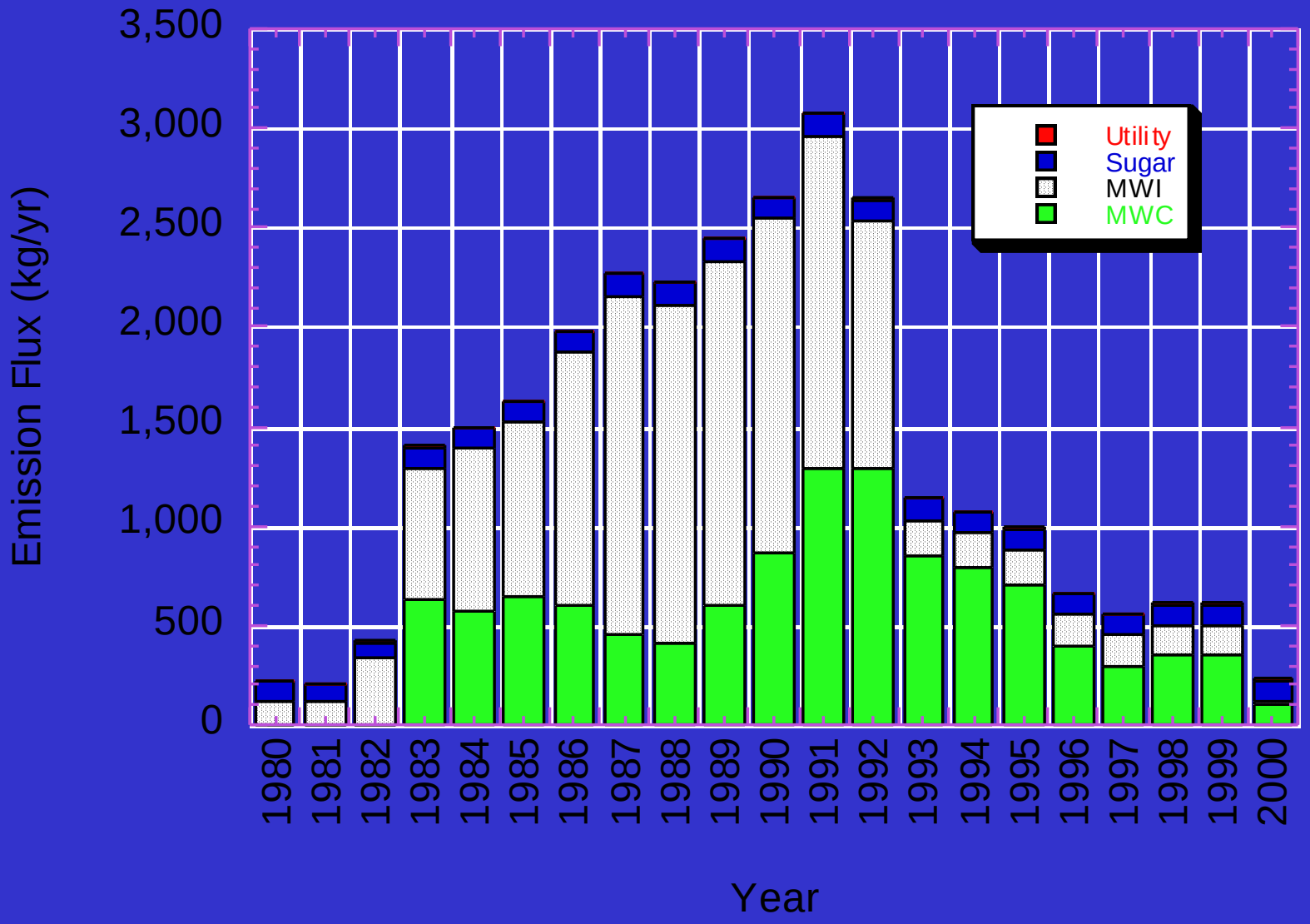
Hg emissions

Average Fish Mercury Concentrations in NE MA in 1999 and 2004

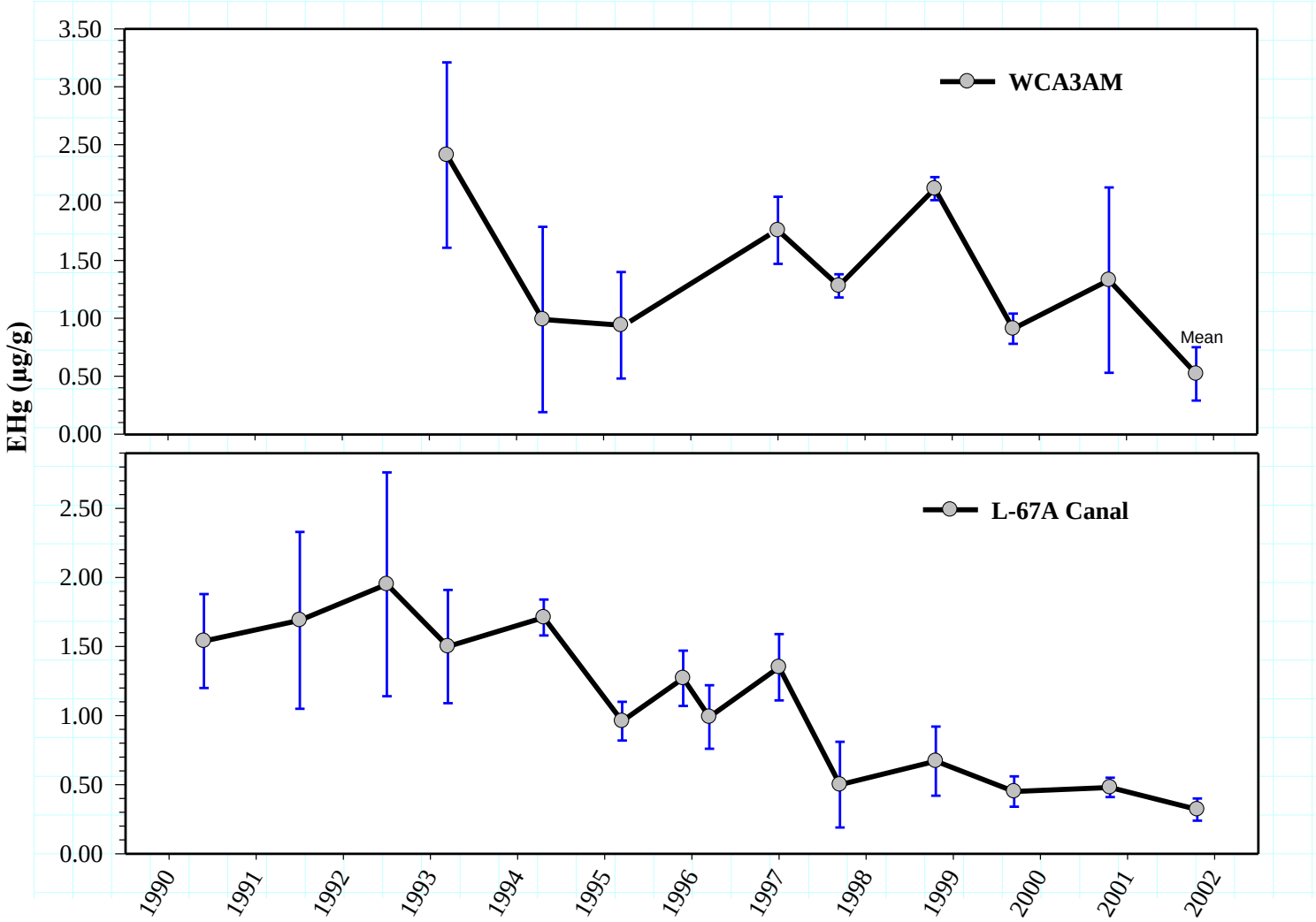


C. Mark Smith PhD, MS. 2005.

Changes in South Florida Emissions of Hg Based on Emission Inventory. From RMB Associates (2002).



Mercury in Largemouth Bass at a long-term trend monitoring site



Data from Lange, 2002

MERCURY: The Bottom Line

- Reduction of atmospheric sources of mercury from within Florida has led to ~ 80% declines in mercury in Everglades fish and wildlife in less than 15 years since peak deposition.
- To the extent that mercury emissions are in the reactive form (RGM) one can expect to see benefits at local or regional scale within years to decades.
- The main driver of the Everglades mercury problem is mercury load - overwhelmingly from atmospheric deposition.
- There is synergy with co-deposition of Hg & Sulfate, which combine to exacerbate Hg methylation.