Predicting PAH Contamination in Resident Shellfish

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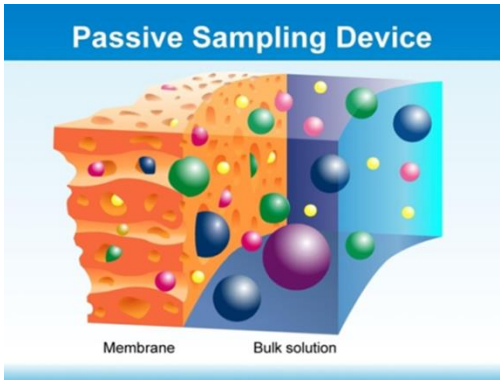
Oregon State University

Background

- Contaminant levels in shellfish needed for consumption advisories
  - Traditional methods cost- and time- consuming
- Passive samplers mimic uptake in organisms
  - Booij et al 2006, Alvarez et al 2014, Joyce et al 2015, Fernandez et al 2015



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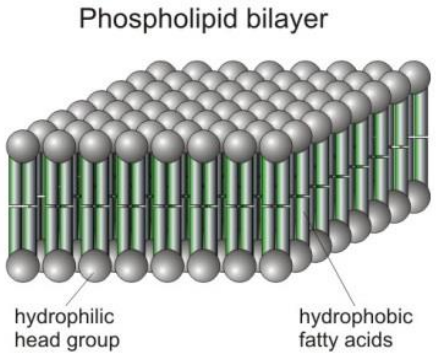
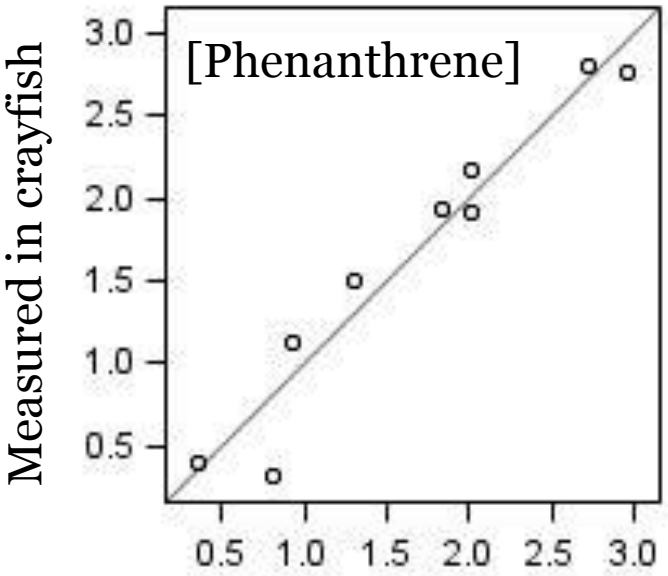


Background

- Passive samplers predict PAH levels in resident crayfish, *Pasifasticus leniusculus* (Forsberg et al 2014)
  - 15 PAHs
  - Different model for each PAH



(Forsberg et al 2014)

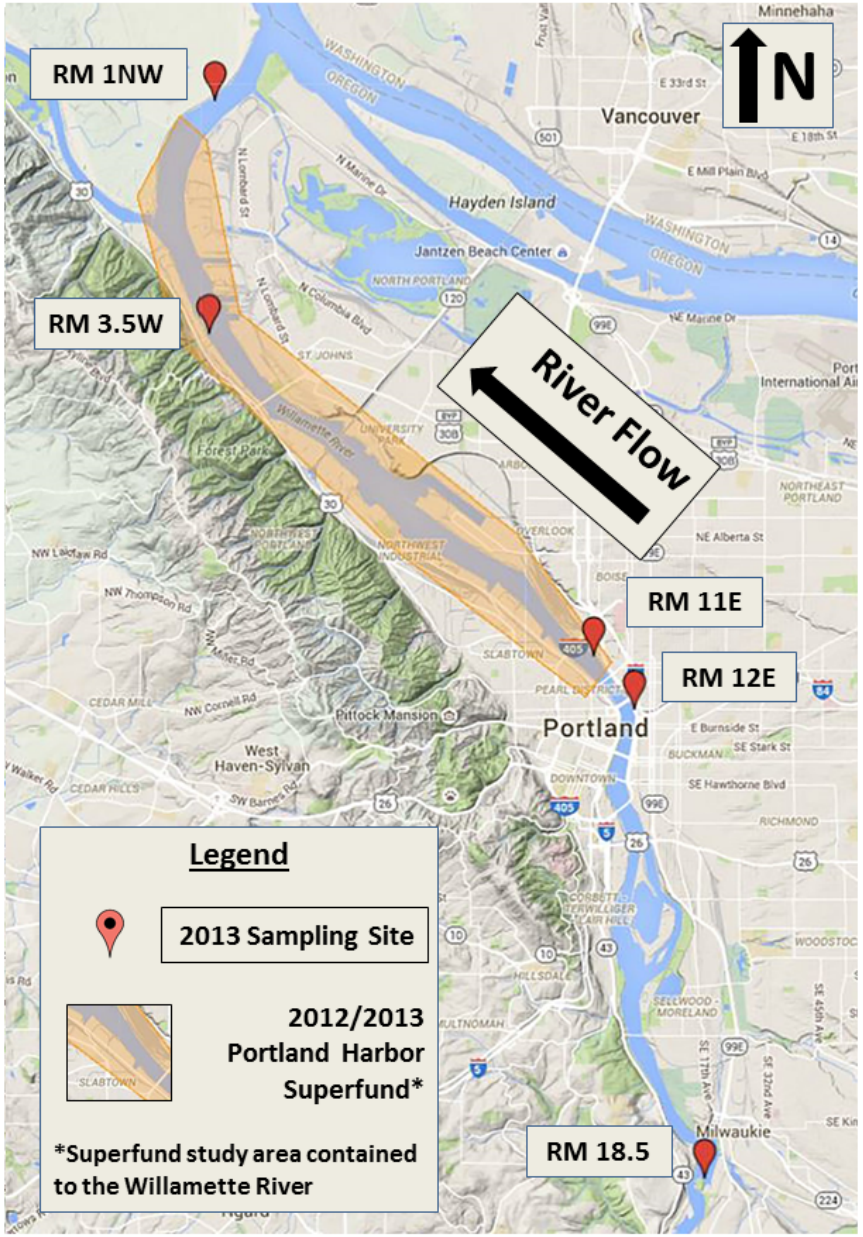
Objective & Hypothesis

- **Objective:** Predict PAH contamination in resident crayfish using PAH levels in water, measured by LDPE passive samplers

- **Hypothesis:** PAH concentrations in water correspond predictably with concentrations in resident crayfish, *Pacifastacus leniusculus*

Sampling Sites

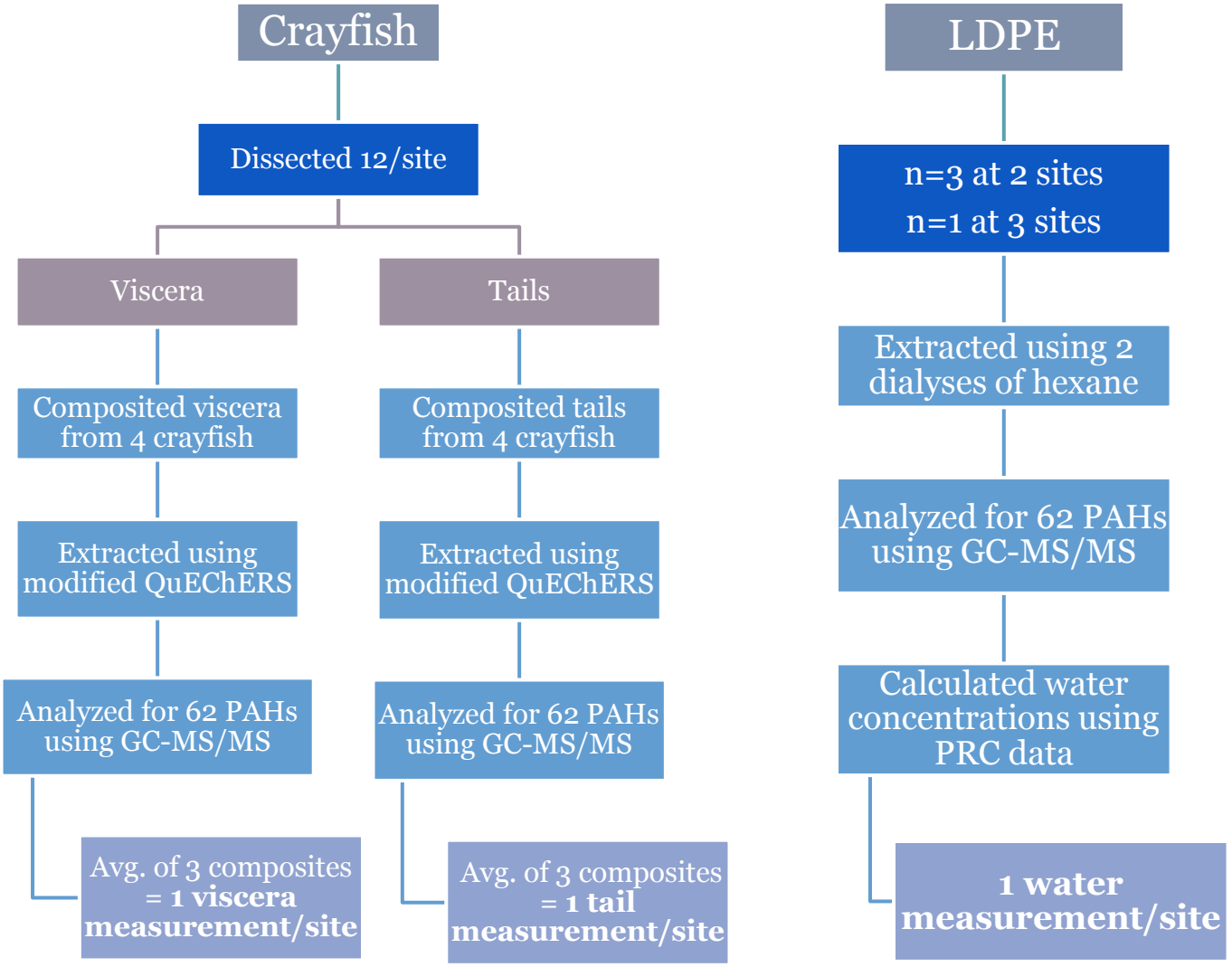
- 5 sites in the Willamette River in Portland, OR
  - Upriver (RM 18.5, 12E)
  - Portland Harbor Superfund Megasite (PHSM) (RM 11E, 3.5W)
  - Downriver (RM 1NW)



Sampling Design

- Resident crayfish collection and LDPE passive water sampler deployment spatiotemporally paired
- September – October, 2013

Sample Processing & Analysis



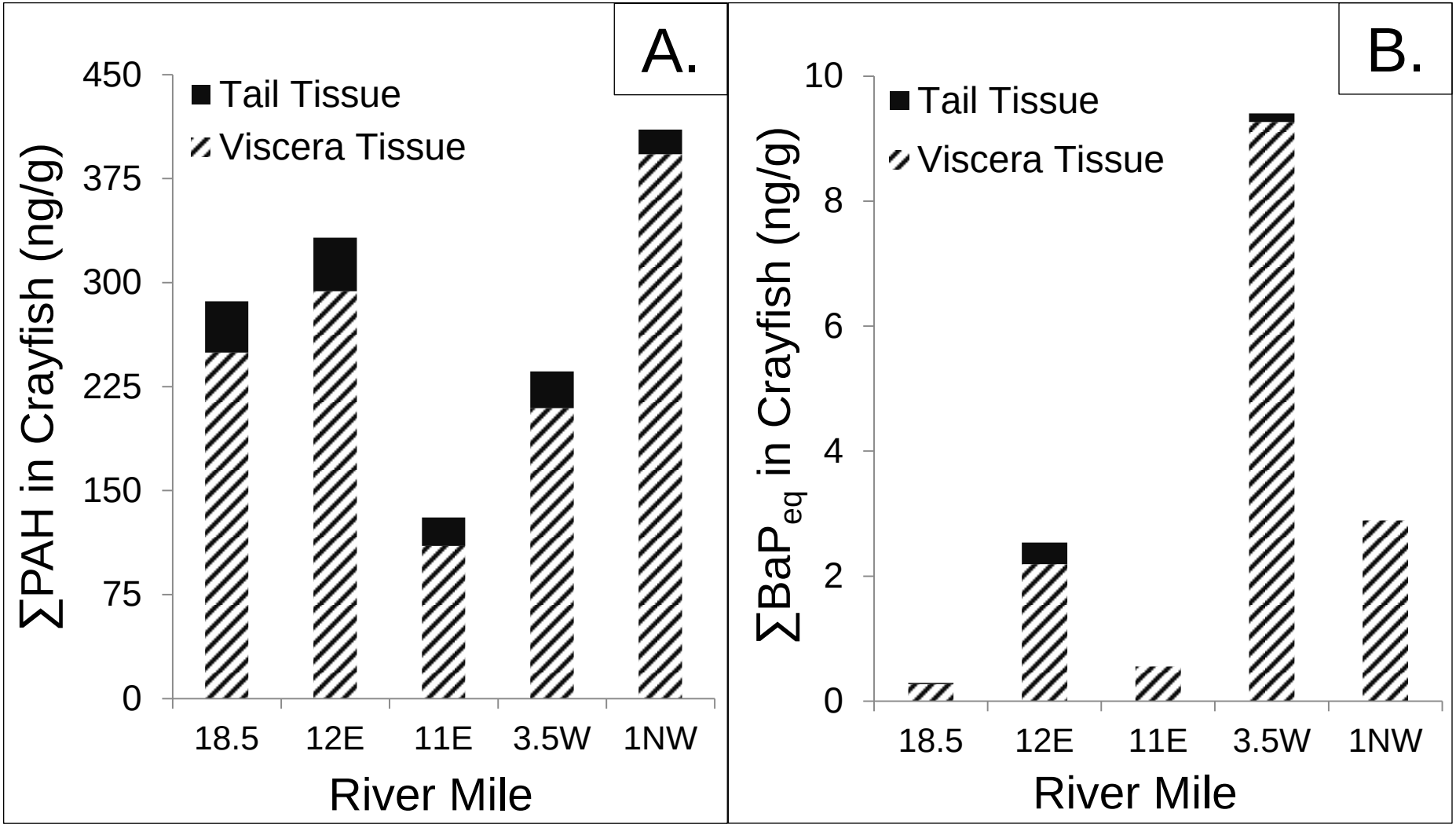
Carcinogenic Potency Estimates

- Benzo[a]pyrene equivalent (BaP_{eq})
- Estimates carcinogenic potency of PAH mixtures
- Using relative potency factor (RPF) approach (EPA 2010):

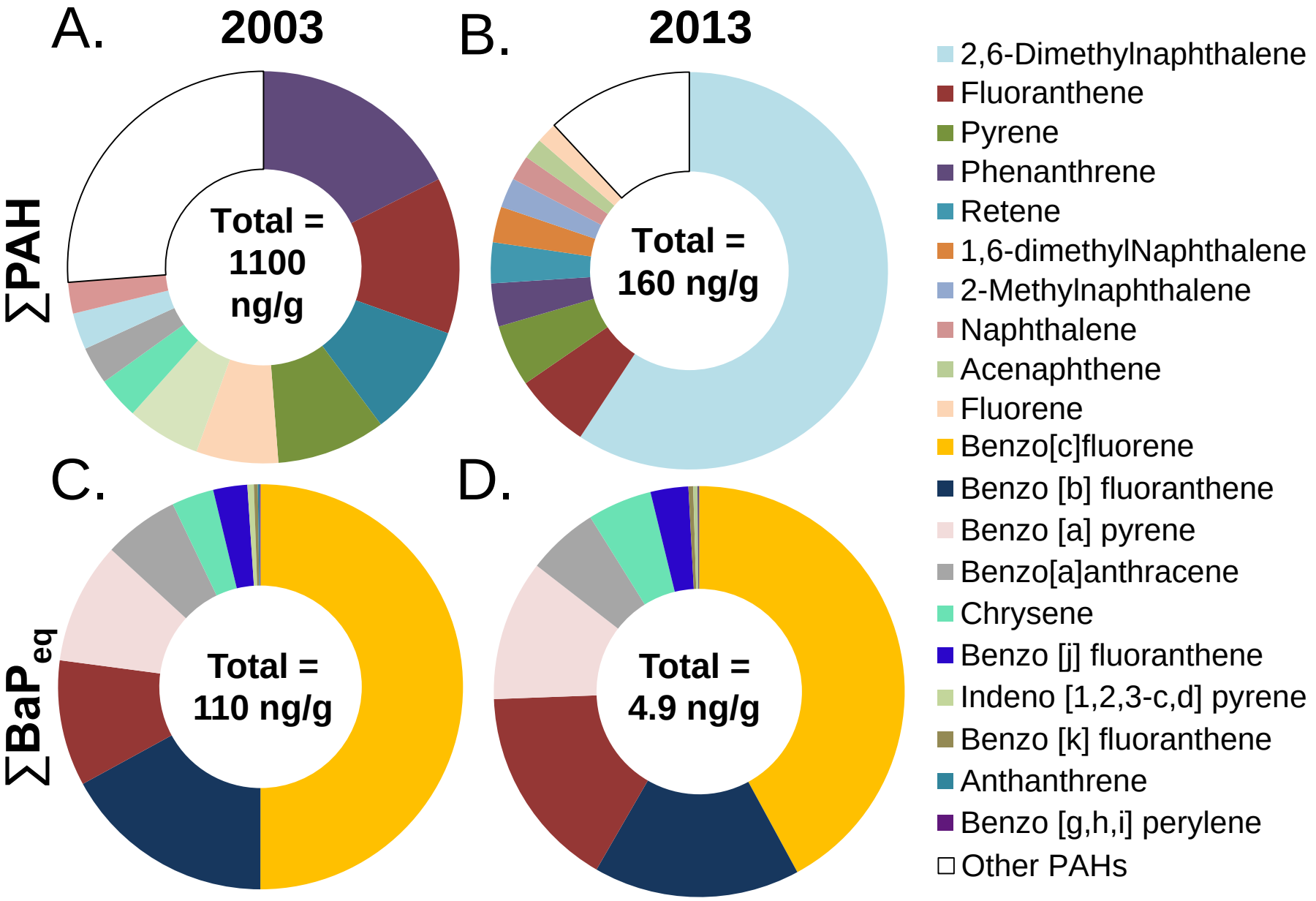
$$\sum BaP_{eq} = \sum(C_{PAHi} * RPF_{PAHi})$$

- Analytical method contained 23 of 26 PAHs with RPFs

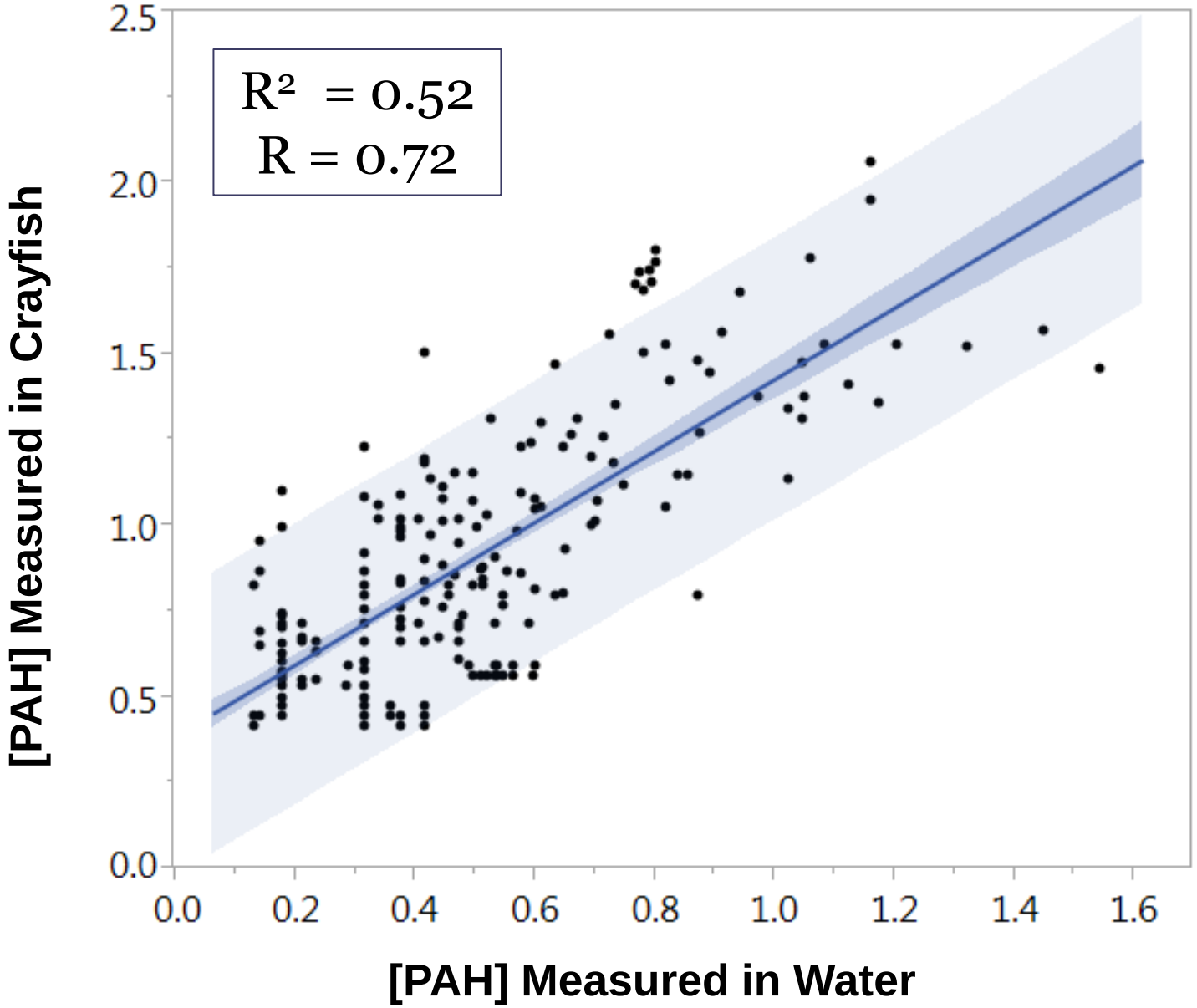
PAHs in Crayfish Viscera vs. Tails



PAH Profiles in PHSM Crayfish Viscera



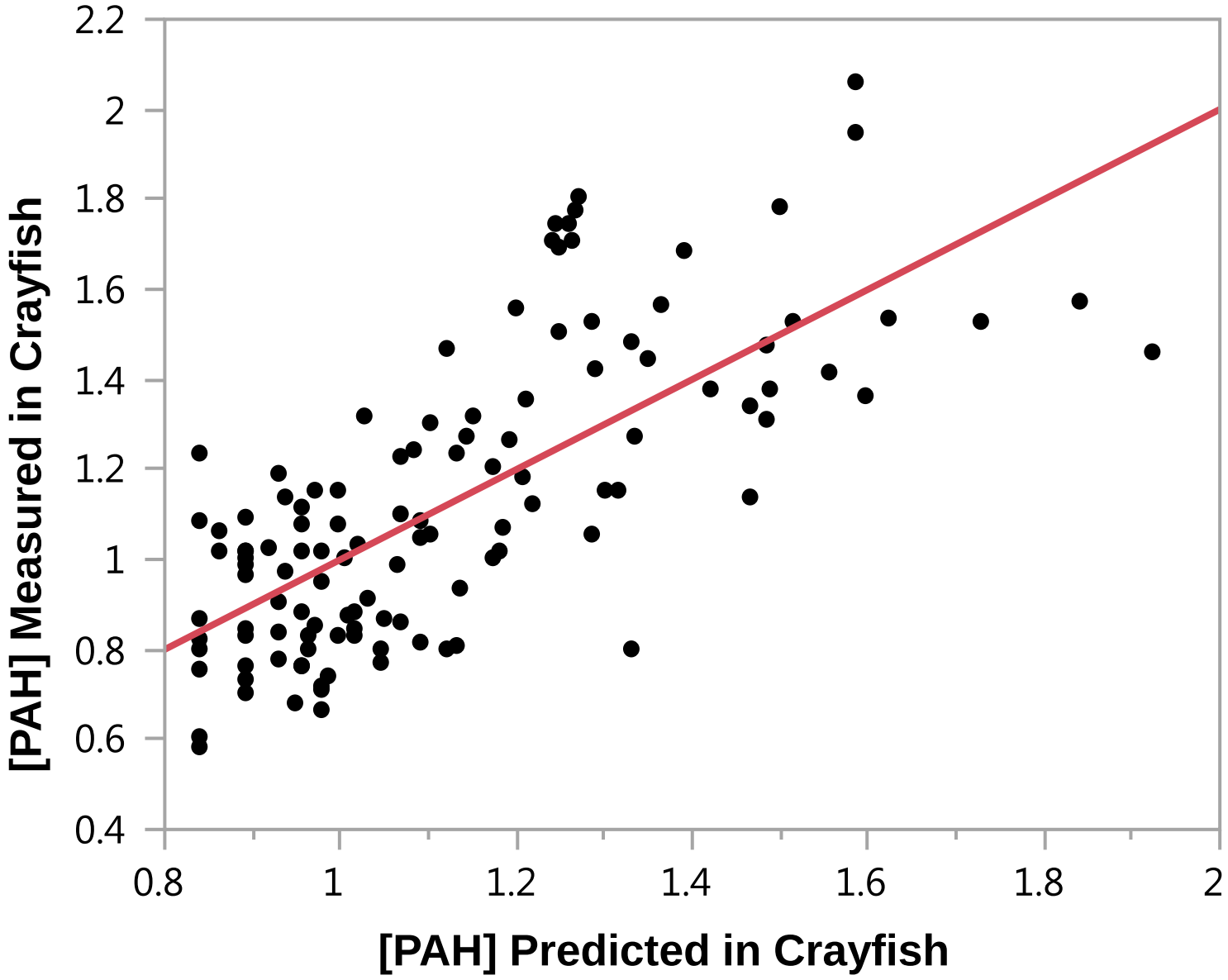
Predictive Model



Predictive Model

- $[\mathrm{PAH}]_{\mathrm{crayfish}} = 0.88 \times [\mathrm{PAH}]_{\mathrm{water}} + 0.56$
- **Only inputs: [PAH] in water**
  - Freely dissolved (C_{free})
- **One model includes 34 PAHs**

Model Predictions



Model Predictions

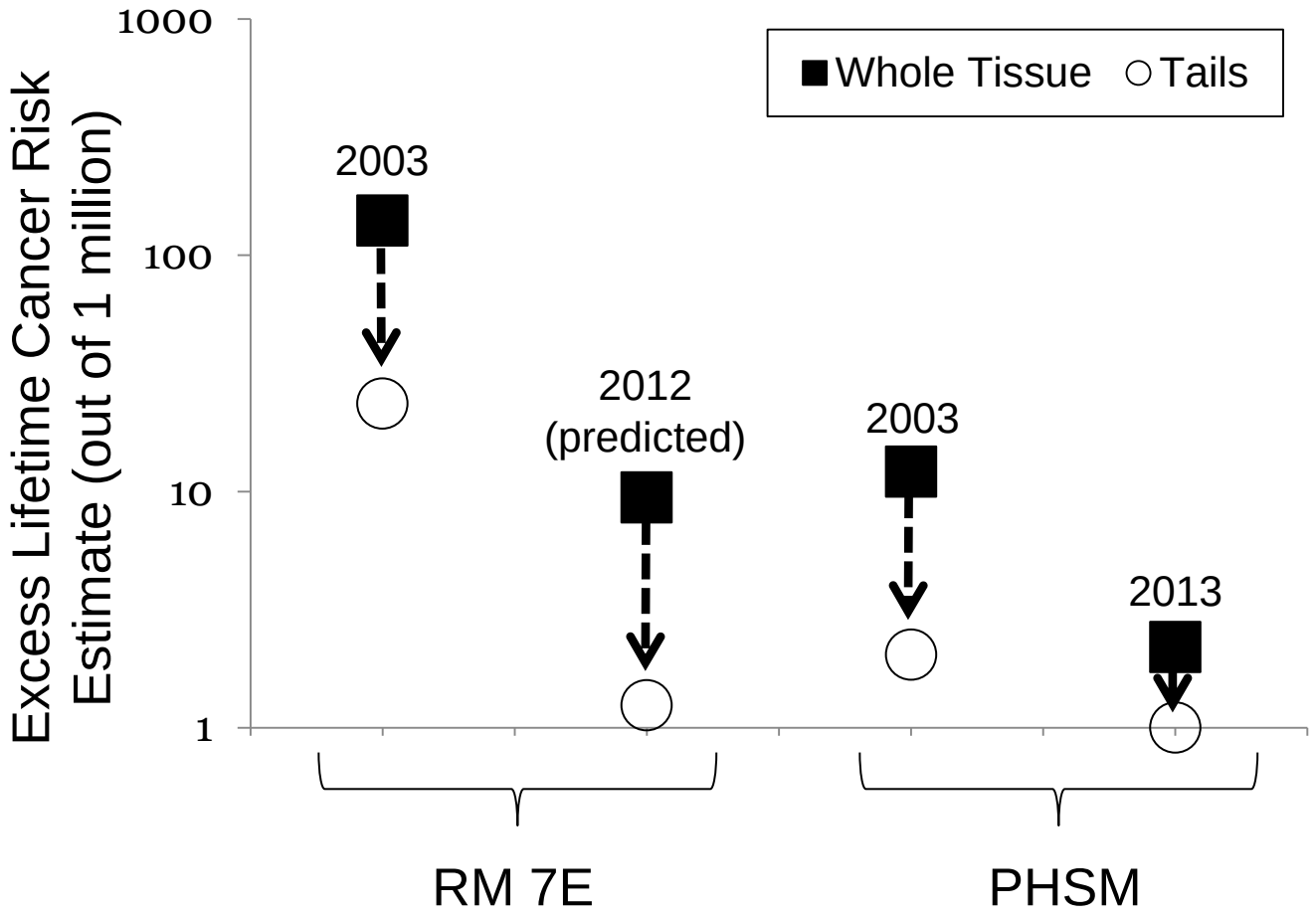
- Predicts individual [PAH] in crayfish viscera within a factor of 2, on average (34 PAHs)
  - Forsberg et al 2014 predicted within factor of 3 (15 PAHs, multiple models)
  - Fernandez et al 2015 predicted within factor of 1.7 on average (3 PAHs, high variability)

- Predictive ability comparable to previous studies, over a broader range of PAHs

Risk Assessment – Human Consumption

- Excess lifetime cancer risk (ELCR) used to compare relative risks associated with consuming crayfish tissues
  - Used BaP_{eq}
- Parameters:
  - 95^{th} % adult ingestion rate = 18 g/day (ATSDR 2006)
  - Acceptable risk level = 1 in 1 million (ATSDR 2006)

Excess Lifetime Cancer Risk (ELCR) Estimates



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Implications

- PAH contamination profile differs if use ∑PAH vs. $\sum BaP_{eq}$
  - Use appropriate metric when assessing risk
- Crayfish tails have 1-2 orders of magnitude lower PAH levels than viscera
  - Substantially less risk if only eat tails
- Simple model requires only water concentrations, predicts crayfish [PAH] within factor of 2
  - One model predicts 60 PAHs
  - Estimates carcinogenic risk
  - Adaptable to other shellfish

Questions?