

Mercury in Soils of Two Contrasting Watersheds in the Eastern U.S.

Douglas A. Burns, Laurel G. Woodruff, Paul
M. Bradley, Mark Marvin-DiPasquale,
William F. Cannon

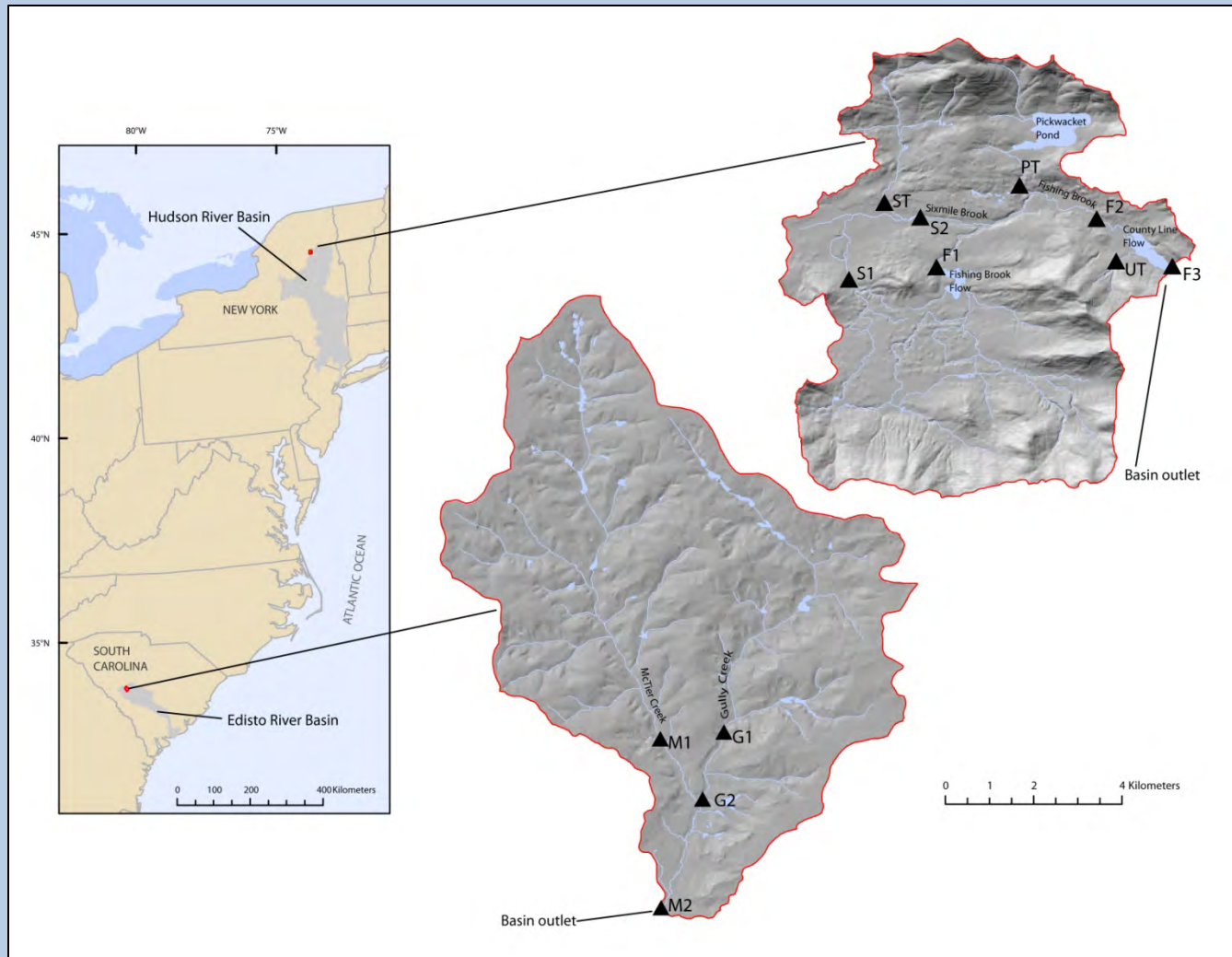
Soils Key to Understanding Hg Cycle

- Largest store in terrestrial ecosystems
- Human activities have increased global soil pool by ~ 20%
- Decades to centuries of Hg deposition
- Big questions:
 - Rate at which soil Hg cycles?
 - How much can be mobilized to aquatic and terrestrial ecosystems?
 - How responsive to changes in Hg emissions?

Plan for Talk – Smaller Questions

- What is the relation between Hg in soils and Hg in surface waters?
 - Concentrations and pools
 - THg and MHg
- Comparison of two watersheds – Adirondack Mountains, NY; Coastal Plain, SC
- Similar Hg concentrations in surface waters and aquatic biota

Study Basins



Fishing Brook

Adirondack Mtns, NY

- 65 km² catchment
- Heterogeneous landscape
- Forested – 86%
- Wetlands – 8%
- Open Water – 3%

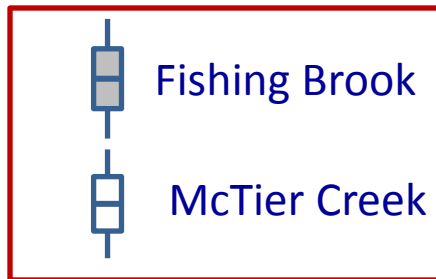
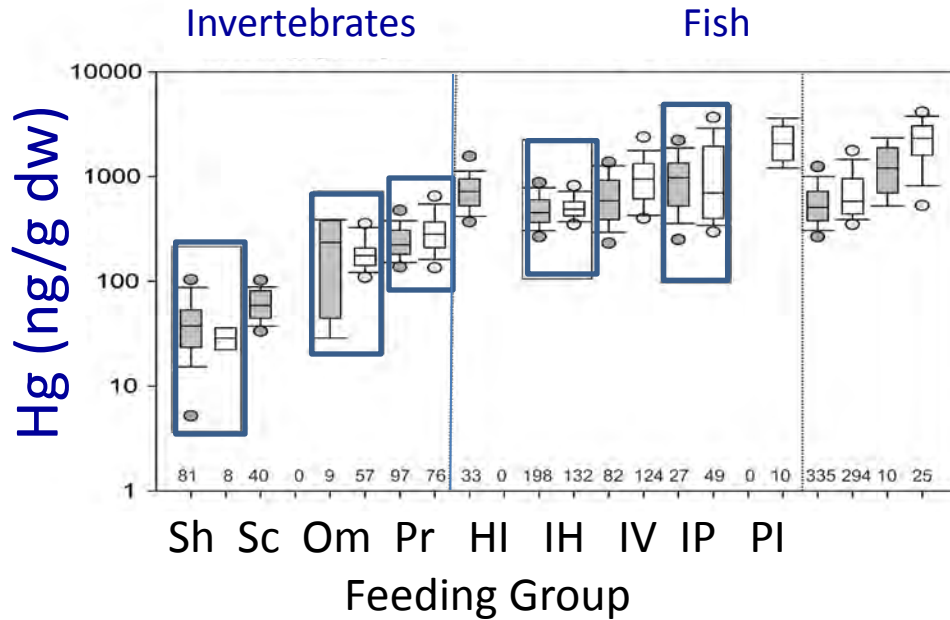


McTier Creek Coastal Plain, SC

- 79 km² catchment
- Forested – 55%
- Wetlands – 6%
- Open Water – 1%
- Ag. Land – 17%



Hg in Aquatic Biota



Boxes denote no significant difference ($p > 0.05$)

Hg levels similar among these two streams



Data from K. Riva Murray, USGS
Murray et al., 2011, Ecotoxicology

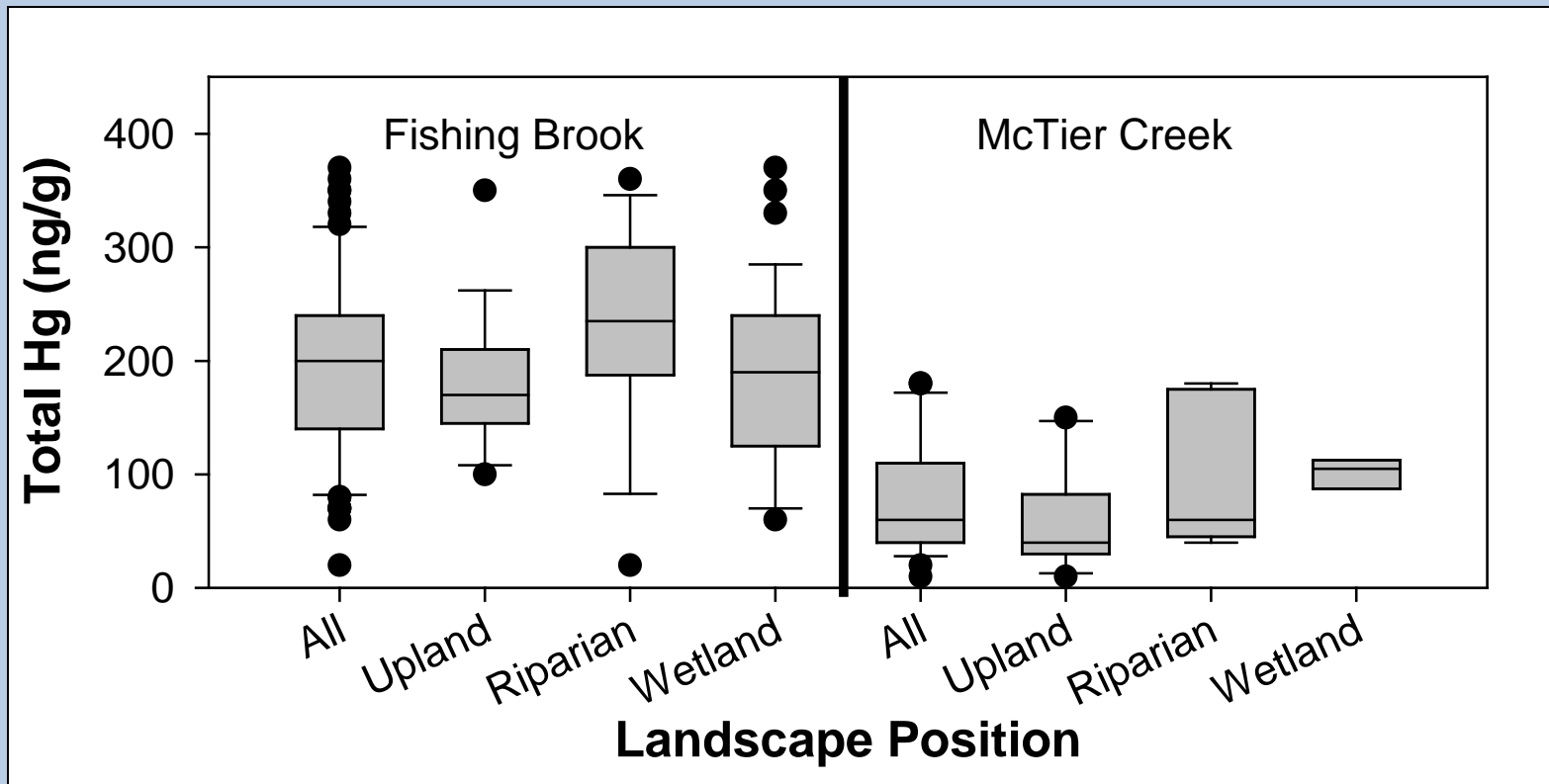
Soil Characteristics

- Fishing Brook –
 - Uplands – bouldery sandy loam; Spodosols
 - Riparian/Wetlands – sand, silt, muck, peat; Entisols, Histosols
- McTier Creek –
 - Uplands – sand, Ultisols
 - Riparian/Wetlands – loamy sand, muck loam, Inceptisols, Entisols
- Sharp differences – climate, glacial history

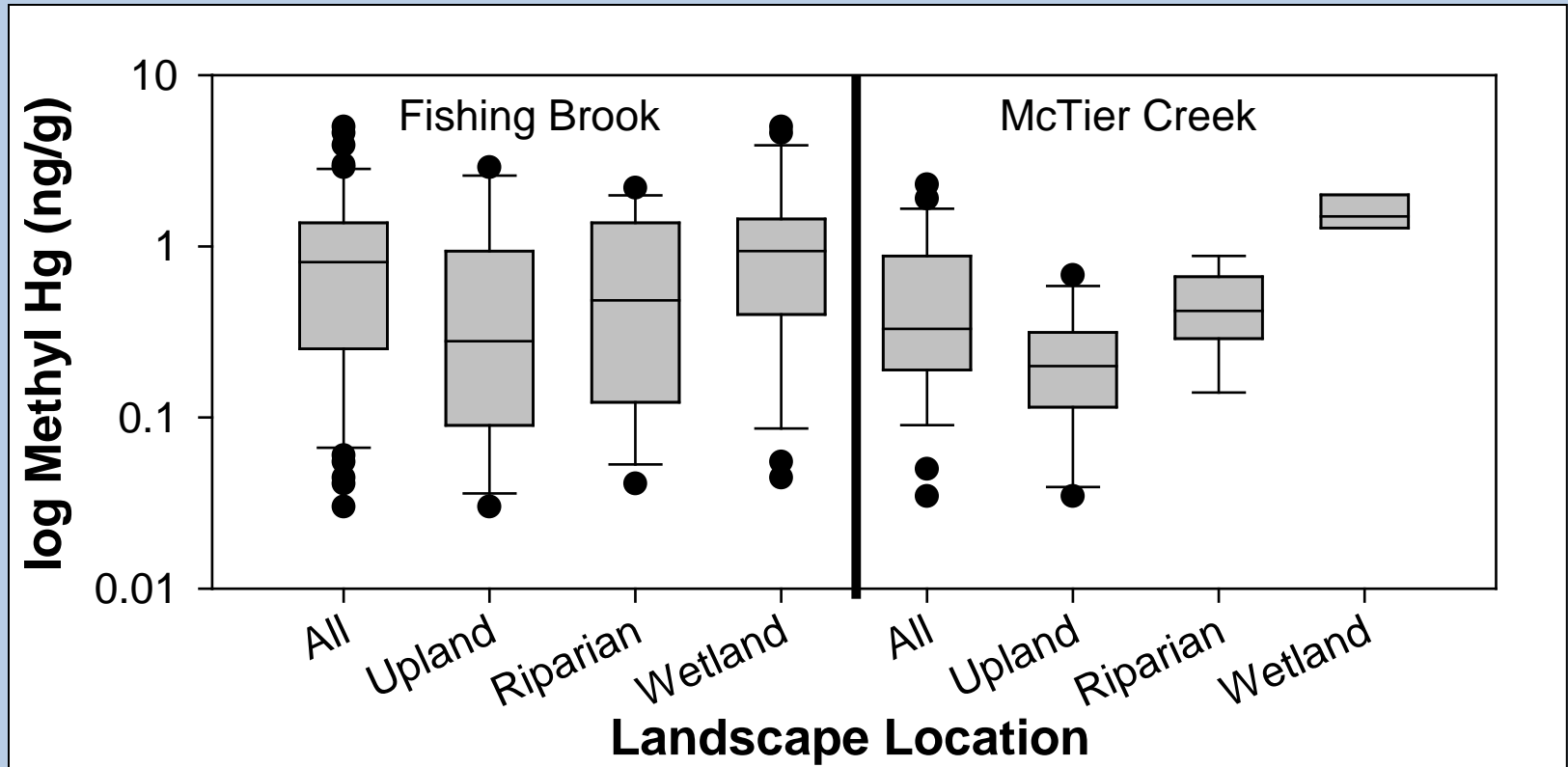
Soil Sampling

- Fishing Brook – 163 samples, 70 locations, multiple depths
- McTier Creek – 81 samples, 24 locations
- Analysis Focus – landscapes that are important in Hg cycle, uplands (forested), wetlands, riparian
- Data – THg, MHg, organic matter, bulk density

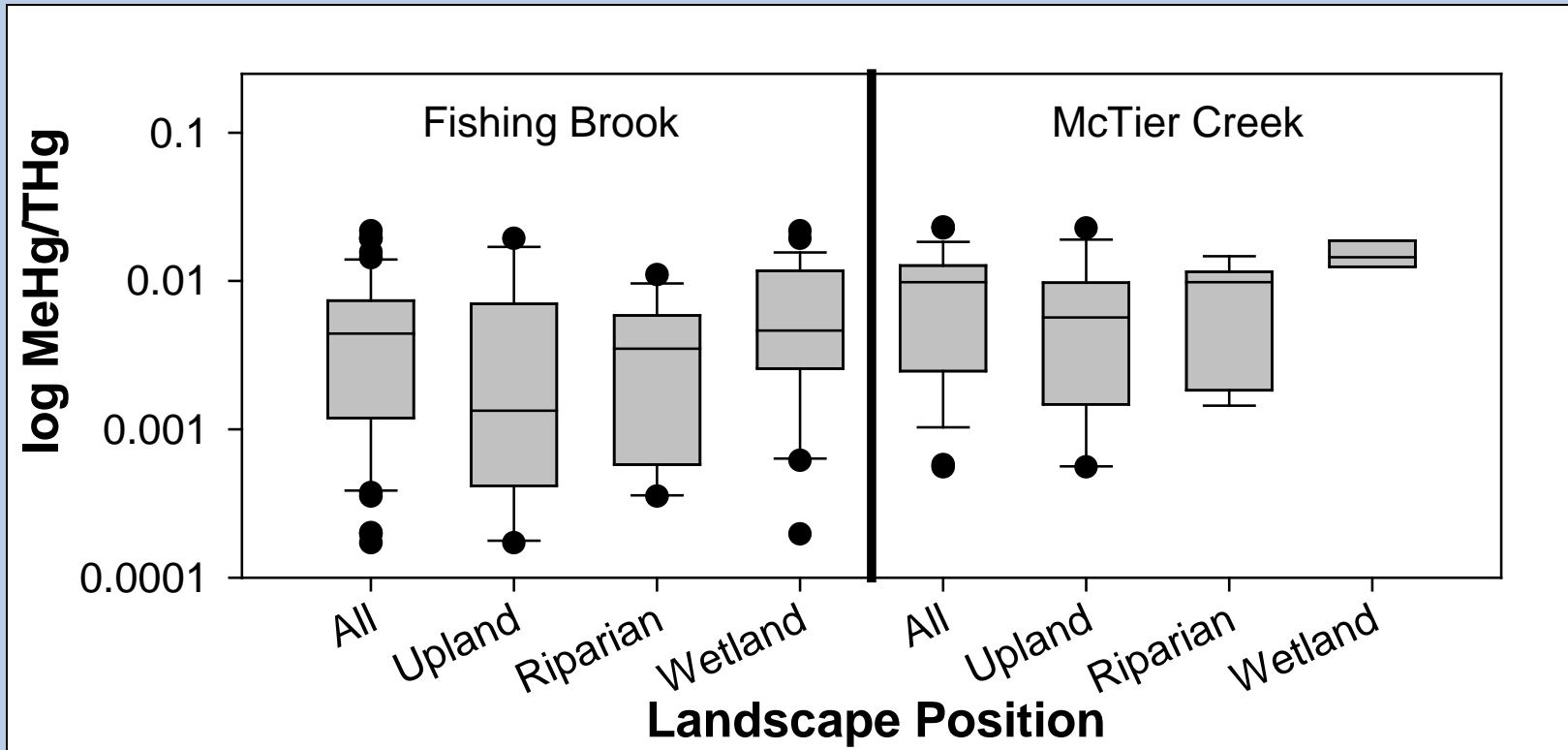
Total Hg – Oa/A Horizons



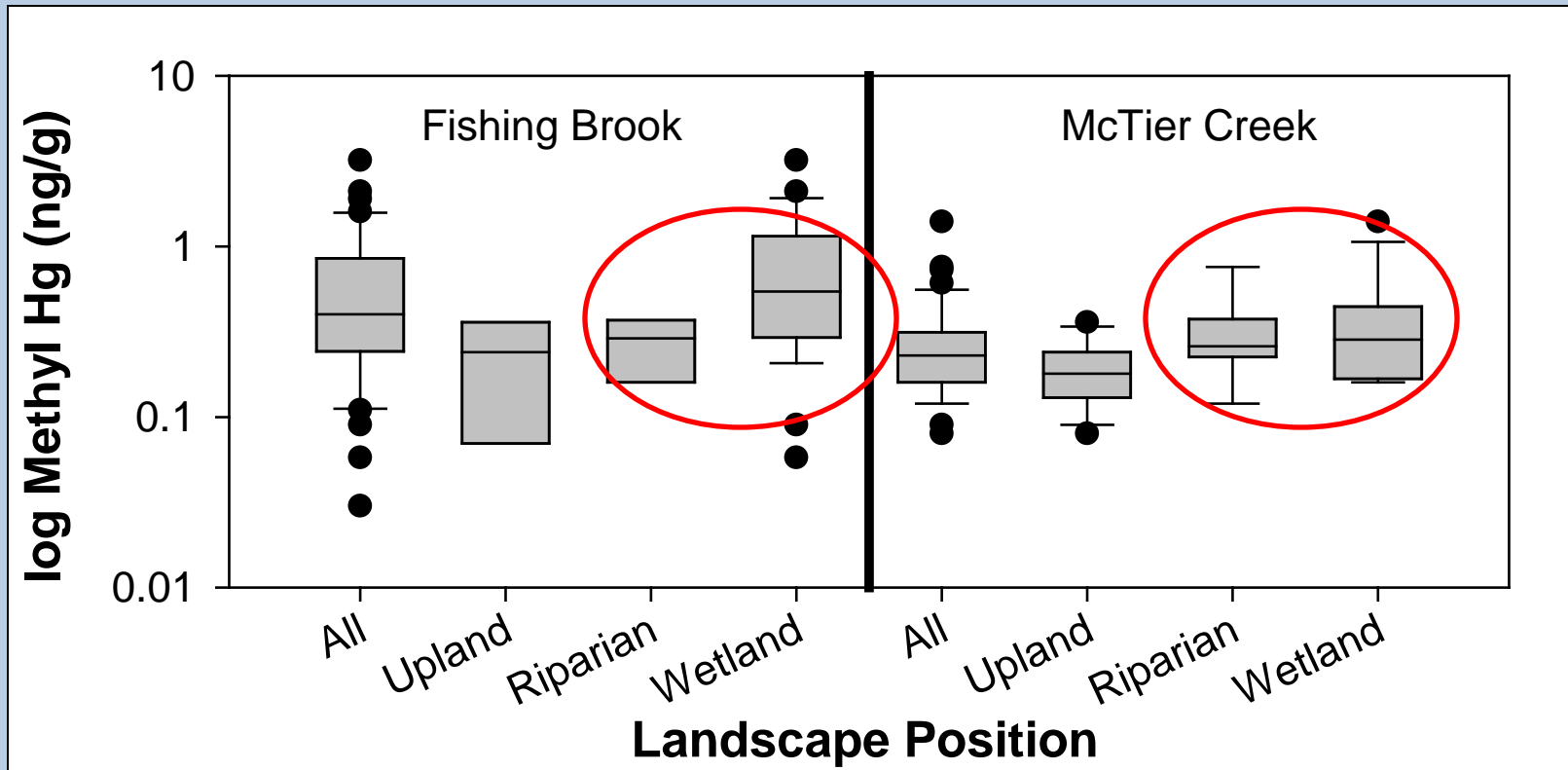
Methyl Hg – Oa/A Horizons



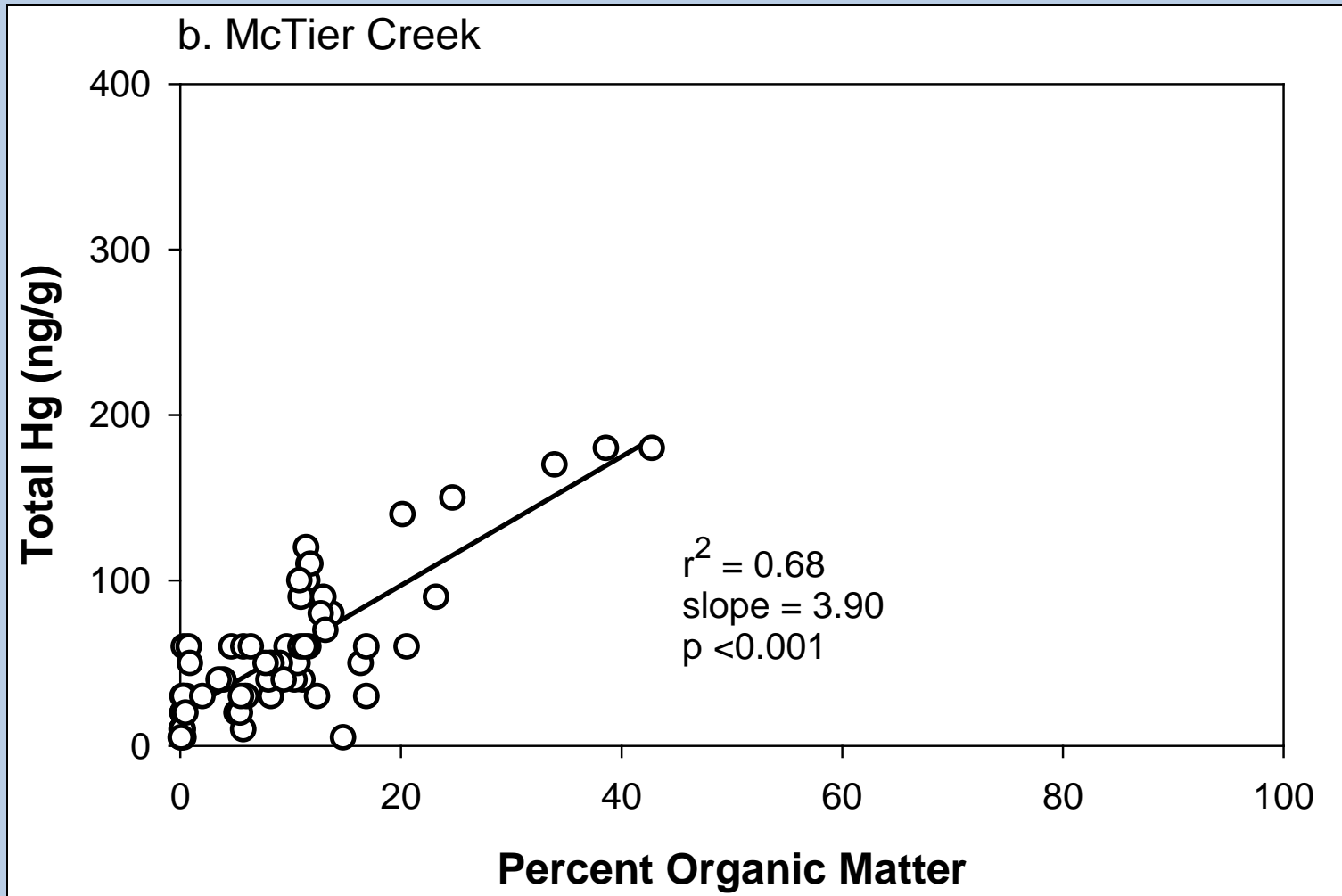
MHg/THg – Oa/A Horizons



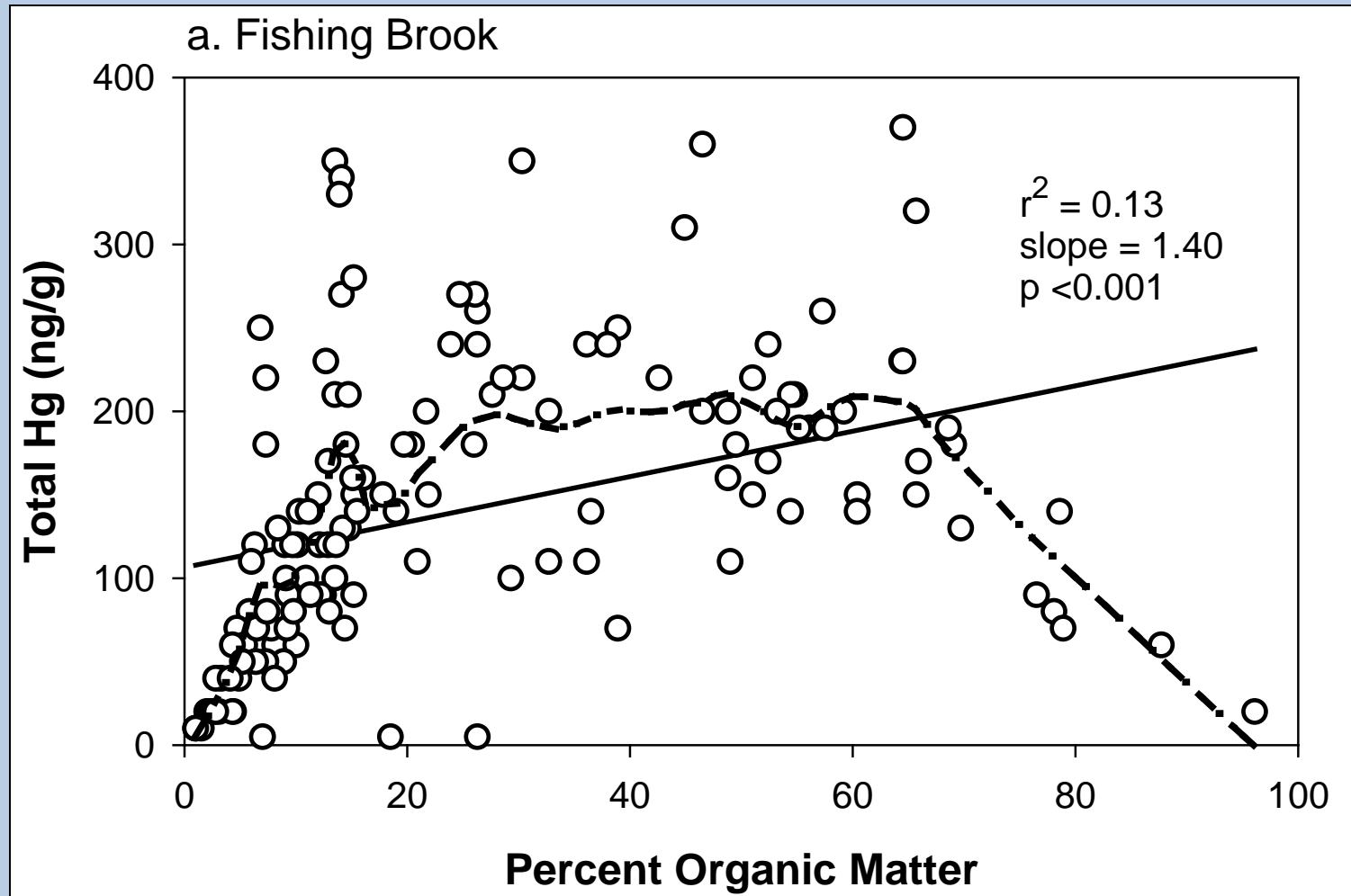
Methyl Hg - B horizons



McTier Creek – Hg - %OM



Fishing Brook – Hg - %OM



MHg - %OM – Both Sites

- No relation in Oa/A horizon samples
- Significant relation ($p < 0.05$) in B horizon samples, but explains only 20 – 30% of variation
- B horizon relation stronger at McTier Creek

Hg Storage

Parameter	Fishing Brook	McTier Creek
Total Hg ($\mu\text{g}/\text{m}^2$)	2570*	690
Methyl Hg ($\mu\text{g}/\text{m}^2$)	8.4	10.3
Organic Matter (kg/m^2)	38.8*	4.7

Storage estimated for the top 30 cm of soil

Did not attempt to estimate rock fragments in soil

Implications of Storage Data

- Turnover time = soil store/annual deposition
- Fishing Brook – THg = 408 yrs, MHg = 133 yrs
- McTier Creek – THg = 70 yrs, MHg = 104 yrs
- More atmospheric Hg deposition has been retained in ADK soils
- Stream loads slightly greater in Fishing Brook
- Suggests that gaseous losses from soils much greater in McTier Creek catchment

Discussion – Total Hg

- Hg concentrations and storage greater in Adirondacks than Coastal Plain – more soil organic matter in ADKs
- Concentration varied little across landscape types
- THg more efficiently stored by organic matter in southern Coastal Plain

Discussion – Methyl Hg

- Concentrations slightly greater in ADKs than Coastal Plain, but differences not significant
- Stores slightly greater in Coastal Plain than ADKs, but differences not significant
- MHg/THg greater in Coastal Plain
- MHg and MHg/THg greater in wetlands and riparian soils than in uplands

Conclusions

- ADK soils have greater THg stores than southern Coastal Plain soils
- Methyl Hg stores are similar at both sites – consistent with similar MHg in surface water and biota
- MHg/THg greater in southern Coastal Plain – suggests greater methylation efficiency, consistent with warmer climate
- Greater THg stores and turnover time in ADK soils suggests recovery from reduced deposition will be more gradual and prolonged in north

Acknowledgements

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