



Great Lakes Mussel Watch: Embracing Innovative Approaches to Meet Changing Environmental Priorities

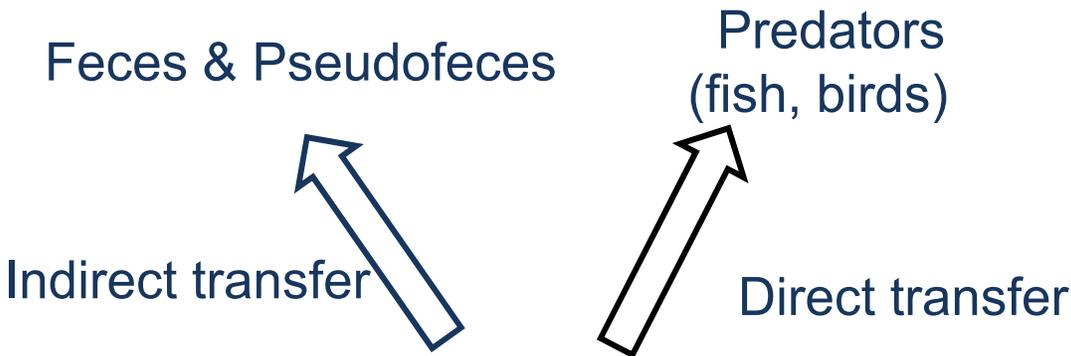
*Ed Johnson, Kimani Kimbrough, Erik Davenport
Greg Piniak (National Centers for Coastal Ocean Science)

Annie Jacob (Consolidated Safety services)



Dreissenid mussels as biomonitors

- Proven biomonitors in native Europe
- 'Keystone' species in the Great Lakes
- Significant role in biomagnification & cycling of contaminants



1091-1520 ppb
PCB



118 - 256 ppb
PCB



29 -97 ppb
PCB

Kwon et al.
2006

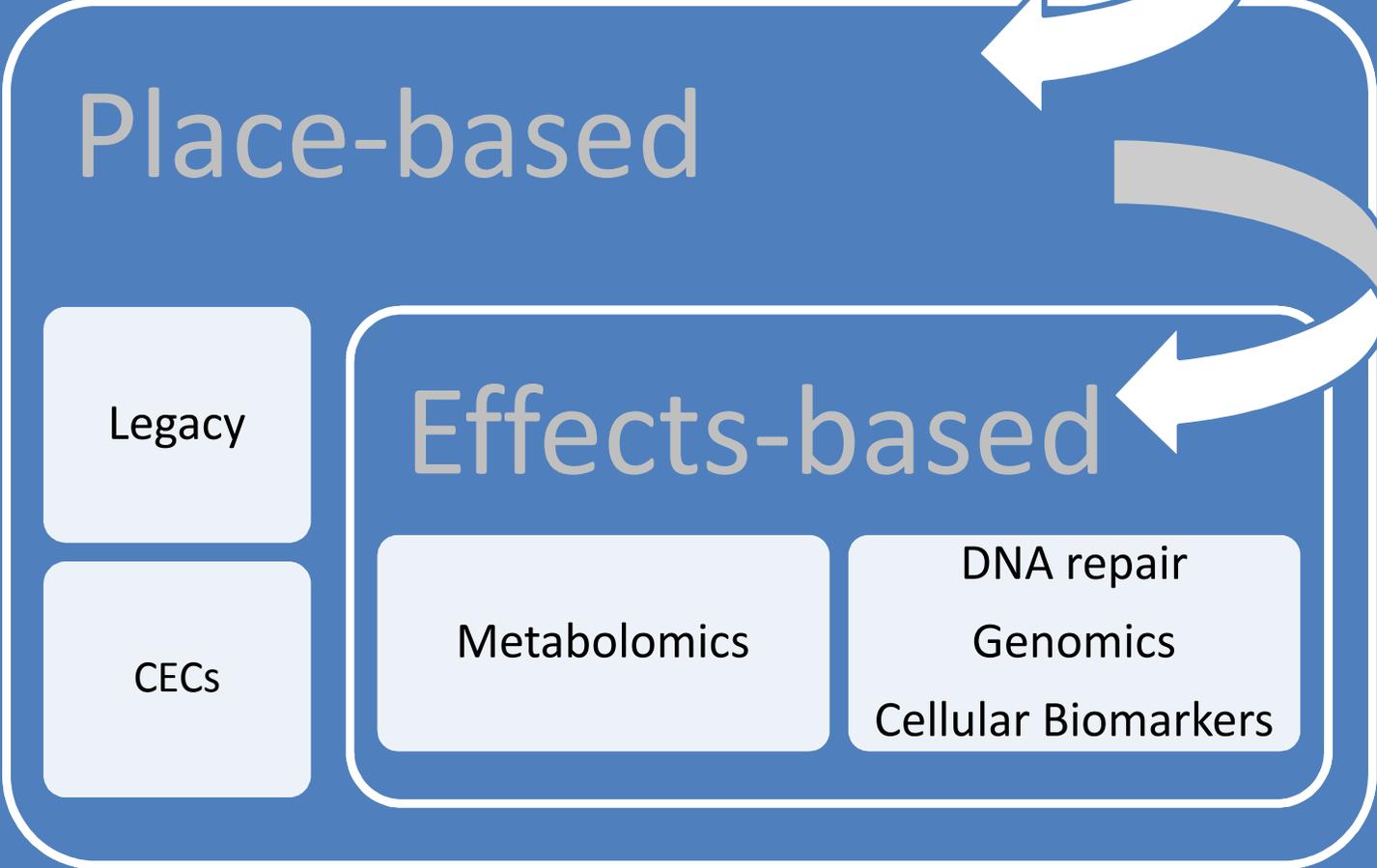


GLRI- Approach

Basin wide Monitoring

Legacy

Reference
Sites
AOC sites



Place-based

Legacy

CECs

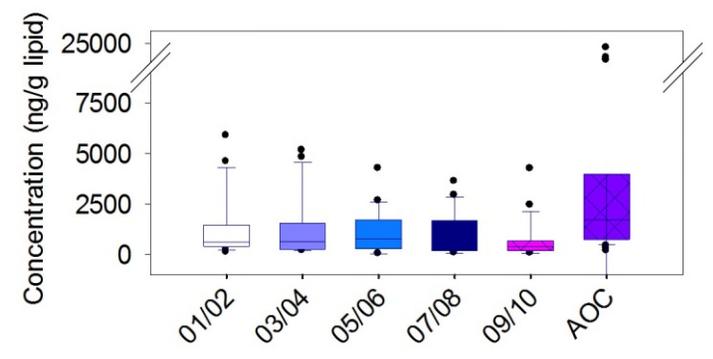
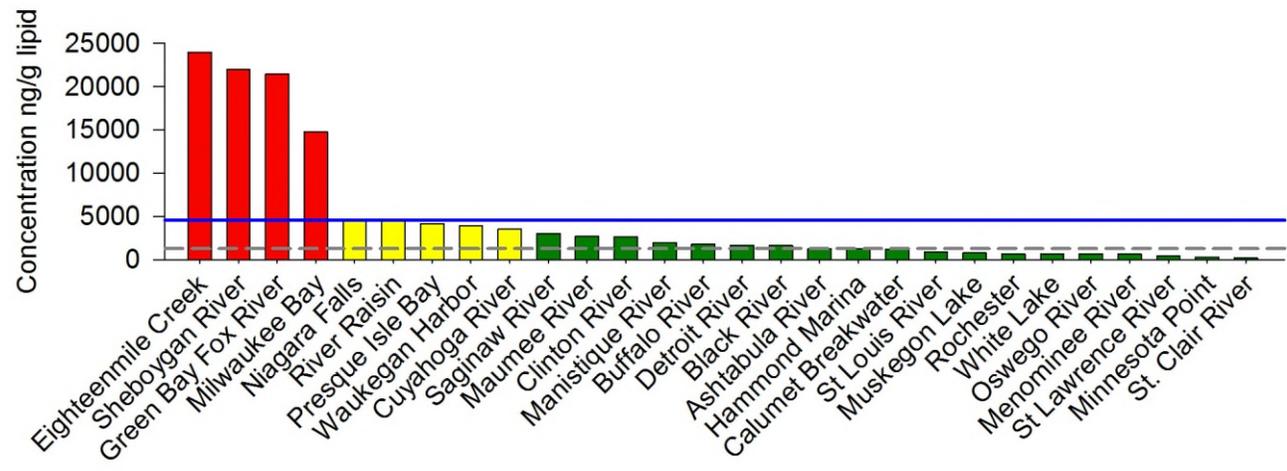
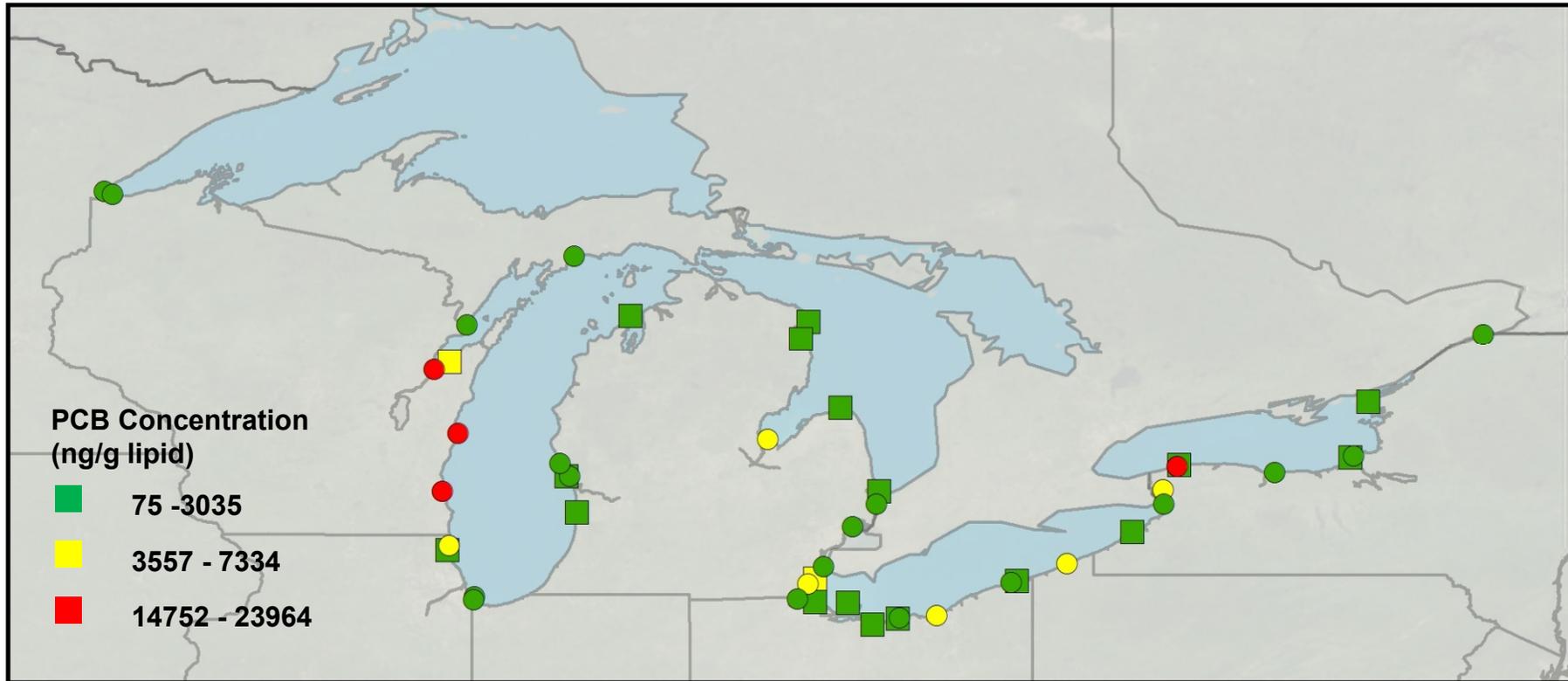
Effects-based

Metabolomics

DNA repair
Genomics
Cellular Biomarkers



Basin wide Monitoring (2009/2010)





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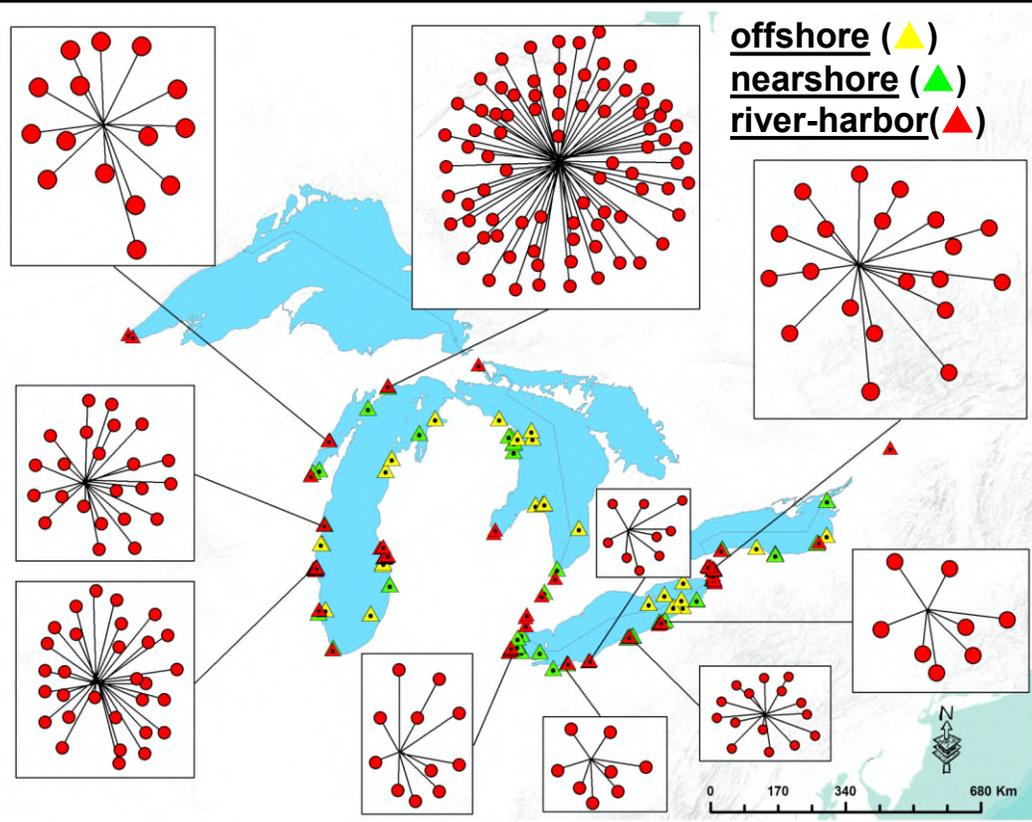
Metabolomics

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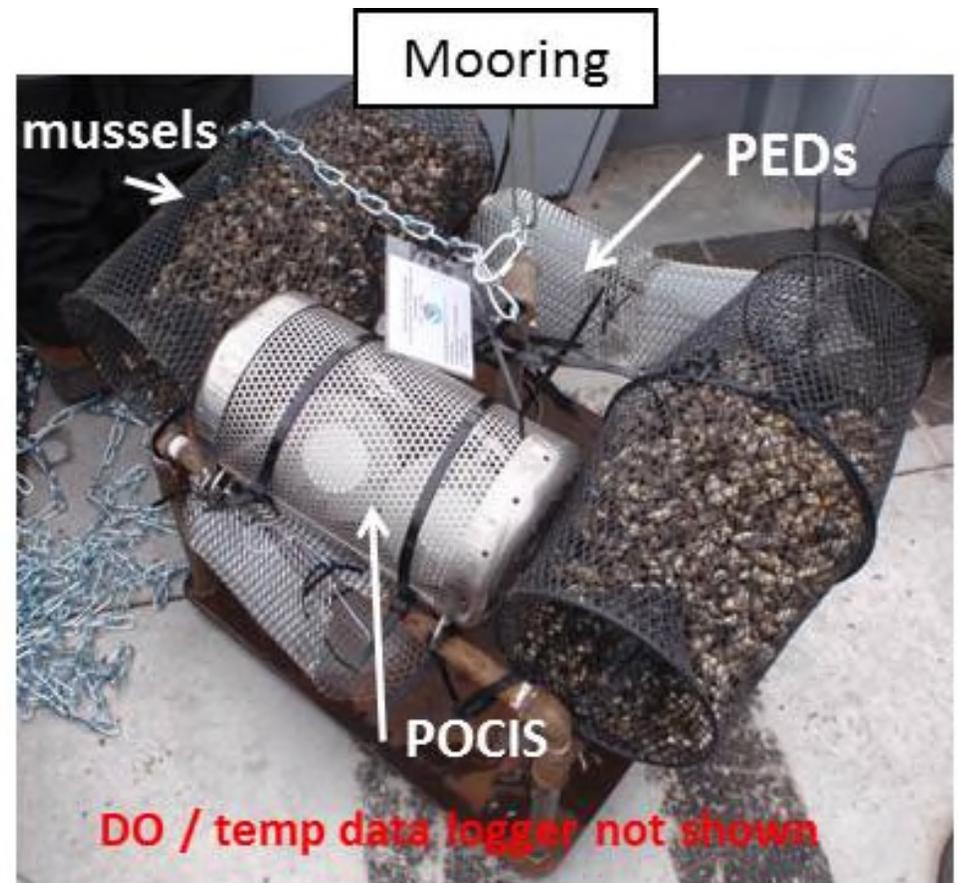
Place-based intensive assessment



offshore (▲)
nearshore (▲)
river-harbor (▲)

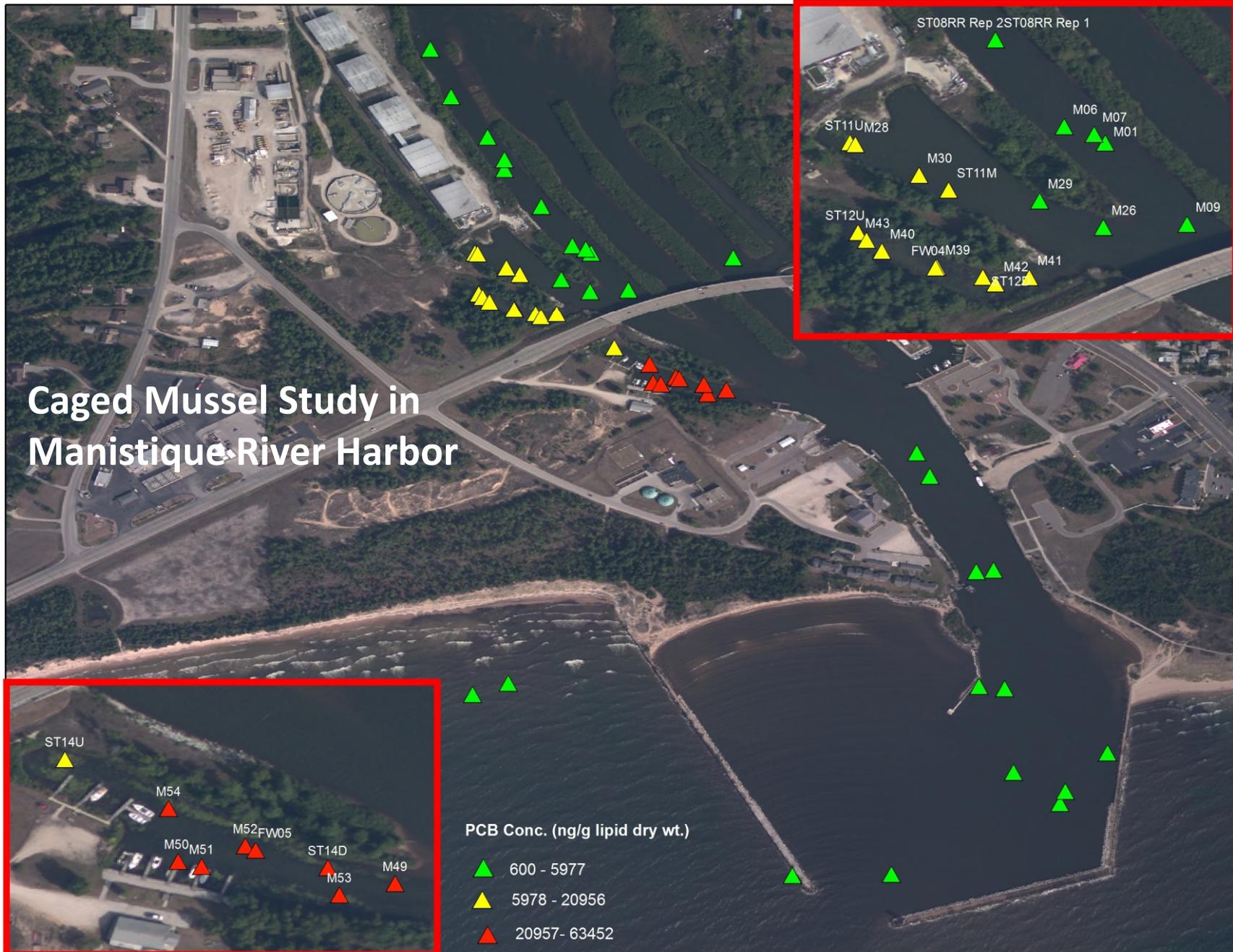
- Manistique River harbor
- Milwaukee Estuary / harbor
- Niagara River and its tributaries
- Maumee River harbor
- Ashtabula River harbor
- Cuyahoga River harbor

- GLRI Phase 1 and Phase 2
- Caged Mussel Deployments (5-10 weeks)
- Multi-matrix – POCIS, PEDs, Hester Dendy & Data loggers
- Mussel Chemistry and Mussel Health



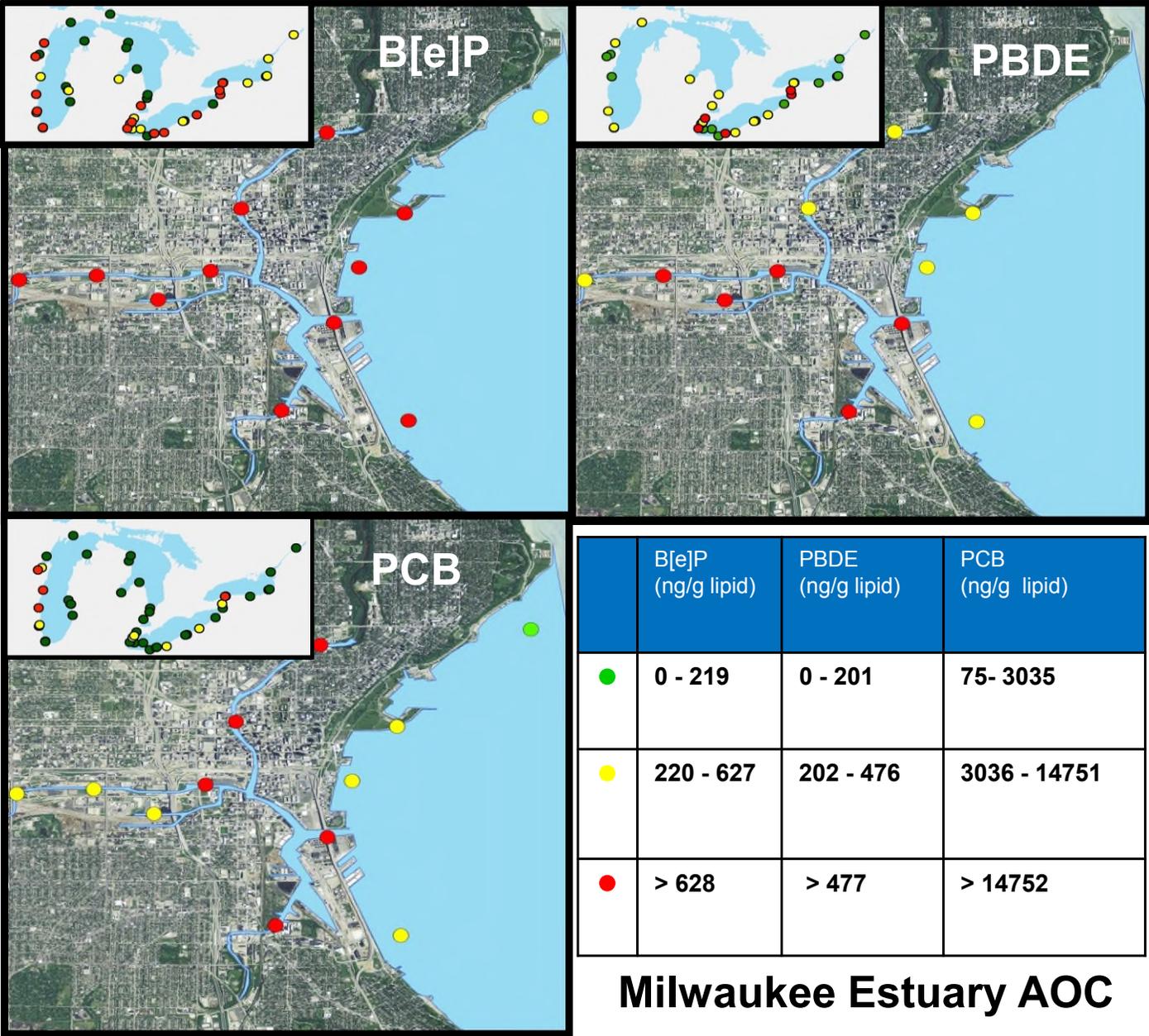


PCB source tracking effort



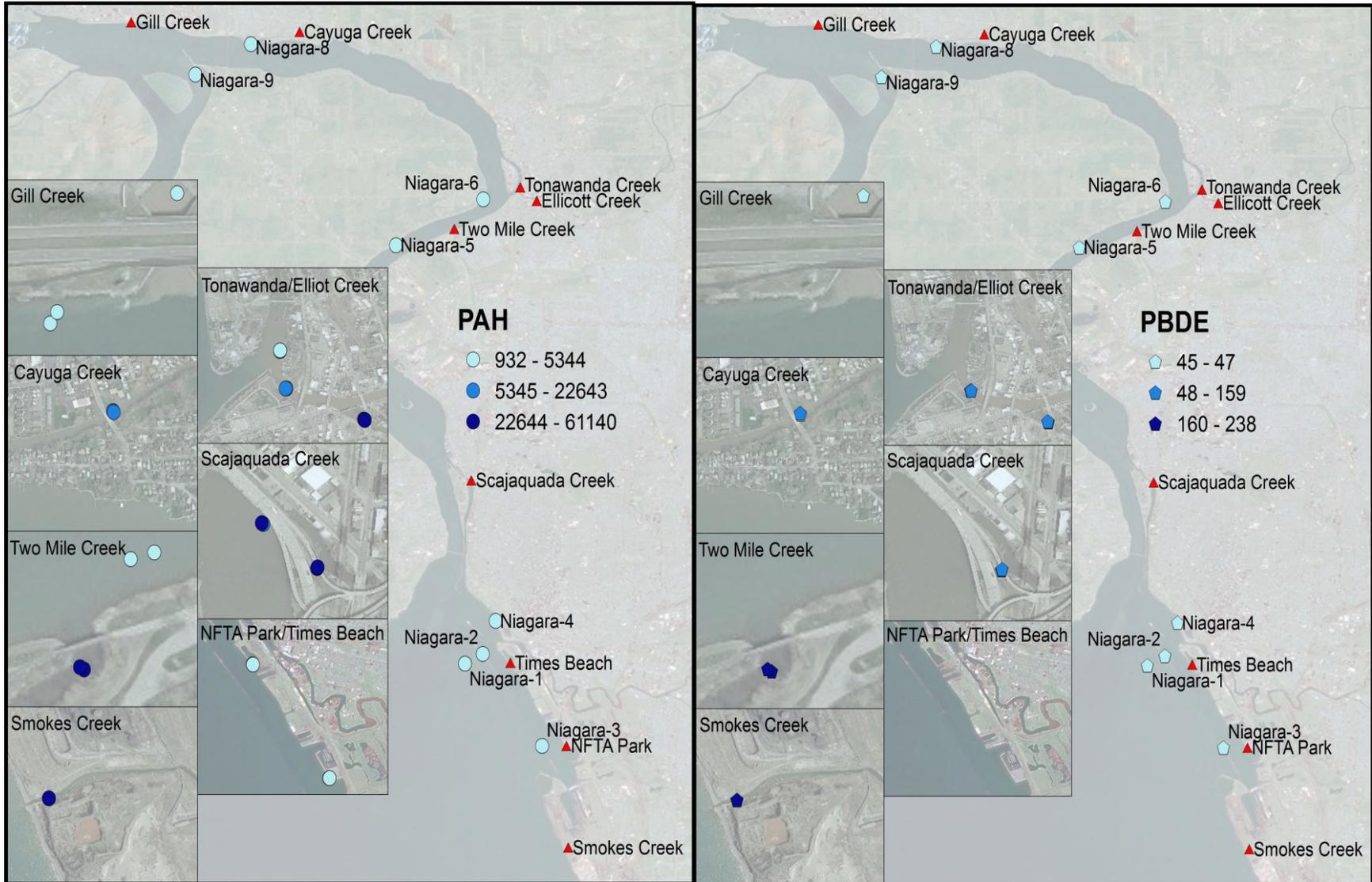


Site characterization





Site Characterization





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Effects-based Monitoring

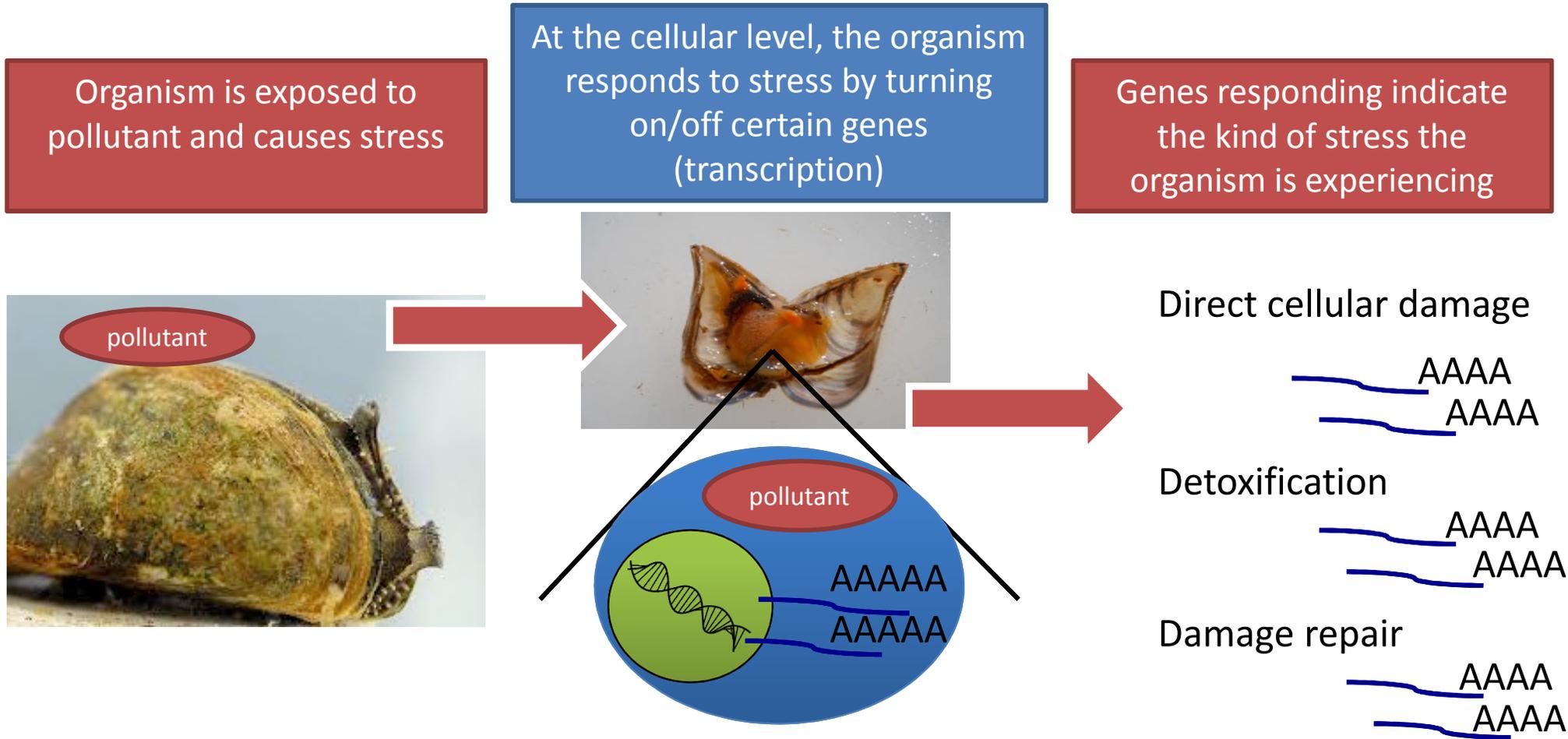


Figure modified from Poynton and Vulpe 2009

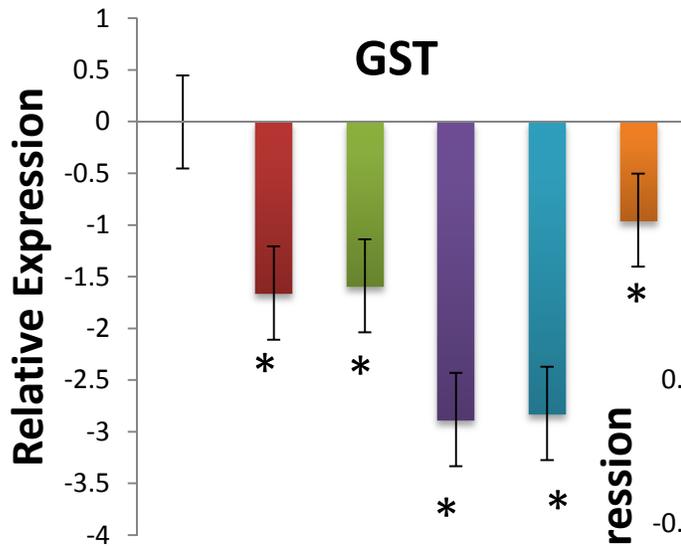


Genomics

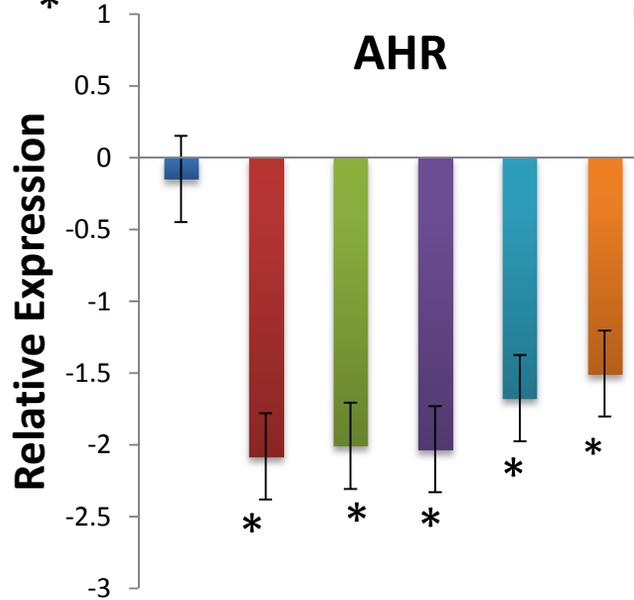


- Find significant differences among sites in expression of several genes of interest

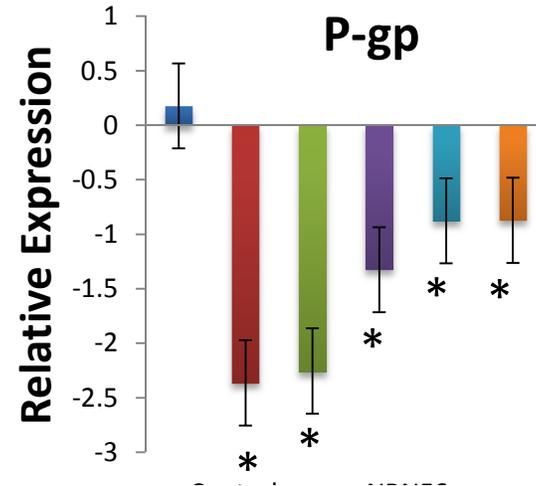
Control NRNF6 NRTW01B NREL01A NREL02A NRTW02A



Glutathione s Transferase:
Detoxification of xenobiotic
and endogenous compounds



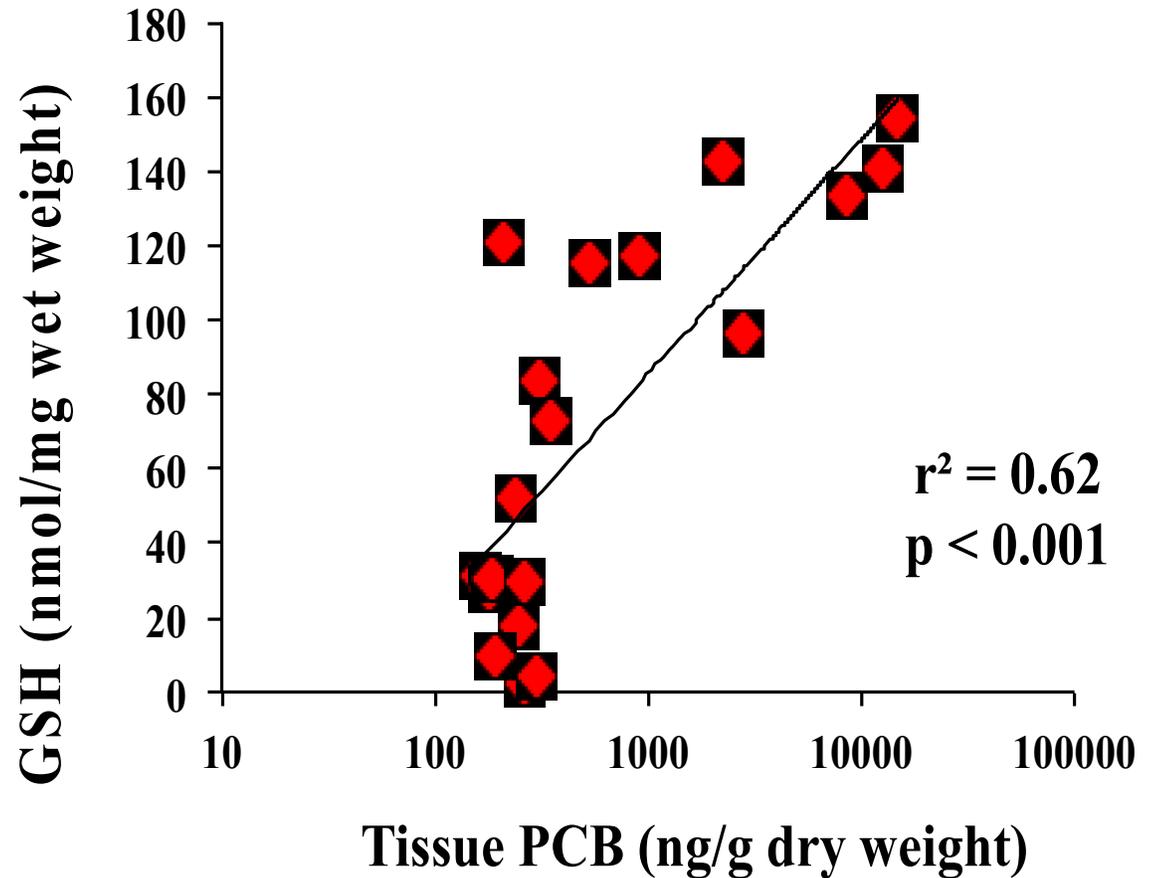
Aryl Hydrocarbon Receptor: Activates several phase one
and phase two metabolizing enzymes genes



P-glycoprotein: Efflux xenobiotic
substances out of the cell

(*p<0.05. Error bars represent one SEM)

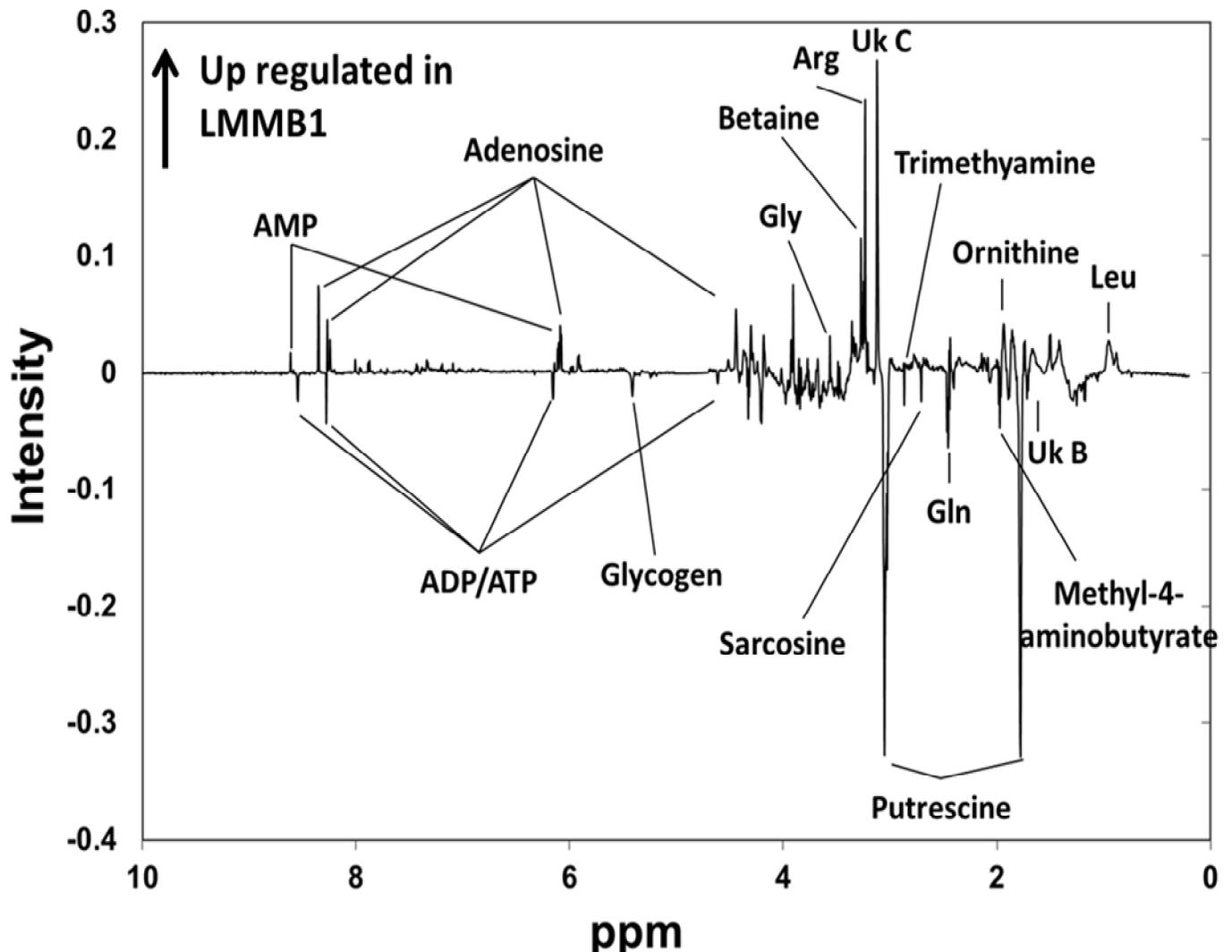
- **Glutathione (GSH) levels were significantly related to organic contaminants, especially PCBs.**
- **Zebra mussels have very low baseline GSH levels, (1/10th or less of what is typically observed in marine bivalves) which increases their sensitivity to pollutants.**



- **GSH plays a major role in detoxification pathways of organic pollutants (e.g. cytochrome P450s and amelioration of reactive oxygen species), so the increased levels of GSH indicate significant bioreactivity of the organic pollutants accumulated in the tissues of the zebra mussels.**



Are there differences between reference and impacted sites ?



Yes.

Intensity changes from zero (reference) are shown for the impacted site.



For additional questions or information please contact:

Kimani.Kimbrough@noaa.gov

of

Ed.Johnson@noaa.gov

Data from this effort are captured in NOAA's DIVER and ERMA web tools



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