

# Using transplanted mussels (*Mytilus trossulus*) to monitor and track PAH contaminants in the Puget Sound nearshore



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[https://wdfw.wa.gov/conservation/research/projects/marine\\_toxics/](https://wdfw.wa.gov/conservation/research/projects/marine_toxics/)

- PAH pollutants are entering the nearshore food web of the Puget Sound, especially along shorelines adjacent to highly urbanized areas (e.g. Seattle).
- Total PAH concentration in mussels increases with the percent of impervious surface (a proxy for urban development) in watersheds adjacent to the shoreline.
- Transplanted mussels can be a useful tool to help identify different sources of PAHs to Puget Sound shorelines.

Stormwater delivers a diverse range of contaminants to receiving waters in Puget Sound, including toxic polycyclic aromatic hydrocarbons (PAHs). Understanding the sources and extent of PAH contamination in the nearshore is critical to managing the health of Puget Sound's marine ecosystems. In the winter of 2012/13, the Washington Department of Fish and Wildlife's Toxics-focused Biological Observing System (TBiOS) team conducted a large-scale, active biomonitoring study using native bay mussels (*Mytilus trossulus*) transplanted from a local aquaculture source (Penn Cove, WA) to characterize the extent and magnitude of nearshore contamination in the Puget Sound.

Because of the success of that study, TBiOS now conducts mussel surveys on a biennial basis, with three completed to date (winters of 2012/13, 2015/16, and 2017/18). Puget Sound mussel monitoring is a collaborative effort, coordinated by TBiOS and funded primarily through the Stormwater Action Monitoring program (40 sites), with a number of other state, county, tribal, and local partners and stakeholders funding additional sites (30~50) each survey.

Citizen science volunteers support the program by deploying and retrieving the mussels in anti-predator cages. Monitoring sites cover a broad range of land-use types and mussel soft tissue composites from each site are analyzed for a range of organic contaminants (e.g. PAHs, PCBs, PBDEs, DDTs) and metals.

Here we report on PAHs from the 2012/13 and 2015/16 surveys. PAHs were detected at all of the monitoring sites and were the most abundant organic contaminants measured. Total PAH concentrations ranged from 29 (2013) to 7,350 ng/g dry weight (2016) and were highest in the most urbanized areas of Puget Sound, especially in Elliott and Salmon Bay (Seattle), Eagle Harbor (Bainbridge Island), Commencement Bay (Tacoma), and

several other locations also had elevated total PAHs. There was a strong positive correlation between PAH concentration and the percent of impervious surface in watersheds adjacent to the shoreline (Figure 1). Impervious surface, used here as a proxy for urban development, is strongly linked to stormwater contamination.

We used principal component analysis (PCA) to explore the pattern of PAHs in mussels from sites with at least 50% detected values in both years and calculated the ratio of alkylated-phenanthrene/phenanthrene, a forensic tool used in source tracking, in each sample. The PCA indicated that two broad groups of mussel sites were dominated either by parent PAHs or by alkylated homologs of PAHs (Figure

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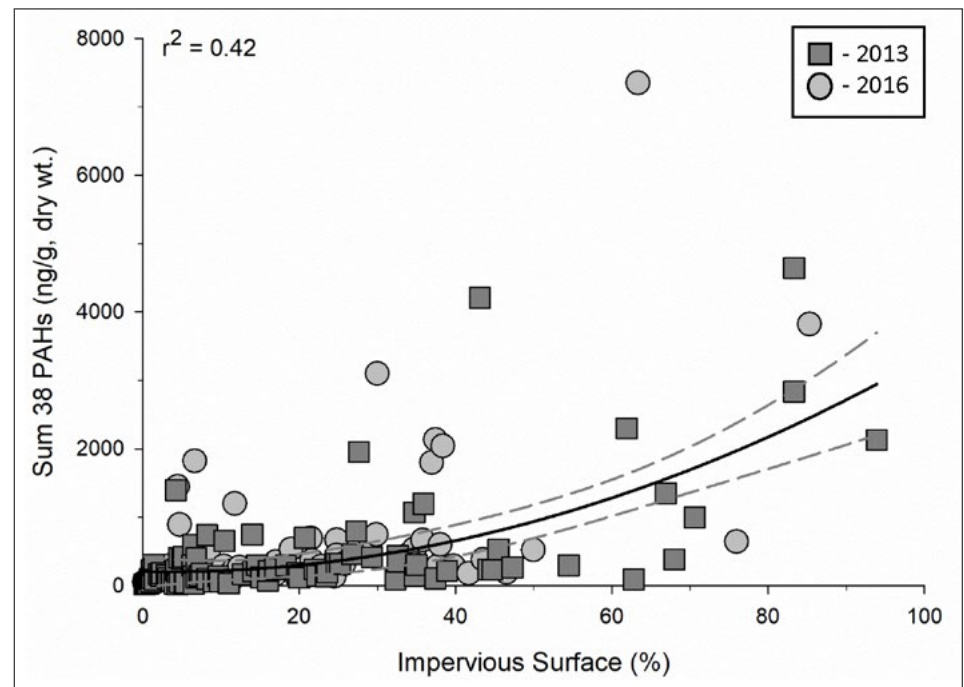


Figure 1. The concentration of  $\sum_{38}$ PAHs increased with percent impervious surface in nearshore watersheds (stepwise multiple linear regression of log-transformed  $\sum_{38}$ PAHs versus Impervious Surface;  $p < 0.0001$ ,  $r^2 = 0.42$ ). Circles/squares represent transplanted mussel sites; solid black line is the predicted regression curve; dotted lines are the 95% confidence intervals.

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2, PC1 axis). A pyrogenic signature (more parent PAHs) dominated the two groups on the right, with combustion of biomass (e.g. wood burning) and automobile exhaust likely the major sources of PAHs. A petrogenic signature (more alkylated

homologs) dominated the group on the left, suggesting those locations are exposed to higher amounts of unburned diesel, gasoline, motor oil, or hydraulic fluids. The findings from these surveys indicate PAH contaminants are entering the nearshore

food web of the greater Puget Sound, especially along shorelines adjacent to highly urbanized areas, and demonstrate how transplanted mussels might be useful in identifying sources of PAHs along the shorelines of Puget Sound.

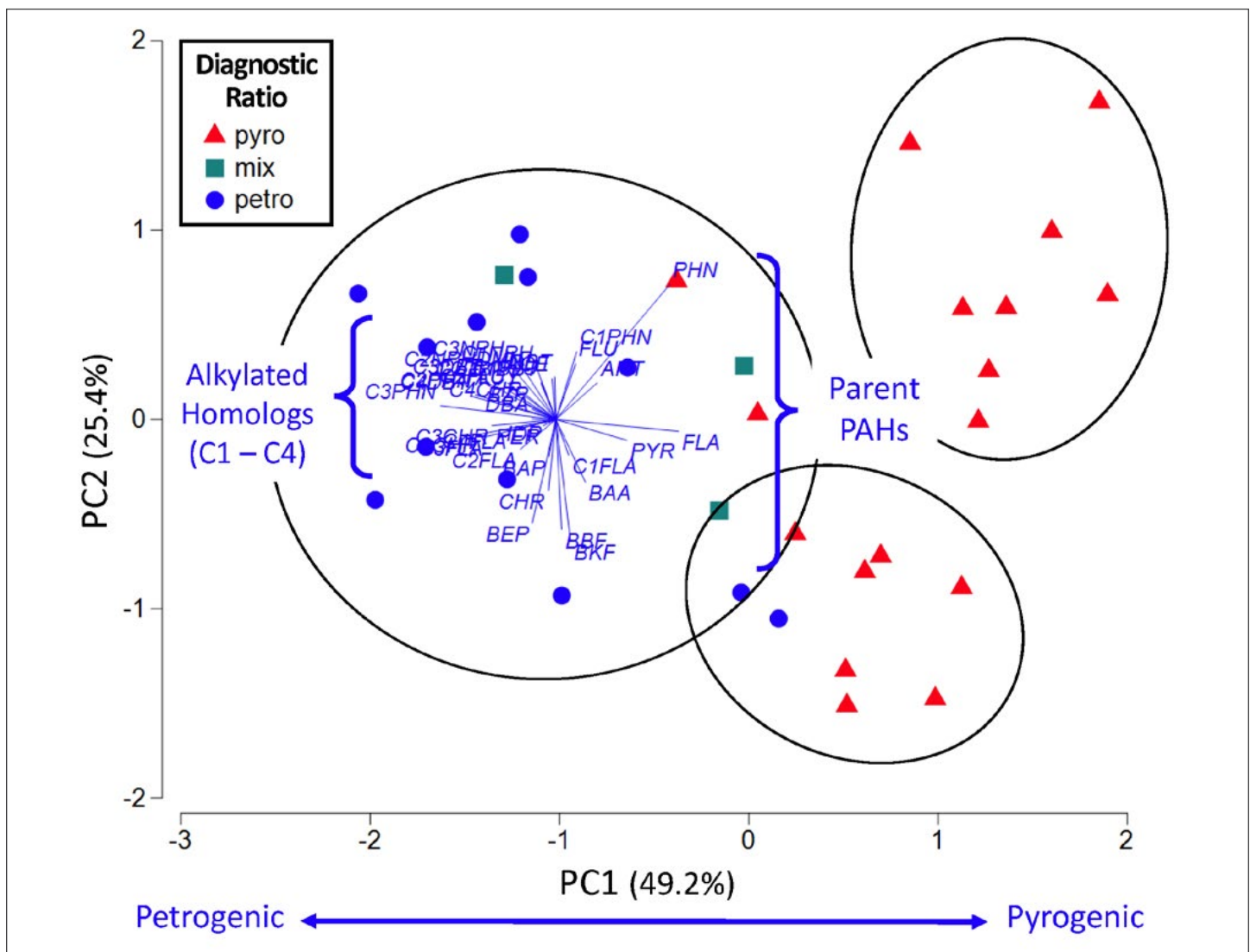


Figure 2. Principal component analysis of 37 PAHs in mussels from 32 sites with at least 50% detected PAHs in 2012/13 and 2015/16 surveys. PAH vectors are shown in blue; % variation explained by each principal component axis indicated in parenthesis. Ratio of alkylated-phenanthrene/phenanthrene in mussel sites were pyrogenic (red triangles), mixed (green squares), or petrogenic (blue circles).

## RECOMMENDED CITATION

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