The Dragonfly Mercury Project

a national scale evaluation of variation in biosentinel mercury concentrations and landscape drivers across US national parks

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Dragonfly larvae: bio-sentinels of relative Hg risk among waterbodies

- Ubiquitous across water bodies
- Vector to terrestrial foodwebs
- Exhibit site fidelity
- High and consistent %MeHg
  (this research: 83±0.7%)
- In Great Lakes parks, correlated with fish Hg (Haro *et al.* 2013, ES&T)
- Bio-sentinel for fishless waters

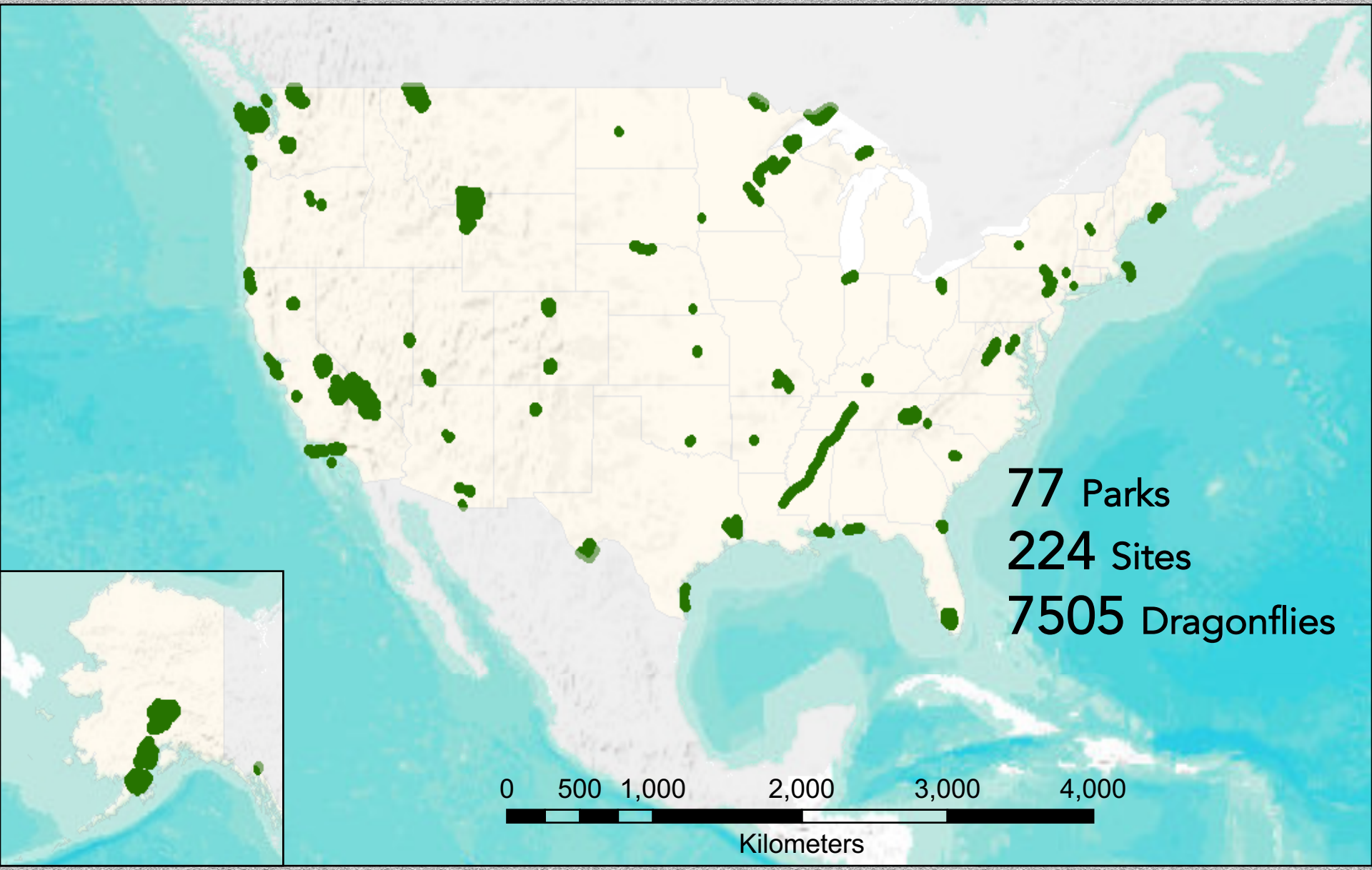






Photos: Acadia Learning

Sampling sites in national parks, 2014-2016



Citizen scientists collect larvae with trained park staff

- Over 3,237 citizens in 2013–2016:
  - High school students
  - Interns and Youth Conservation Corps
  - Local conservation groups
  - Park visitors and volunteers
- Park staff use project protocol and sampling kits



Girl Scouts at Women's Rights NHP, 2016


Saguaro NP, 2015


Lewis & Clark NHP, 2015


Shenandoah NP, 2016

Poster RP-100

Methods

1. Sampling kits prepared in USGS and UMaine labs, then shipped to participating parks





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2. NPS contact leads citizen scientists in field sampling

Water: "Clean hands-Dirty hands" method

Sediment: Mini-corers sample upper 2 cm; 3 replicates

Dragonfly larvae: At ~3 sites/park, 20 specimens/ site individually bagged

Site characterization: Field notes, coordinates, observations







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Dragonfly samples analyzed via DMA (THg) and MERX & method 1630 (MeHg)

Water samples filtered and analyzed at USGS Mercury Lab

3. Samples shipped to USGS & UMaine for analyses:

Dragonflies: THg, MeHg (subset)
Water: THg, MeHg, DOC, pH, anions, conductivity
Sediment: THg

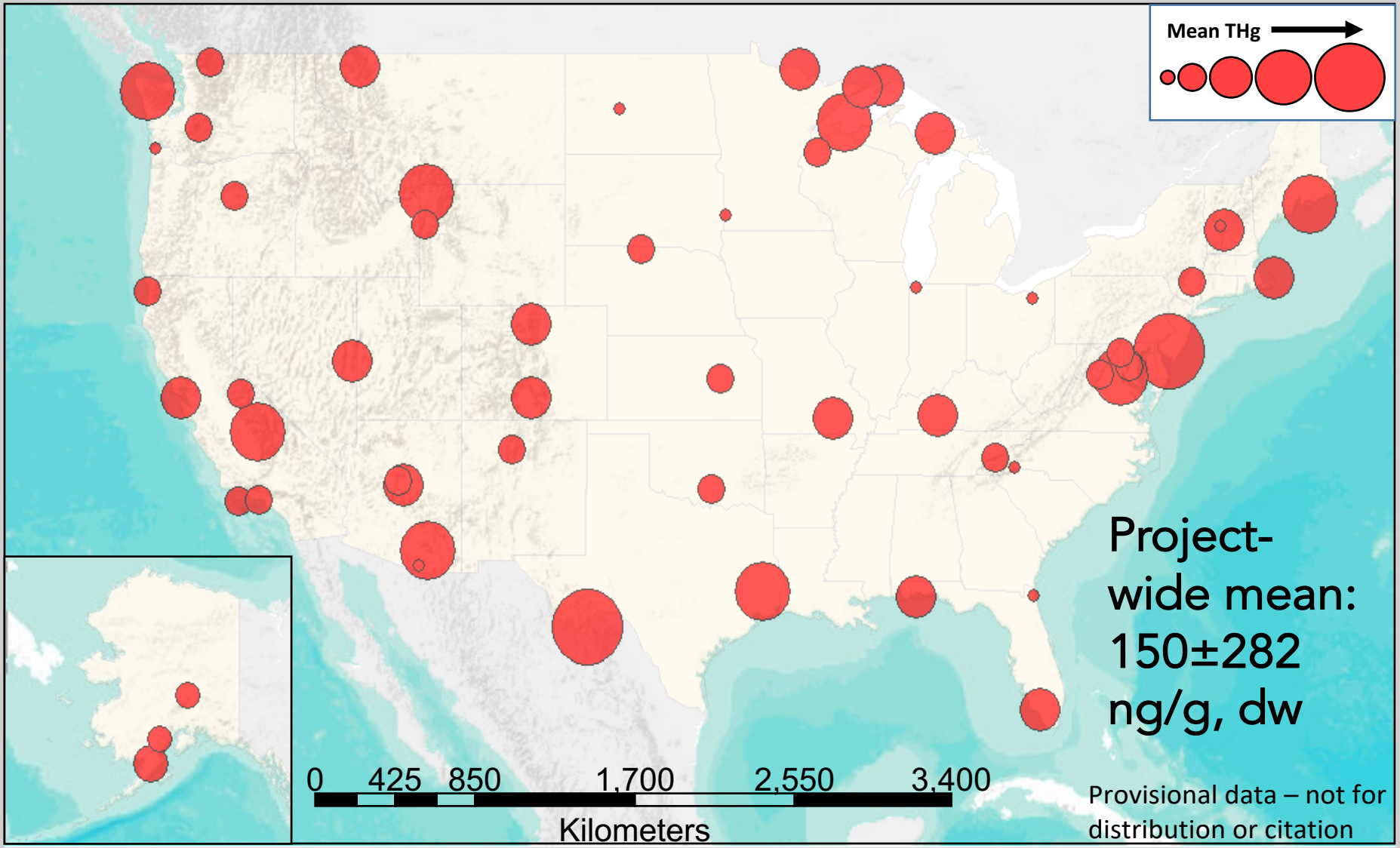






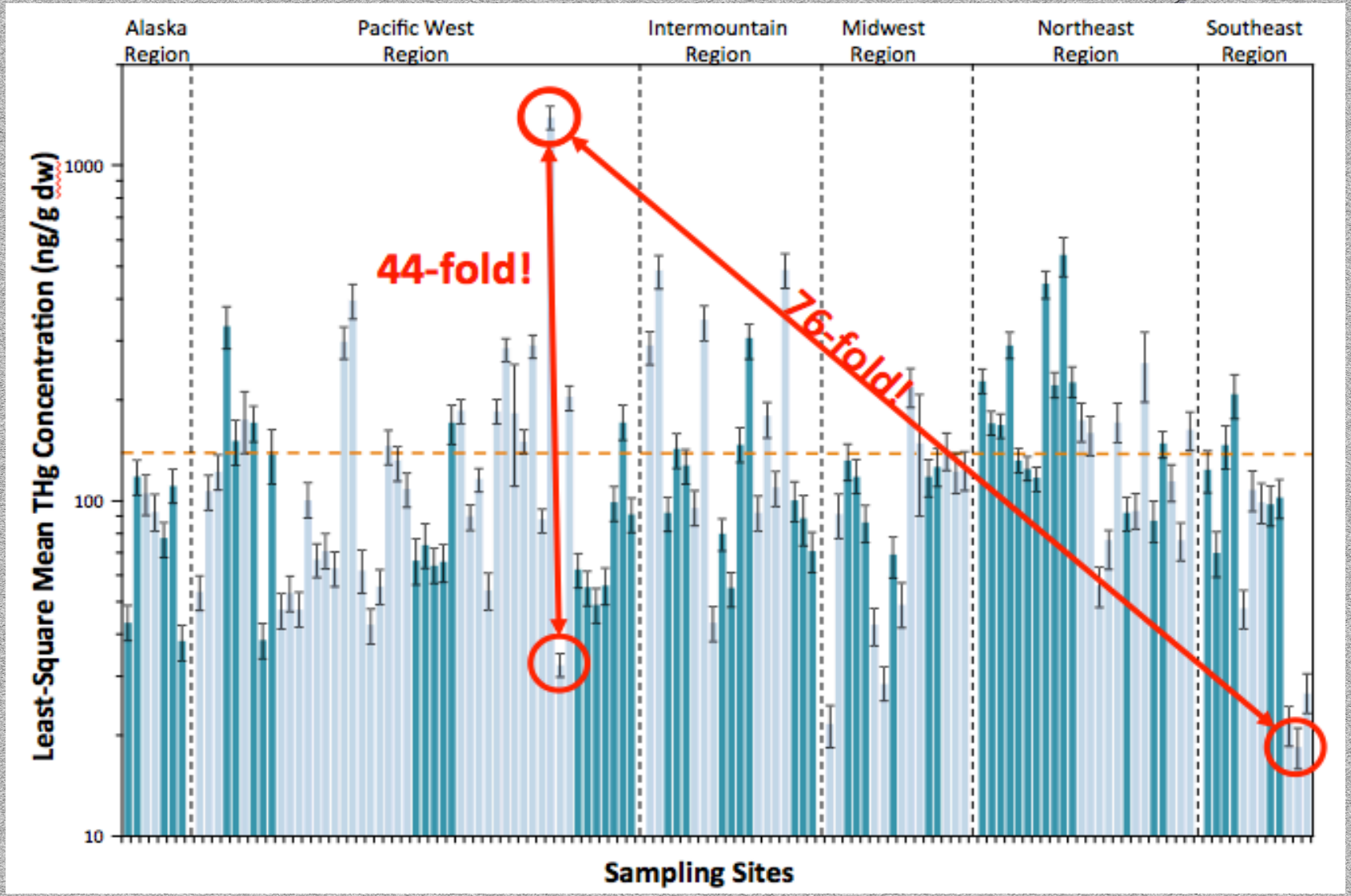
Obj. 1: National-scale baseline data

Spatial variability in Park Mean Total Mercury Concentrations, 2014 - 2015



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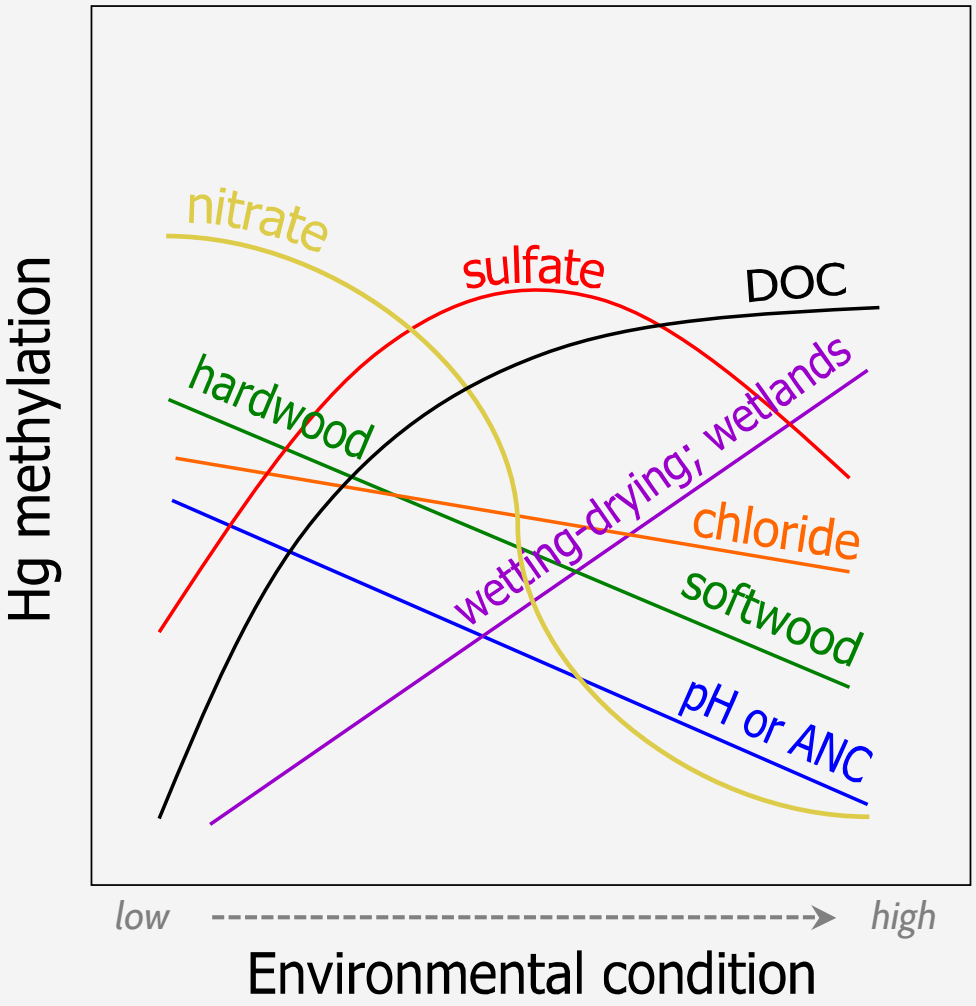
THg in larvae is highly variable, within & among parks

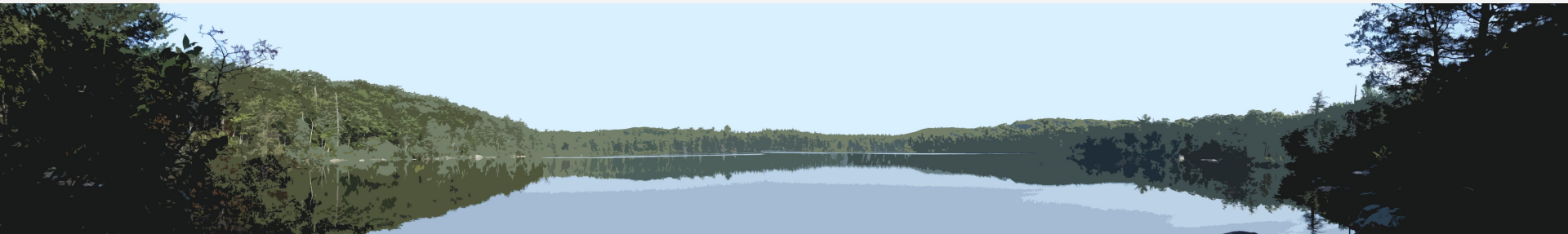


Provisional data – not for distribution or citation

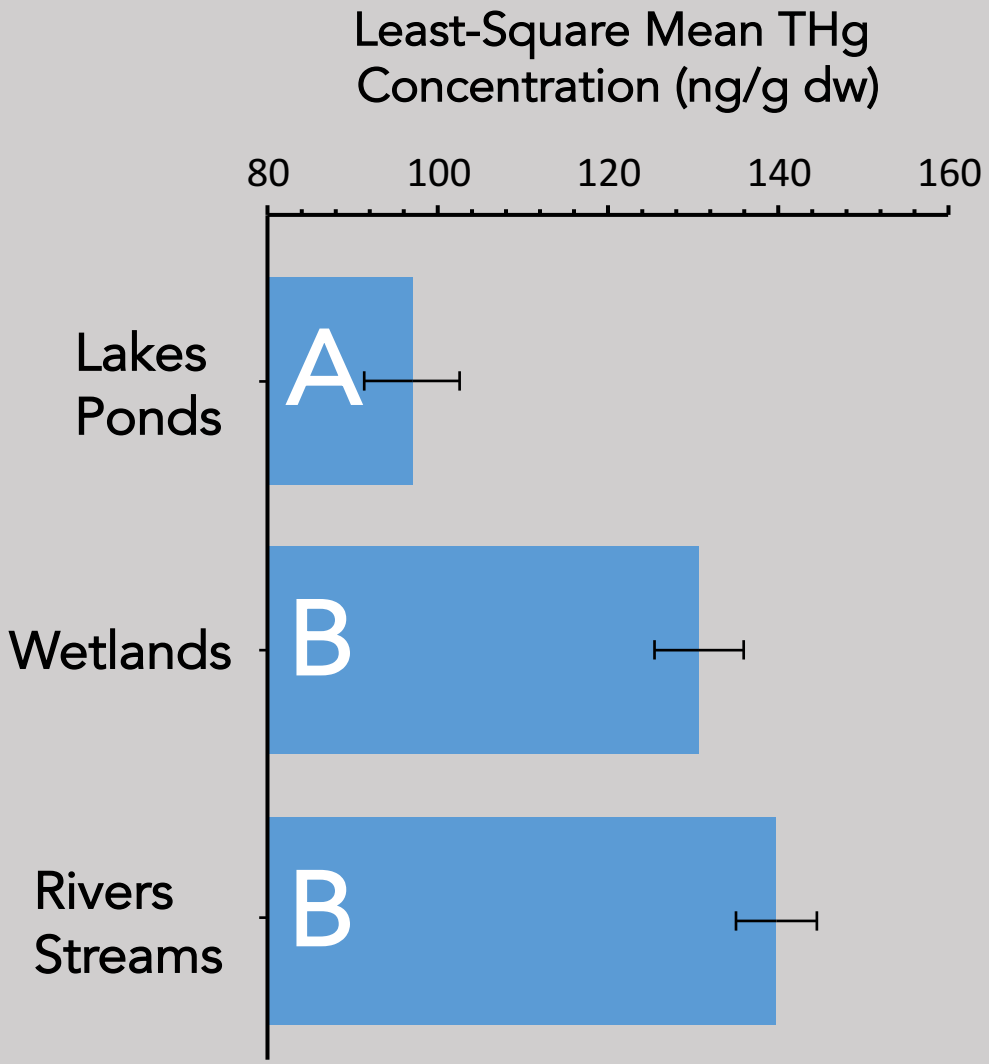
Eagles-Smith et al. 2016, USGS FS 2016-3005

Obj. 2: which habitats and catchment characteristics influence vulnerability to Hg accumulation in foodwebs?





Obj. 2: THg varied among aquatic habitats

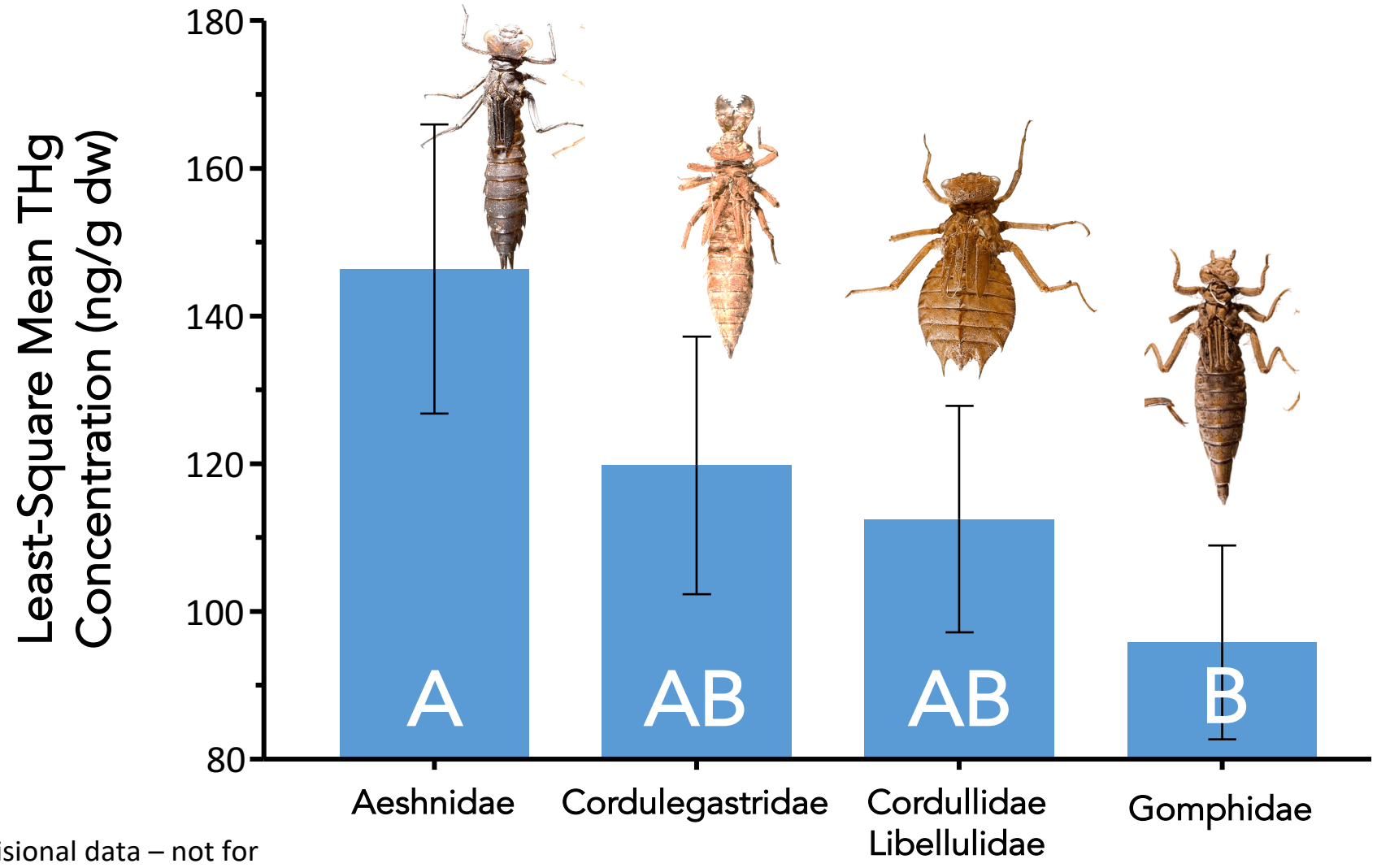




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How do dragonfly larvae characteristics affect Hg?

Taxonomic variation

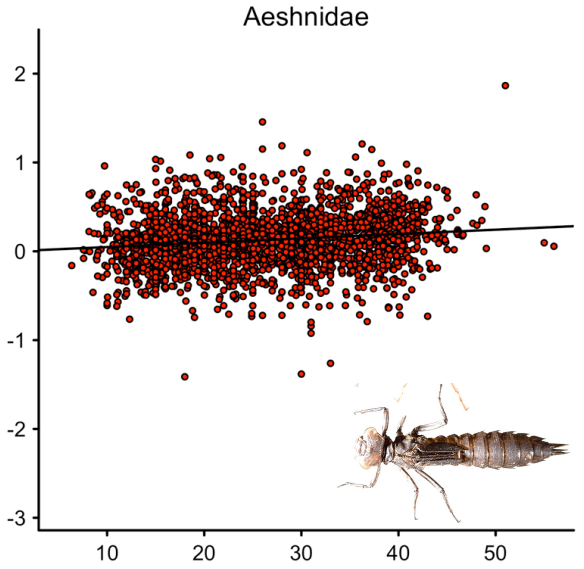


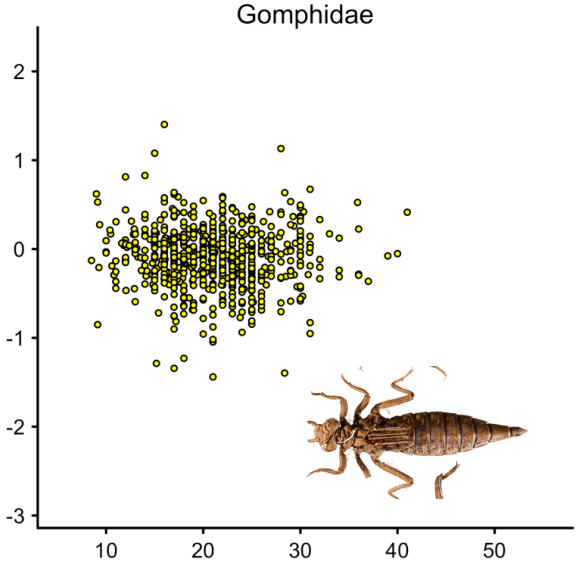
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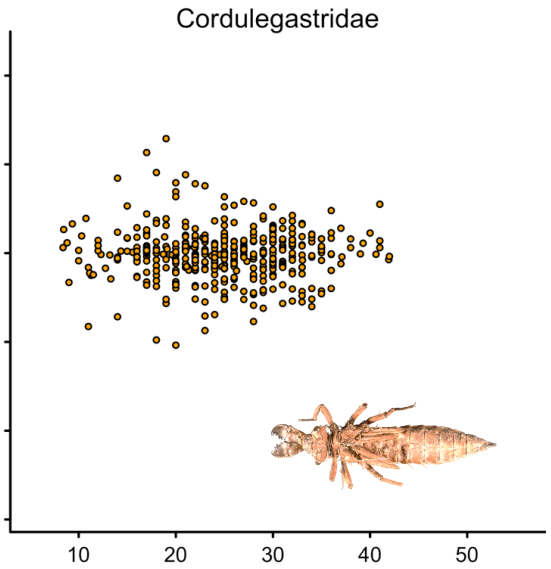
How do dragonfly larvae characteristics affect Hg?

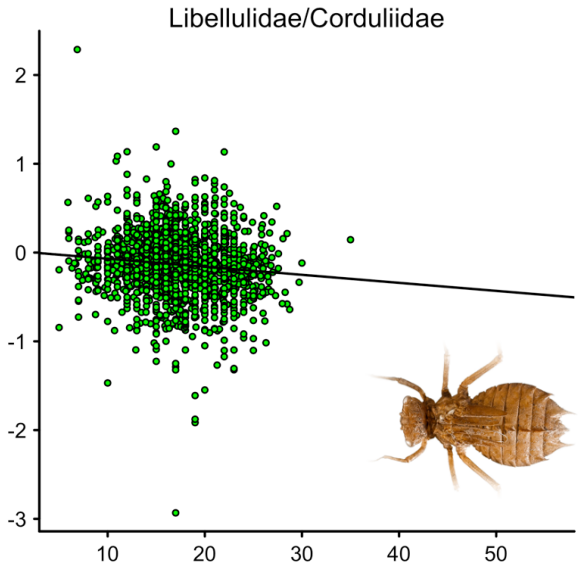
Body size (length)

Partial residuals, accounting for site





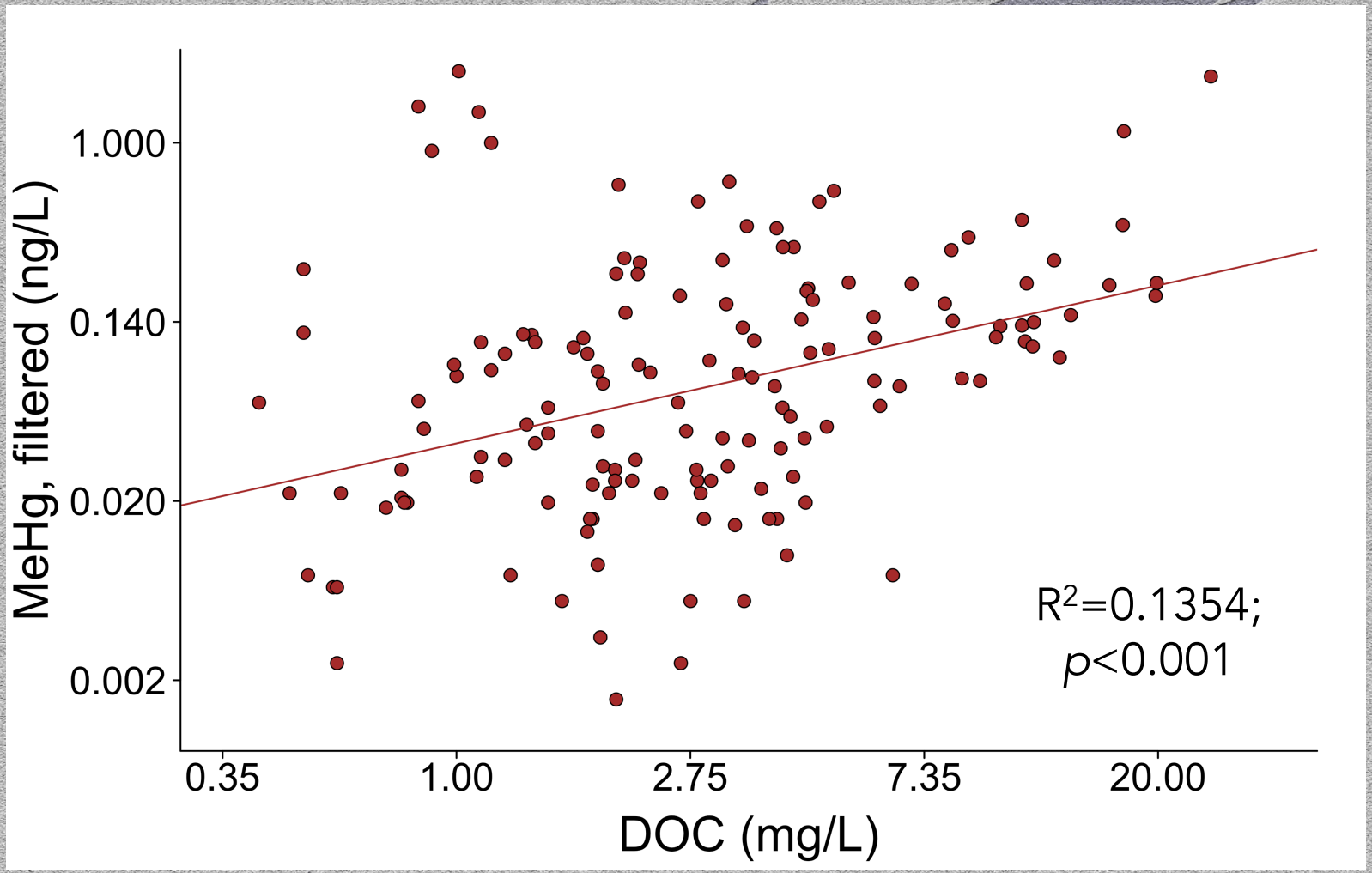




Dragonfly length (mm)

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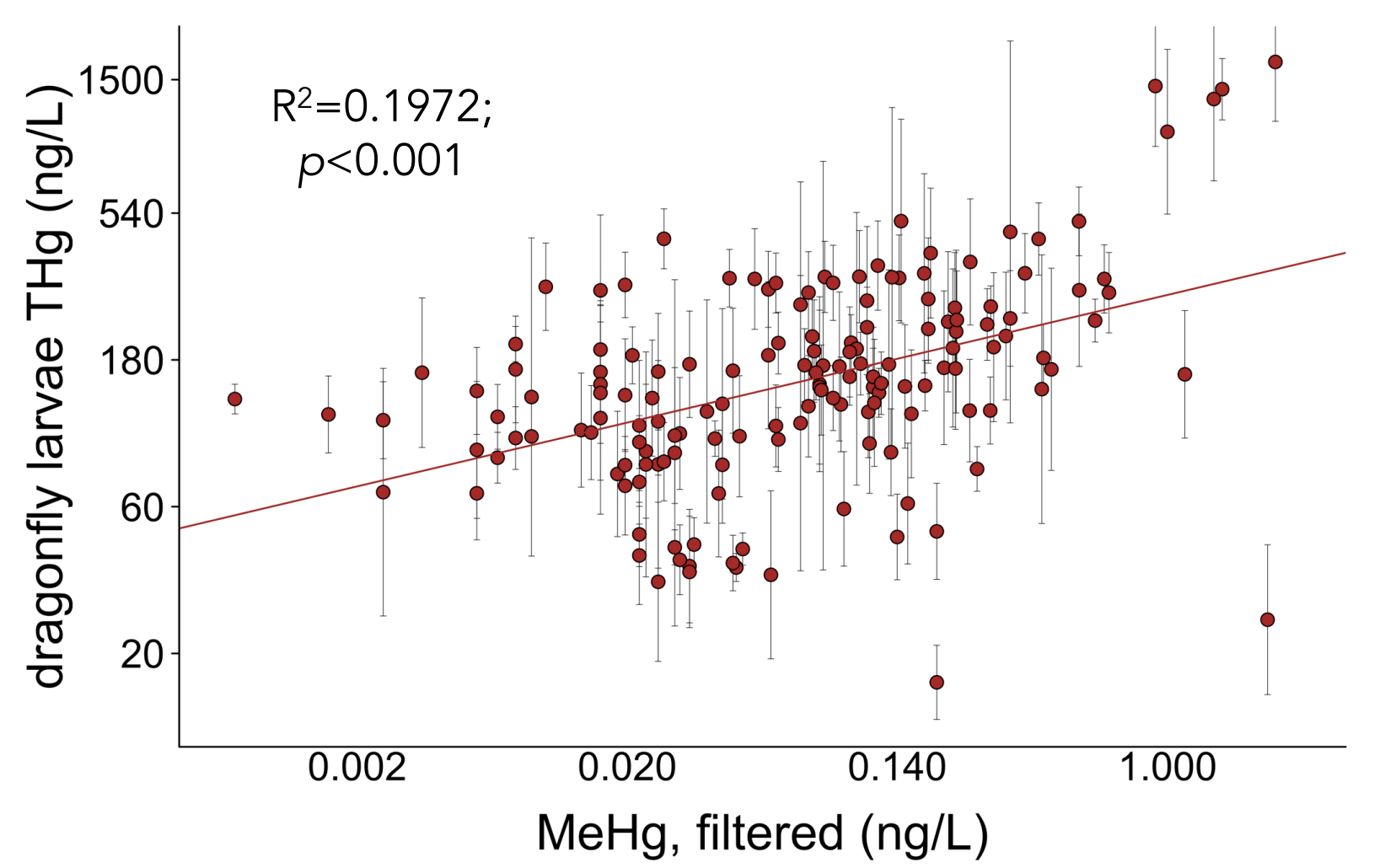
Water chemistry: DOC significantly (but weakly) related to MeHg in water



Statistics performed on log-transformed data

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Water MeHg → dragonfly THg significantly related (again weak)



Dragonfly larvae: Geo means by site; water MeHg log-transformed

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Summary & ongoing work

- Continental scale insight into Hg bioaccumulation at relatively low TP predators (equivalent to prey fish); whereas typical large spatial-scale monitoring focuses largely on sport fish
- Baseline to measure effectiveness of Hg reduction policies (e.g., MATS)
- Benefits to citizen scientists through discovery of the natural world and civic engagement
- Continued investigation of habitat and chemistry drivers



Jordan Pond at Acadia NP, 2014

Acknowledgements

Many field crews, including over 3,200 citizen scientists

Park staff and partners at >77 national parks

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Project web site:

http://go.nps.gov/dragonflymercury

USGS science for a changing world

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