Mercury Concentrations in Crayfish Collected From New York Streams (1989-2001)

Stephanie Johnson, SUNY-ESF, Syracuse, NY

Karen Riva-Murray, USGS, Troy, NY

Robert Bode, NYSDEC, Troy, NY

NYSDEC Stream Biomonitoring Unit

- Initiated in 1972
- Assess stream quality with macroinvertebrates
- 3 categories of sampling:
  - Trend monitoring
  - Site assessment
  - Waterbody assessment
- 1987 – RIBS (Rotating Intensive Basin Studies)
  - 3 monitoring networks: routine, intensive and biological screening
  - Basins studied for 3 years
  - 5-yr rotation

The Dataset

- Macroinvertebrate tissue data collected between 1989-2001
- ~16,000 tissue samples analyzed
- 5 groups of invertebrates
- 83 different contaminants
- Purpose: Monitor water quality by use of macroinvertebrates

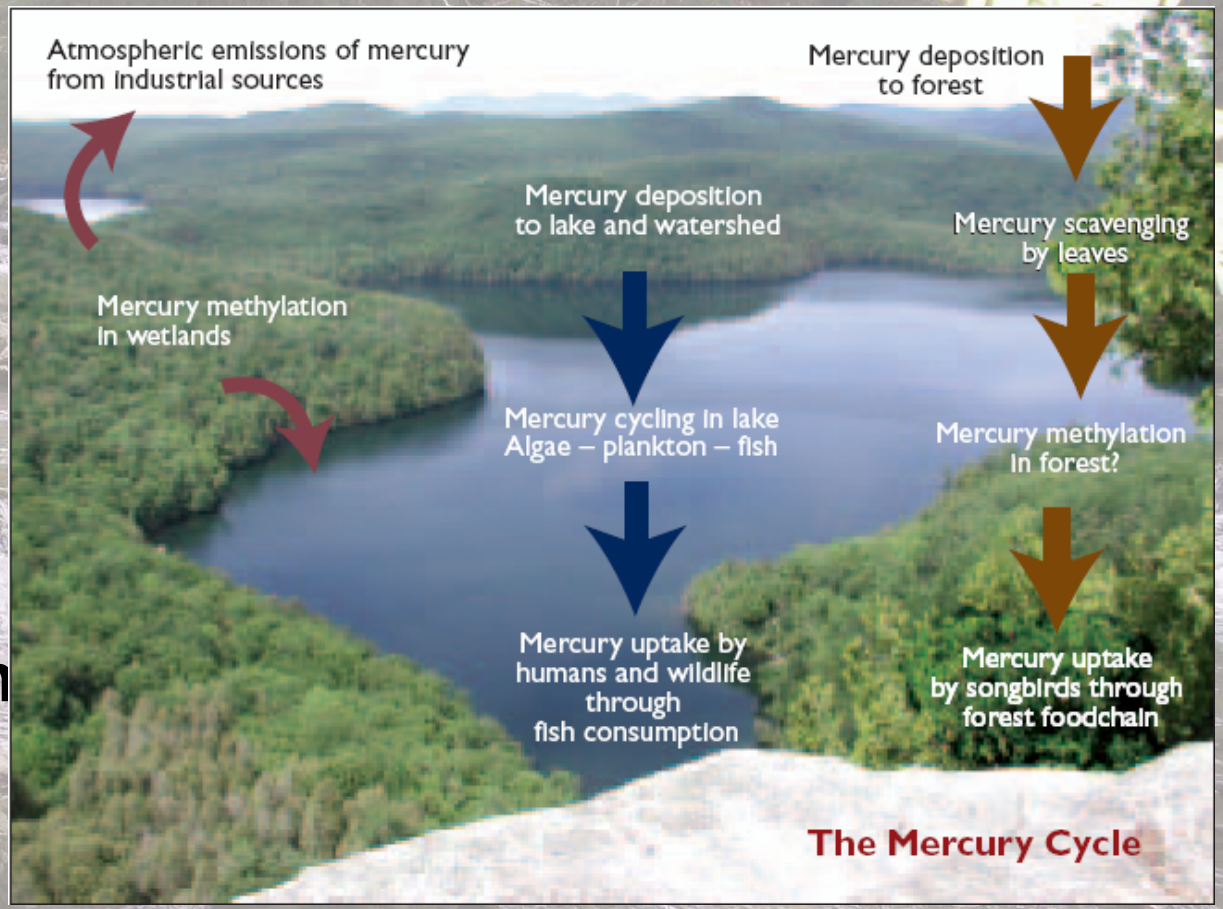
Goals

- Examine potential spatial patterns of mercury in crayfish
- Identify factors, if any, influencing mercury distribution
- Update the Provisional Level of Concern for mercury

Why Mercury?

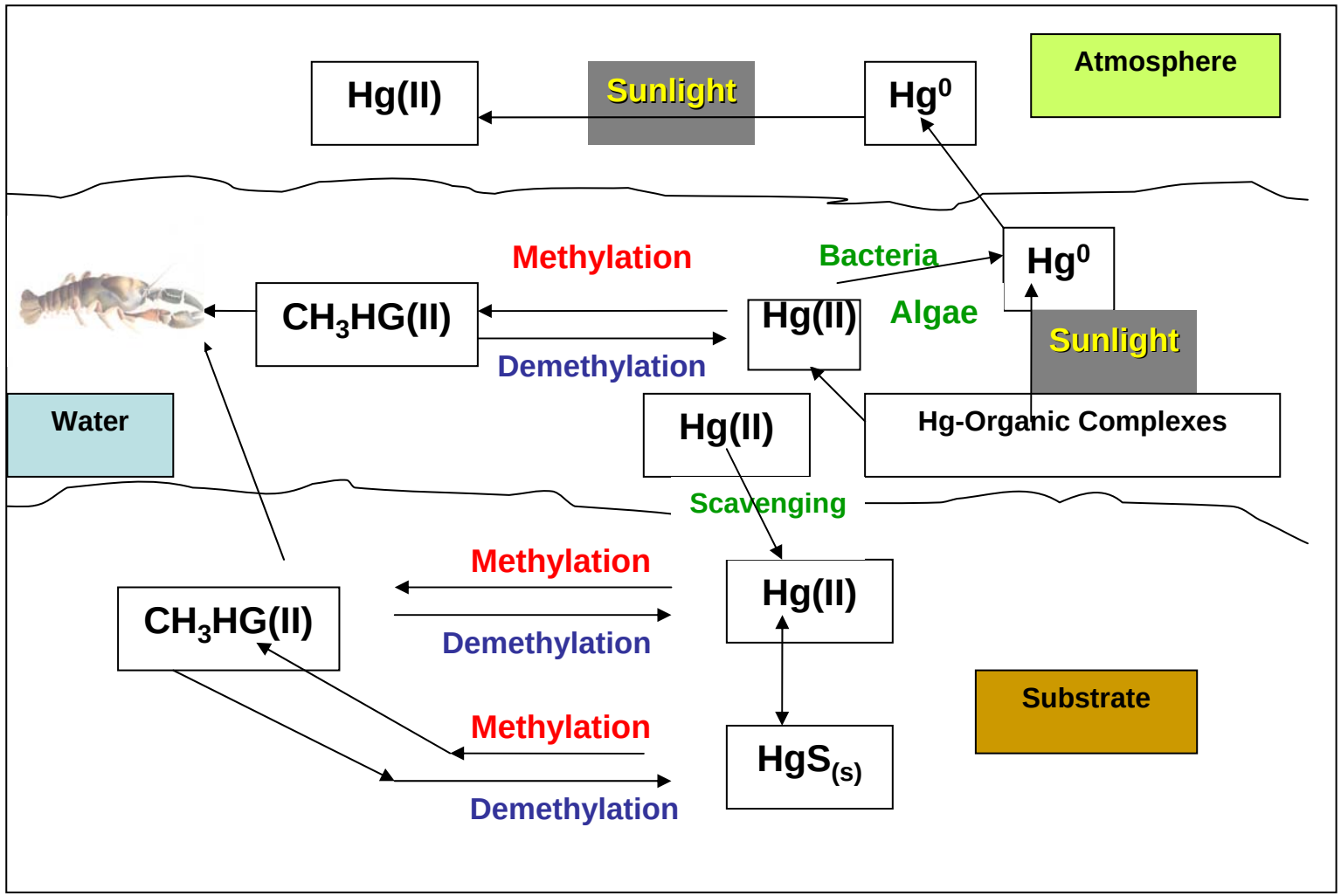
Focus on Mercury:
The mercury cycle

- Atmospheric deposition
- Anthropogenic input
- Bioaccumulation
- Biomagnification
- Fish consumption advisories



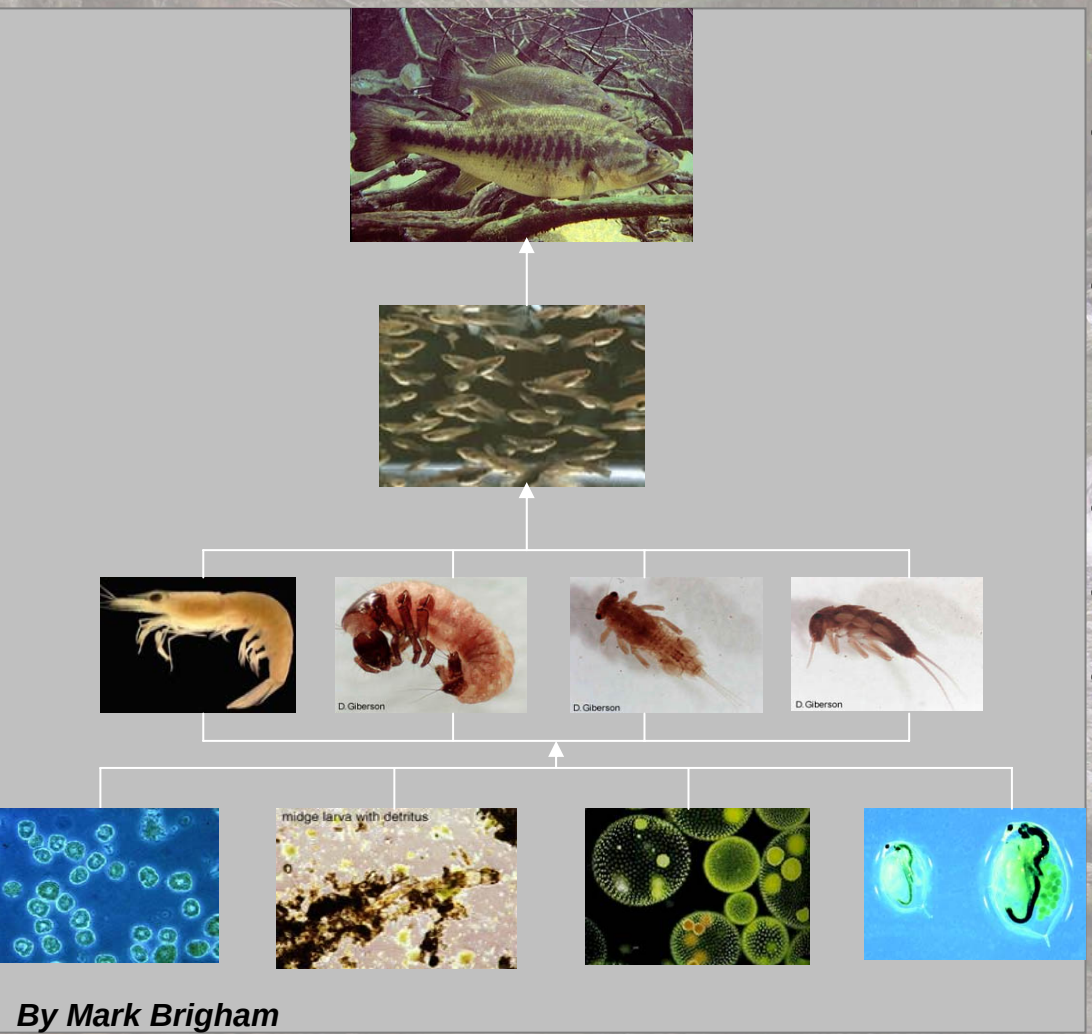
Biodiversity Research Institute, 2005

Focus on Mercury: The mercury cycle



Why Crayfish?

Crayfish
Their role in assessing stream quality



- Less migratory than fish
- Can occupy various feeding levels, from detritivore to carnivore
- Important prey species
- Wide distribution
- Limited stream data

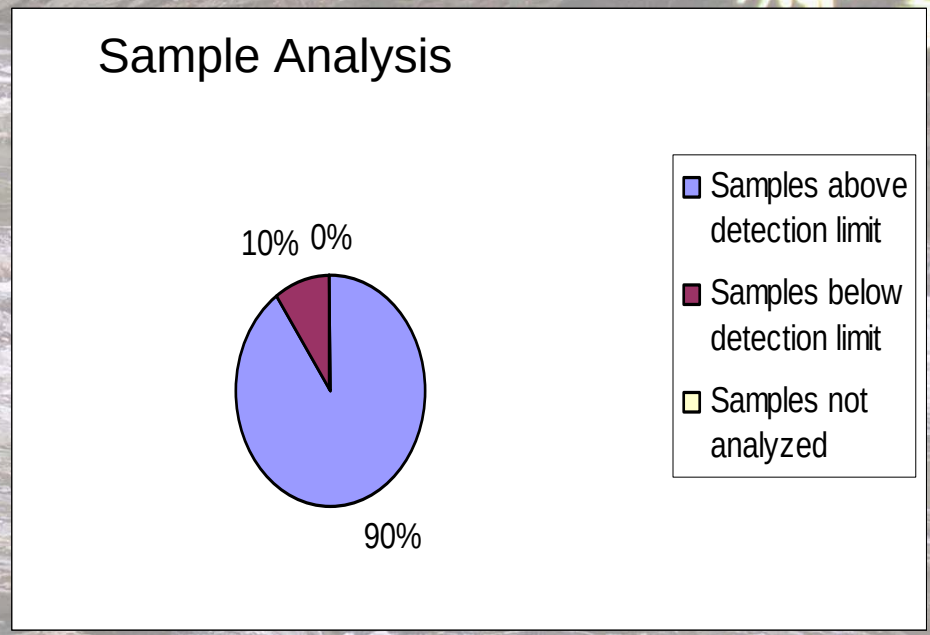
By Mark Brigham

Methods

- **Field:**
  - **Hand pick**
  - **Site selection**
- **Laboratory:**
  - **Whole body (dry wt.)**
  - **Length and weight**

Findings and Methods

- 58% of samples were crayfish
- Samples collected from 197 locations in 16 basins
- Detection limit:
  - Converted to half the minimum detection level of 0.03 µg/g
  - Divided by 3.5 to get wet weight
  - Value = 0.004 µg/g



Findings and Methods (cont'd)

- **Provisional level of concern (PLOC):**
  - **Facilitates 'red flag' concentration for macros across the state**
  - **Samples above 97th percentile**

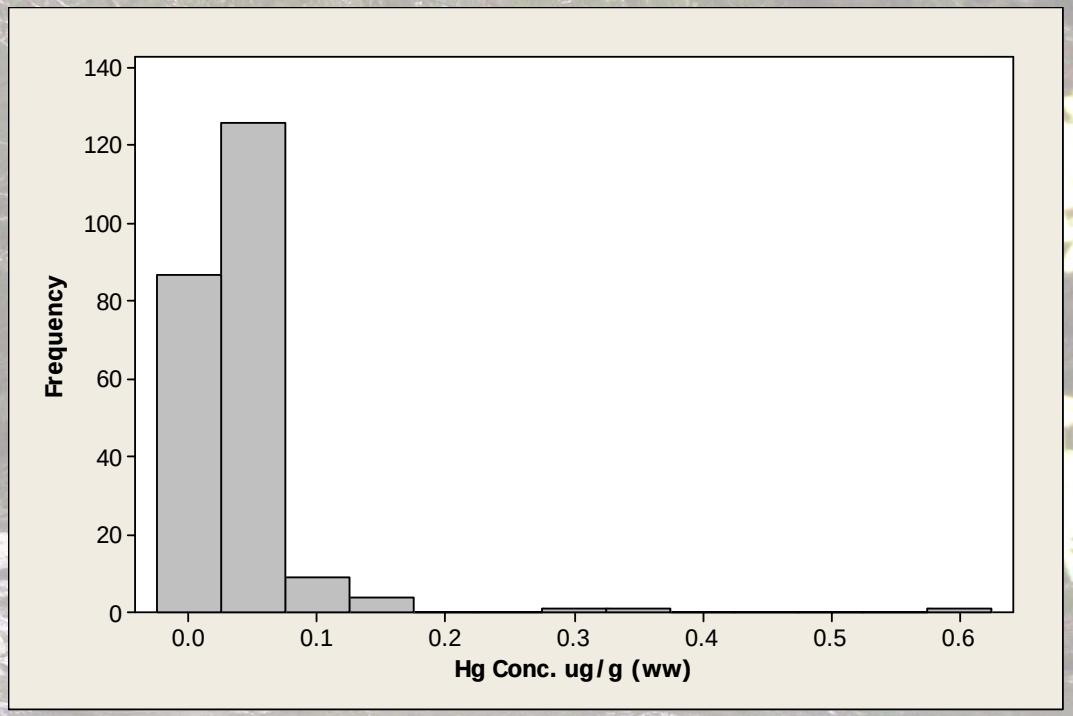
Calculated PLOC: 0.075 µg/g

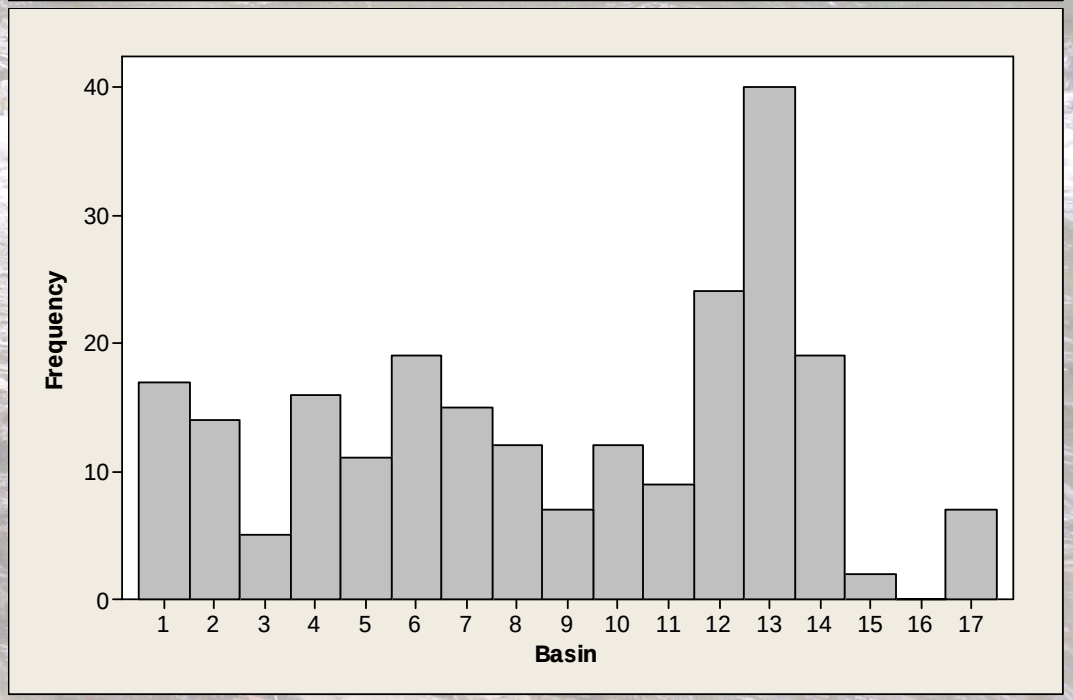
Previous PLOC: 0.100 µg/g

Overall Mercury Stats (value in wet wt. (µg/g))	
Lower Quartile	0.018
Minimum	0.004
Median	0.029
Maximum	0.611
Upper Quartile	0.042
Mean	0.038
Standard Deviation	0.052
Provisional Level of Concern	0.075
Sample Size	229

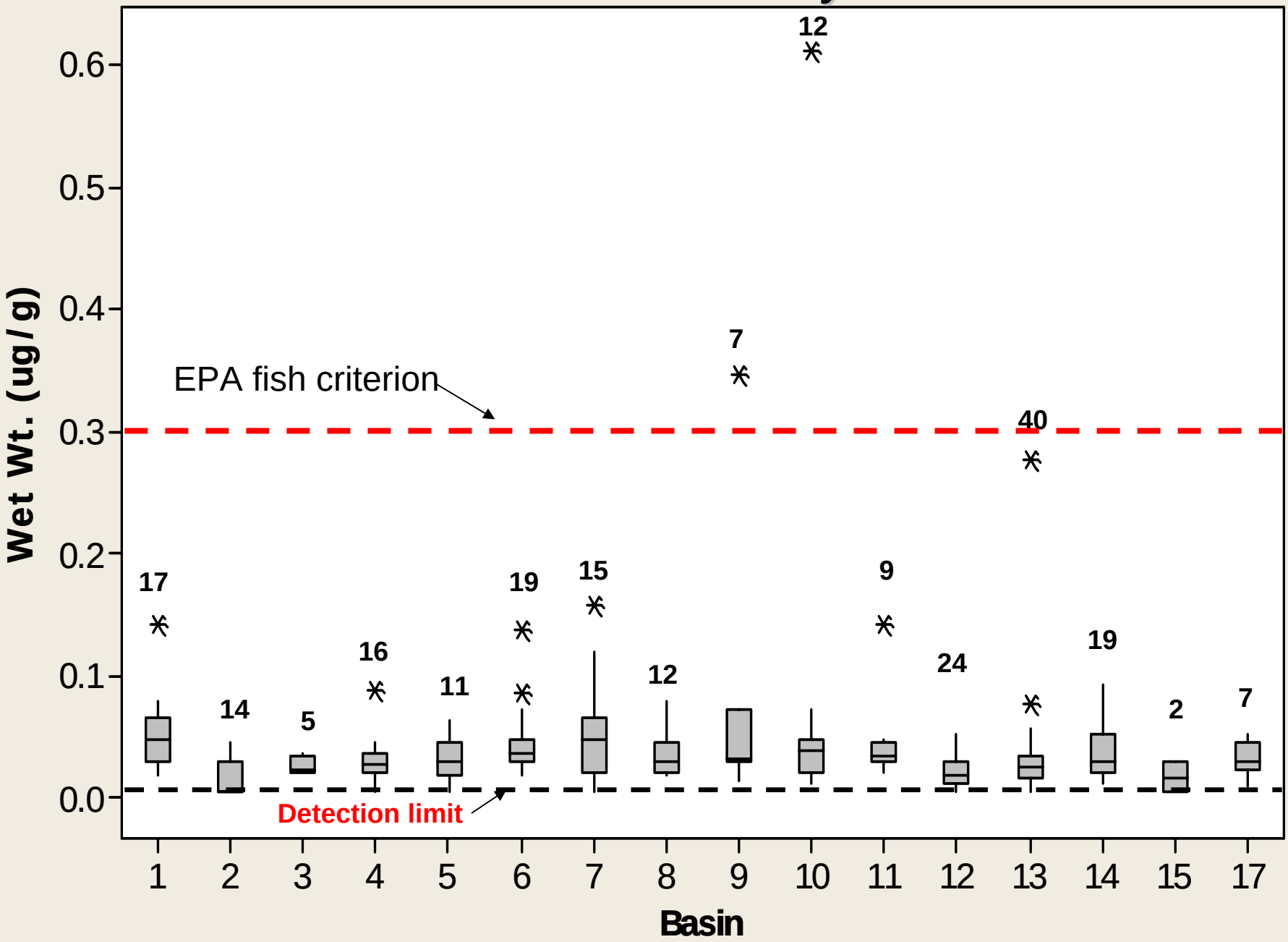
Data Distribution

- **Hg concentration range:**
  - **0.004 to 0.611 µg/g**
- **126 values between 0.025 and 0.075 µg/g**
- **The Lower Hudson was the most sampled basin (n = 40)**
- **The Housatonic Basin was not sampled**

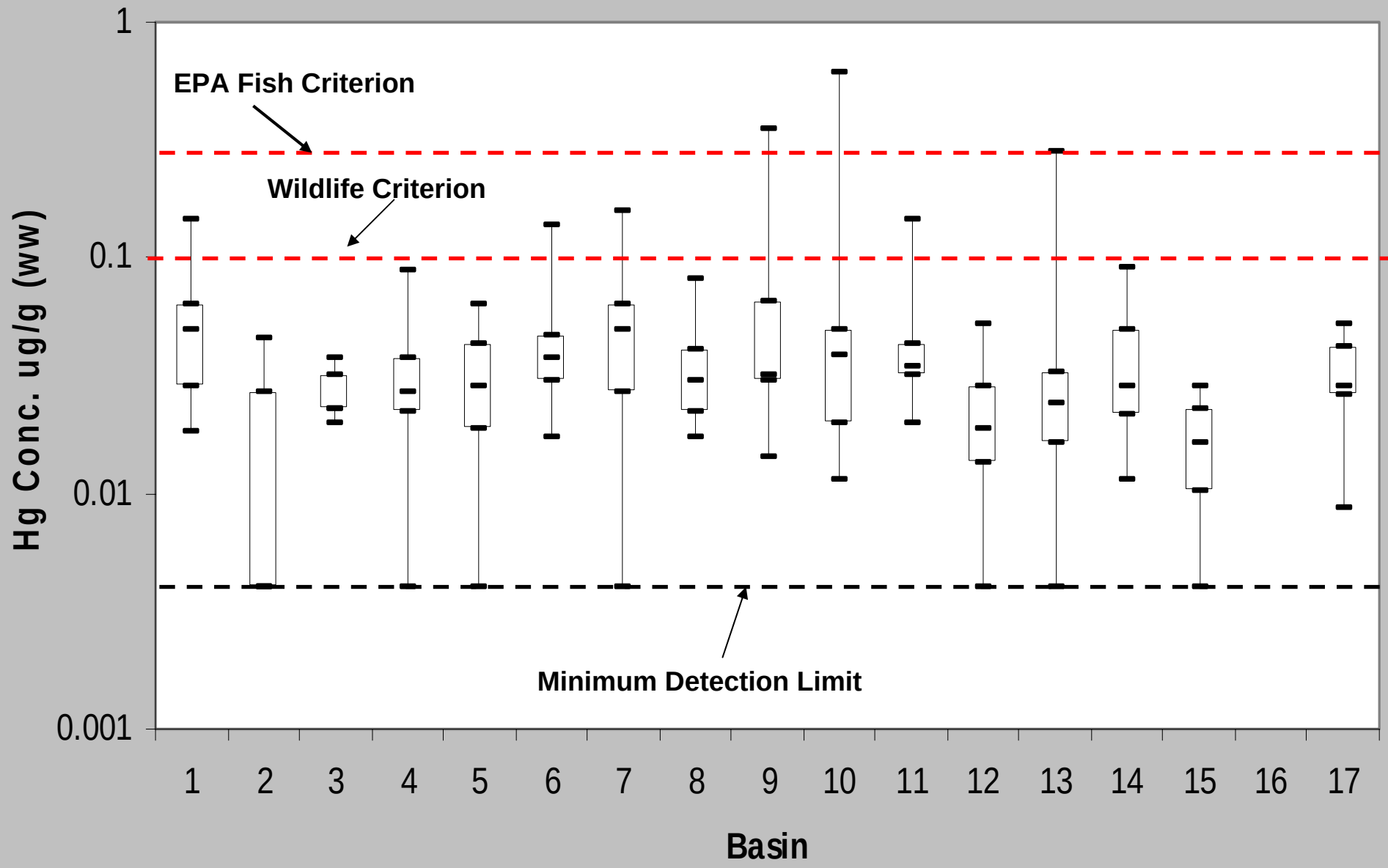




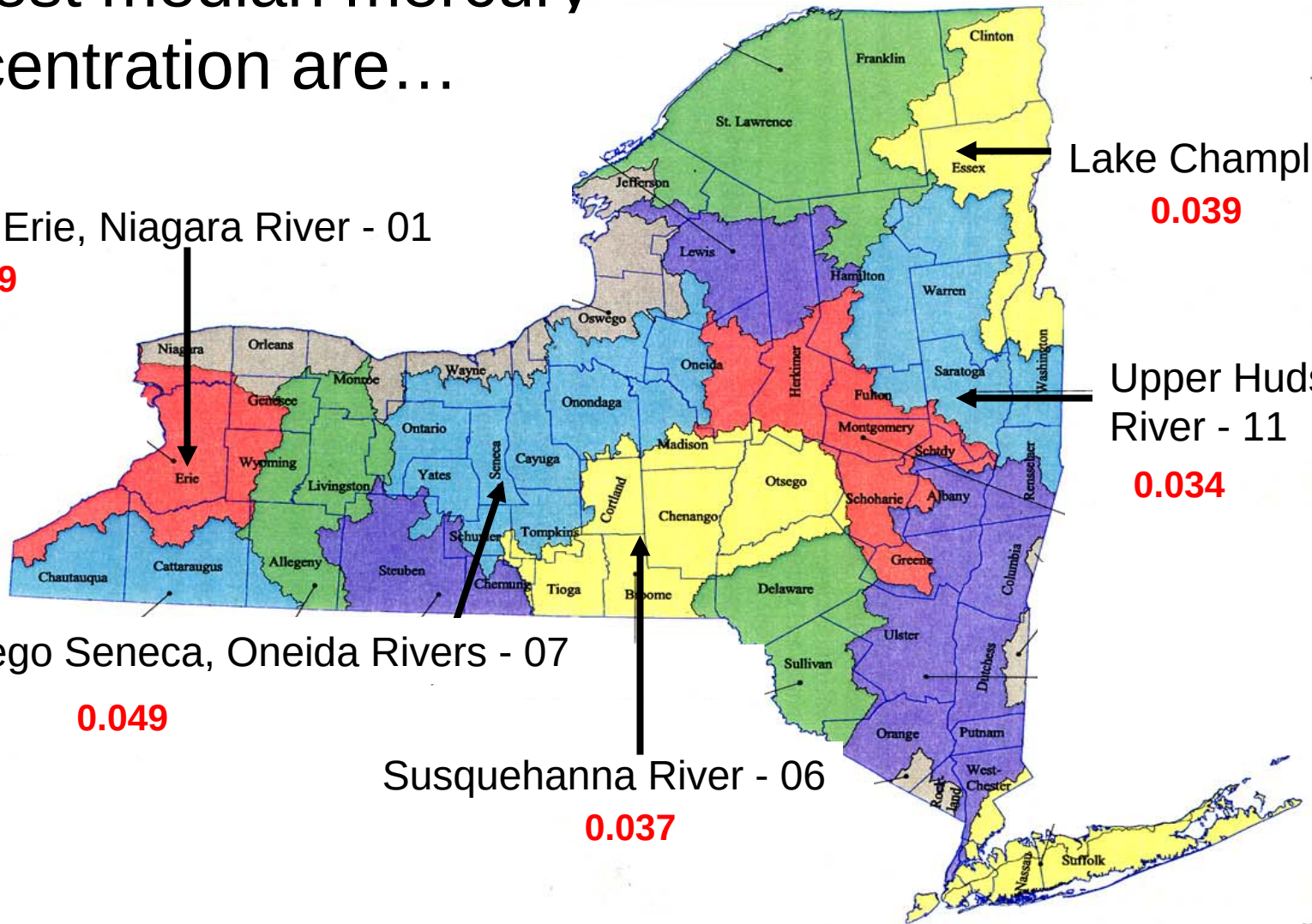
RESULTS: Crayfish



Results: Crayfish



Top 5 basins with the highest median mercury concentration are…



Lake Champlain - 10

0.039

Lake Erie, Niagara River - 01

0.049

Upper Hudson River - 11

0.034

Oswego Seneca, Oneida Rivers - 07

0.049

Susquehanna River - 06

0.037

(value is in wet weight µg/g)

Where in NYS were the Highest Hg Concentrations in Crayfish Found?

Location/ Station	Basin	Site description	Wet Wt. Concentration (µg/g)	Sampling Year
GCHZ03	10 - Lake Champlain	Great Chazy River. Champlain, above Rte. 9 bridge	0.6114	1994
GTCH01	9 – St. Lawrence	Oswegatchie River, above Fine	0.3457	1990
PATS04	13 – Lower Hudson	Patroon Creek, Albany, above I-90 pond, Central Ave.	0.2771	1991
SKAN08	7 – Seneca – Oneida – Oswego	Skaneateles Creek, below Jordan, Rte. 31	0.1571	1995
BATTA	11 – Upper Hudson	Batten Kill, Vt. Border, above 313 parking area	0.1428	1990
CAZE05A	1 – Lake Erie/Niagara River	Cazenovia Creek, Buffalo, Parkside Dr. Bridge	0.1428	1994

Potential Factors Influencing Mercury Concentrations in Crayfish

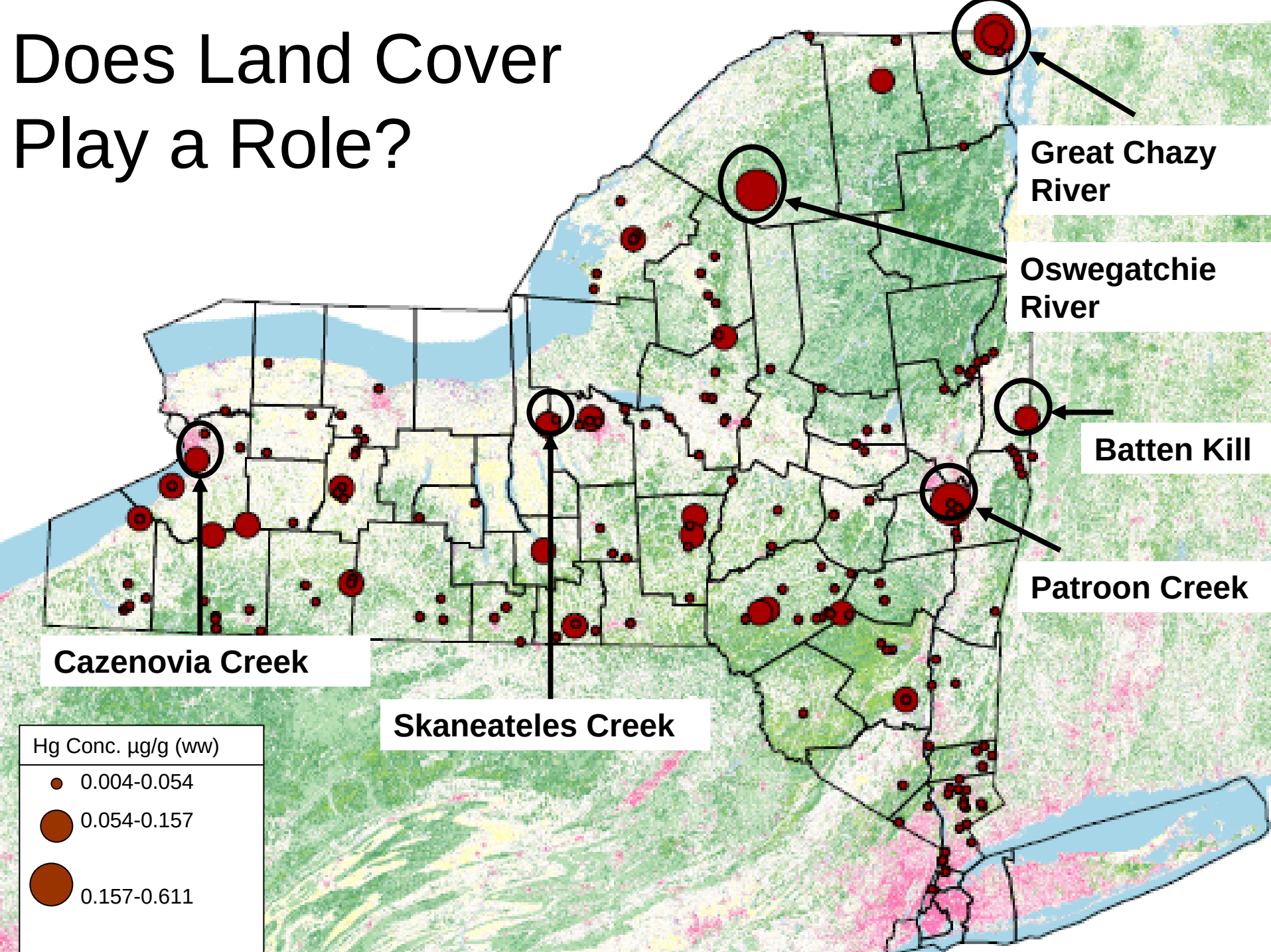
- Size
  - weight?
  - carapace length?
- Land cover
  - Urbanization?
  - Wetlands?
- Pollution
  - Point Source?
  - Non-point?

Findings: Size Analysis

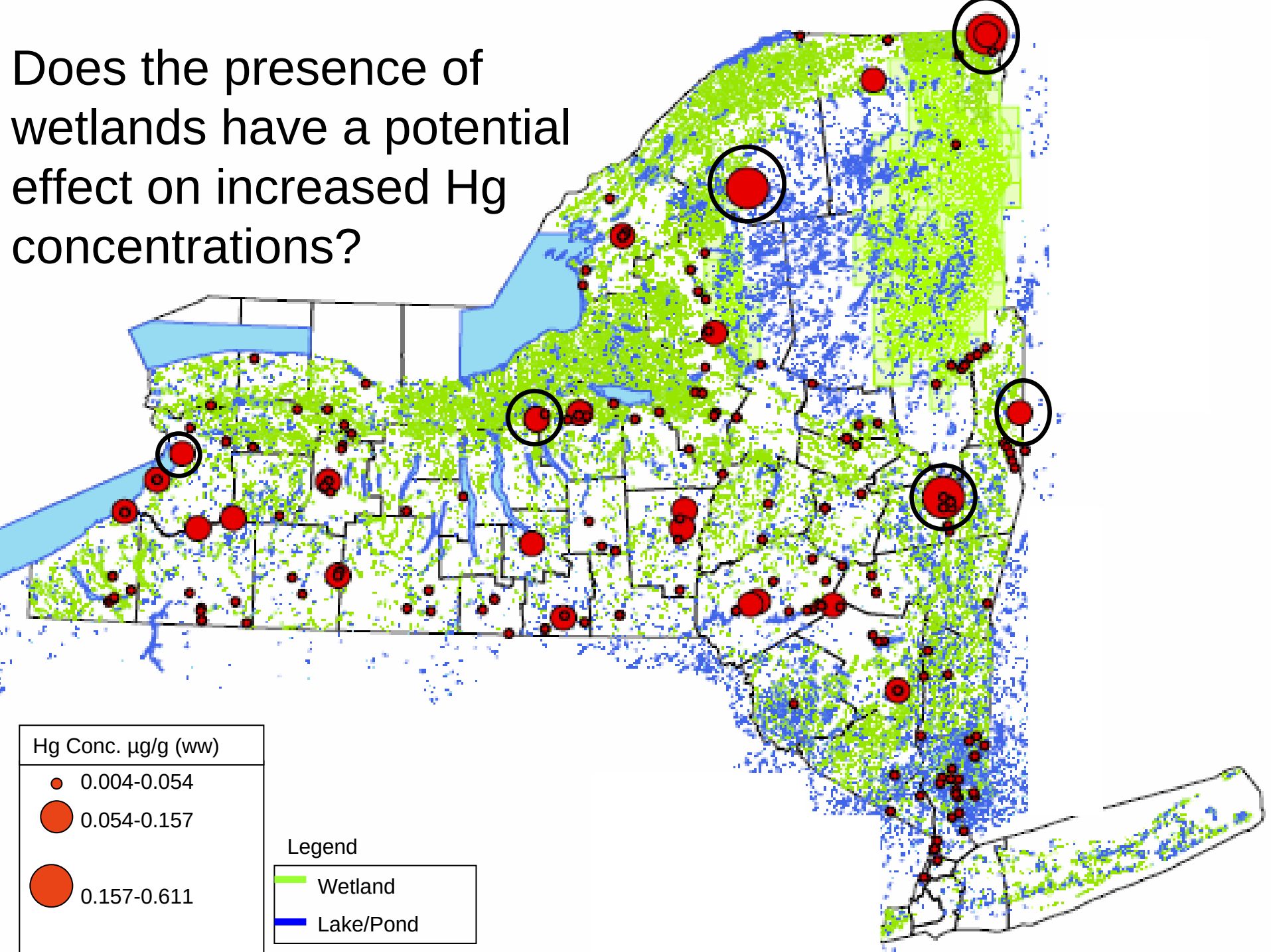
	Wet Weight (g)	Carapace Length (mm)
n	37	25
Min.	1.38	7.50
Median	4.20	26.60
Max.	20.15	47.00
Mean	5.85	25.70

*****No significant correlation was found between mercury concentration and weight or length*****

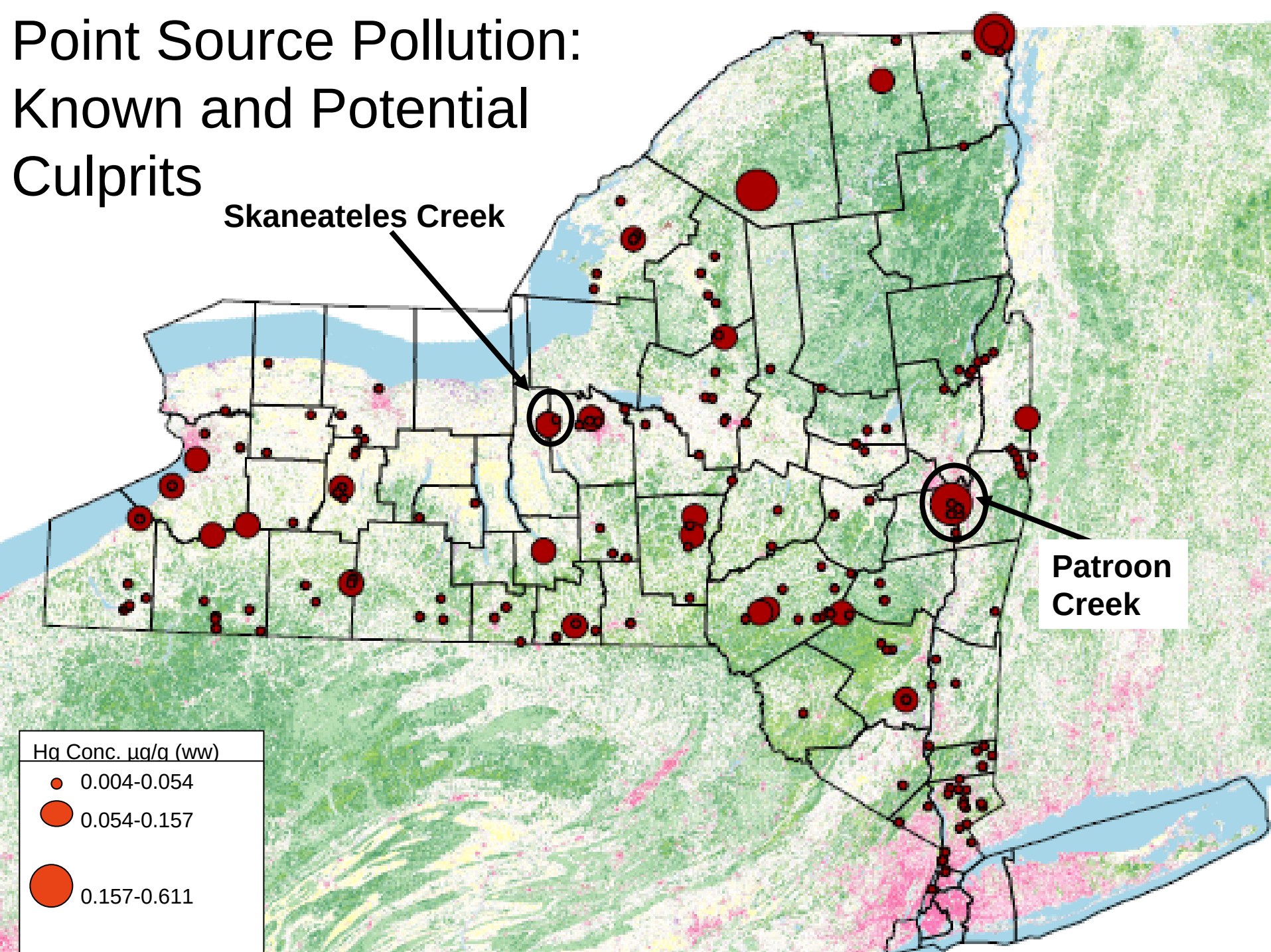
Does Land Cover Play a Role?



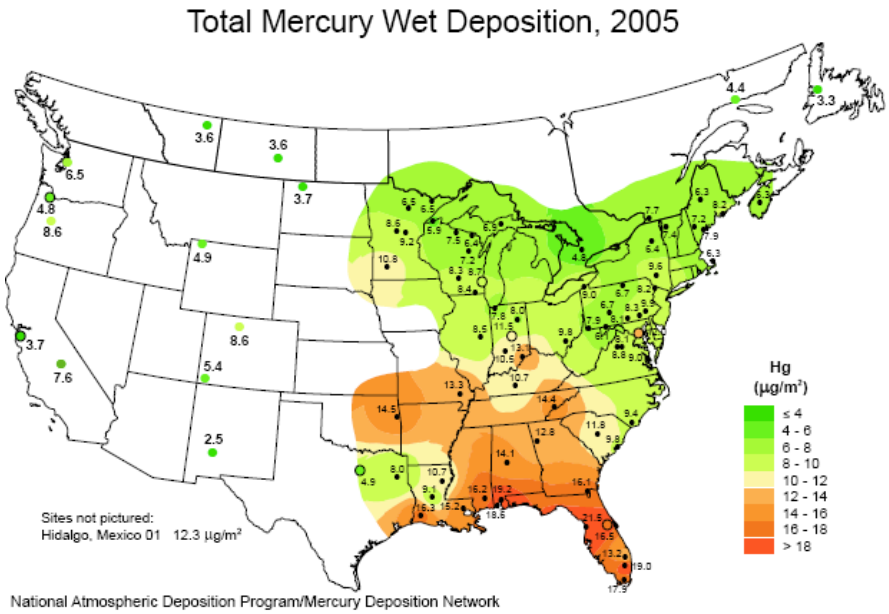
Does the presence of wetlands have a potential effect on increased Hg concentrations?

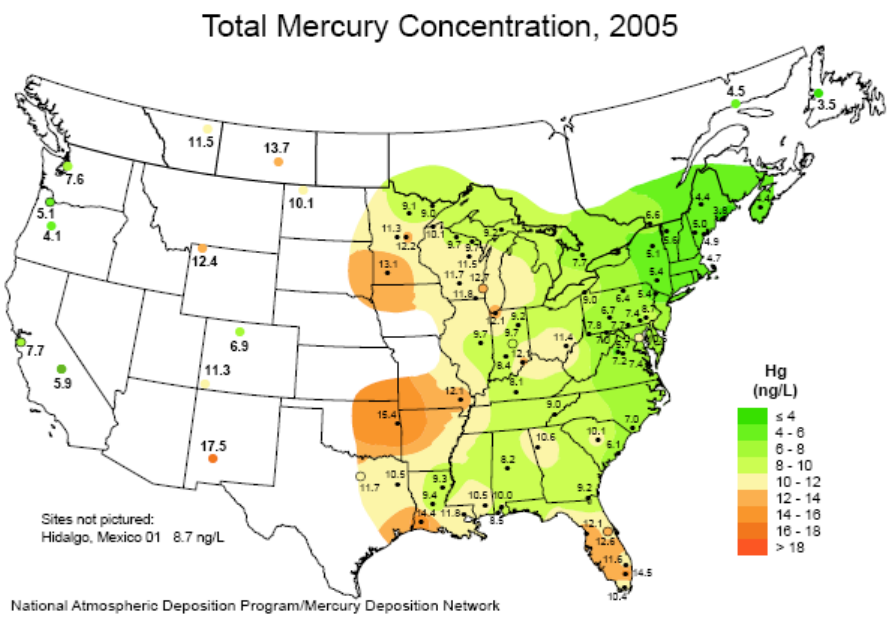


Point Source Pollution: Known and Potential Culprits

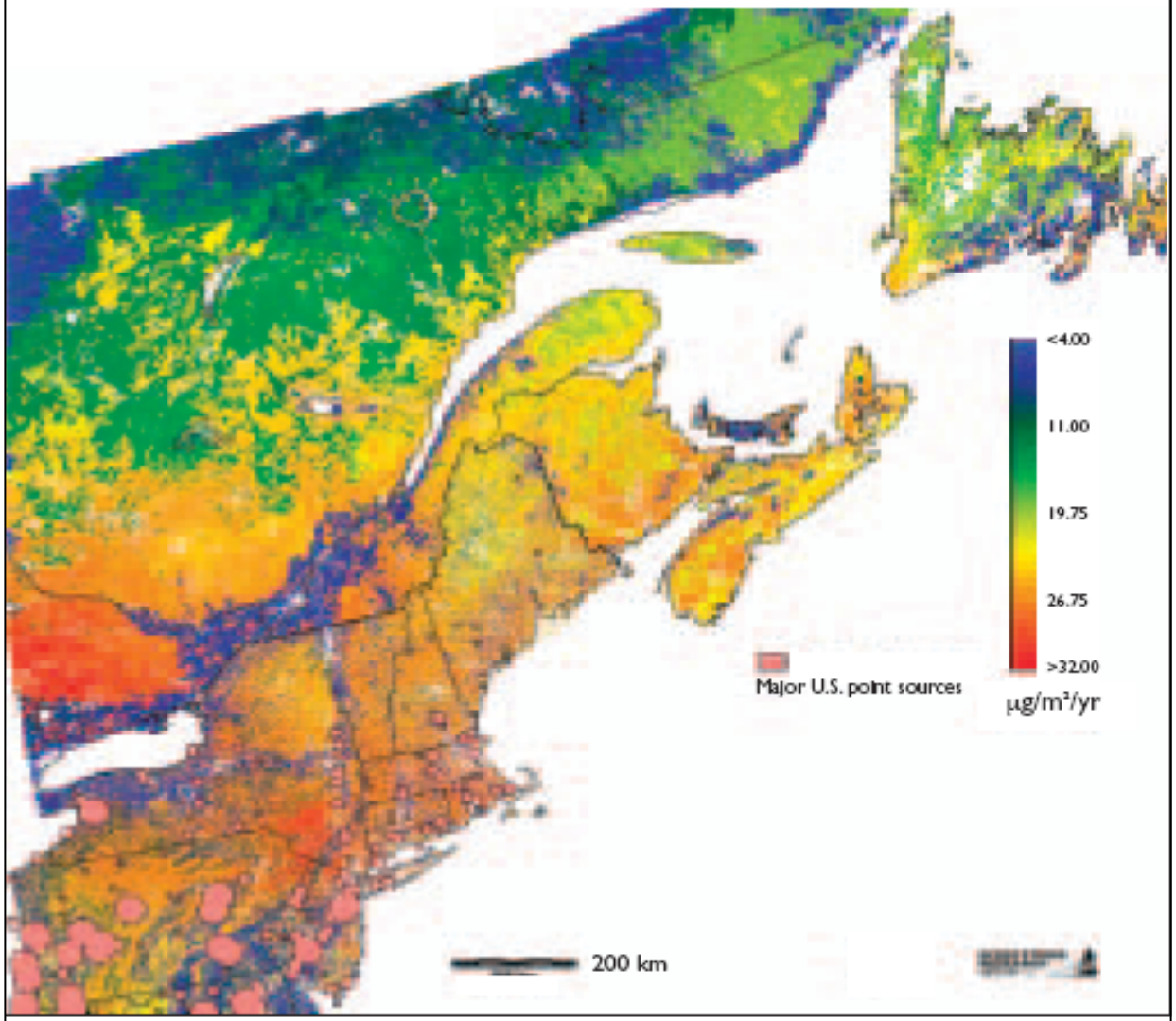


Atmospheric Deposition in New York…how do we compare?





Estimated Total Mercury Deposition in Northeastern North America



Total mercury deposition based on a new model intended to better depict dry deposition. The model does not fully incorporate the effects of large point sources in the region and those areas are masked in pink.

Biodiversity Research Institute, 2005

Conclusions

- Provisional level of concern: 0.075 µg/g
- Biomagnification considerations
- No one clear factor appears to contribute to mercury distribution and the concentrations observed, but there are definite influences
- Definite point sources
- Wetlands, DOC, pH, and atmospheric deposition have been shown to play a role
- Continued research on benthos in lotic systems is essential for understanding mercury distribution

Acknowledgements

- Karen Riva-Murray, USGS, Troy, NY
- Robert Bode, NYSDEC, Troy, NY
- Doug Burns, USGS, Troy, NY
- A. J. Smith, NYSDEC, Troy, NY
- Margaret Novak, NYSDEC, Troy, NY
- Diana Heitzman, NYSDEC, Troy, NY
- Neil Ringler, SUNY-ESF, Syracuse, NY
- Edna Bailey Sussman Fund