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Bonnie Lo
DFO/SFU

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

Lo, B.P.^{1,2}, Sadler, K.³, MacDuffee, M.⁴, Scott, D.⁴, Colbourne, K.², Marlatt, V.L.¹, Brown, T.M.²



¹ Biological Sciences, Simon Fraser University, Burnaby, British Columbia, ² Pacific Science Enterprise Centre, Fisheries and Ocean Canada, West Vancouver, British Columbia, ³ Water quality monitoring and surveillance, Environment and Climate Change Canada, Vancouver, British Columbia, ⁴ Raincoast Conservation Foundation, Sidney, British Columbia

Introduction

- The Fraser River is the largest river in British Columbia
 - once considered to be one of the world's most productive salmon rivers¹
 - home to 19 Chinook populations
 - 94% (15/16) are classified under Species at Risk Act as Endangered (10), Threatened (4) or Special concern (1)
 - critically important species to First Nations, recreational anglers and commercial fisheries
 - main food source for Southern Resident killer whales³
- The Fraser River estuary passes through Metro Vancouver, a heavily urbanized region. This has resulted in it being heavily impacted by numerous anthropogenic activities including⁴:

- forestry
- mining
- pulp and paper
- wood preservation
- chemical manufacturing

- urban and agricultural runoff
- wastewater (sewage) treatment discharge

○ There is a history of pollution inputs into the lower Fraser River estuary

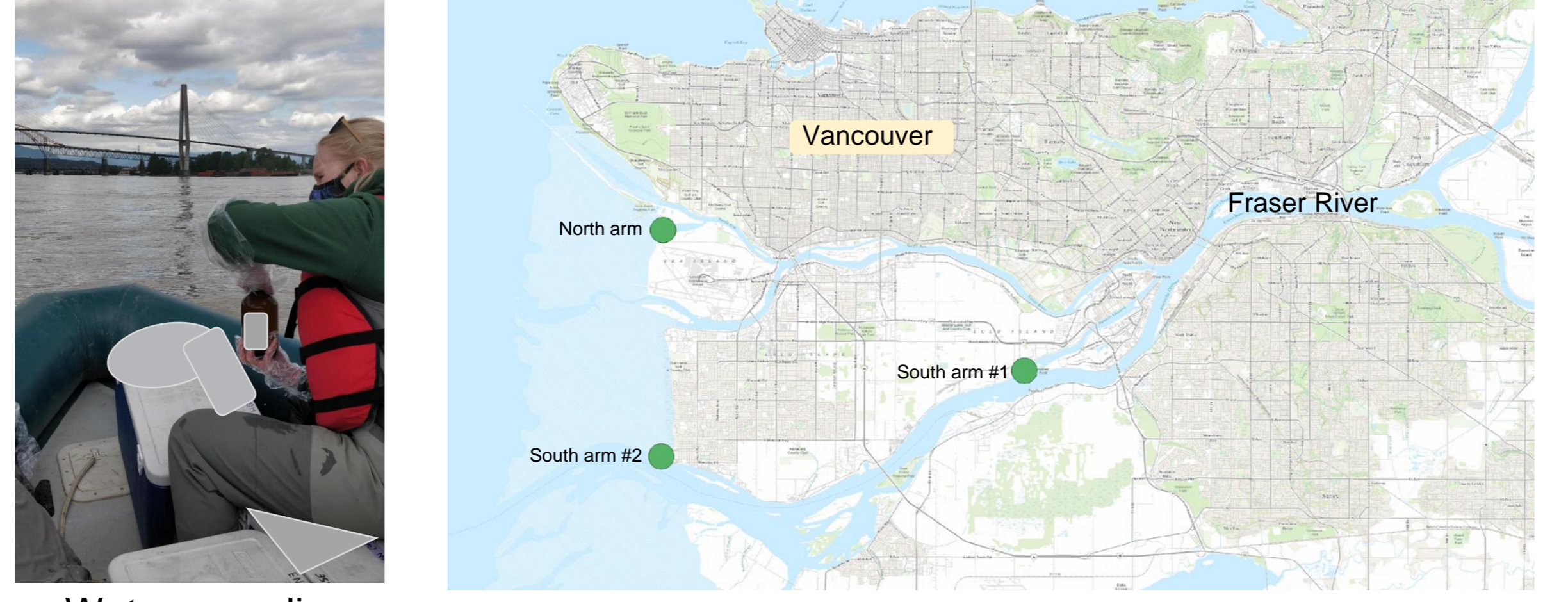
○ Few studies have measured contaminant concentrations across numerous environmental matrices

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
 - Pharmaceutical & Personal Care Products (PPCPs)
 - Pesticides
 - Polycyclic aromatic hydrocarbons (PAHs; found in coal, crude oil & gasoline)
 - Flame retardants (brominated & chlorinated)
 - Polybrominated diphenyl ethers (PBDEs; used in products to increase flame ignition resistance)
 - Per- and Polyfluoroalkyl Substances (PFAS; found in many consumer & commercial products)
 - Polychlorinated Biphenyls (PCBs; industrial & commercial uses)
 - Alkylphenols (surfactants found in a variety of consumer & commercial products)

- 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
- Sediment sampling annually



- Water sampling May-June, monthly

Preliminary results

Organic contaminant related findings in two matrices: juvenile Chinook and water

- **Whole Juvenile Chinook**
 - 612 analytes were measured in chinook composite samples
 - 308 were detected in North arm (n=3)
 - 209 were detected in South arm #1 (n=1)
 - And 287 were detected in South arm #2 (n=2)
 - 4-nonylphenol was the contaminant with the highest concentration at all sites
 - analyte was not detected in water
 - Virginiamycin M1 (an antibiotic) was one of top 5 highest concentrations in South arm sites but not detected in North arm juvenile Chinook tissues or any water samples
- 1 of 14 Canadian Environmental Quality Guidelines for tissue was exceeded
 - BDE-99, Federal: 1.08 (EQG 1 ng/g)

Site	n	Concentration in whole juvenile Chinook (ng/g)			
		4-nonylphenol		Virginiamycin M1	
		mean	Standard error	mean	Standard error
North arm	3	116.4	4.6	Not detected	
South arm #1	1	149.7	Not applicable	9.66	Not applicable
South arm #2	2	219.2	8.5	3.19	3.19

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

- **Water**
 - More than 175 analytes of 590 measured were detected at each site
 - Analytes 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: perylene, benzo[ghi]perylene, chrysene (Ontario interim WQGs⁶)
 - Exceedances at all sites

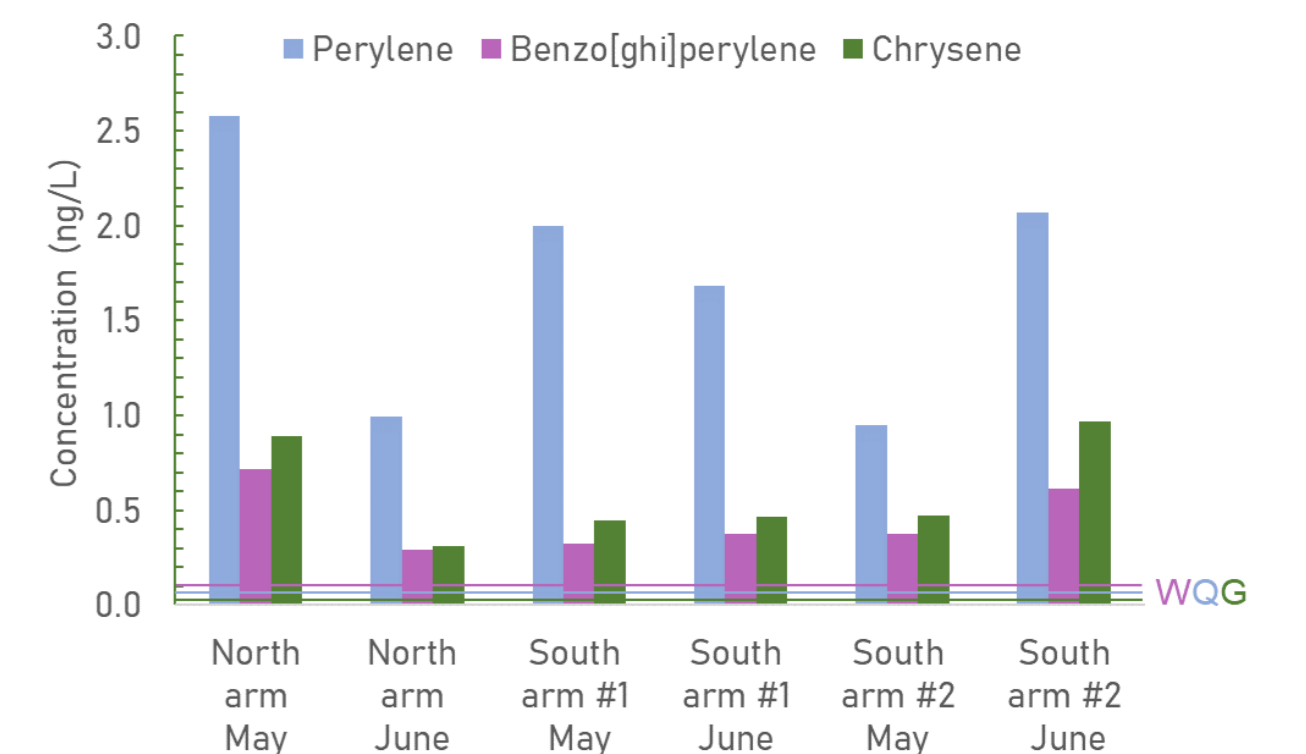


Figure 2. Water concentrations of perylene, benzo[ghi]perylene and chrysene

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 upriver 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.

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Image credits: Introduction graphics-Bonnie Lo; Fish collection-Hasnah Nathani, Sediment sampling-Claire O'Brien, Water sampling-Bonnie Lo

References: ¹Northcote, T. G. 1989; ²COSEWIC, 2018, ³Ford, J. K. B., 2009, ⁴Shaw, D.P. 1998 ⁵BC Ministry of Environment. Water Protection and Sustainability Branch. 1992, ⁶Ontario Ministry of Environment and Energy. 2021