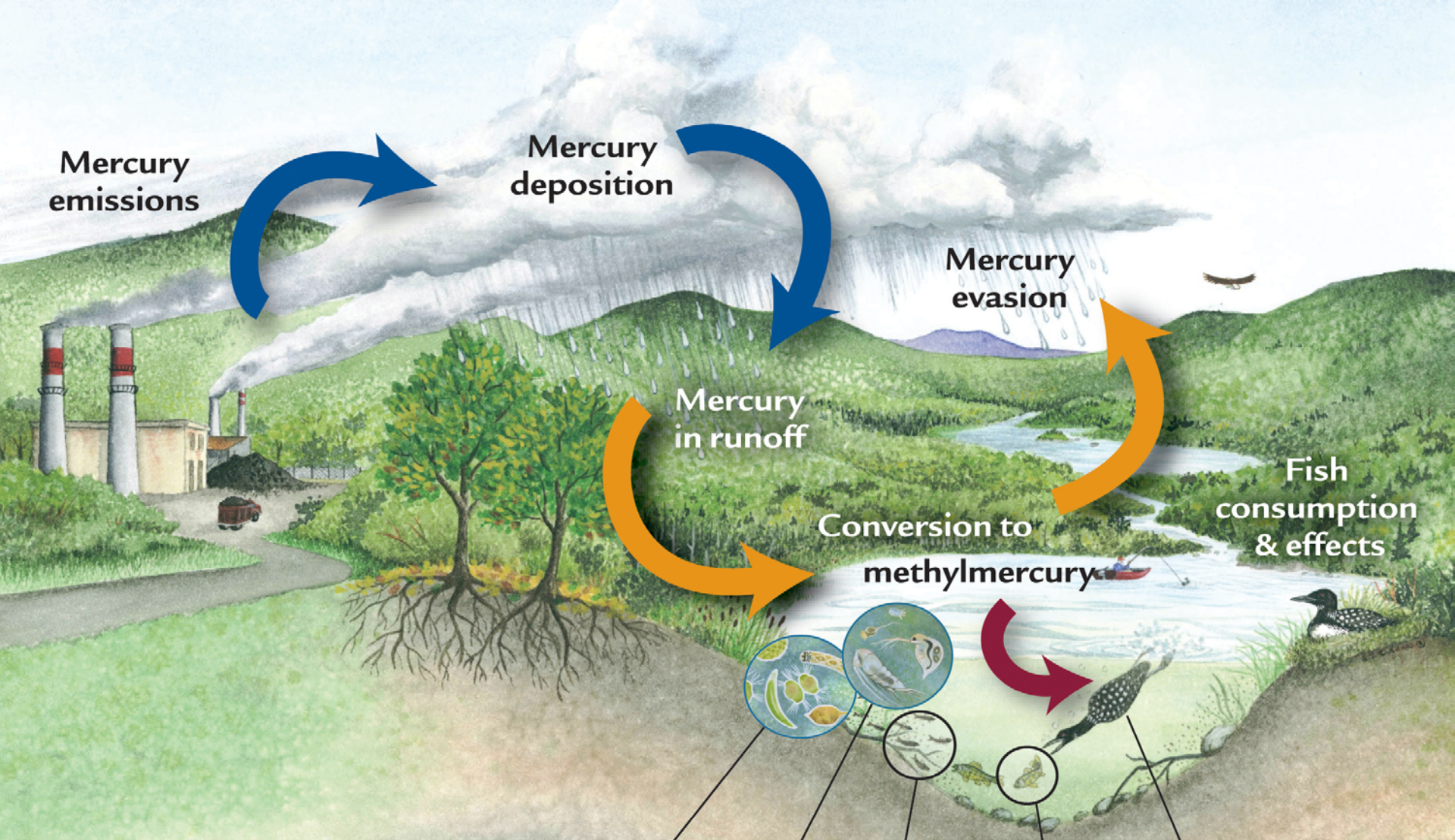


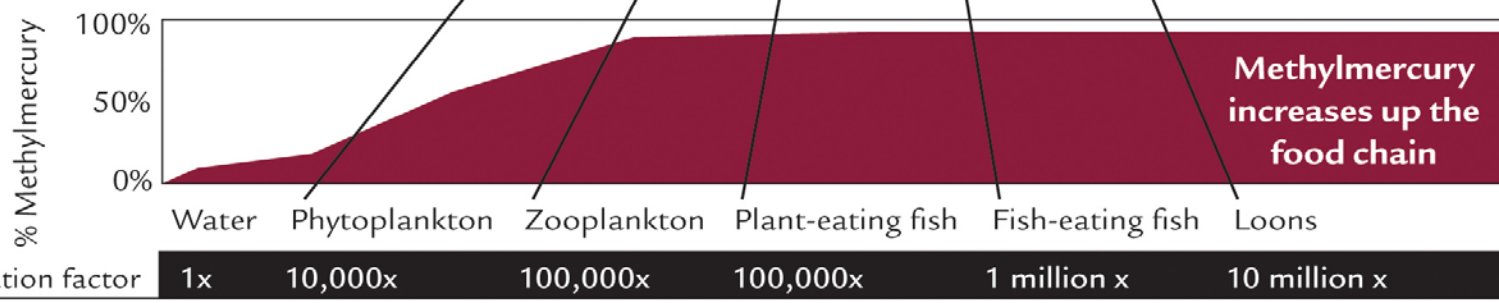
DETERMINING SOURCES OF MERCURY EXPOSURE IN TERRESTRIAL SONGBIRDS



Evan M. Adams, Martin T.K. Tsui,
Allyson K. Jackson, David C. Evers,
Joel D. Blum



Bioaccumulation of methylmercury in fish & wildlife



Methylmercury bioaccumulation factor

High methylating
wetlands

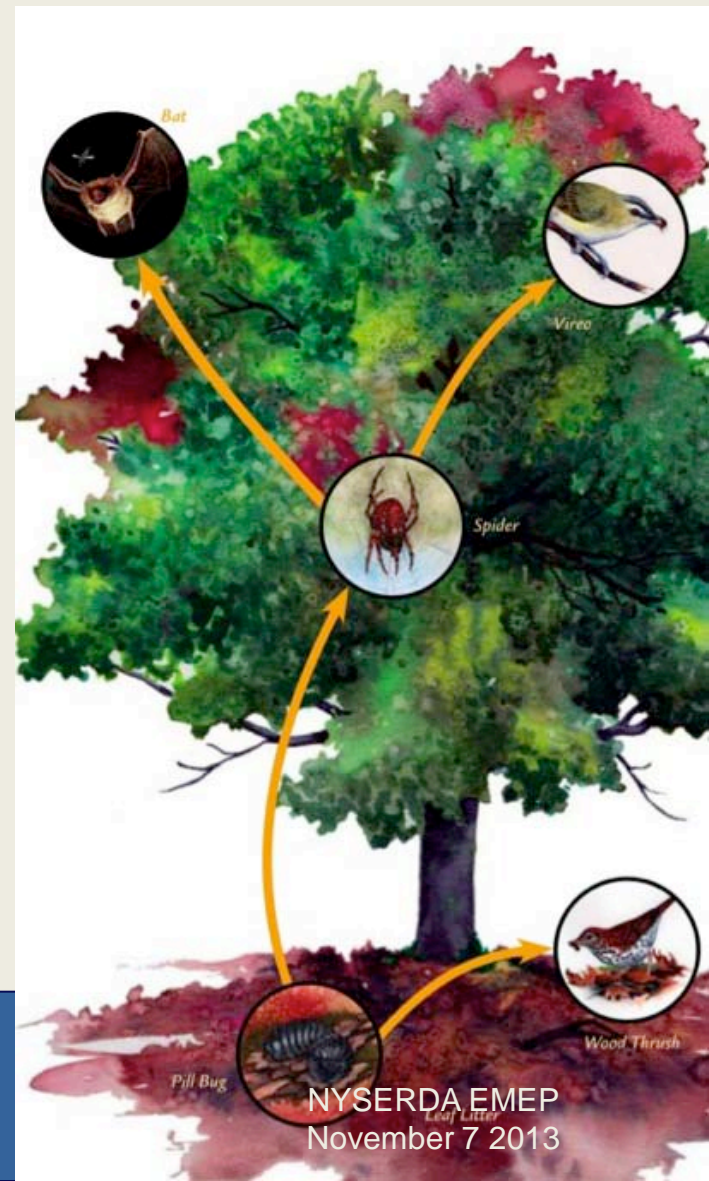
High MeHg
invertebrates

High trophic level
wildlife



Songbirds as Hg Indicators

- Advantages:
 - Small home ranges
 - Easy to sample and capture
 - Well-studied
 - Ubiquitous across ecosystems





N = 6565 records

- 1999 – 2012
- Breeding season only

● Blood Sampling Site

Target Indicators for Mercury in the Northeast

Mercury exposure depends on both species characteristics (such as trophic level) and habitat characteristics (such as wet-dry cycles). To disentangle differences between habitat and species, BRI chose an indicator songbird species to best represent the mercury risk in each ecosystem type. Because little brown bats are found in many different ecosystems, they are considered an unrestricted ecosystem indicator.



Ecosystem Type
High Elevation
Forests
Indicator
Bicknell's Thrush



Ecosystem Type
Upland Forests
Indicator
Wood Thrush



Ecosystem Type
Forested Rivers
and Creeks
Indicator
Louisiana
Waterthrush



Ecosystem Type
Unrestricted
Indicator
Little Brown Bat



Ecosystem Type
Bogs and Beaver
Ponds
Indicator
Rusty Blackbird

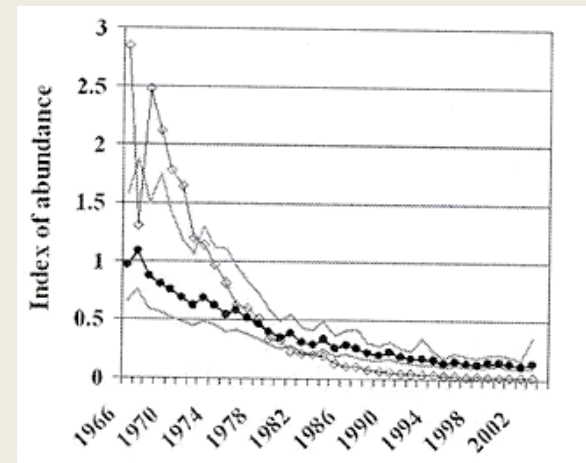
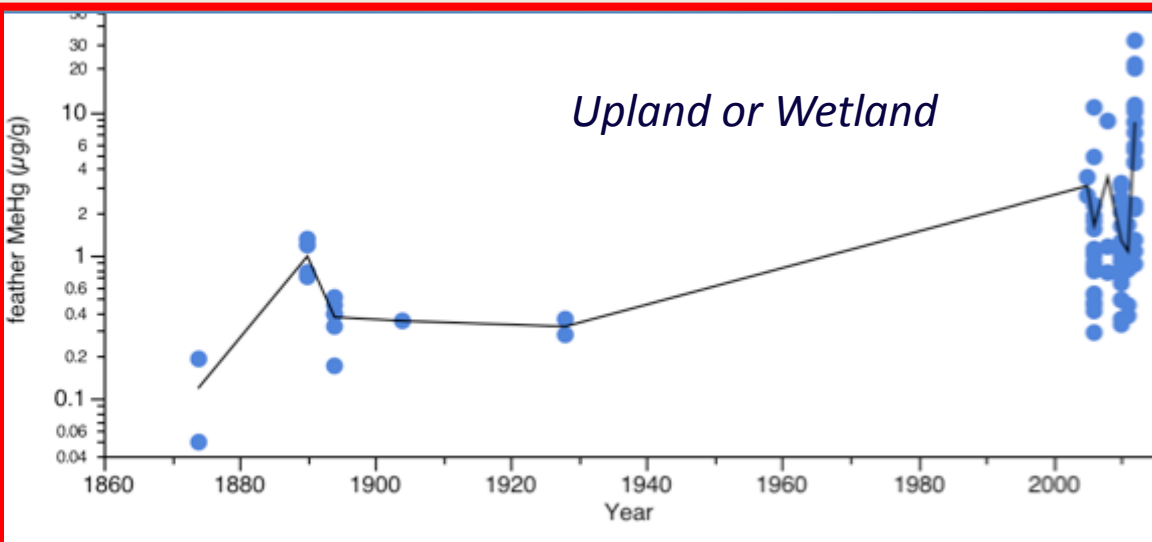


Ecosystem Type
Estuaries
Indicator
Saltmarsh Sparrow

Upland

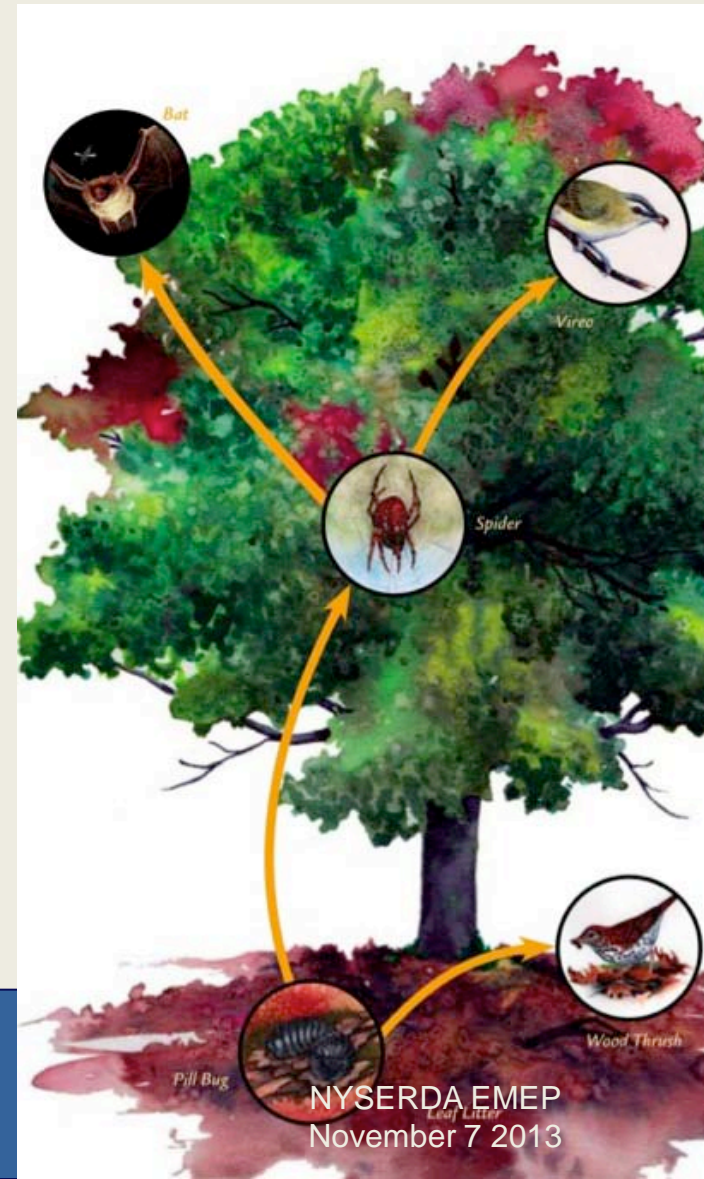
Temporal Changes in Feather MeHg:
museum and field feathers trends

Wetland



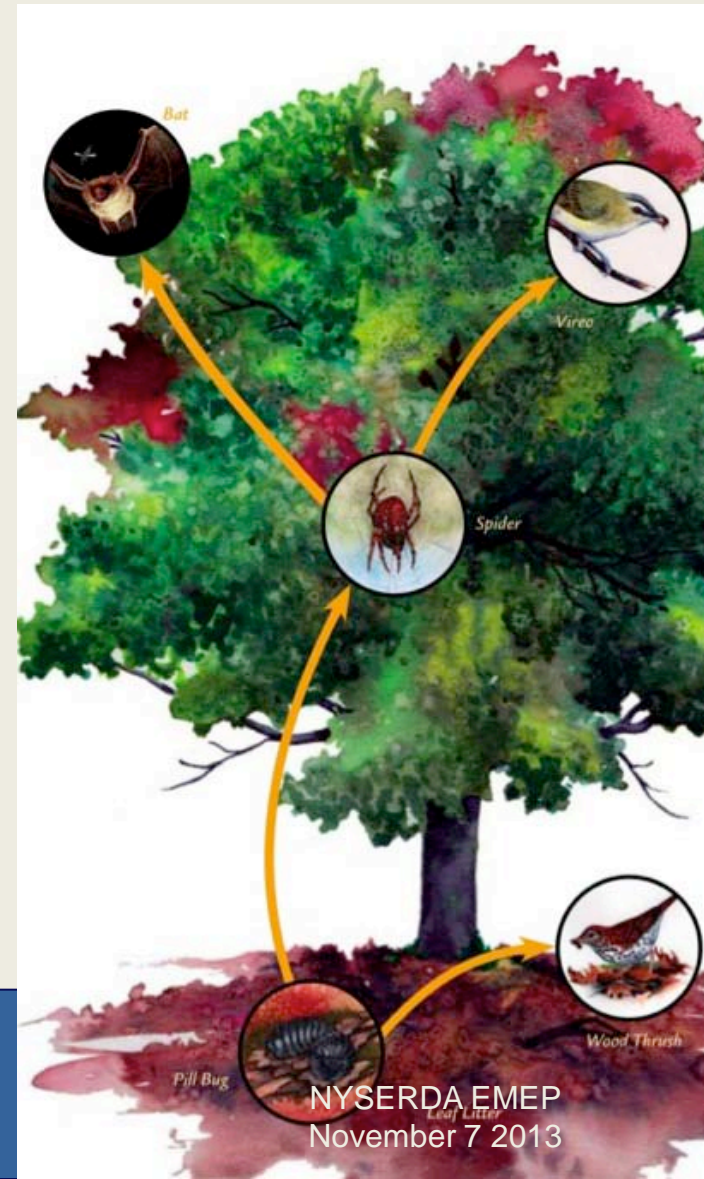
Songbirds as Hg Indicators

- Disadvantages:
 - Species acquire Hg in different ways
 - Differing foraging habits and habitats
 - Species eliminate Hg body burden differently
 - Via molting strategies
 - Hg affects all species differently
 - Differing effect levels, life histories and population dynamics

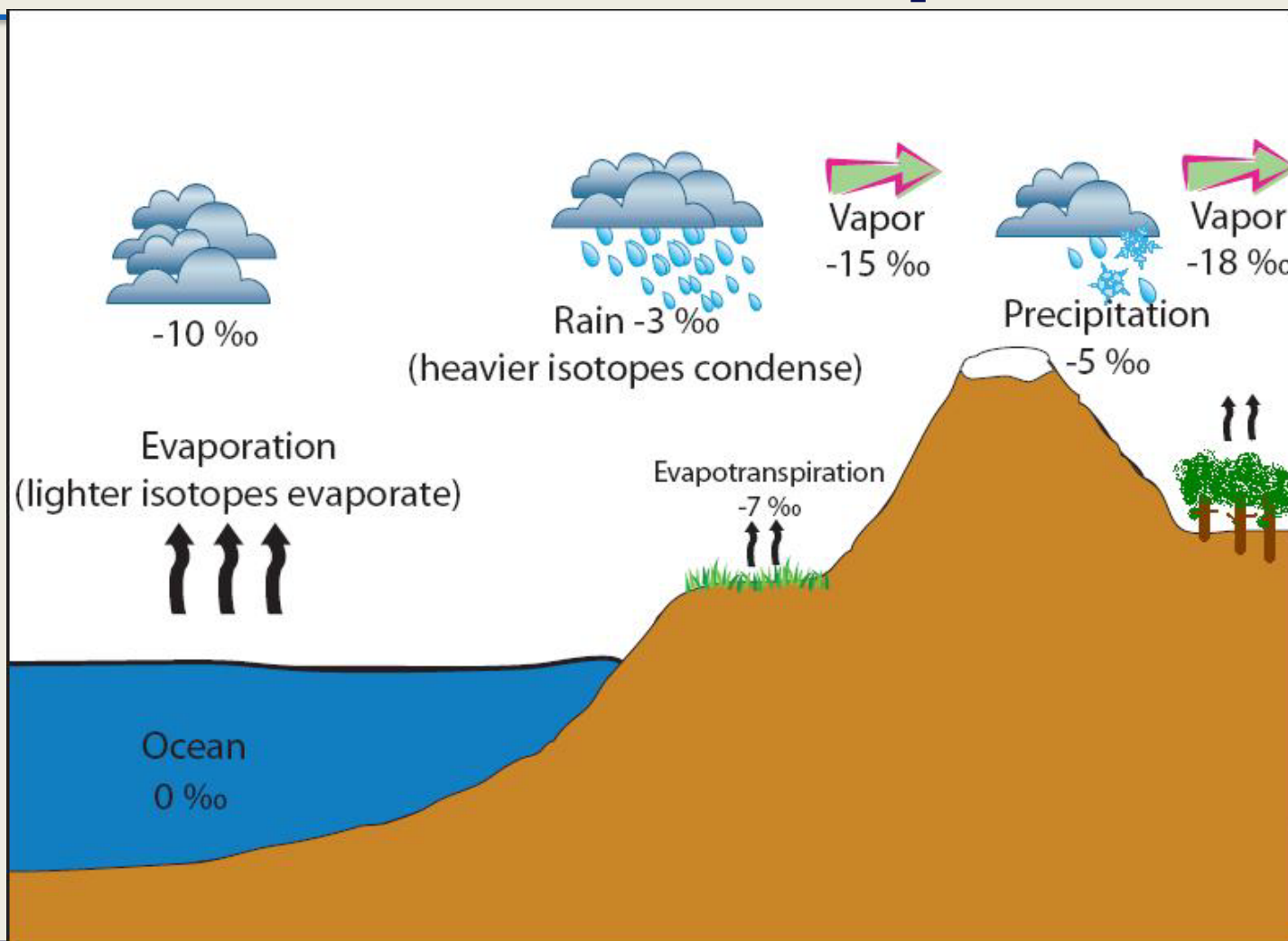


Songbirds as Hg Indicators

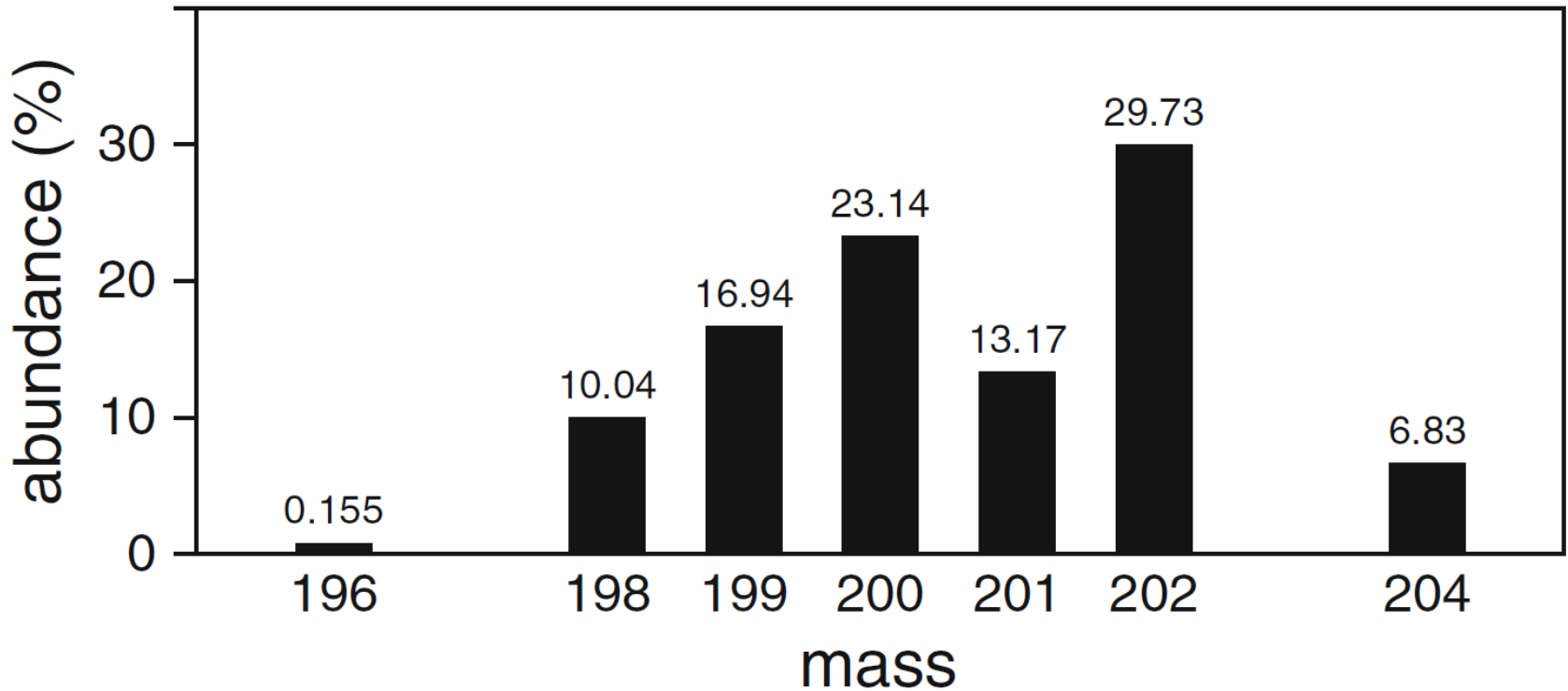
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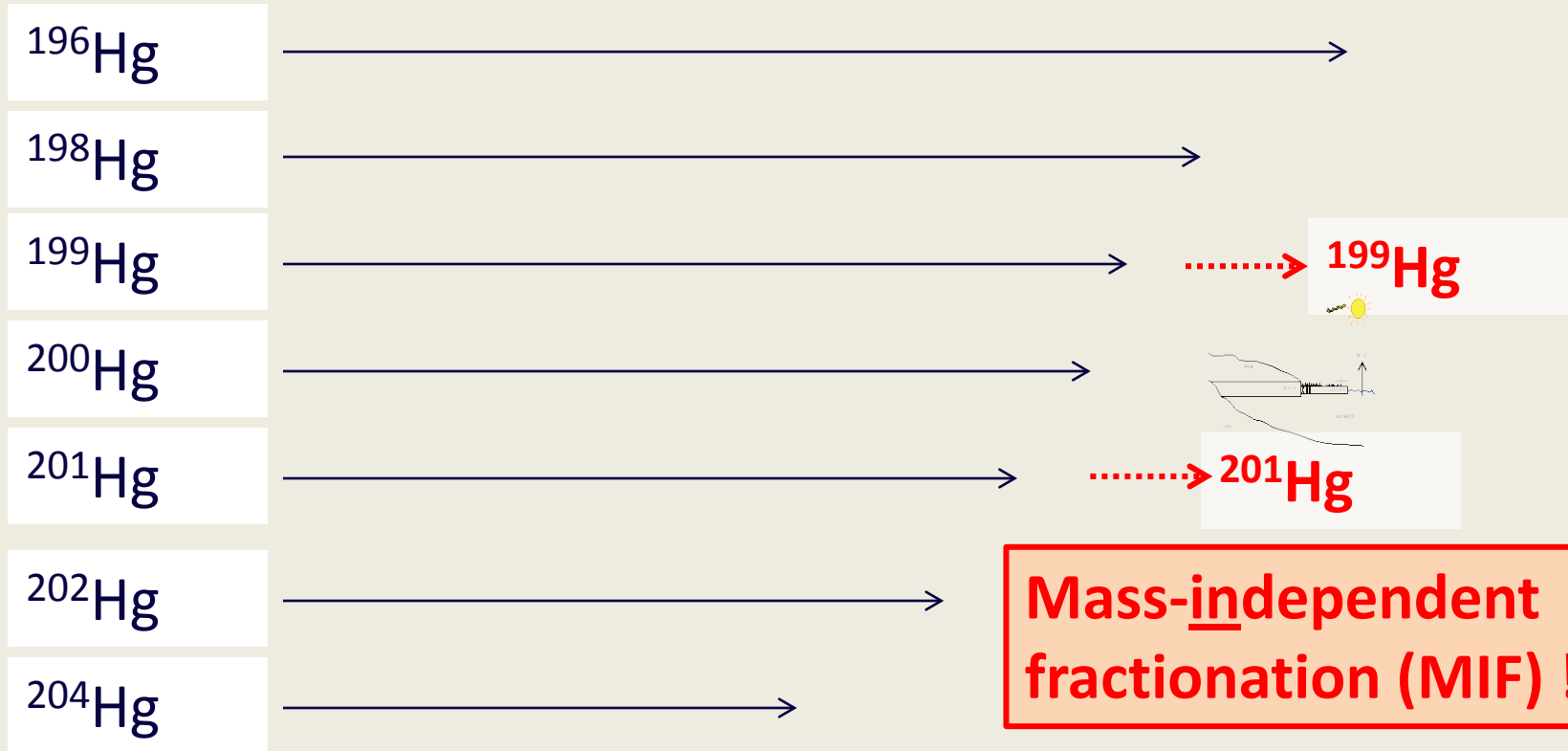
Stable Isotopes



Stable Hg isotopes

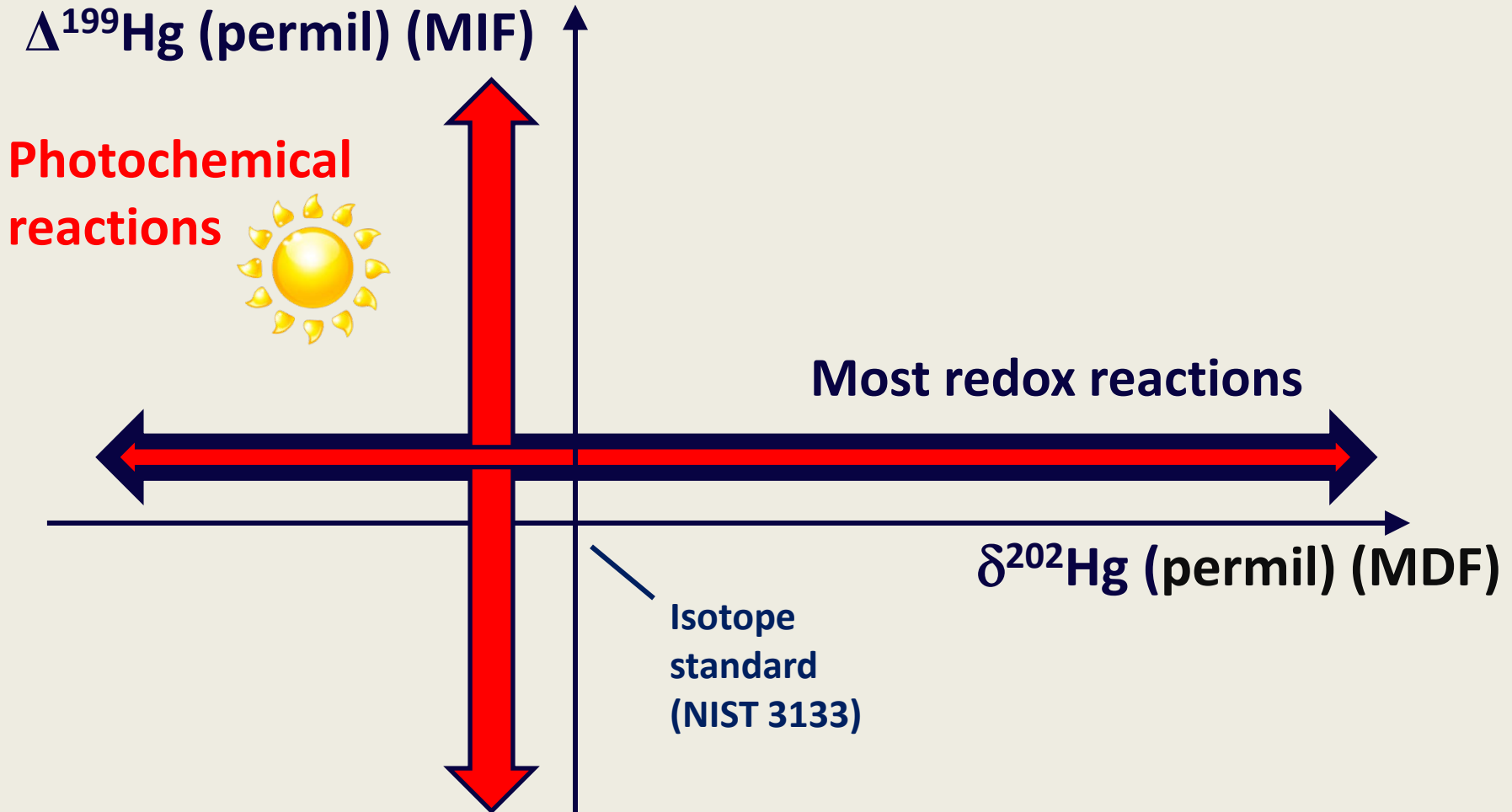


Kinetic fractionation of isotopes

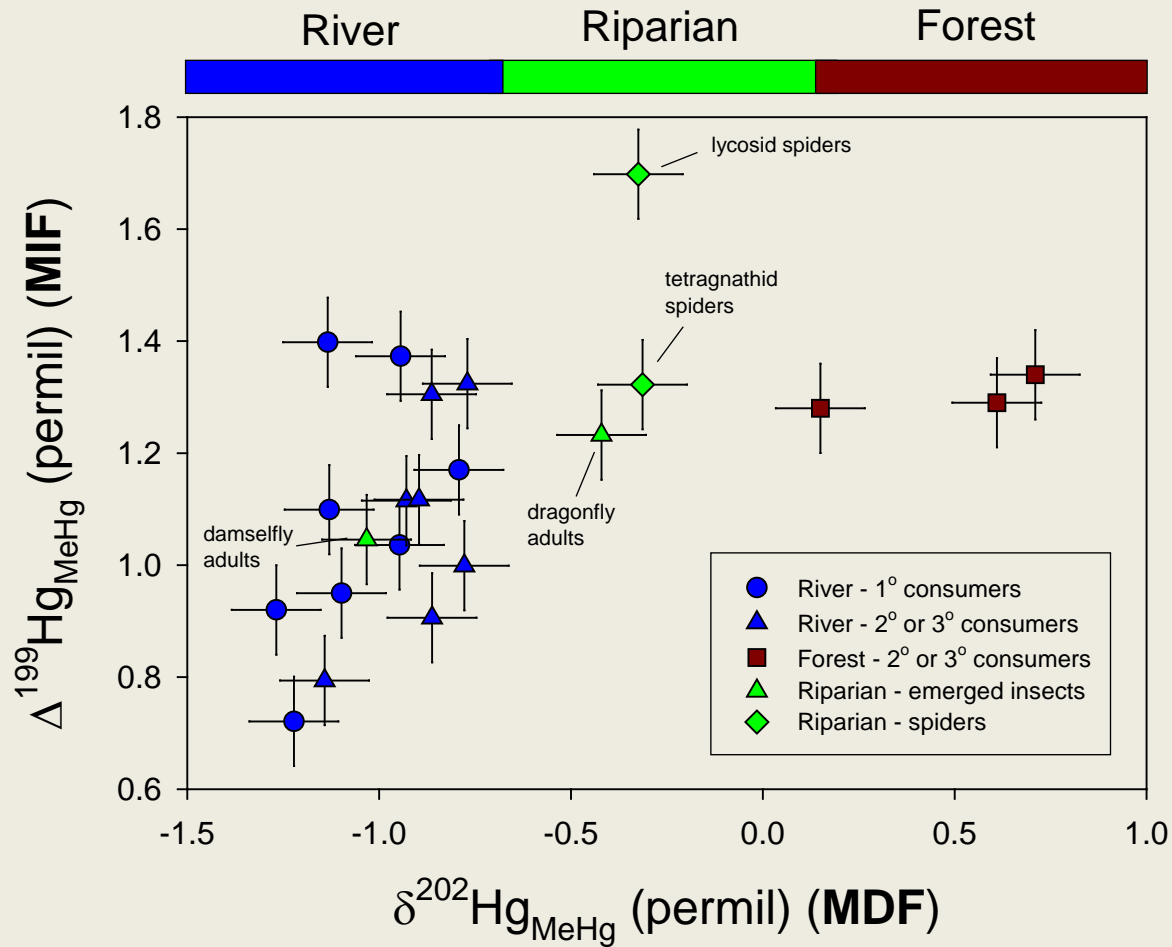


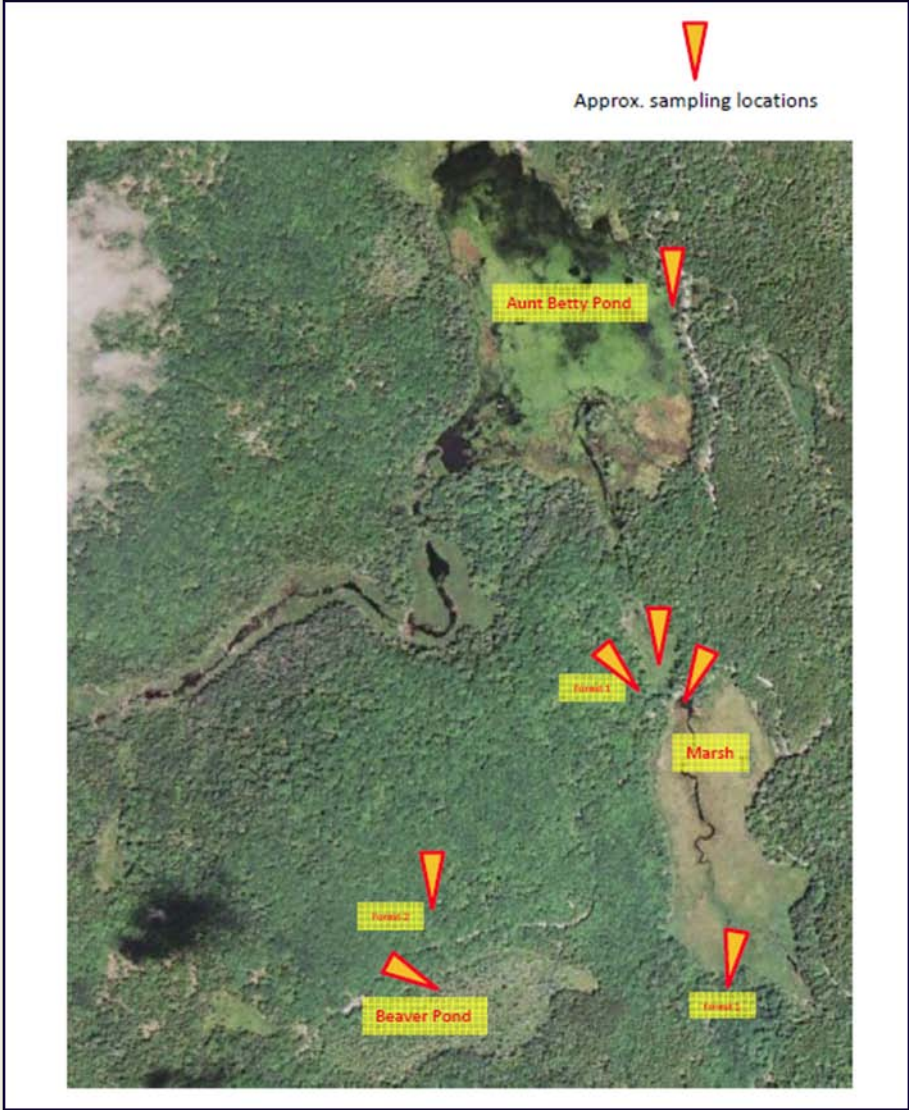
Lighter isotopes react faster -- mass dependent fractionation (MDF) !!!

2D plot -- MDF vs. MIF

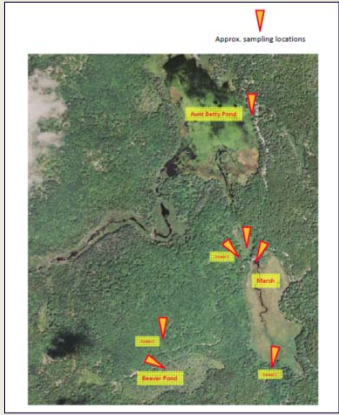


A northern California study – distinguish MeHg sources



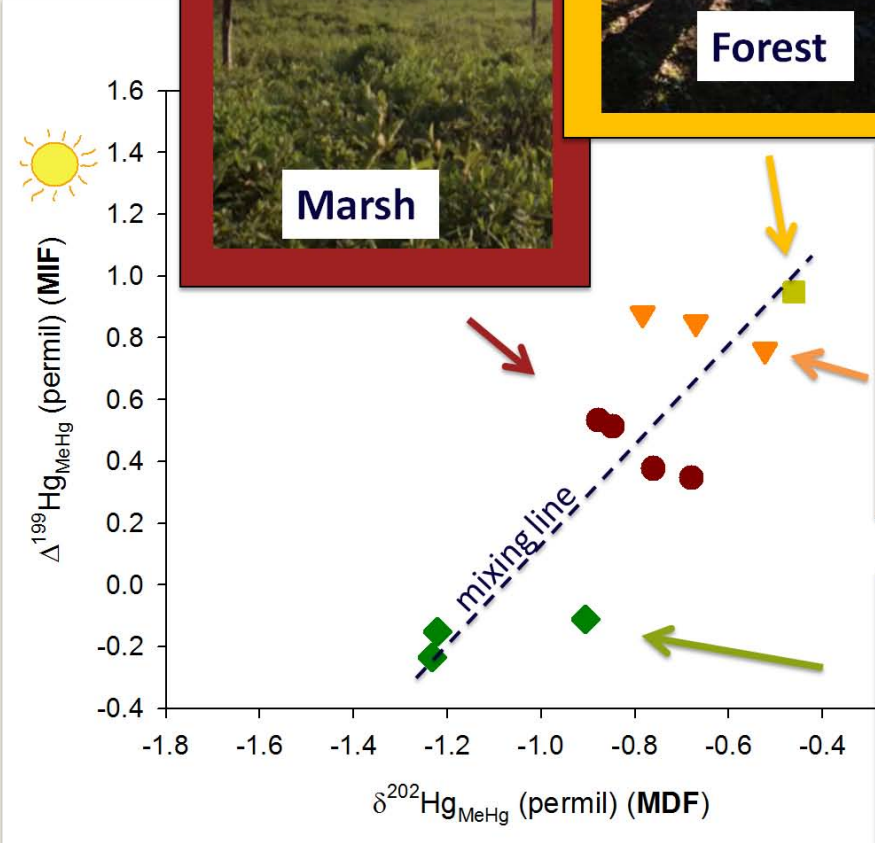
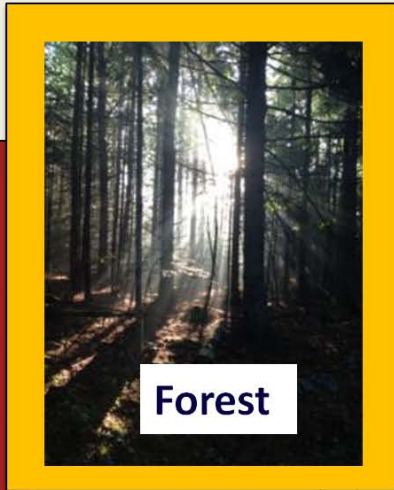
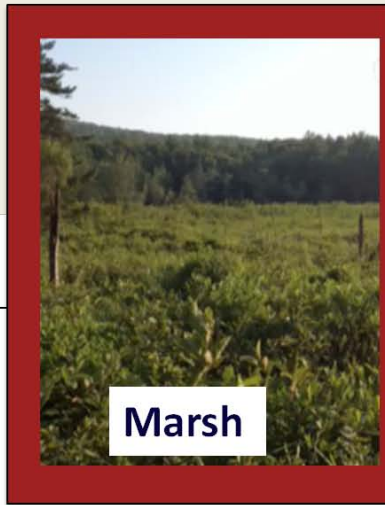


Water flow



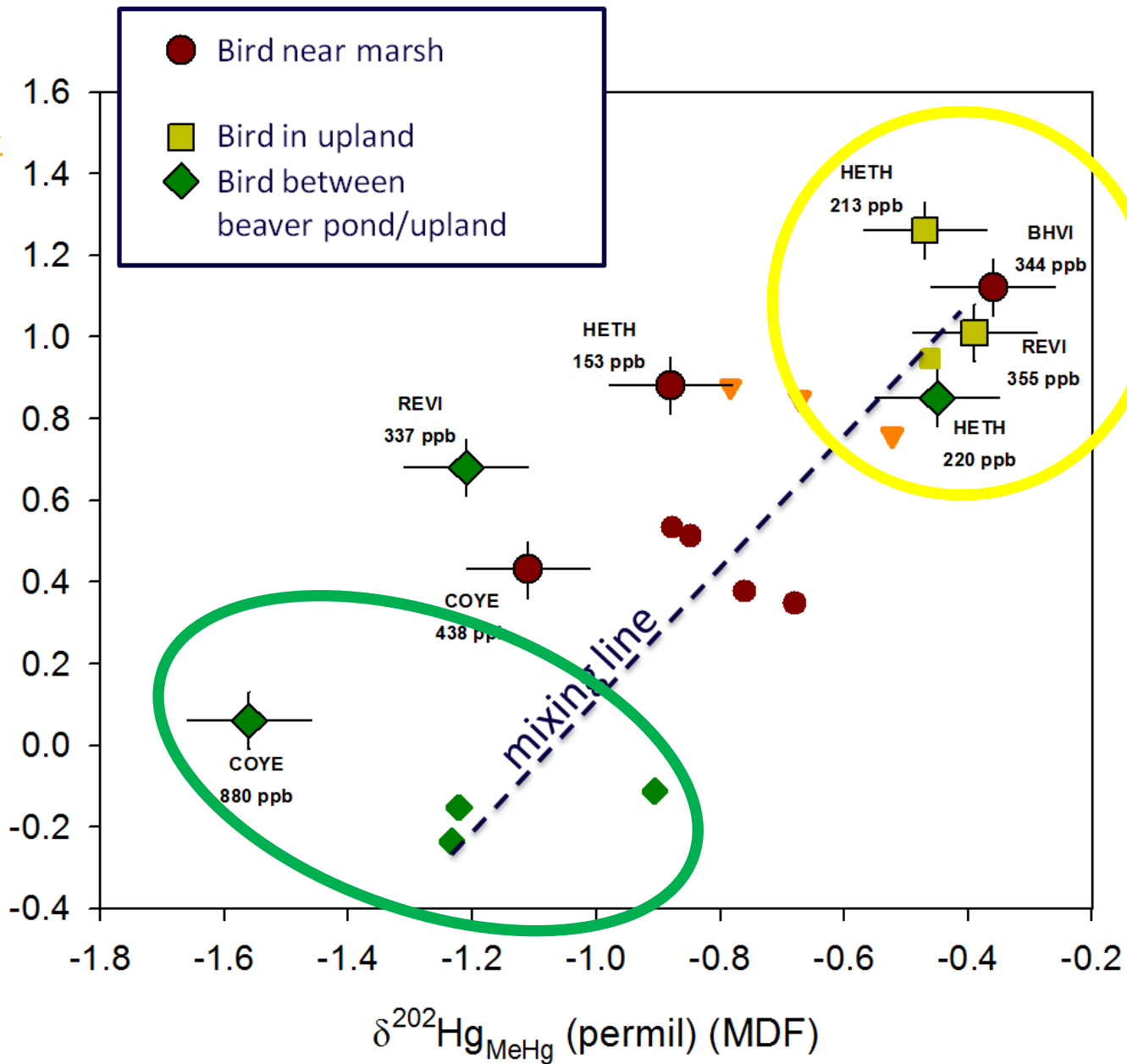
Water flow ↑

Downstream we see mixing between upland, marsh and forested wetland signals





$\Delta^{199}\text{Hg}_{\text{MeHg}}$ (permil) (MIF)

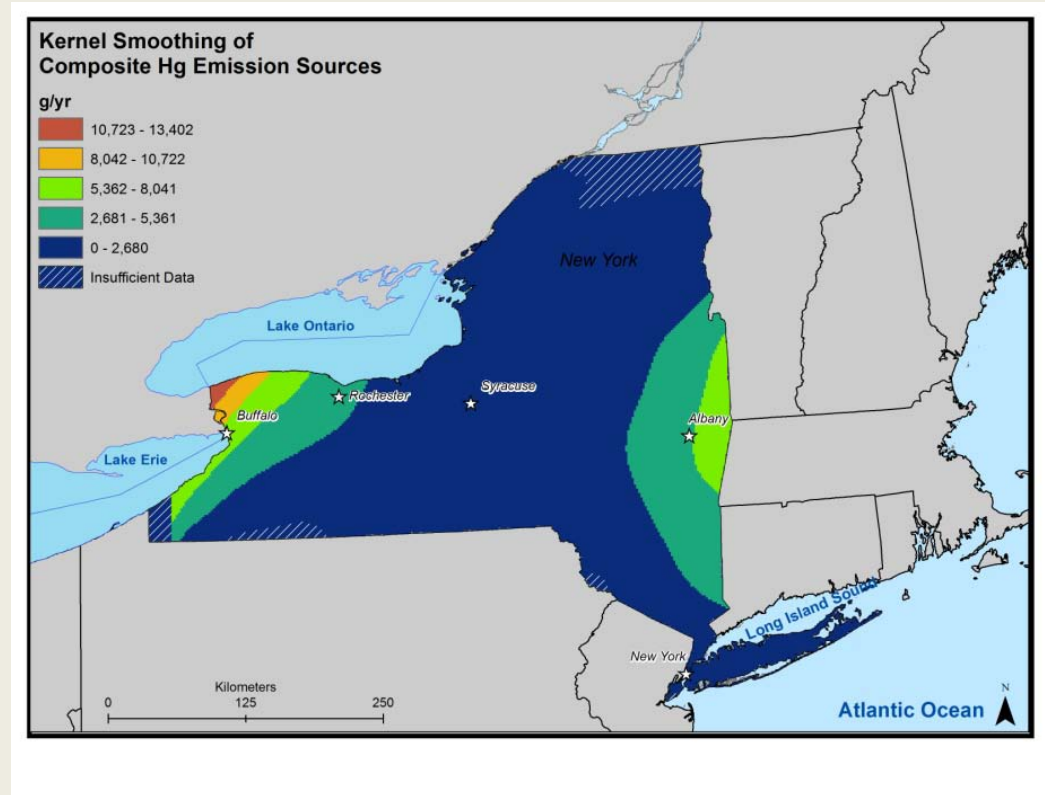


Two NYSERDA Projects

- Long-term Hg monitoring
 - We just completed Year 1 of 5 summer monitoring work
- NY source-typing with Hg isotopes
 - Adirondacks and Long Island
 - Data have been collected, analysis continues

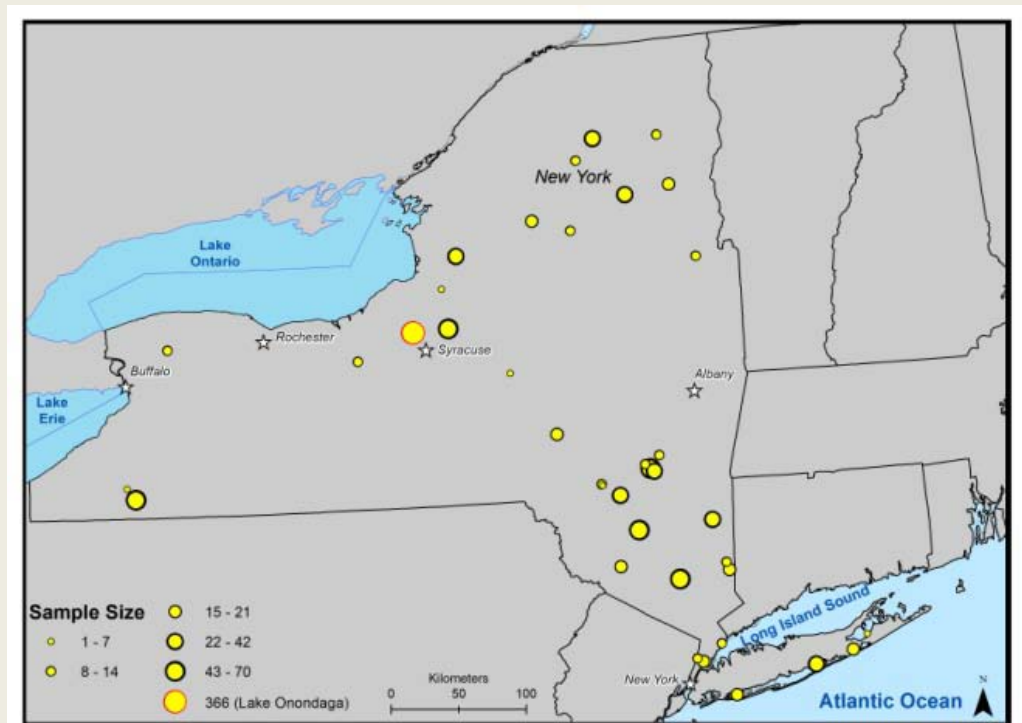
Long-term Monitoring Plan

- Samples Areas with **HIGH** and **LOW** local Hg deposition rates

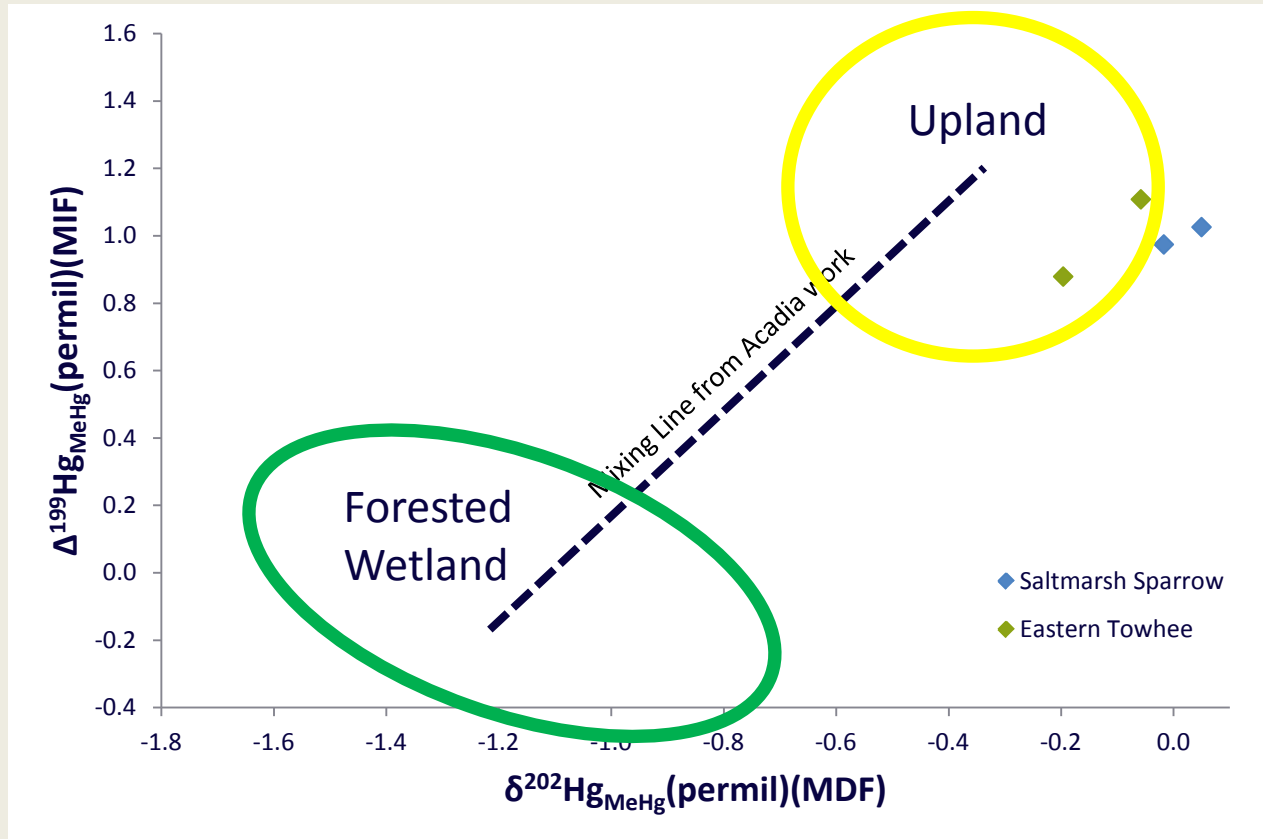


Long-term Monitoring Plan

- Samples areas with high and low previous sampling effort
- Increased spatial coverage
- Continued monitoring of areas with high previous sampling effort



Update on the Hg isotope study



Summary

- By combining basic monitoring with isotopic source typing we can gain the long-term, spatially explicit data set needed to assess trends while also identifying local and global sources of Hg

Future Research Needs

- Disentangle endogenous vs. exogenous effects of Hg isotope ratio
- Species-level fractionation
- Conservation of mixing relationships among multiple habitats



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