A comparison of the relative abundance of polycyclic aromatic hydrocarbon (PAH) chemicals in creosote-treated wood pilings (CTWP), low-density polyethylene passive samplers, and herring embryos exposed to CTWPs

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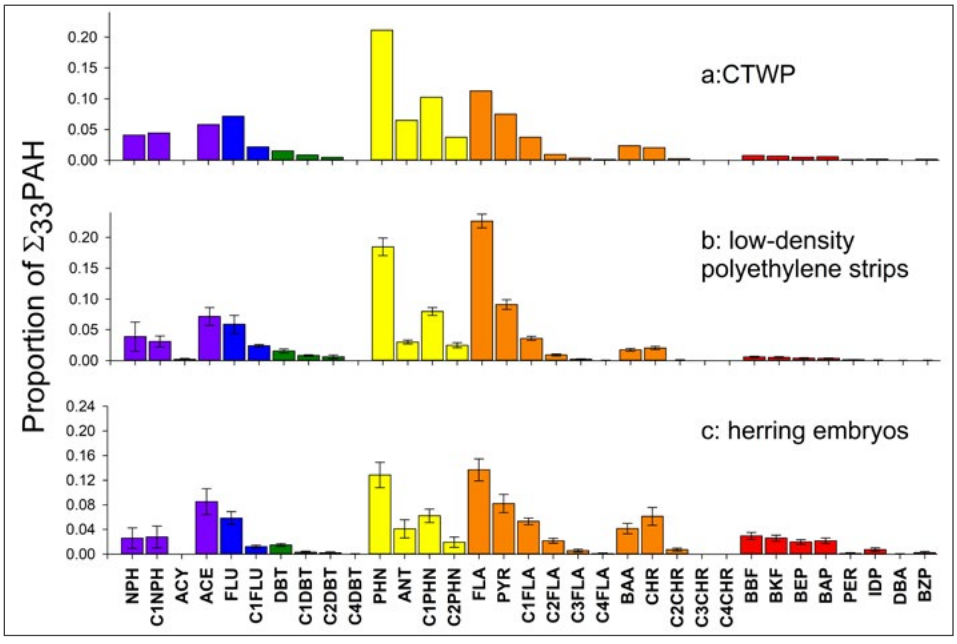
https://wdfw.wa.gov/conservation/research/projects/marine_toxics/

Fish embryos spawned in Puget Sound nearshore marine habitats face a risk of exposure to a wide variety of toxic chemical pollutants during their incubation. Of particular concern are polycyclic aromatic hydrocarbons (PAHs), chemicals originating from oil spills, combusted fossil fuels, and creosote-treated wood pilings (CTWPs). Removal of CTWPs and prohibiting their use in marine waters are two recovery practices aimed at reducing PAHs and other creosote-related chemicals in marine waters. We used manually spawned and field-deployed Pacific herring embryos (*Clupea pallasii*) as a sensitive indicator of PAH exposure from CTWPs, to test the efficacy of a CTWP removal project in Quilcene Bay, Washington. An incomplete CTWP removal process resulted in unintended exposure of herring embryos to CTWP chemicals, resulting in an unanticipated opportunity to describe uptake of CTWP chemicals in developing embryonic fish in a field setting.

To better understand the link between this putative PAH source and embryos, we measured PAHs in wood fragments from the CTWPs, and in passive sampling devices (simple low-density polyethylene strips) which were deployed with the caged herring embryos (incubated for 10 days of a 12-day incubation period). The proportional concentration of each PAH chemical (33 parent and alkylated homolog PAH compounds) are reported here in these three matrices: (a) CTWPs, (b) passive samplers, and (c) herring embryos (Figure). Overall, the PAH pattern in these matrices were similar, albeit with a few notable differences. The total mass of PAHs in all matrices was dominated by 3-ring (yellow-colored bars) and 4-ring (orange bars) PAH compounds. Phenanthrene (PHN) and fluoranthene (FLA) were the most abundant PAHs, individually accounting for 13 to 23% of total PAHs, and their alkylated homologs were always less abundant than parent PAHs. The sulfur-containing heterocyclic PAH dibenzothiophene (DBT), which is often reported in creosote, and two of its alkylated homologs (C1DBT and C2DBT; green bars) were measured in all matrices at low levels. Low-molecular-weight two- and three-ring PAHs including naphthalenes (NPH), acenaphthene (ACE; violet bars) and fluorenes (blue bars) were detected in all matrices. Embryos exhibited a slightly heavier PAH signal than the CTWP and passive samplers, with greater proportions of four- to six-ring compounds (orange and red bars) such as benzo(*a*)anthracene (BAA), chrysene (CHR), benzo(*b*)- and benzo(*k*)fluoranthene (BBF and BKF), and benzo(*e*)- and benzo(*a*)pyrene (BEP and BAP). These results suggest that although herring embryos exposed to CTWPs accumulated PAHs in a pattern roughly equivalent to the creosote source, the greater abundance of four- to six-ring compounds in embryos indicate possible differential uptake or metabolism of PAHs in embryos. The strong congruence of PAH patterns in the passive sampling devices with CTWP wood, and their overall similarity with the embryo PAH pattern, suggests these devices have value as a proxy for embryos in studies evaluating the dissolution of PAHs from CTWP wood, and the threat of PAHs to living embryos in field settings.

- **Herring embryos exposed to creosote-treated wood pilings (CTWP) accumulated polycyclic aromatic hydrocarbons in a pattern similar to the CTWP source.**
- **Passive samplers (simple low-density polyethylene strips) have utility as a proxy for embryos in field settings.**



The proportional concentration of each of the 33 parent and alkylated homolog PAH compounds in the three matrices: (a) creosote-treated wood pilings (CTWPs), (b) low-density polyethylene strips (passive samplers), and (c) herring embryos.

RECOMMENDED CITATION

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