A preliminary ranking of contaminants of concern in juvenile Harrison Chinook and their habitat in the Fraser River, British Columbia.

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Introduction

The Fraser River is the largest river in British Columbia: once considered to be one of the world’s most productive salmon rivers, home to 19 Chinook populations (94% of 15/16 are classified under Species at Risk Act as Endangered (10), Threatened (4) or Special concern (1)).

The river has a history of pollution inputs into both freshwater (sewage) and marine environments (effluent from pulp and paper, chemical manufacturing, mining, and urban runoff). The Fraser River estuary passes through Metro Vancouver, a heavily urbanized region. This has resulted in it being heavily impacted by numerous anthropogenic activities including:

- Forestry
- Mining
- Pulp and paper
- Chemical manufacturing
- Urban and agricultural runoff
- Wastewater (sewage)
- Preservation

There is a history of pollution inputs into the Fraser River estuary. Few studies have measured contaminant concentrations across numerous environmental matrices.

Objective: Conduct a ranking of anthropogenic contaminants in juvenile Chinook salmon and their habitat (water and sediment) in the Fraser River estuary and evaluate the risks posed to juvenile Chinook salmon health.

Methods

- 600 contaminants of concern from up to 12 contaminant classes were measured in juvenile Chinook and their habitat (water, sediment) including but not limited to:
  - Metals
  - Pharmaceuticals & Personal Care Products (PPCPs)
  - Pesticides
  - Polycyclic aromatic hydrocarbons (PAHs; found in coal, crude oil & gasoline)
  - Flame retardants (brominated & chlorinated)
  - Polychlorinated Biphenyls (PCBs; industrial & commercial uses)
  - Alkylphenols (surfactants found in a variety of consumer & commercial products)
  - Polyorganochlorinated Bisphenol A (POPs; industrial uses)

- Fish collection: May-June
  - Harrison River Chinook stock selected due to: spawning location origin in the lower Fraser River; rely most heavily on estuarine habitat.
  - North arm, South arm #1 (downriver of a large secondary wastewater treatment plant (WWTP)), South arm #2 (near the mouth of the river).

- Water sampling: May-June, monthly
  - North arm, South arm #1 (downriver of a large secondary wastewater treatment plant (WWTP)), South arm #2 (near the mouth of the river).

- Sediment sampling annually

Preliminary results

- 1 of 14 Canadian Environmental Quality Guidelines for tissue was exceeded:
  - BDE-99, Federal: 1.08 (EQG 1 ng/g)

- More than 175 analytes of 590 measured were detected at each site:
  - Analyses from all contaminant classes were detected.
  - 5 of 71 Canadian Water Quality Guidelines (WQGs) were exceeded:
    - Total PCBs and PCB 126 (British Columbia WQG5)
    - PAHs: pentylbenz[a]anthracene, chrysene (Ontario interim WQG0)
  - Exceedances at all sites

Discussion

- EQGs are available for 12% of water analytes and 2% of tissue analytes detected, therefore a prioritization/ranking assessment using only EQGs is not possible; EQGs (tissue or water) were rarely exceeded.
- Contaminant profiles in whole juvenile Chinook and water differed, confirming the importance of measuring contaminants in multiple matrices in order to characterize risk.
- Concentrations of antibiotic Virginiamycin M1 were greater in South arm than North arm suggesting that differences may be driven in part to wastewater treatment plant discharges.

- Ongoing research: Data 2021 will provide additional samples, including a semi-urban site (Harrison River) located upstream from Metro Vancouver: Contaminant risk (and ranking) will be further explored by comparing measured concentrations to toxicity threshold values from a variety of databases. Contaminant profiles will complement a field-based health effects study using molecular techniques (‘omics’) and traditional apical measurements (e.g. fish size).

Results from this research will be used to inform Chinook conservation, recovery, and management efforts, especially as they relate to Fraser River Chinook and Southern Resident killer whales.

Acknowledgments

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Table 1. Measured concentration of 4-nonylphenol and Virginiamycin M1. Note: No tissue guidelines for these analytes.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Concentration (ng/L)</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Minimum</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>4-Nonylphenol</td>
<td>1.08</td>
<td>0.001</td>
<td>0.0001</td>
<td>0.00</td>
<td>4.000</td>
</tr>
<tr>
<td>Virginiamycin M1</td>
<td>0.00</td>
<td>0.000</td>
<td>0.000</td>
<td>0.00</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Figure 1. Fraser River estuary sampling sites

Figure 2. Water concentrations of pentylbenz[a]anthracene, chrysene (Ontario interim WQG0)