Unregulated PAHs in crayfish and passive sampling devices: Increased cancer risk estimates?

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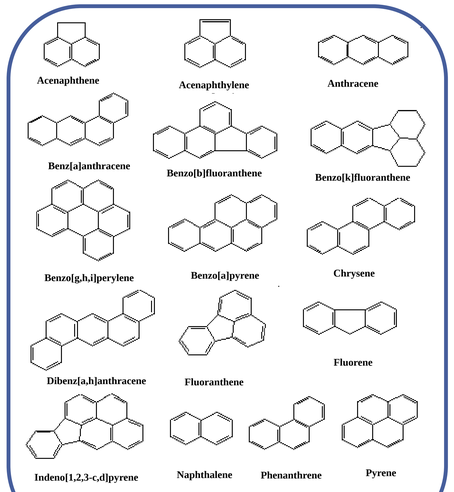
Introduction

U.S. EPA's draft report, "Development of a relative potency factor approach for polycyclic aromatic hydrocarbon mixtures," (EPA 2010) presented a new list of carcinogenic polycyclic aromatic hydrocarbons (PAHs) of concern. This report also proposed an approach for estimating carcinogenicity associated with exposure to PAH mixtures. Each PAH was given a Relative Potency Factor (RPF). These RPFs scale the PAHs' carcinogenicity relative to benzo[a]pyrene (B[a]P). Five of the PAHs included have higher RPFs than B[a]P, highlighted in **Figure 2**[1]. Research is needed to determine the range of concentrations at which these PAHs are found in the environment. We use passive sampling devices to assess these concentrations.

Hypothesis

Incorporating **EPA 2010 PAHs** into cancer risk assessments increases the estimated risk associated with consuming crayfish.

Figure 1. Signal crayfish, *Pacifastacus leniusculus*.



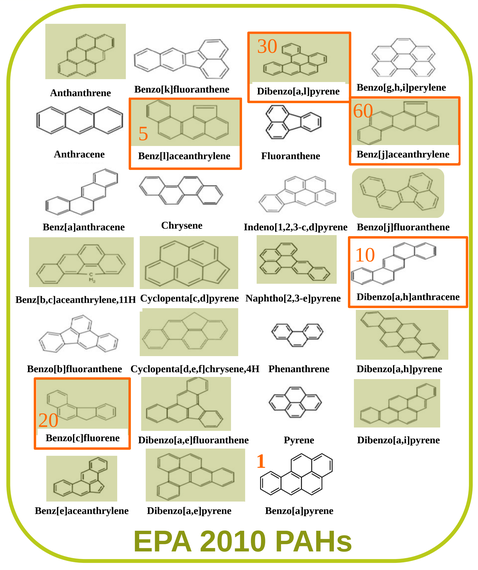


Figure 2. PAHs with "final RPFs based on tumor bioassay data"[1]

Shading = Not in the 16 priority list Orange box = RPF greater than B[a]P

Orange number = RPF

Methods

- Analyzed crayfish, *Pacifastacus leniusculus*, and low density polyethylene (LDPE) passive sampling devices collected and deployed in the Willamette River in Portland, Oregon, in the Portland Harbor Superfund site

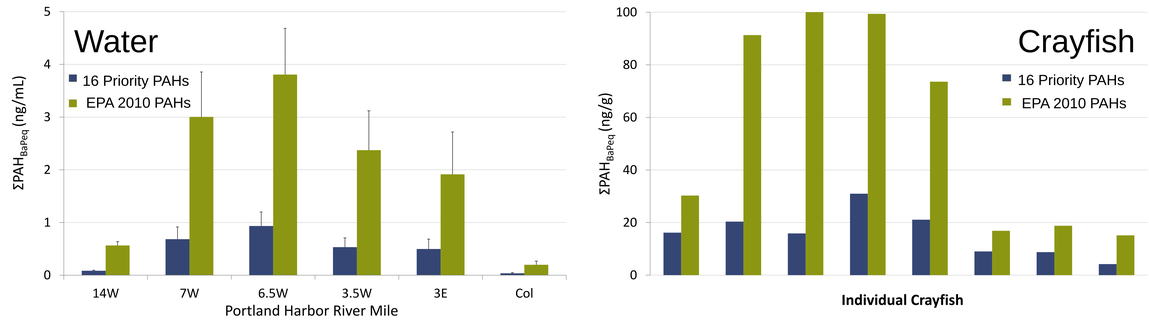
  LDPE deployed in the water, extract concentrations back-calculated to water concentrations

- Used a novel GC-MS method to quantify 62 PAHs, including 23 from the **EPA 2010** list

  Calculated sum benzo[a]pyrene equivalent (BaP_{eq}) PAH concentration using the RPF approach

Results

ΣPAH_{BaPeq} increases in *both* water and crayfish when assessment includes EPA 2010 PAHs, instead of just 16 Priority PAHs



Increased lifetime cancer risk estimates

- 1 in 700,000 → 1 in 200,000
  - Least contaminated crayfish
  - National average ingestion rate[2]
- 1 in 17,000 → 1 in 5,000
  - Most contaminated crayfish
  - 95% ingestion rate[2]

Figure 3. Signal crayfish, *Pacifastacus leniusculus* (left). Deploying LDPE passive sampling devices in Portland Harbor Superfund site (right).

Conclusions

- **EPA 2010 PAHs** are present in water and crayfish from the Portland Harbor Superfund site
- **EPA 2010 PAHs** increase the BaP_{eq} PAH concentration **2 to 7 times** from **16 priority PAHs**
- **This increases the estimated cancer risk associated with consuming crayfish**

Future Work

Determine if PAH concentrations in water (back-calculated from LDPE) predict PAH concentrations in resident organisms, and test predictive models.

References

1. U.S. Environmental Protection Agency (EPA). 2010. *Development of a Relative Potency Factor (RPF) Approach for Polycyclic Aromatic Hydrocarbon (PAH) Mixtures* – Integrated Risk Information System.
2. (2009). Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Washington, DC, U.S. Environmental Protection Agency. **1:** Fish Sampling and Analysis.

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