

Summary of mercury sources and dynamics in the environment



Chris Eckley, EPA R-10 LSASD

2020/03/03

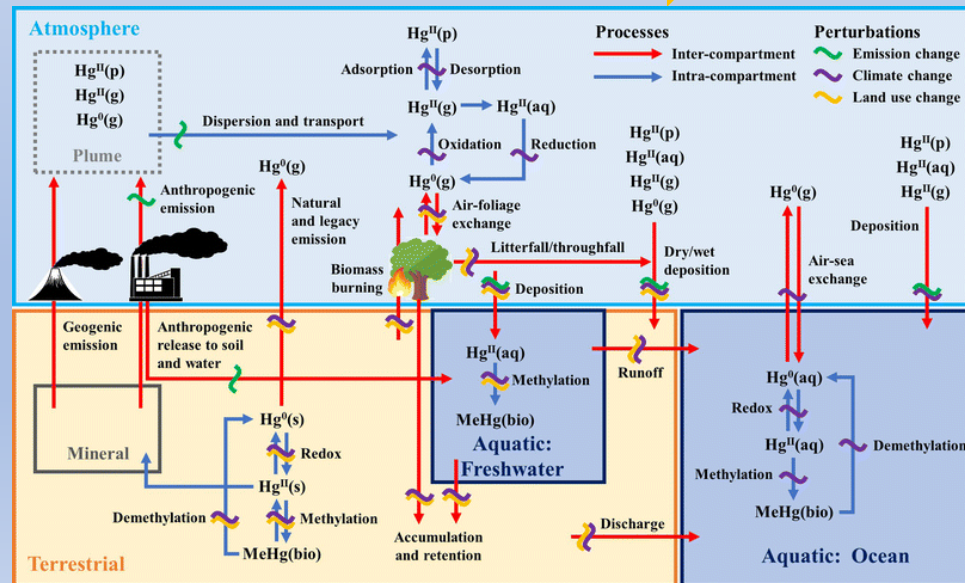
The Mercury Cycle

Mercury Releases



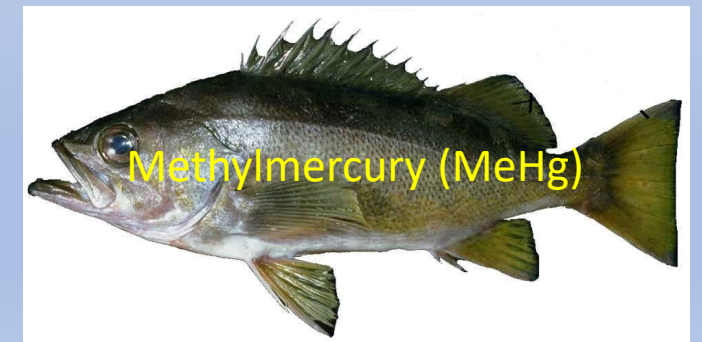
Mercury in the Environment

Transport, Methylation,
Bioaccumulation



Source: Obrist et al, 2018

Mercury Exposure



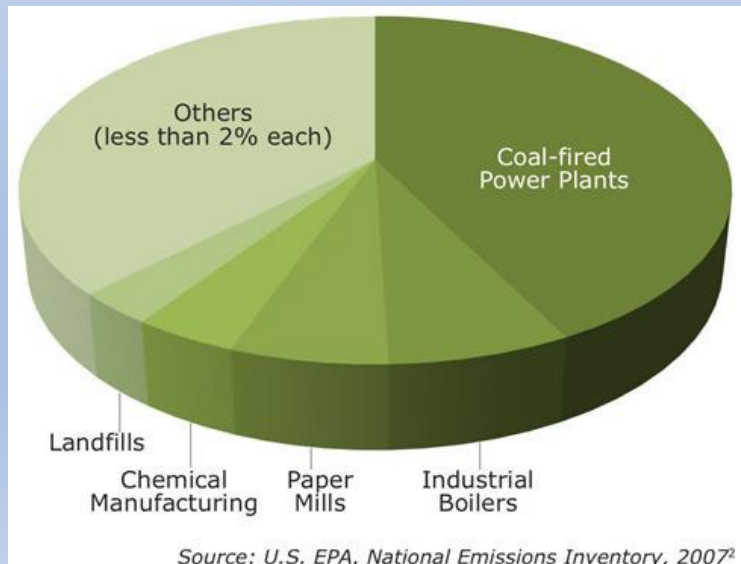
Global Mercury Pollution

- Mercury is a global pollutant (& a local pollutant)
- Long atmospheric lifetime (0.5-2 yr) of Hg^0 before deposition

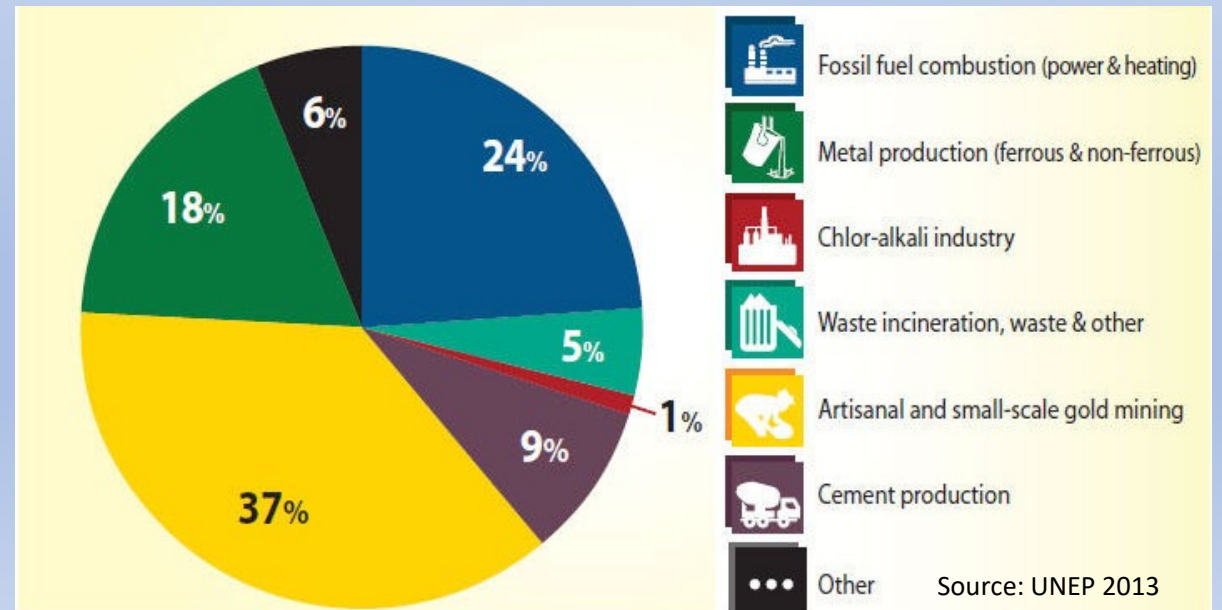


- Sources of Hg emissions:

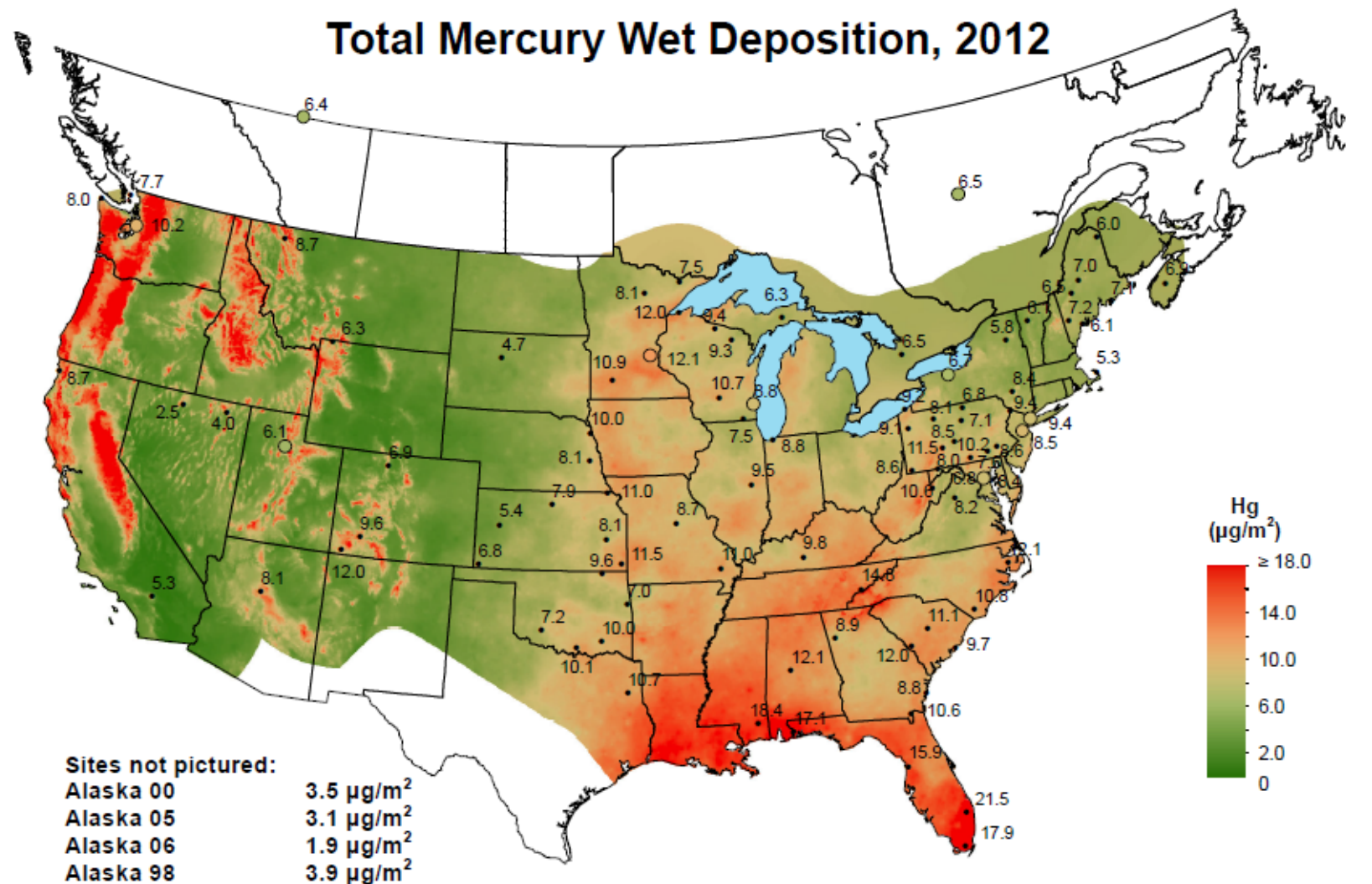
US Sources



Global Sources

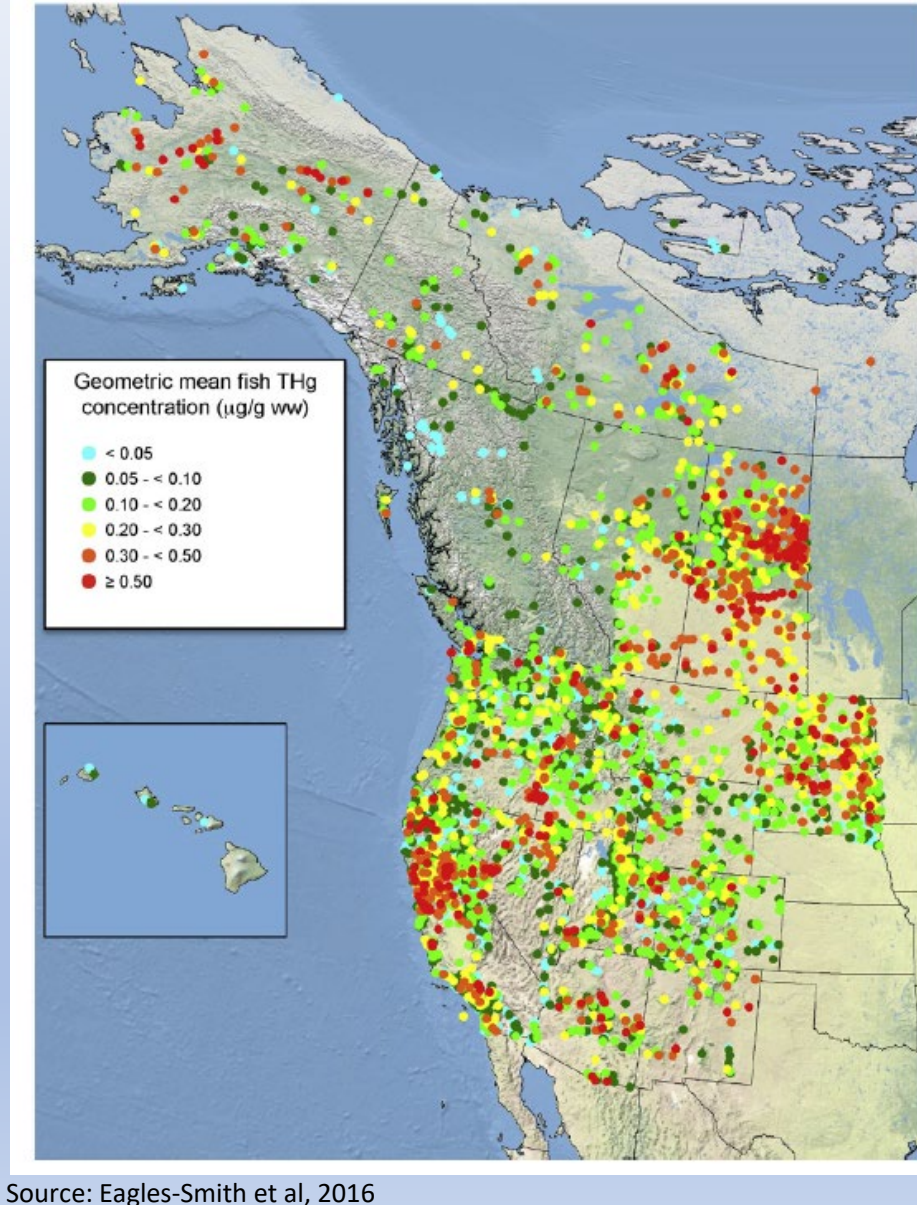
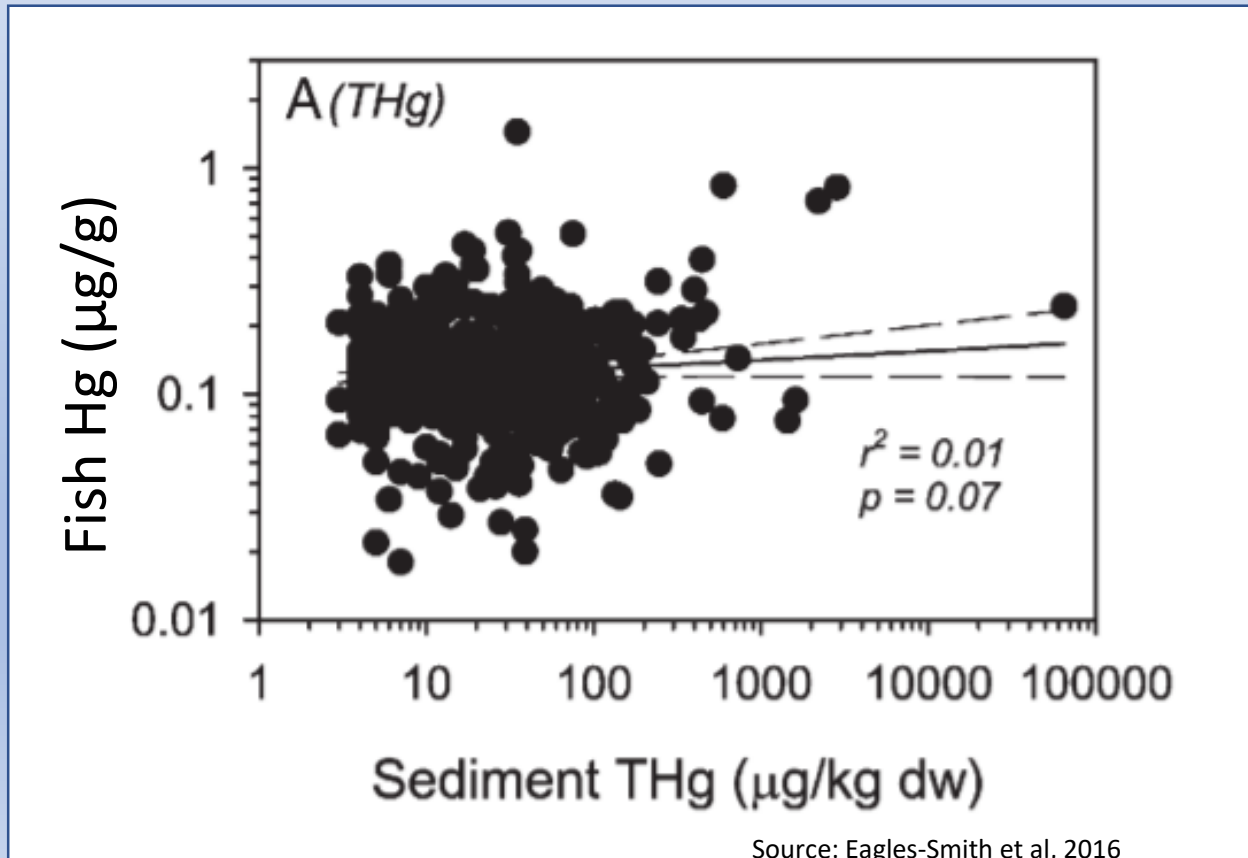


Mercury Deposition



Spatial variability in fish Hg concentrations

- Fish Hg concentrations are spatially variable
- Fish Hg concentrations are not well correlated with the total-Hg in sediment

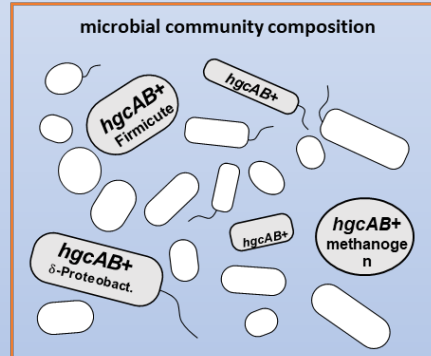
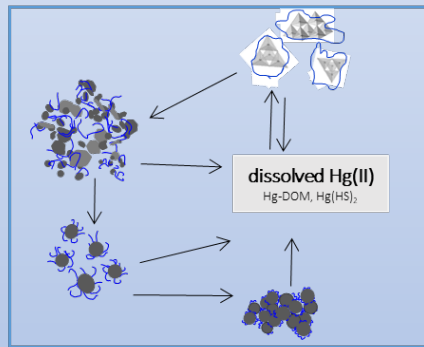


Factors that affect spatial variability of fish Hg

Methylmercury (MeHg) production

Bioavailable
Inorganic Hg

Anerobic
Microbiome



= MeHg

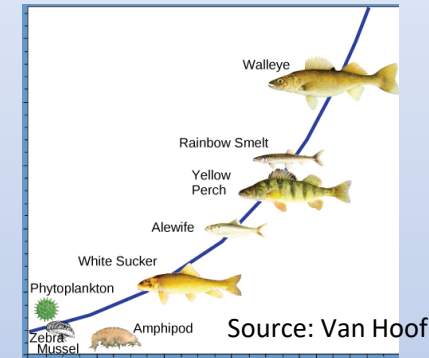
Adapted from: Hsu-Kim et al, 2018

Wetlands: important zones of
methylation



Photo: Goulet

Foodweb variables

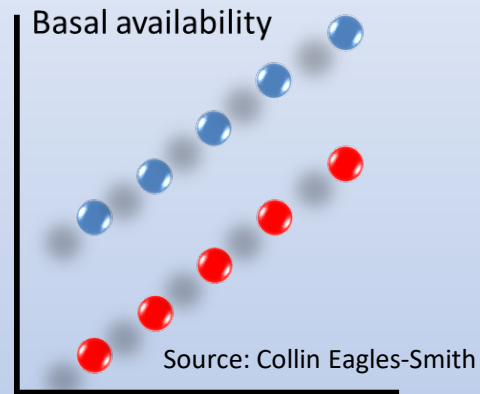


Trophic position

Trophic transfer efficiency

Mercury

Trophic position



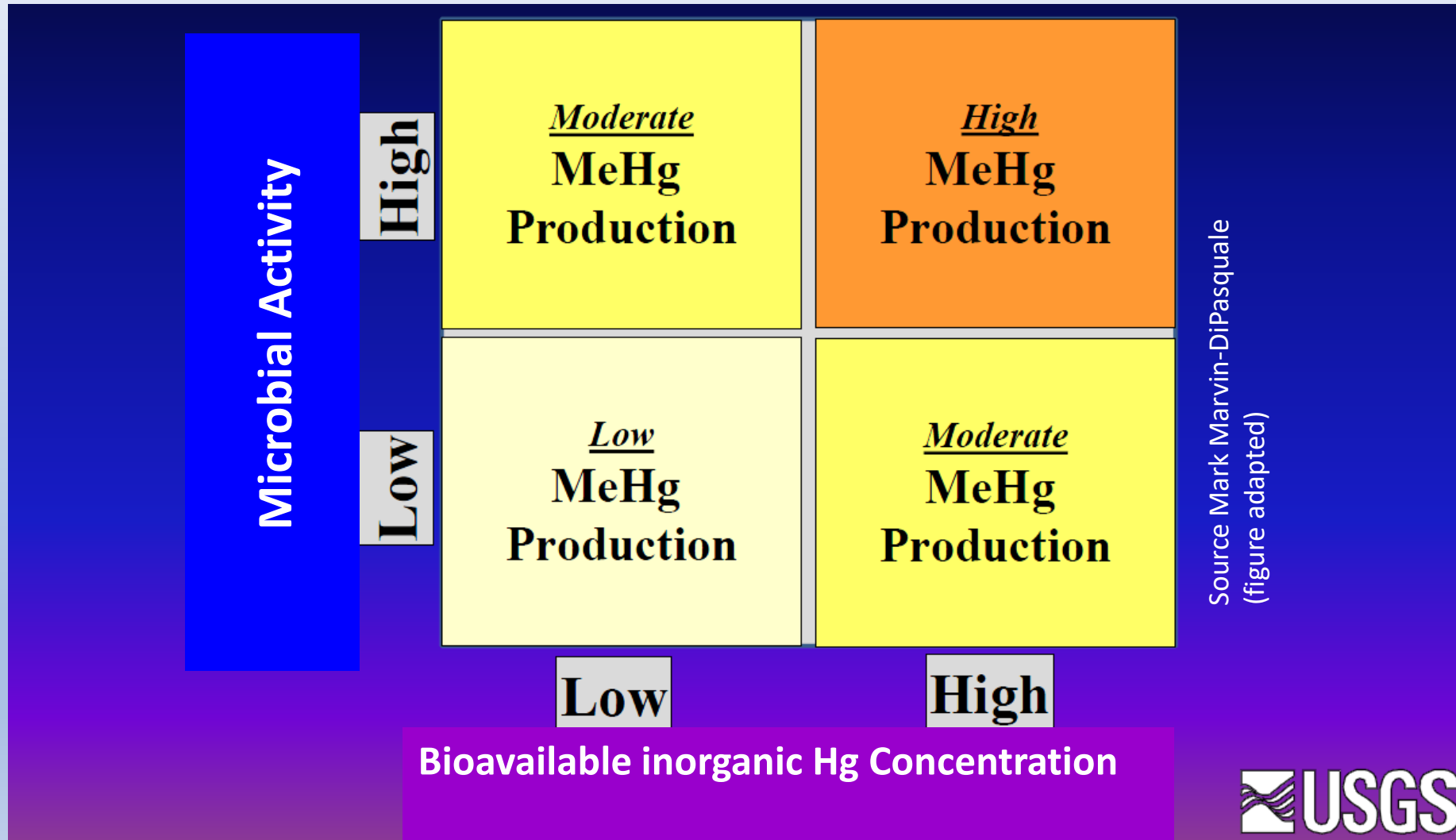
Trophic position

Food chain length

Mercury

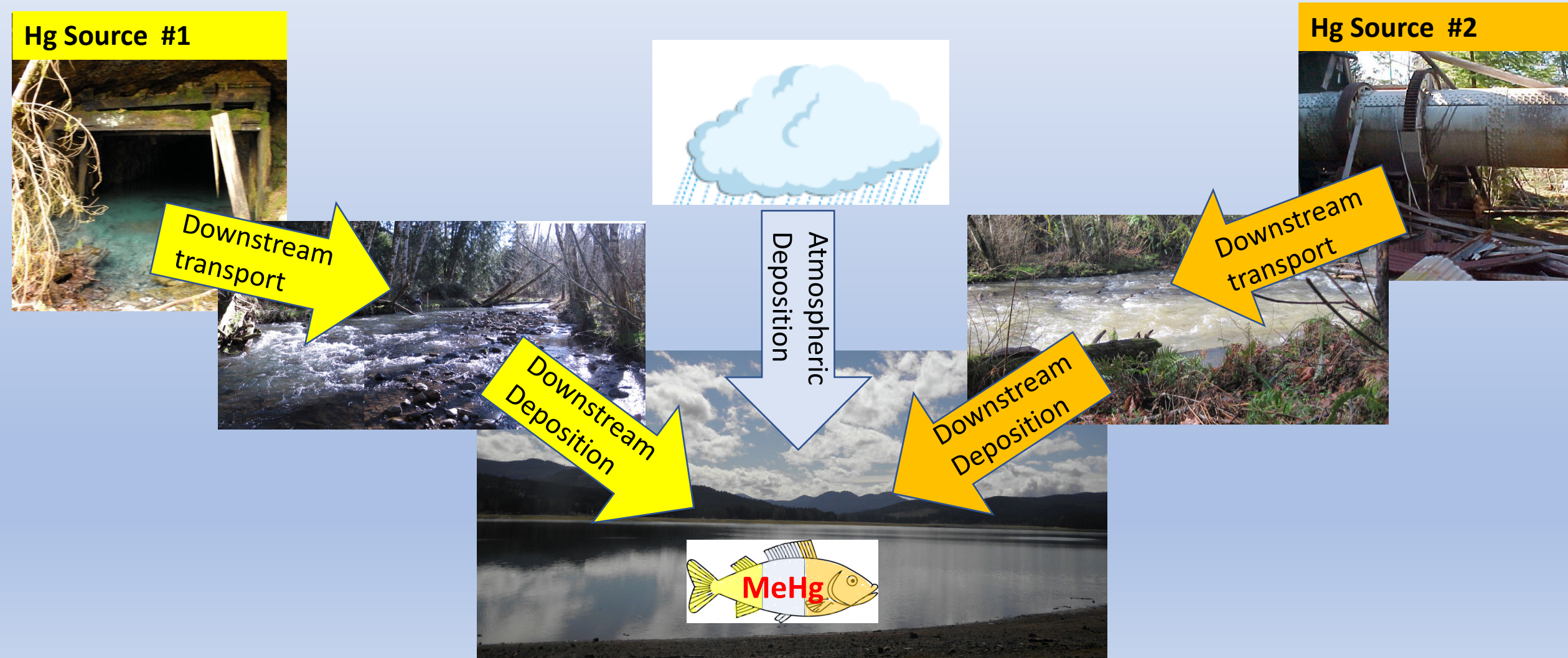
Trophic position

Factors affecting Hg methylation

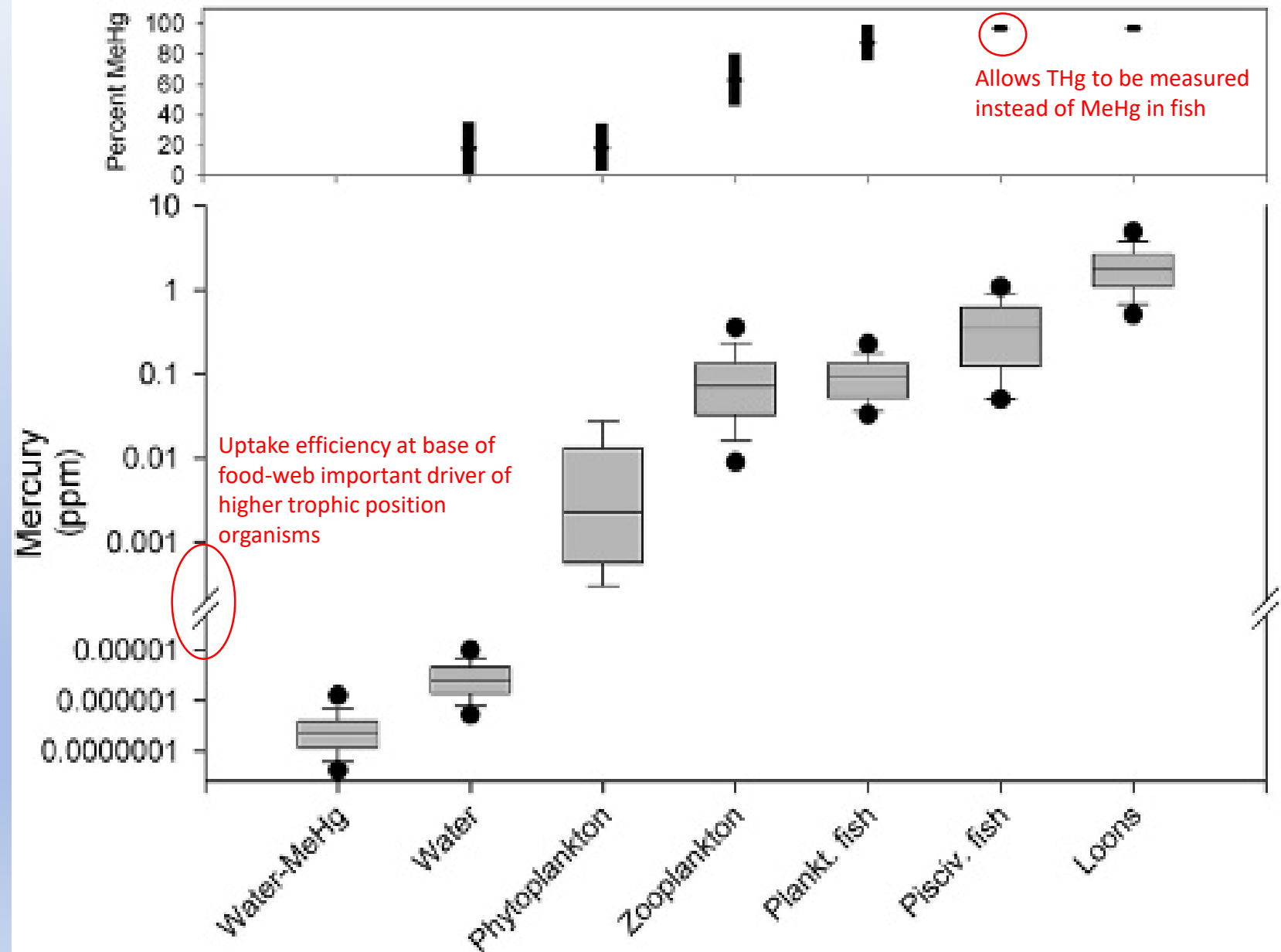


Fish contain Hg from multiple sources

- Downstream/wind of contaminated sites the source of Hg pollution can be more difficult to discern, especially when there are multiple potential sources with different bioavailability

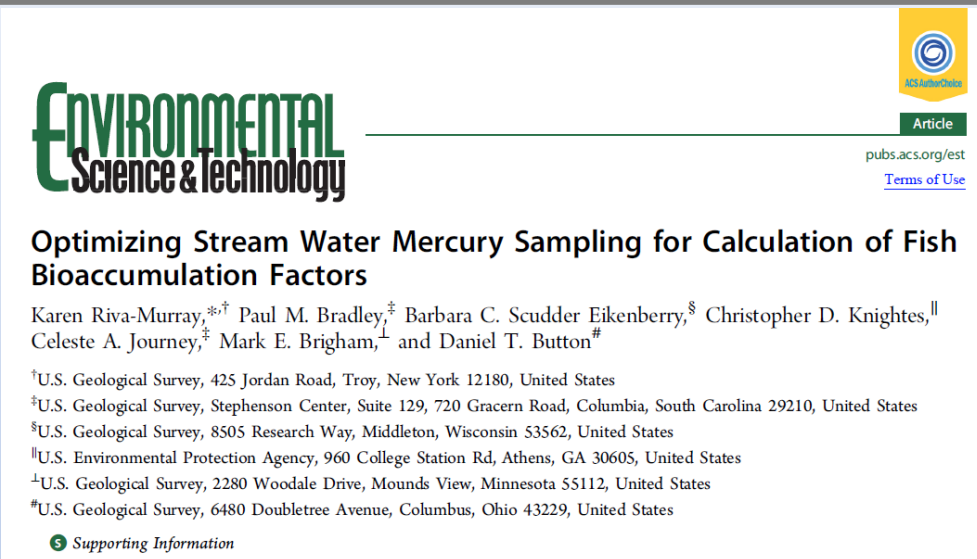


Methylmercury bioaccumulates/biomagnifies in biota

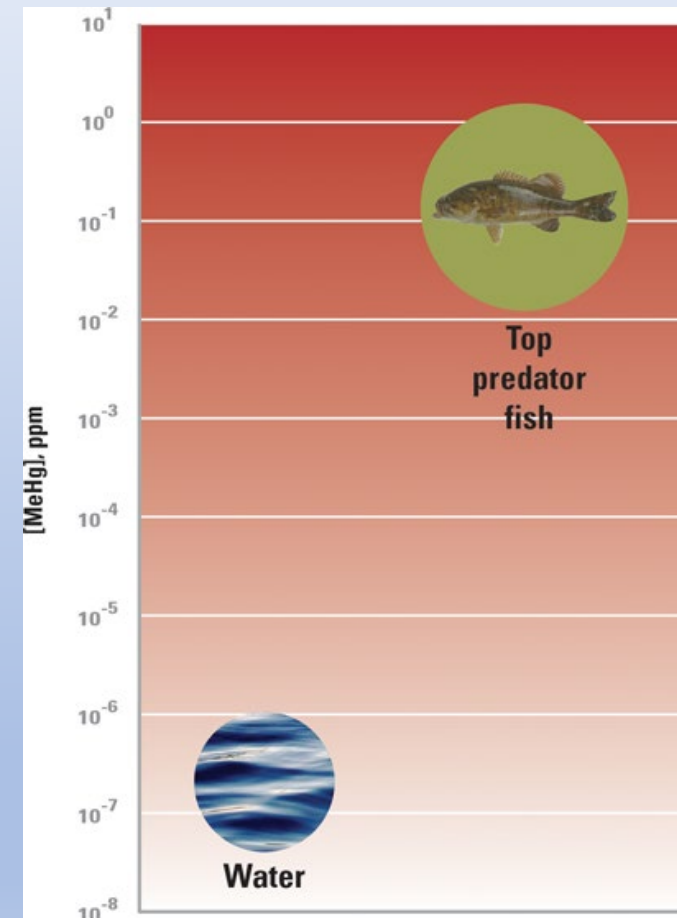


Source—Driscoll et al, 2007 Box and whisker plots of mercury (Hg) concentrations in water and aquatic biota in eastern North America. Also shown are the ranges for the percentage of total Hg occurring as methylmercury (MeHg). All values were obtained from NERC (Northeastern Ecosystem Research Cooperative) data and represent wet weight, except those for phytoplankton, which were obtained from Watras and colleagues .

Monitoring: water & fish tissue

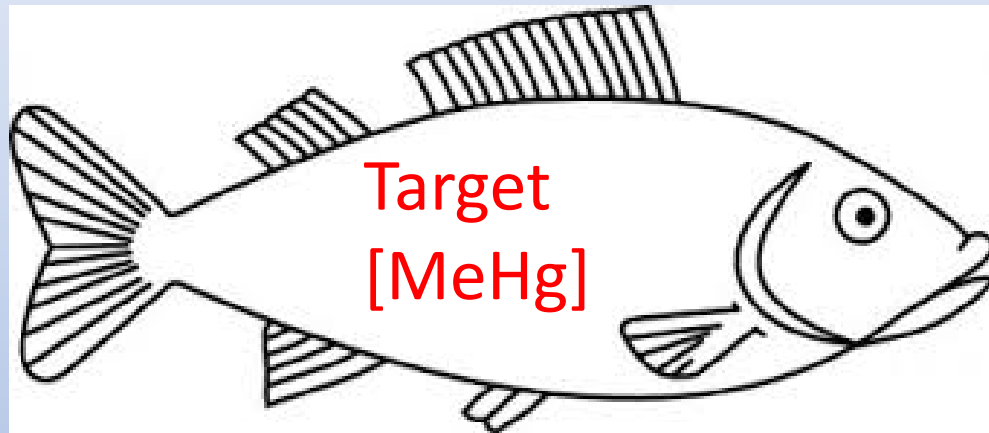


- BAFs for fish are widely employed for regulatory purposes.
- Mercury BAFs are calculated as: $(\text{Hg fish})/(\text{Hg water})$
- Paper evaluates the influence of water sample timing, filtration, and mercury species on the relation between fish and water Hg concentrations to identify optimum Hg water sampling approaches.
- Recommendation: best fit with fish data for mean annual filtered MeHg concentrations

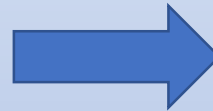


Monitoring: water & fish tissue

Water MeHg/THg Translator



Food web
dynamics



Water [Dissolved MeHg]

MeHg/THg
translator



[Whole water THg]

Questions

