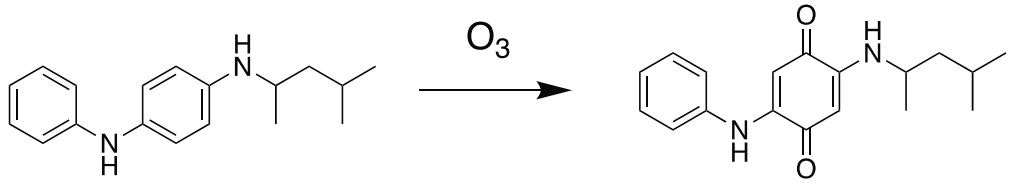
Mitigating Inputs of Tire Wear Toxins to Protect Salmonid Habitat on Vancouver Island

Tire Wear Toxins Overview

Stormwater runoff has been recognized as the cause of acute mortality, now referred to as 'urban runoff mortality syndrome' (URMS), in coho salmon (*Oncorhynchus kisutch*) in the Pacific Northwest for decades[4]. However, it wasn't until 2020 that the compound responsible for the death of 40 to 90% of Puget Sound's returning coho in its most urbanized watersheds was identified: N-(1,3-dimethylbutyl)-N-phenyl-p-phenylendiamine quinone, commonly referred to 6-PPDQ[4]. Derived from N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine (6-PPD), 6-PPDQ is a transformation product. 6-PPD is an antiozonant that has been added to tire rubber since the 1970s to prevent them from cracking and degrading[4]. As tires are used, particles come off and are left to reside on the roadway until washed away by rainfall.



6-PPD **6-PPD Quinone**

Studies have identified that stormwater runoff is the greatest contributor of 6-PPDQ to urban waterways[3,5]. Stormwater runoff entering waterways with toxic concentrations (parts-per-trillion or ng/L) of 6-PPDQ can cause URMS to occur in numerous salmonid species in a matter of hours. Impacted local species impacted include coho (41 – 95 ng/L)[2,3], Chinook (> 67,306 ng/L)[2], and rainbow trout (1,000 ng/L)[1].

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Program Summary

Researchers at the BC Conservation Foundation (BCCF) have partnered with Vancouver Island University (VIU), University of Victoria (UVic), local First Nations, and community stewardship groups to undertake a large-scale 6-PPDQ monitoring program. VIU developed an innovative and sensitive method to directly measure tire wear derived toxins in real-time. This project leverages this technique to answer important questions that will support the protection of salmon and other freshwater organisms. Funding used to support this program was provided by the BC Salmon Restoration and Innovation Fund, Pacific Salmon Foundation, Mitacs, and the Regional District of Nanaimo.

The program has three primary objectives, which include:

1. **What are the major inputs of tire wear toxin on eastern Vancouver Island?**
   Answering this question requires an intensive sampling campaign that monitors toxins in stormwater runoff, streams, and tributaries before, during, and after major rain events at dozens of locations on Vancouver Island.
2. **How do the concentrations of tire wear toxins change over time and space?**
   This requires collecting multiple samples over time and at various distances from known input sources. Knowing how toxin concentrations vary over time will inform mitigation strategies.
3. **How can low-cost nature-based solutions protect urban streams?**
   Environmental engineers at UVic are constructing lab-scale wetlands to evaluate media, designs, and plant species that detoxify roadway runoff. Also, existing green infrastructure (bio-retention ponds, swales, etc.) are being evaluated for tire wear toxin removal.

The longer-term goals of the project include: 1) identifying major 6-PPDQ hotspots and prioritize these sites for future mitigation efforts; 2) determine the most efficient means of mitigating 6-PPDQ and identifying potential locations for mitigation efforts; and 3) be part raising awareness of the issue within the community, all levels of government, and tire manufacturers to ensure conservation actions are implemented and tire wear toxins (TWT) are reduced/removed from waterways where they directly threaten vulnerable salmonid species.

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Role of the Volunteers

Volunteers have been sampling in all regions along the East Coast of Vancouver Island, from Campbell River south to Victoria. They have been integral is collecting a large portion of the data to date. As weather conditions are variable in intensity and timing, it would not be possible to cover the geographic area that has been to date without them.

Volunteers are involved in multiple aspects of the project including site selection and sampling.

Sampling Information

Prior to sampling, there must be at least 48 hours of dry weather to allow tire wear particles to build up on the roadway, followed by significant rainfall, meaning that runoff is observed. BCCF monitors the weather forecast and emails the sampling window to volunteers for their specific region. Correspondence with available volunteers carries on through the entirety of the sampling efforts until sample pick up. BCCF regularly communicates with those sampling to respond to any questions that may arise, especially when weather patterns are shifting.

The ideal time to collect a water sample is variable between each waterway, as they each vary in the number of stormwater point sources and characteristics (i.e., topography, flow, catchment area, etc.). It is best to try and sample shortly after runoff has begun (~1 – 3 hours), but that will be variable between regions and locations.

Once collected, samples are to be stored in a cool, dark place (either a cooler with an ice pack or a fridge) and remained capped. The compound breaks down relatively quickly; however, keeping it cool and capped can keep the samples viable for a few weeks.

After each group collects samples, BCCF arranges for samples to be picked up from volunteer's homes and transported to VIU AERL for delivery at the lab. Sample pick up typically occurs the day following collection of the last creek sample ('after' sample) to ensure samples were delivered to the lab in a timely manner for analysis.

Resources

Project Website
(www.tireweartoxins.com)

Data Dashboard

Year 1 Summary Report

References

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