Algal blooms reduce the uptake of toxic methylmercury in freshwater food webs

Paul C. Pickhardt, Carol L. Folt, Celia Y. Chen, Bjoern Klaue, and Joel D. Blum

Outline

- Intro to Hg, cycling, toxicity
- Hg in Nevada
- Hypothesis
- Design
- Results
- Discussion

Image credit: Bionerd, 2008, *Element mercury (Hg), liquid form*. Accessed 31-01-2021. https://commons.wikimedia.org/wiki/File:Pouring_liquid_mercury_bionerd.jpg

Mercury (Hg)

-Hydrargyrum, Latin for “silver water”

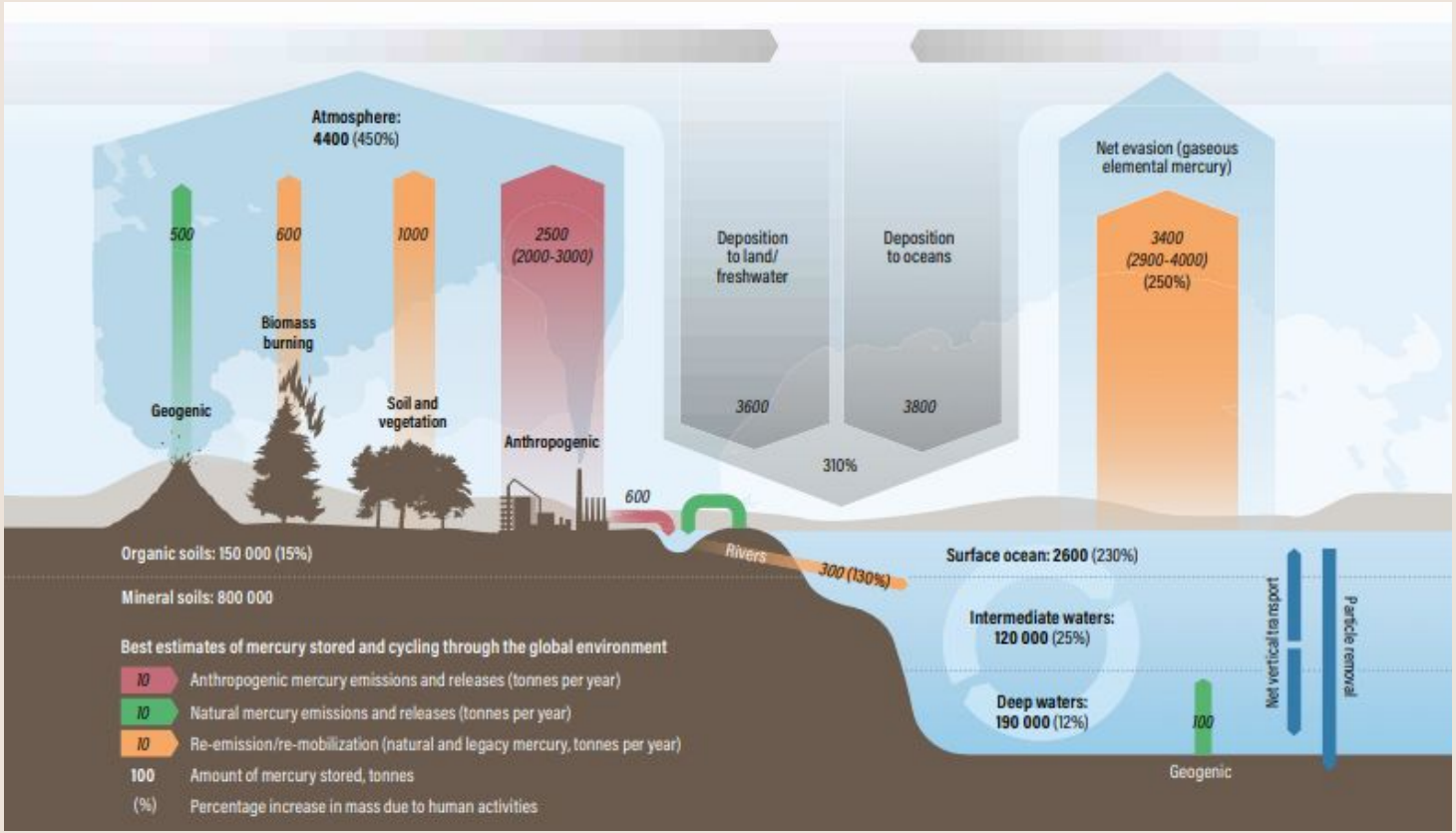
-liquid at standard temperature and pressure

-Historical uses include medicine, paint, and gold extraction (still practiced in artisanal gold mines)

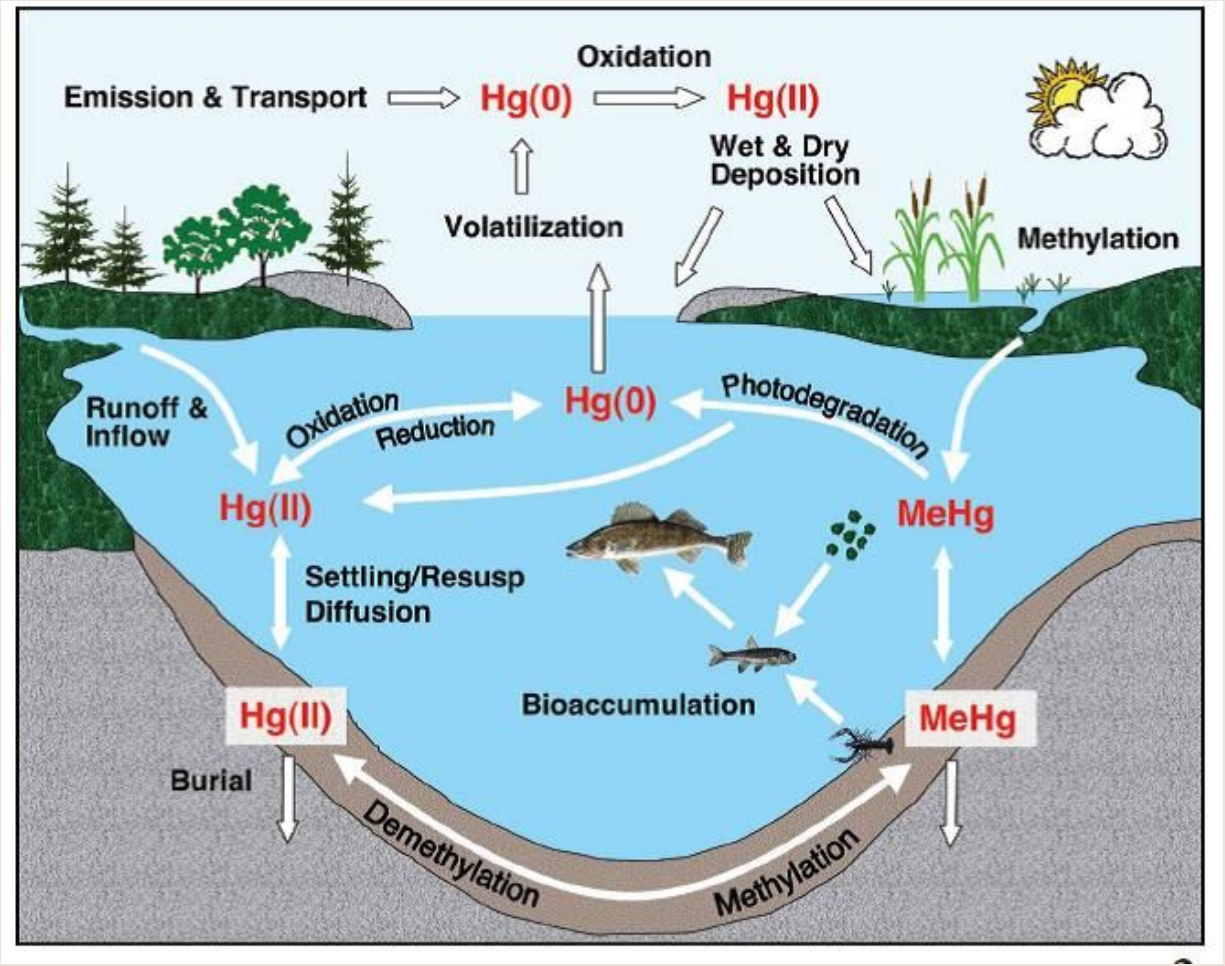
Form Determines Toxicity and Behavior

Form	Toxicology
Elemental Hg: liquid vs gaseous	Liquid: the least bioavailable, absorption through the skin or intestines is low
	Gaseous: readily absorbed in the lungs, can cross the blood-brain barrier (Mad Hatter's)
Inorganic Hg: (HgII) bound to Cl, S, O	Oxidized Hg: more reactive, binds to thiol groups on proteins, inhibits enzyme activity but does not cross the blood-brain-barrier
Organic Hg: Methylmercury (MeHg)	Organic Hg is the most toxic, accumulates in brain tissue (Minamata Disease)

Park, Jung-Duck, and Wei Zheng. "Human exposure and health effects of inorganic and elemental mercury." *Journal of preventive medicine and public health* 45.6 (2012): 344.

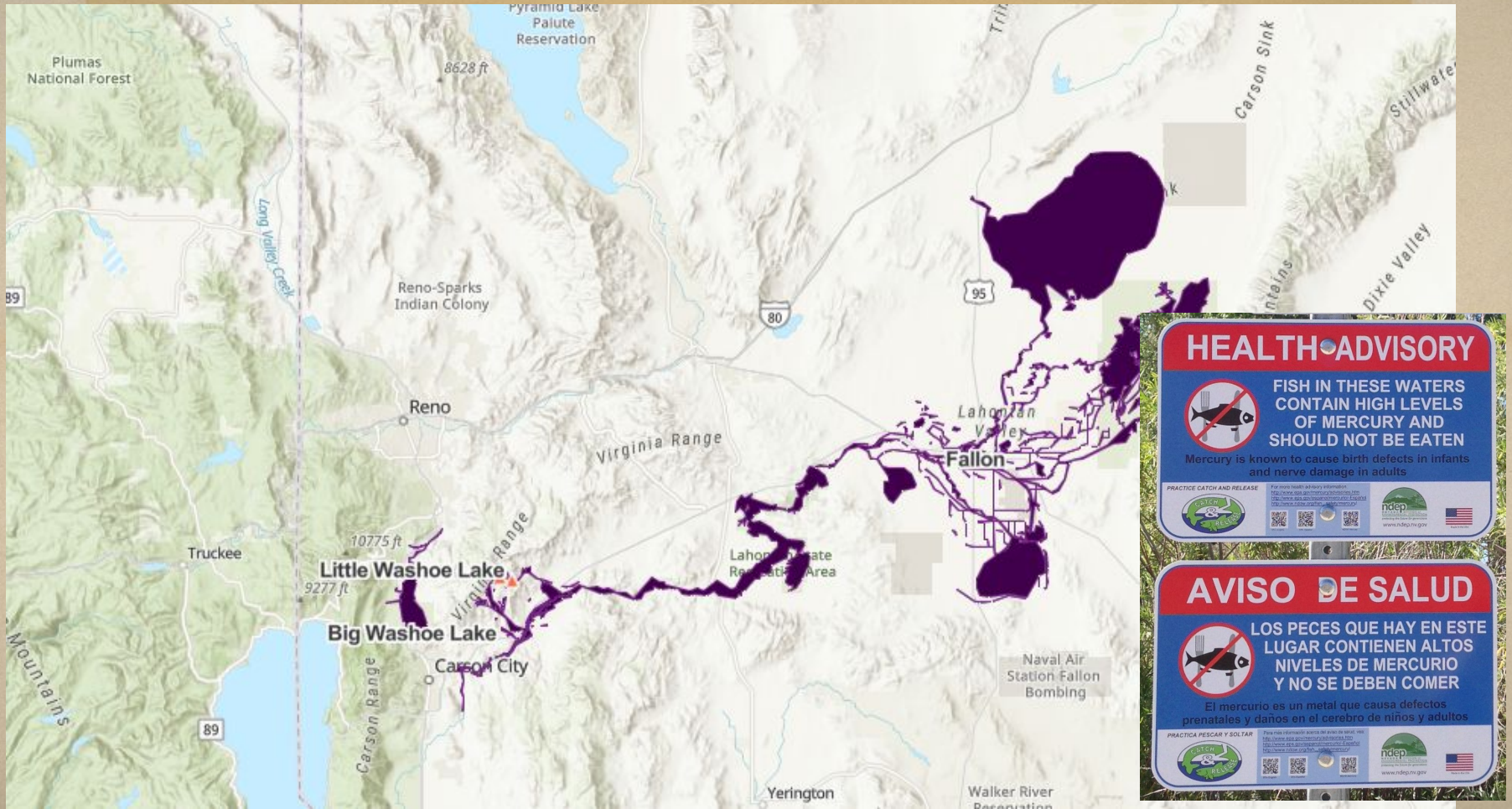


Outridge, Peter M., et al. "Updated global and oceanic mercury budgets for the United Nations Global Mercury Assessment 2018." *Environmental science & technology* 52.20 (2018): 11466-11477.



Engstrom, Daniel R. "Fish respond when the mercury rises." *Proceedings of the National Academy of Sciences* 104.42 (2007): 16394-16395.

Hg in Nevada-Carson River Superfund Site



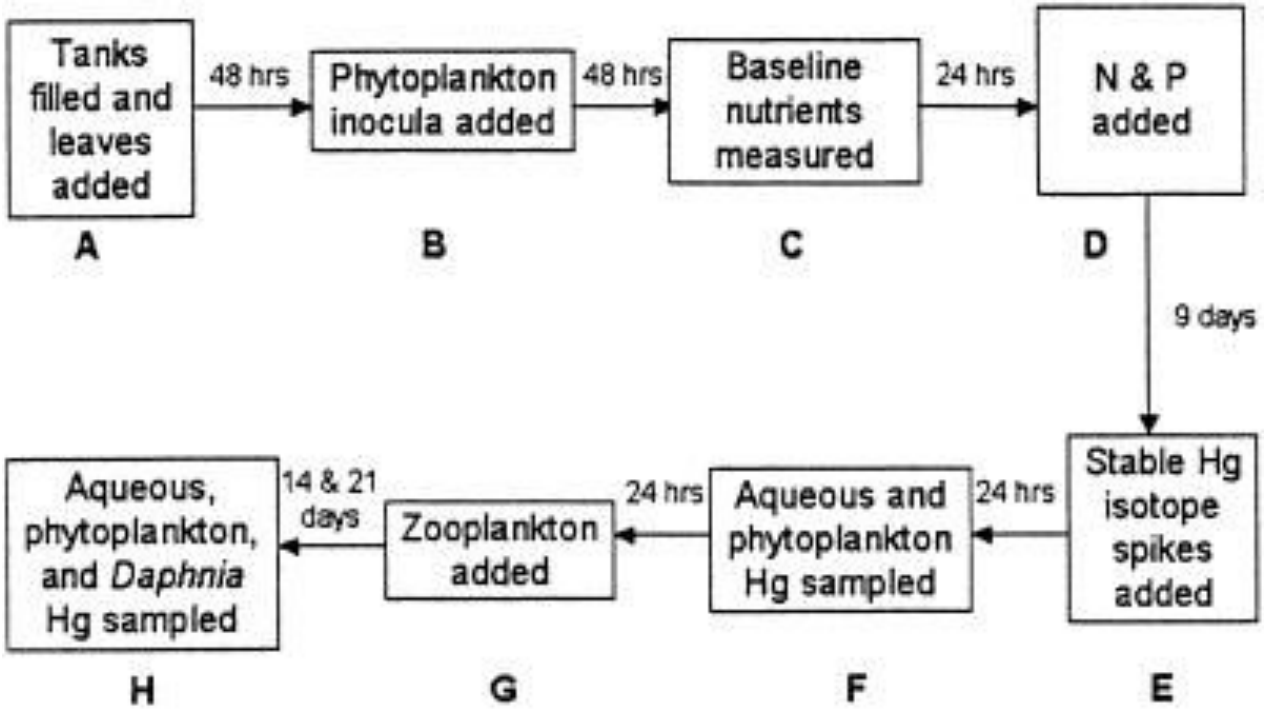
Water flea (Daphnia)
MarekMis, 2019, accessed 02/03/21. https://commons.wikimedia.org/wiki/File:Rodz%C4%85ca_dafnia.jpg

Keywords

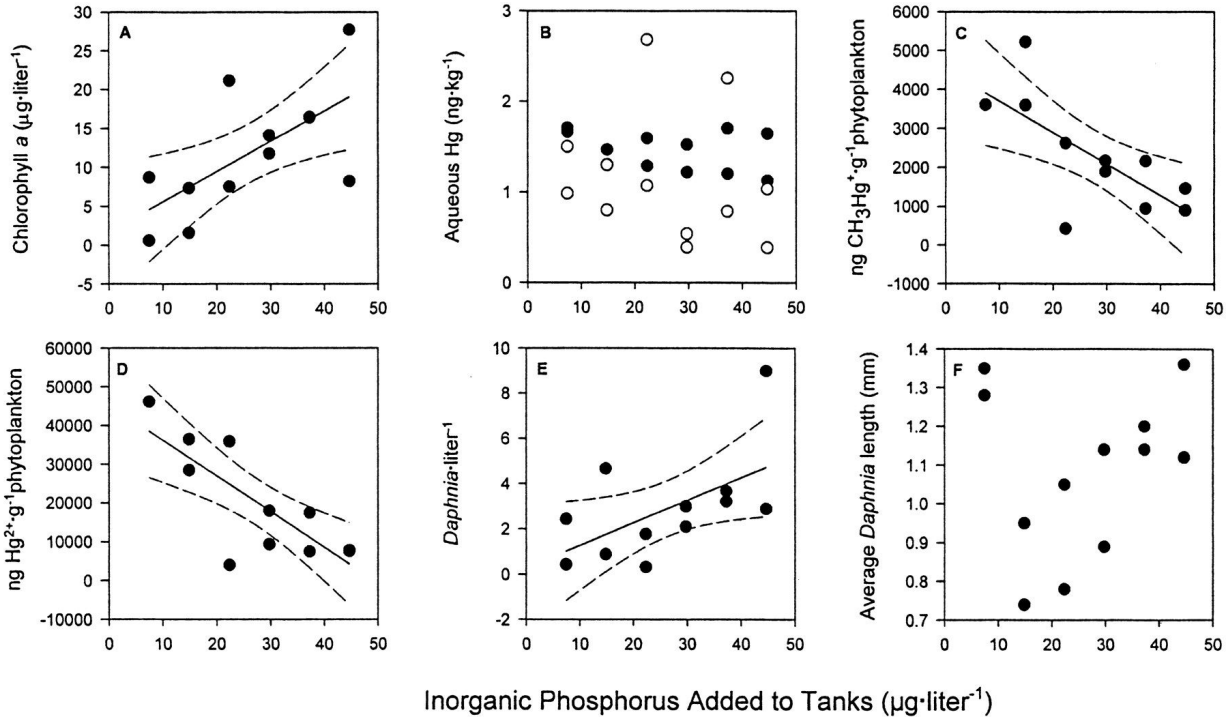
- Zooplankton
- Trophic level
- Oligotrophic, mesotrophic
- Eutrophication
- Biodilution (cell-specific Hg) vs bloom dilution (total conc Hg/total number of cells)

Hypothesis:
Increasing algal biomass reduces MeHg accumulation in food webs (bloom dilution)

Experimental Design



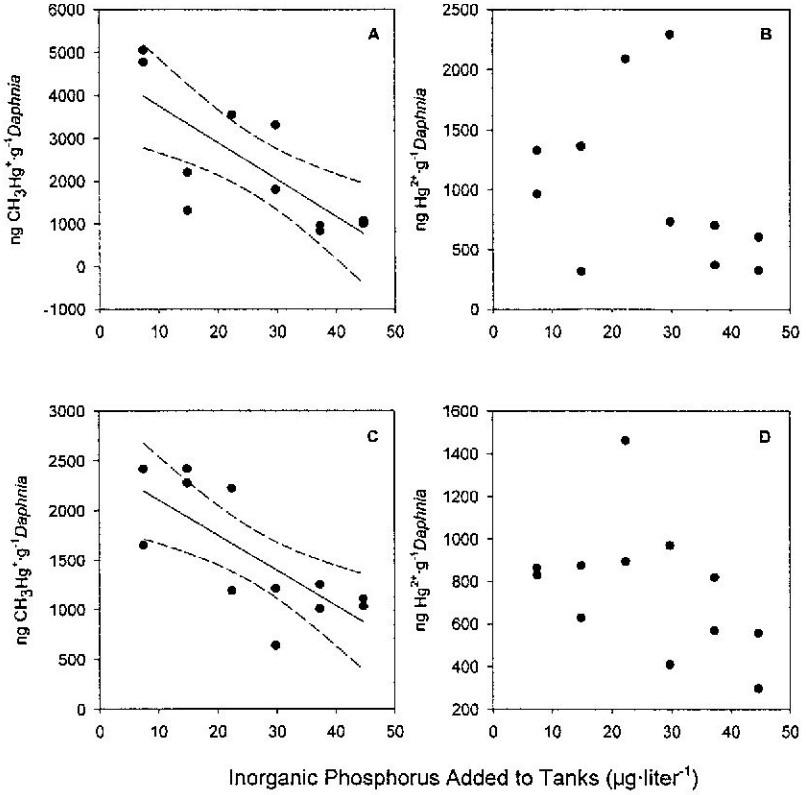
Results- a story in two parts



Results- a story in two parts

2 weeks

3 weeks



- Bloom dilution was observed at time of spike addition
- No difference in uptake of Hg(II) in Daphnia with increasing algae concentrations
- A decreasing trend in MeHg (ng MeHg/g Daphnia)

Questions?

Updates since publication:

-many organisms in many environments can methylate Hg

-rice is also an important pathway for Hg exposure

What did you find most interesting?

Do you agree with the findings?

Any factors/ environmental conditions you would include?