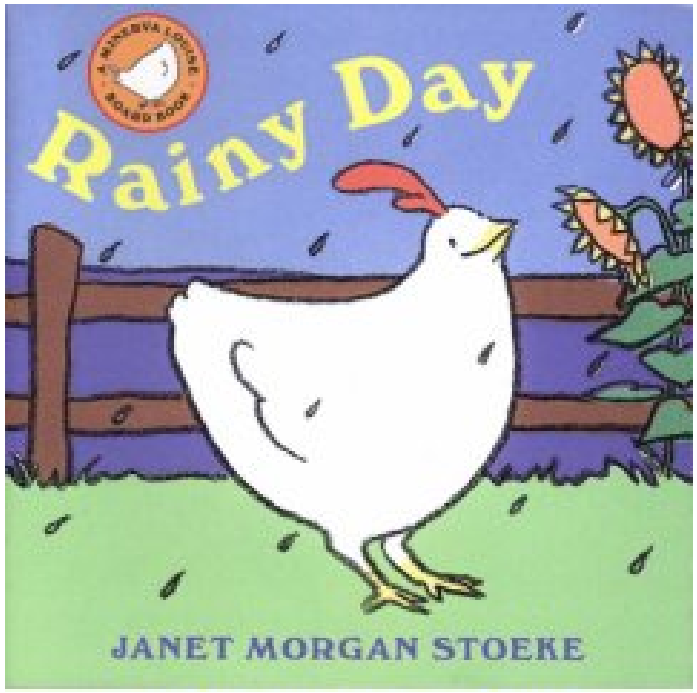
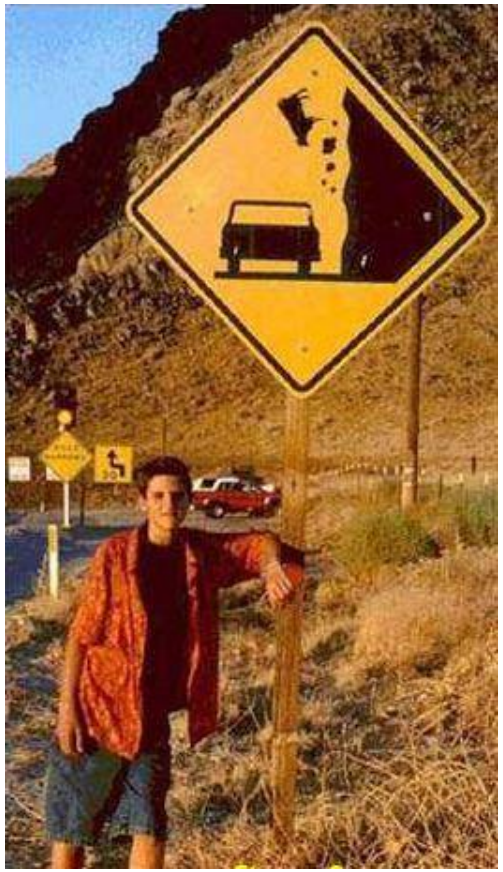
Regional estimates of contaminant deposition in aquatic ecosystems



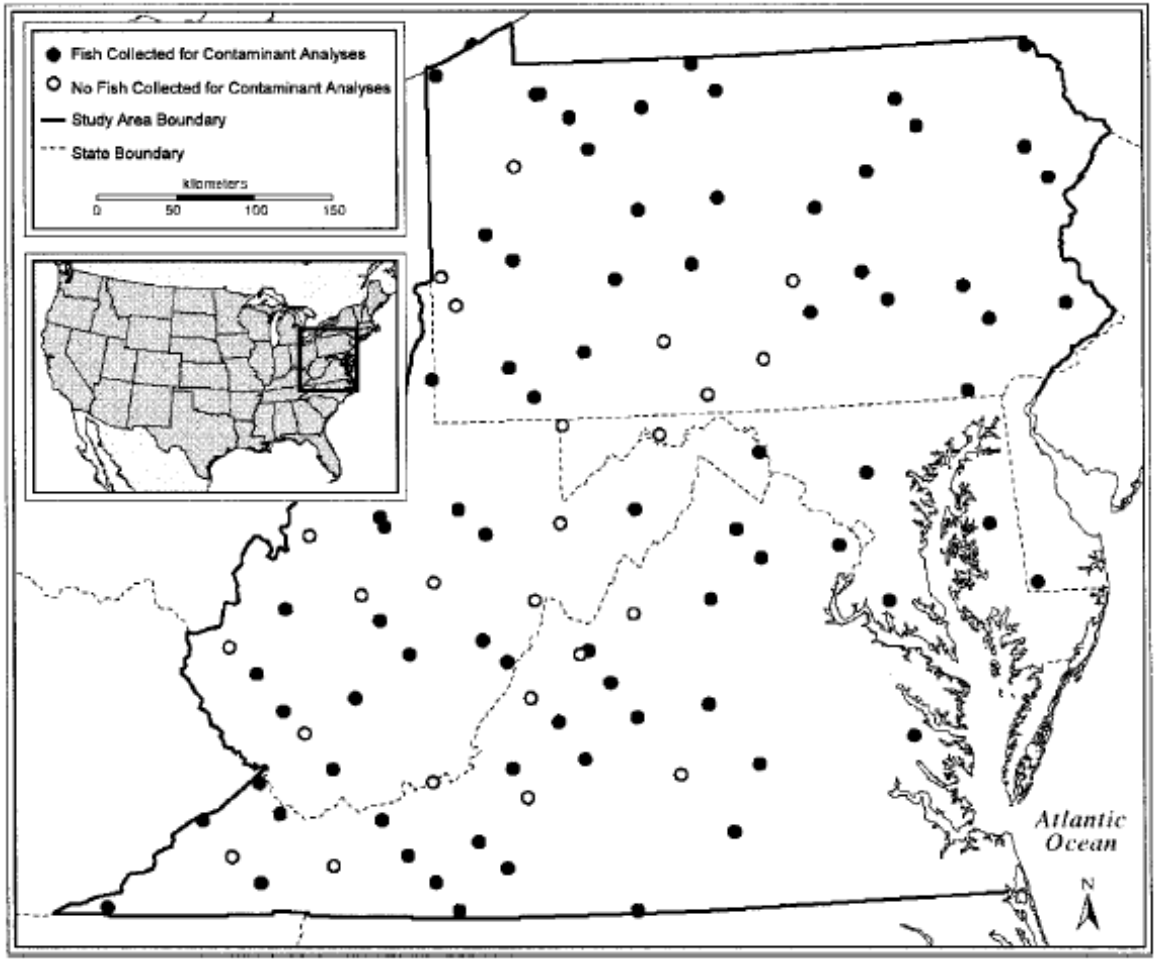
Frank H. McCormick
USDA Forest Service
Washington, DC

Why monitor?



Environmental Monitoring and Assessment Program

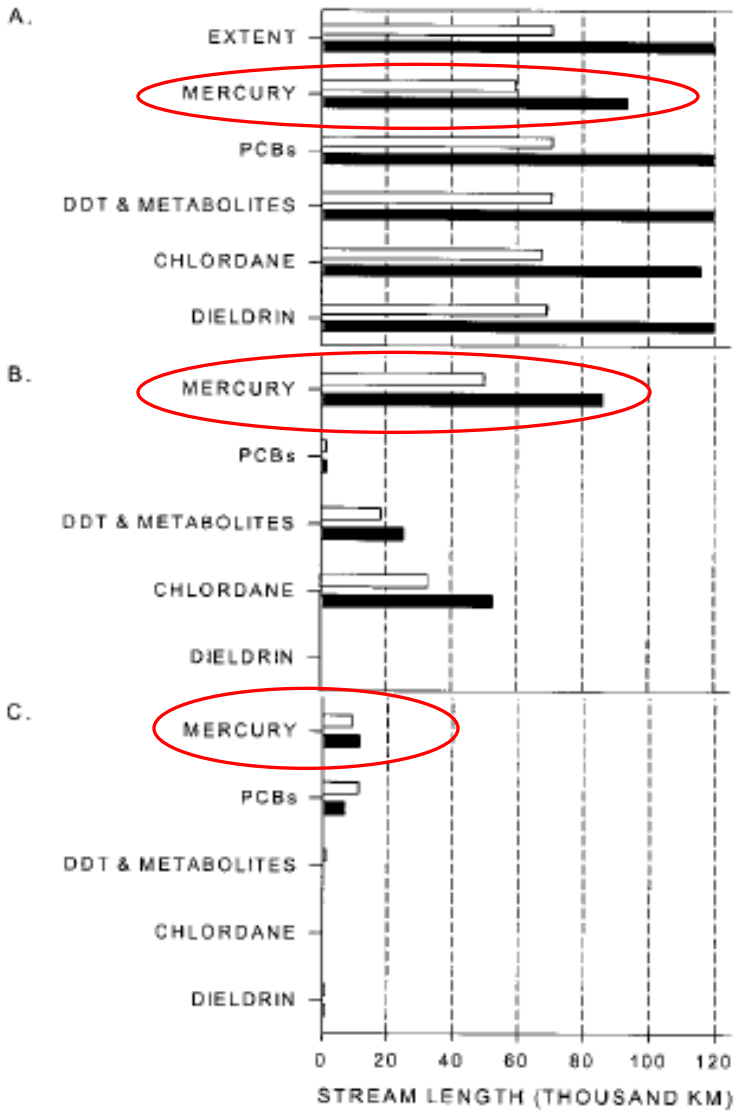
Mid-Atlantic Highlands Assessment



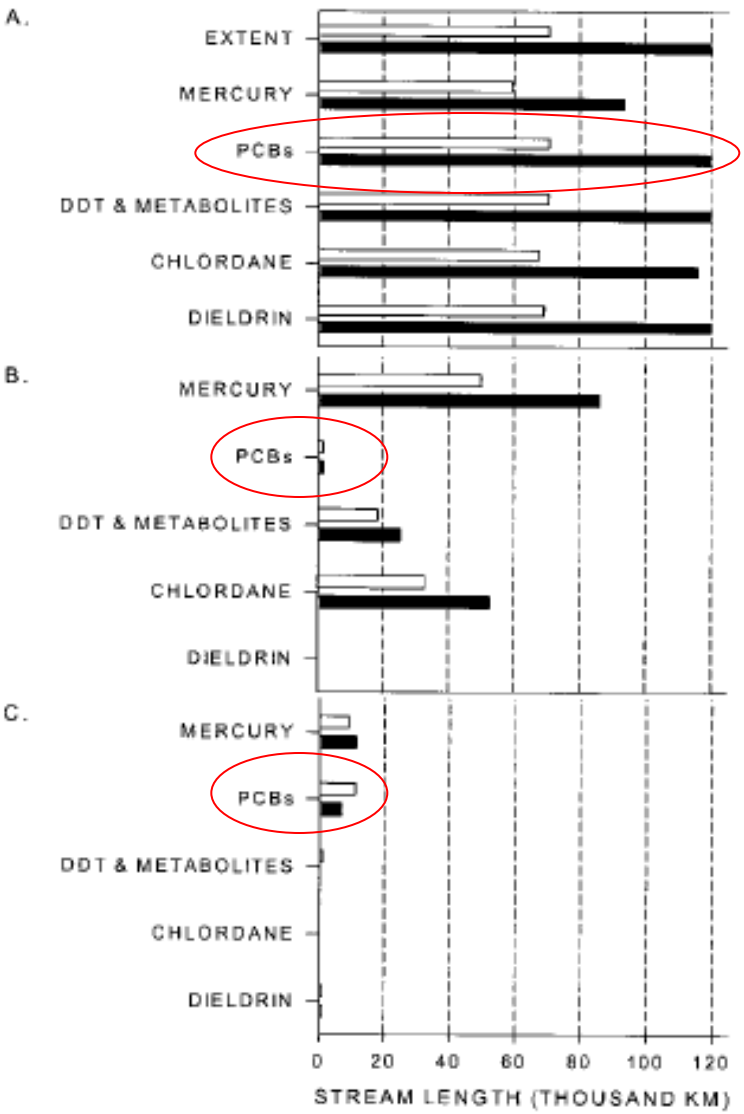
102 sites
77 with fish
70 small fish sites
47 large fish sites
40 sites with both groups

Lazorchak et al. 2003. Contamination of fish in streams of the mid-Atlantic region: an approach to regional indicator selection and wildlife assessment. Environmental Toxicology and Chemistry 22: 545–553

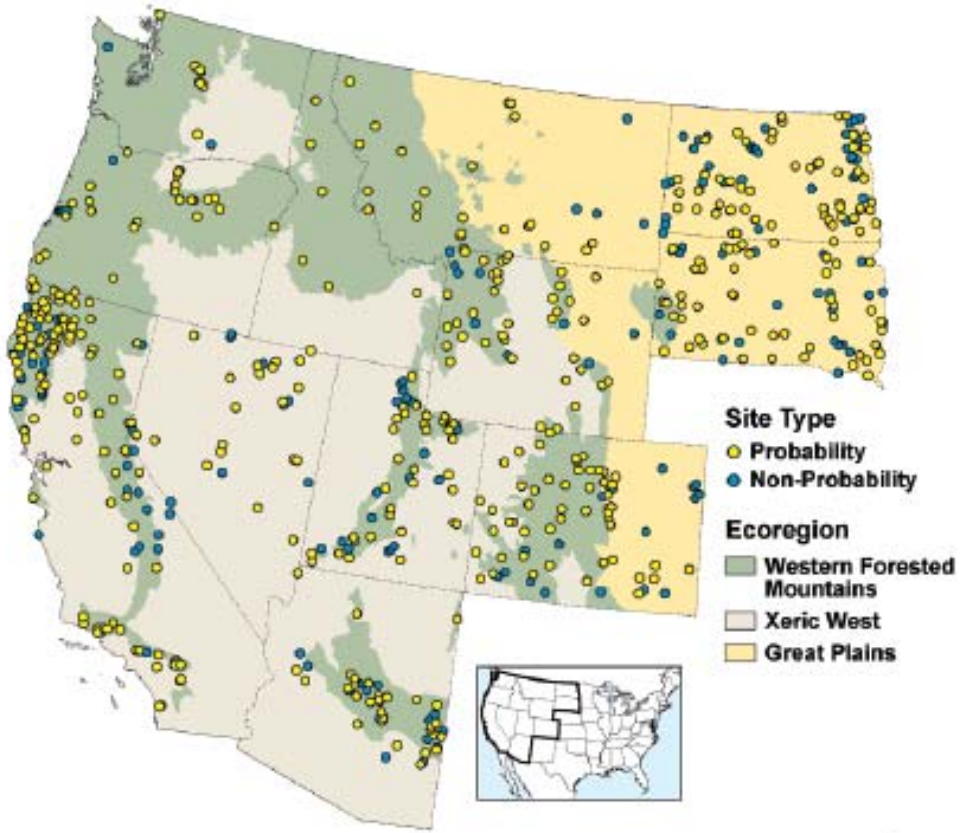
Mercury



PCBs



EMAP West



12 western U.S. states
626 stream/river sites
N=2,707 large (>120 mm TL) fish

All samples exceeded DL (0.0024 *u*g*g-1)

3x higher in piscivores (0.260 *u*g*g-1) than nonpiscivores (0.090 *u*g*g-1).

No relationship to local site disturbance

Suggests atmospheric transport

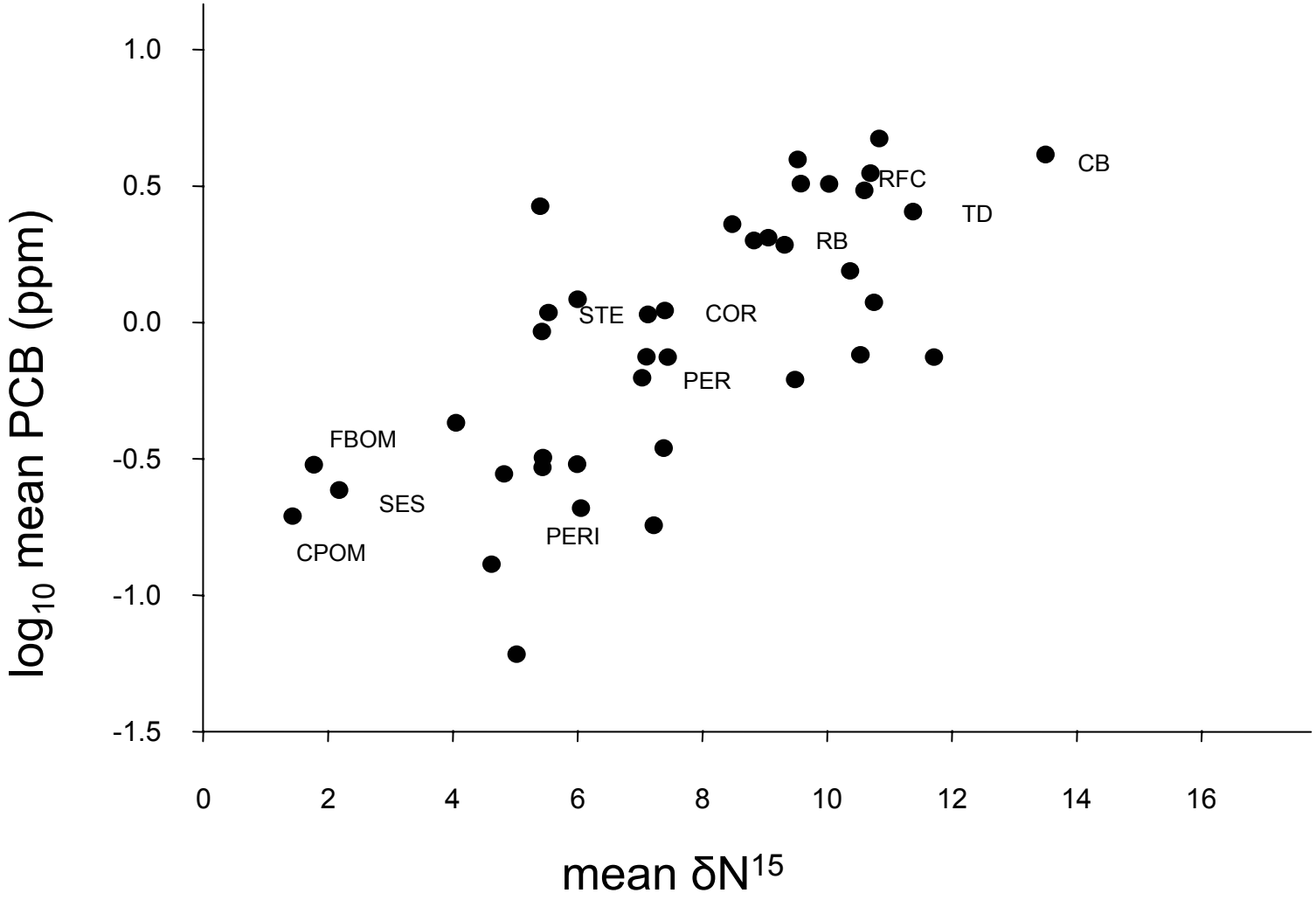
Mercury Concentration in Fish from Streams and Rivers Throughout the Western United States. SA Peterson et al. 2007. Environ. Sci. Technol. **2007**, 41, 58-65.

EMAP-West

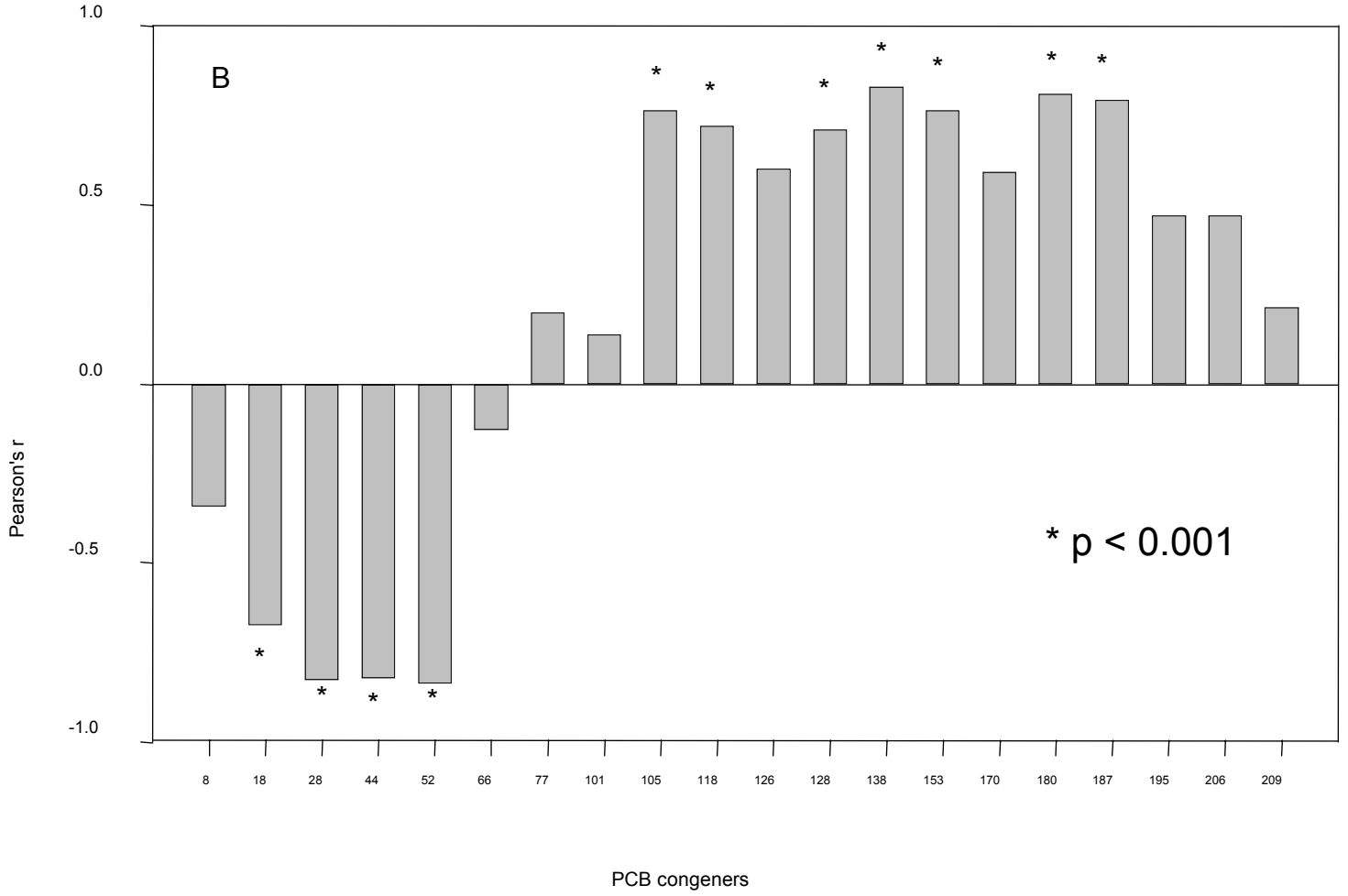
	Stream Length	Pct. With Fish	Pct. of stream length assessed with [Hg]	
			≥0.1	≥0.185
Large Fish				
Piscivore	31,476	61	**93**	**56.8**
Non-Piscivore	168,772	68	25.5	6.1
FAMILY				
Salmonidae	125,191	69	11.4	2.3
Percidae	5707	74	77.8	42.4
Ictaluridae	22,037	44	43.8	21.3
Hiodontidae	4483	52	84.8	41.9
Esocidae	7273	39	78.6	27.4
Cyprinidae	47,660	46	64.4	44.4
Centrarchidae	17,321	52	87.3	32.3
Catostomidae	65,625	58	47.9	14.9
Small Fish	206,520	30	18	3.2

≥0.185 in whole fish equals or exceeds 0.3 ug Hg*g-1 in filet tissue, which exceeds the USEPA (1999) criterion for human consumption.

Trophic Position Predicts PCBs

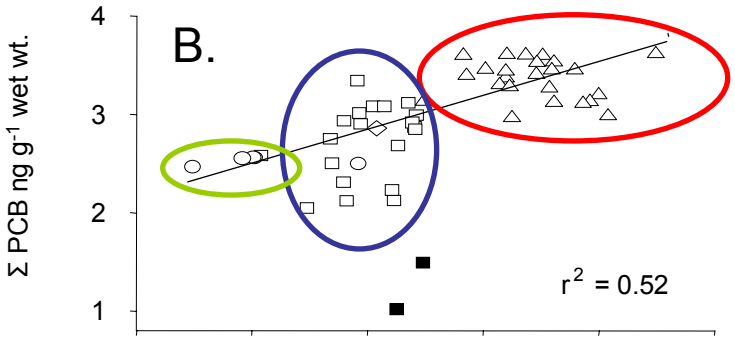


Pearson's correlation coefficients between PCB congeners (proportion relative to ΣPCB) and assemblage structure.

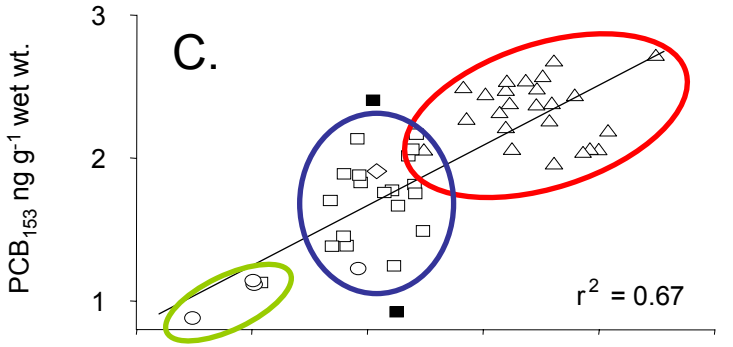


"Light" PCBs may volatilize and be atmospherically transported
"Heavy" PCBs are not atmospherically transported.
"Heavy" PCBs may be transported by migratory fish.

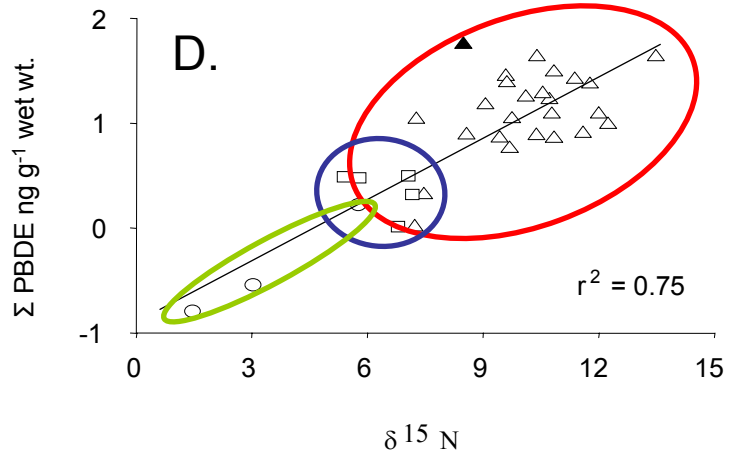
Food Web Biomagnification of Contaminants



Total PCBs are significantly related to δ^{15} nitrogen



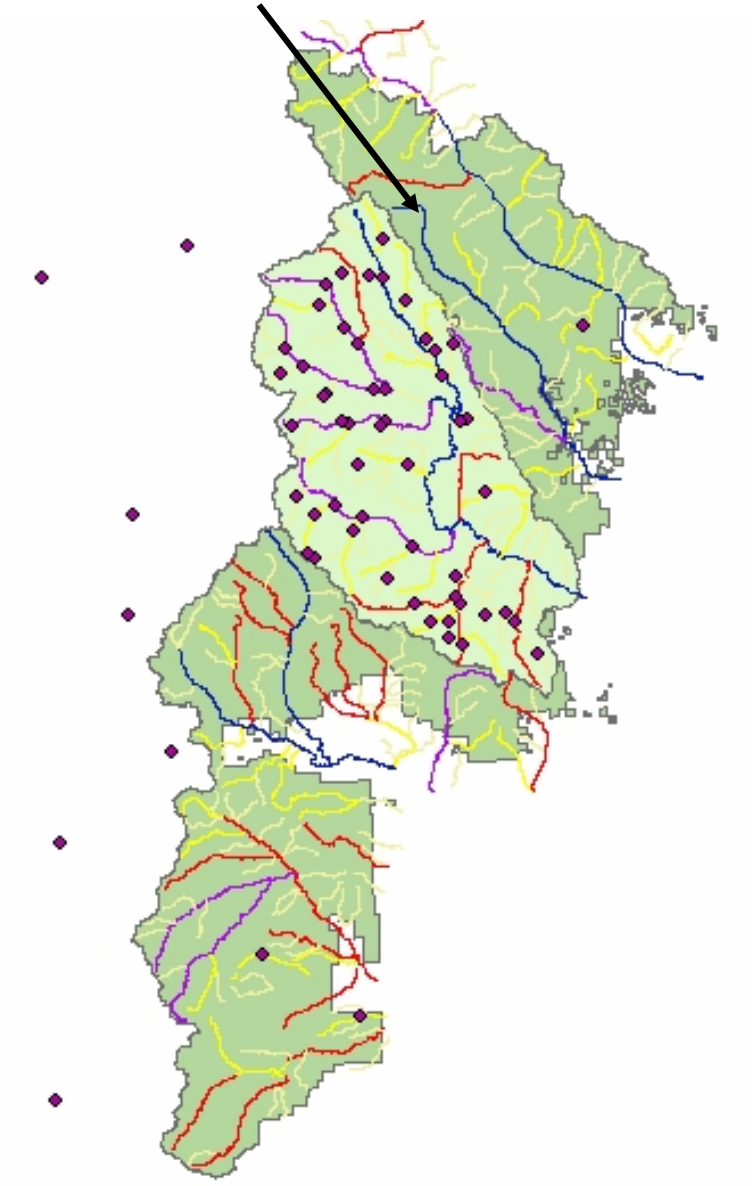
"Heavy" PCBs are significantly related to δ^{15} nitrogen



Flame retardants are significantly related to δ^{15} nitrogen

○ **basal resources (algae)**
□ **invertebrates**
Δ **fishes**

Entiat Experimental Forest



Fish Tissue Contaminants Monitoring in the Entiat River Basin

- Are POCs being bioamplified in the Entiat River system?
  - Adding food web analysis allows linkage of fish and basal resources.
  - Deals with pathways of exposure and long-term persistence of contaminants.
  - Provide baseline data for implementation of BMPs to reduce pesticide input from direct and non-point sources.

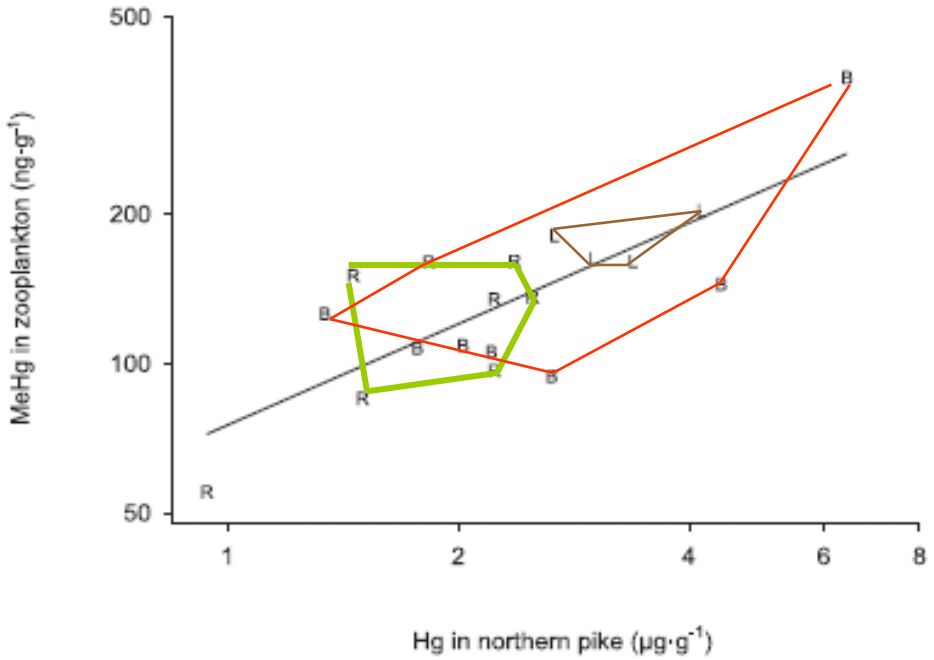
Prescribed burns may be source of re-emitted atmospheric Hg.

If transported to wetlands or riparian zones where methylation can take place, the fish in downstream lakes may eventually show elevated Hg concentrations.

MANAGEMENT ISSUES: If prescribed fire increases fish Hg concentrations, alternative fuel reduction strategies such as mechanized treatment may be preferred treatment options, especially in watersheds prone to mercury accumulation.

Resource management strategies include establishment of management programs for fish consumption advisories.

Fig. 2. Relationship between Hg concentrations in 560-mm northern pike and MeHg concentrations in zooplankton, expressed on a dry weight basis ($r = 0.79$, $p = 0.0000$, $N = 19$ lakes). L, logged lakes ($N = 4$); B, burned lakes ($N = 7$); R, reference lakes ($N = 8$).



Future Scenarios

Increasing temperatures in water and wetland sediments may increase methylation

Increased precipitation?

increased transport of terrestrial Hg to aquatic systems

Increased sulfate deposition may increase methylation

Increased acid deposition may increase methylation

Decreased precipitation?

decreased sulfate deposition = no *increased* methylation

decreased acid deposition = no *increased* methylation

decreased water yield may increase acidity, increasing methylation

Water quality, invasive species, and algal blooms

- Endocrine disrupting compounds
- Emerging contaminants
- Cumulative watershed effects
  - FS is mandated to report on conditions of watersheds
  - Trading credits (Hg, temperature, nitrogen, phosphorus, sediment)

Acknowledgements

- Jim Lazorchak, USEPA
- Tala Henry,USEPA
- Spence Peterson, USEPA
- David Walters, USEPA
- Alan Herlihy, Oregon State University
- Bob Hughes, Oregon State University
- Thom Whittier, Oregon State University
- Karl Polivka, USFS
- Rick Woodsmith, USFS
- $ provided by EMAP-Surface Waters, NOAA Fisheries, and USFS