CREOSOTE BEACH LOG REMOVAL AND ASSESSMENT OF LEACHING INTO BEACH SEDIMENTS IN PUGET SOUND

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introduction
Creosote-treated wood debris is pervasive on Puget Sound’s beaches, where creosote is a pollutant of concern for several reasons:
- Toxic polycyclic aromatic hydrocarbons (PAHs) leach into water and beach sediments around contaminated structures where they accumulate and sometimes reach levels above Washington State Department of Ecology sediment quality standards (Brooks 2003).
- PAHs can be harmful to Pacific herring, English sole and salmonoids, among other marine organisms that colonize treated wood or otherwise utilize contaminated nearshore environments (Vines et al. 2000, Myers et al. 2003, Casillas et al. 1995, 1998).
- Creosote is a human carcinogen, and people are readily exposed to creosote on beaches through direct contact with logs, pilings and beach fires.

Since 2004, funded in part by Governor Gregoire’s Puget Sound Initiative, the Washington State Department of Natural Resources (WA DNR), the Northwest Straits Commission and partners have removed over 6,000 tons of treated pilings and other debris from Puget Sound beaches, including over 1,700 tons of creosote beach logs (see above map). In an attempt to inform these efforts, The Nature Conservancy and WA DNR collaborated to conduct a pilot assessment of the leaching of creosote into beach sediments surrounding rogue creosote logs in two sites with relatively high levels of creosote log deposition and retention. DNR subsequently removed logs from sampled beaches.

objectives
1) Inventory and remove creosote and treated wood from several thousand feet of shoreline in Puget Sound.
2) Perform pilot assessment to determine the extent to which toxic creosote PAHs are present in beach sediments around rogue creosote logs in Puget Sound and answer the following questions to inform clean-up efforts:
   - Do creosote compounds from rogue beach logs leach into surrounding sediments at detectable levels? Are levels above Washington State Department of Ecology (DOE) standards?
   - What factors affect PAH concentrations in sediment samples (e.g., beach environment)?
   - Is there a spatial pattern to leaching around logs?

methods
We sampled beach sediments at several distances and depths (N=249) from creosote and non-creosote logs on two Puget Sound spit-landform beaches to assess transport of creosote into beach sediments.

Sampled Beach Environments
- Wetland/Logon – long residence time
- Spit-bay side – moderate residence time
- Spit-strait side – short residence time

results
do we find creosote compounds in beach sediments?
- One or more PAHs are present above background levels in over 80% of samples near creosote logs and over 95% of samples near untreated logs.
- 86% of untreated logs with detectable levels of one or more PAHs were found either in wetland (25%) or spit-bay side (59%) samples.

Do PAH levels in sediment samples exceed DOE standards?
PAH levels exceeded conservative standards (Apparent Effects Threshold) in samples from:
- 2 of 9 creosote logs from Dungeness Spit (both from the spit-bay side environment)
- 11 out of 12 creosote logs (from all 3 environments) and 3 out of 5 untreated logs at Spencer Spit (from wetland and bayside environments).

what factors affect total PAH concentrations in sediment samples surrounding beach logs?
Dungeness Spit significant factors (F=3.794, p=0.008273):
- Log treatment (creosote > untreated, p=0.01454)
- Beach environment (wetland > spit-bay side and spit-strait side, p=0.01665)
- Sample distance (close (5 cm) > middle (50 cm) and far (25 cm), p=0.02491)

Spencer Spit significant factors (F=4.44, p=0.009665):
- Beach environment (wetland > spit-bay side > spit-strait side, p=0.0178)
- Sample depth (shallow (3 cm) > medium (8 cm) and deep (23 cm), p=0.0165)
- Log treatment is not significant – probably due to high PAH values near untreated logs in the wetland (see conclusions).

conclusions
Based on our data, we found that:
- Creosote compounds are prevalent at detectable levels in beach sediments near rogue creosote logs and may be found in beach sediments near untreated logs in stable environments.
- Some PAH levels exceed DOE thresholds and may cause harm to marine life.
  - Samples from Spencer Spit had higher PAH concentrations than those from Dungeness Spit and were more likely to exceed thresholds.
  - PAH concentrations are higher in stable environments (logon/wetland, spit-bay side) where logs likely have a longer residence time. Species and life stages that preferentially utilize these stable habitats may be more at risk.
  - PAH concentrations are greatest within 5 cm distance and 3 cm depth from logs, but were detected in some samples at the farthest sampling distance.

These pilot results suggest needed actions and possible best management practices:
- Invest in a larger study of creosote leaching into beach sediments and corresponding biological impacts.
- Assess the reduction of PAH levels following removal of sources or structures.
- Assess other potential sources of PAH inputs that would influence study results.
- Invest in strategic creosote removal efforts (log and structures) as a component of Puget Sound recovery, where the following environments might be prioritized:
  - stable, high-risk habitats, especially as they correspond with sites important for at-risk species or sensitive life stages
  - public sites with high human visitation
  - sites with high densities of creosote logs
  - water bodies with poor circulation and reduced flushing of contaminants

Please contact whalesun@wta.org for references and additional study information.