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Prioritizing contaminants of concern in the Fraser River watershed: a risk-based evaluation for outmigrating juveniles and returning adult salmon

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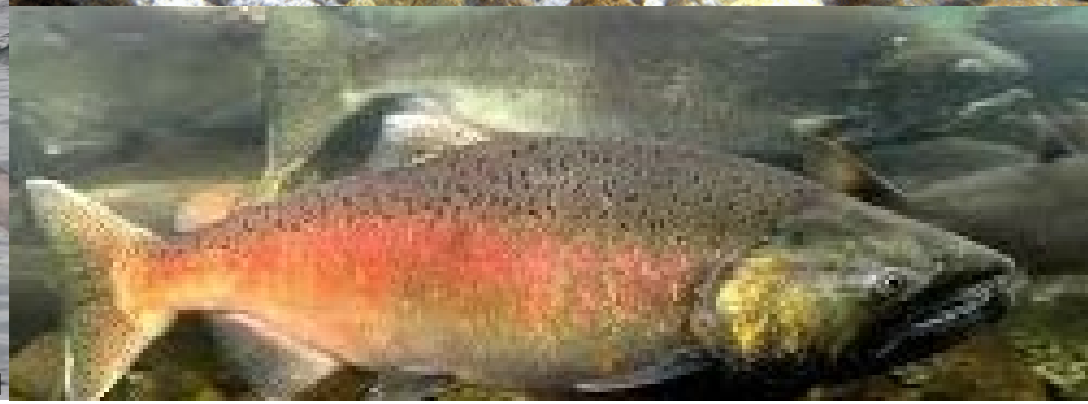


Prioritizing contaminants of concern in the Fraser River watershed: a risk-based evaluation for outmigrating juveniles and returning adult Chinook salmon

T.M. Brown, K. Sadler, B.P. Lo, M. MacDuffee, G. Graham

Fisheries and Oceans Canada

Environment and Climate Change Canada

SFU

RAINCOAST CONSERVATION FOUNDATION

Southern Resident Killer Whales


L.Barrett-Lennard

Top three threats

- Prey abundance – chinook salmon
- Physical and acoustic disturbance
- Environmental contaminants

The Whales Initiative: One of three cetaceans targeted for priority conservation actions by the Government of Canada

Vulnerable to POPs

- High in the food chain
- Long lived
- Low reproductive output
- Limited metabolic capacity to eliminate PCBs

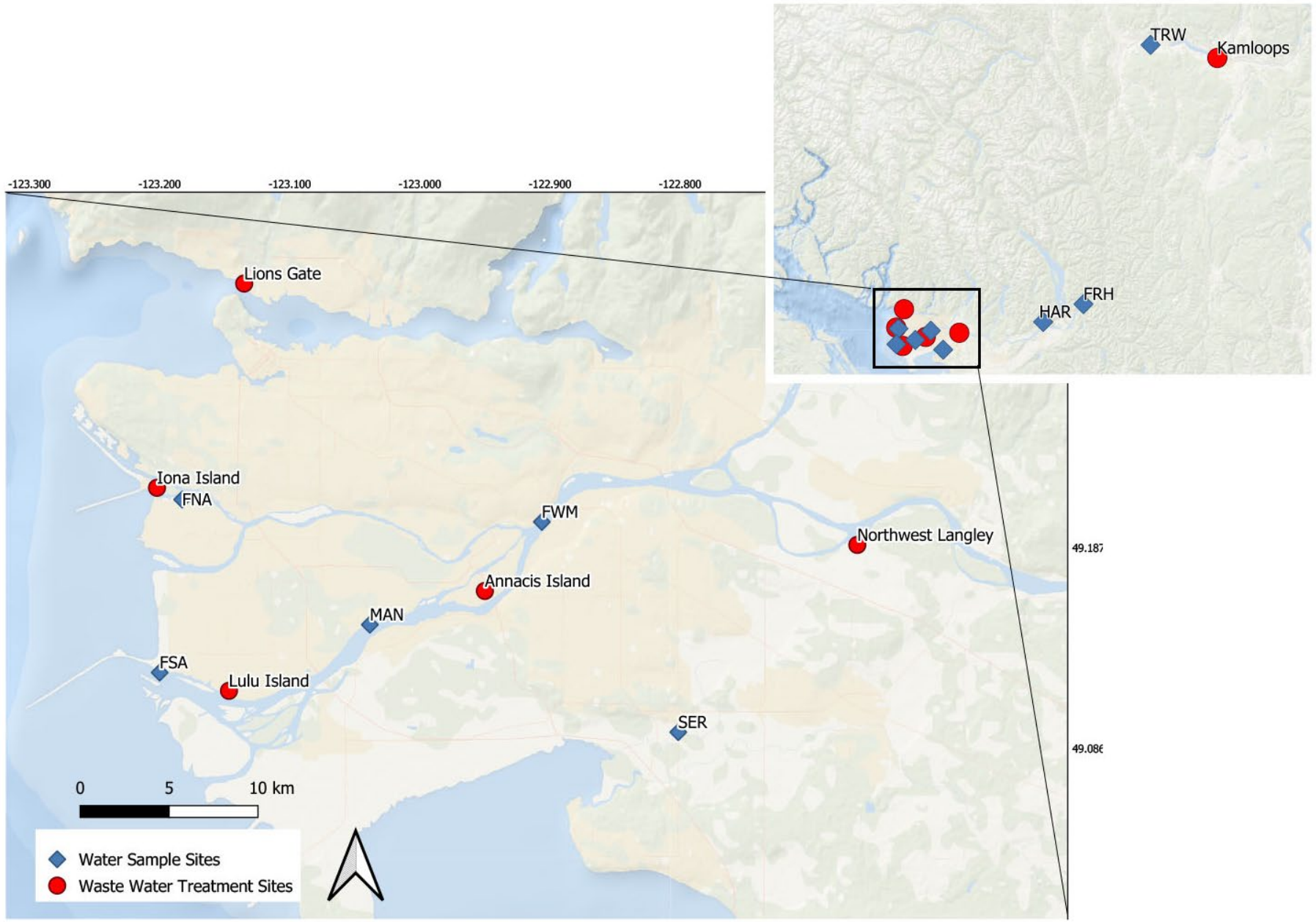
Chinook salmon

- Important for First Nations, recreational and commercial fisheries, & Resident Killer Whales
- Fraser stocks at risk:
  - 1 population classified by COSEWIC as ‘Special Concern’;
  - 6 as ‘Threatened’
  - 7 as ‘Endangered’
- Contaminants identified as one of the greatest threats to salmon, especially juveniles

Fraser River

- Largest river in British Columbia and was the world's most productive salmon river (230,000 km^2 watershed)
- 54 unique populations of salmon; 19 are Chinook
- Point and non-point contaminant source inputs from a wide range of industries and activities
- Little known about juvenile and adult salmon contaminant exposure

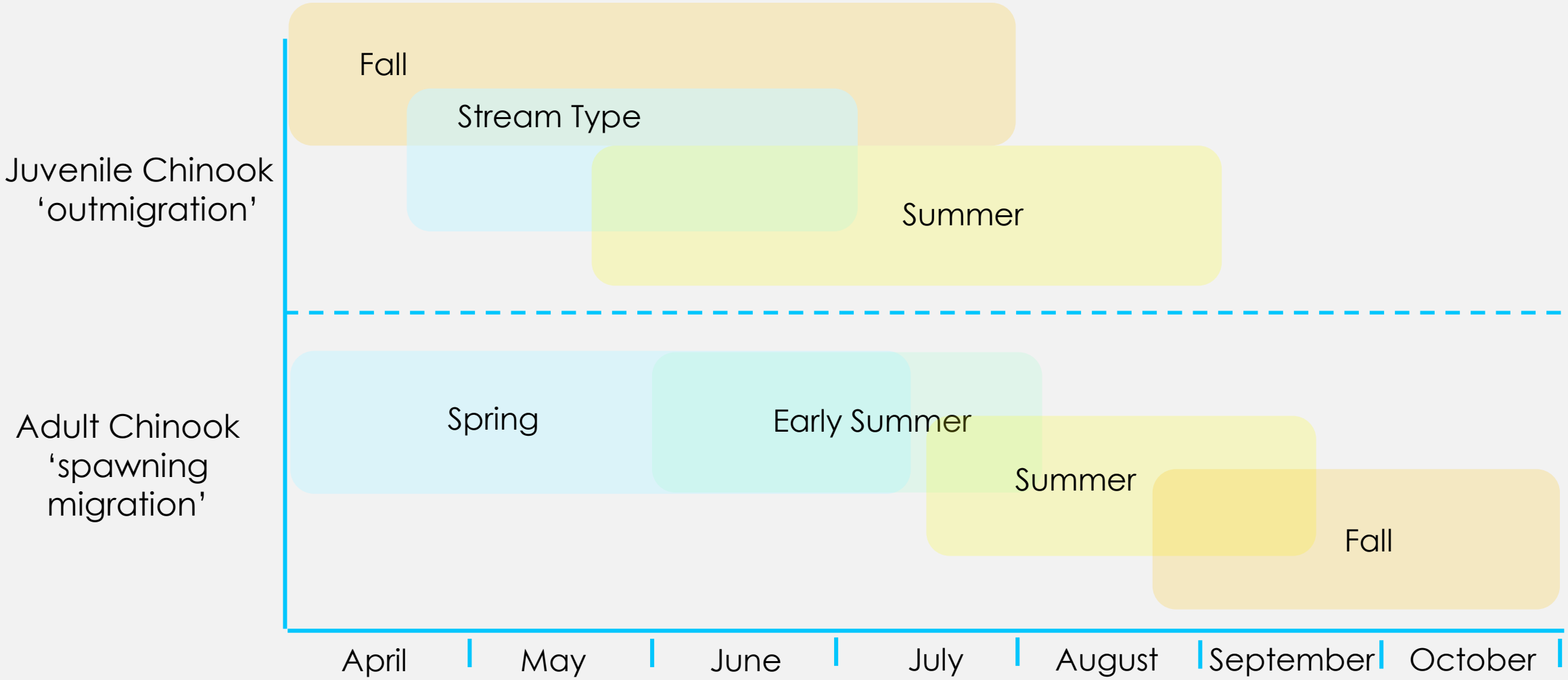
Monthly water sampling (2018-2023) in Chinook habitat



714 Compounds:

- Legacy & current use pesticides
- PPCPs
- PCBs
- PBDEs
- PFASs
- PAHs
- Chlorinated alkanes
- Metals

Chinook Risk Characterization: 7 exposure windows



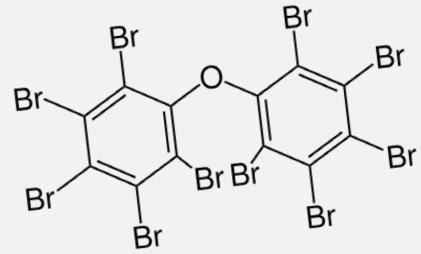
- Stream Type: 13 CUs; 9 Endangered, 3 Threatened, 1 Special Concern
- Summer: 4 CUs, 1 Endangered, 1 Not at Risk, 2 Not Assessed
- Fall: 2 CUs, 1 Threatened, 1 Not Assessed

Ranking of 714 contaminants using 3 approaches

1: Risk Characterization Ratio (RCR) = Water [ ] / Water Quality Guideline (WQG)

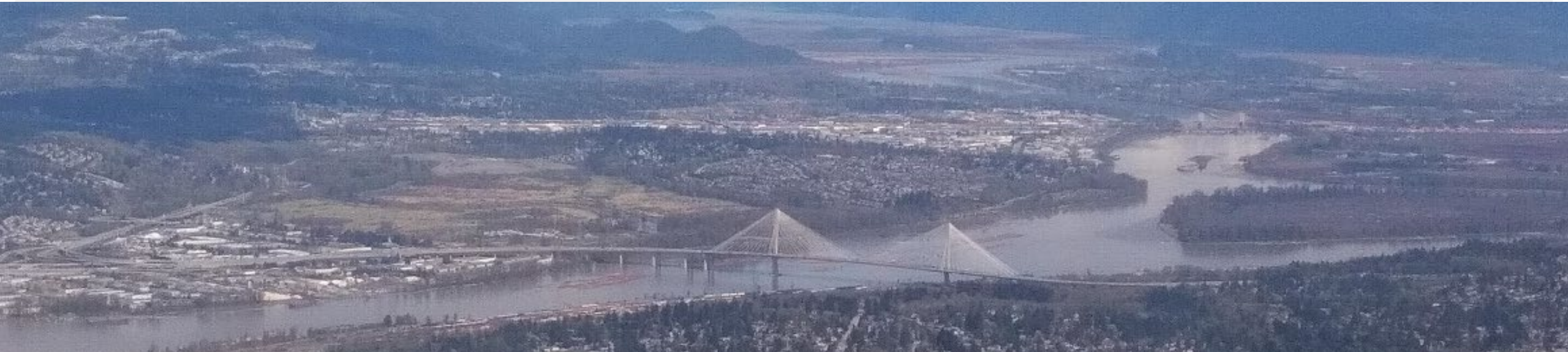
2: Risk Quotients (RQ) = Water [ ] / Effects Threshold$_{ECOTOX}$

3: Exposure Activity Ratios (EARs) = Water[ ] / bioactivity effect [ ]$_{ToxCast}$

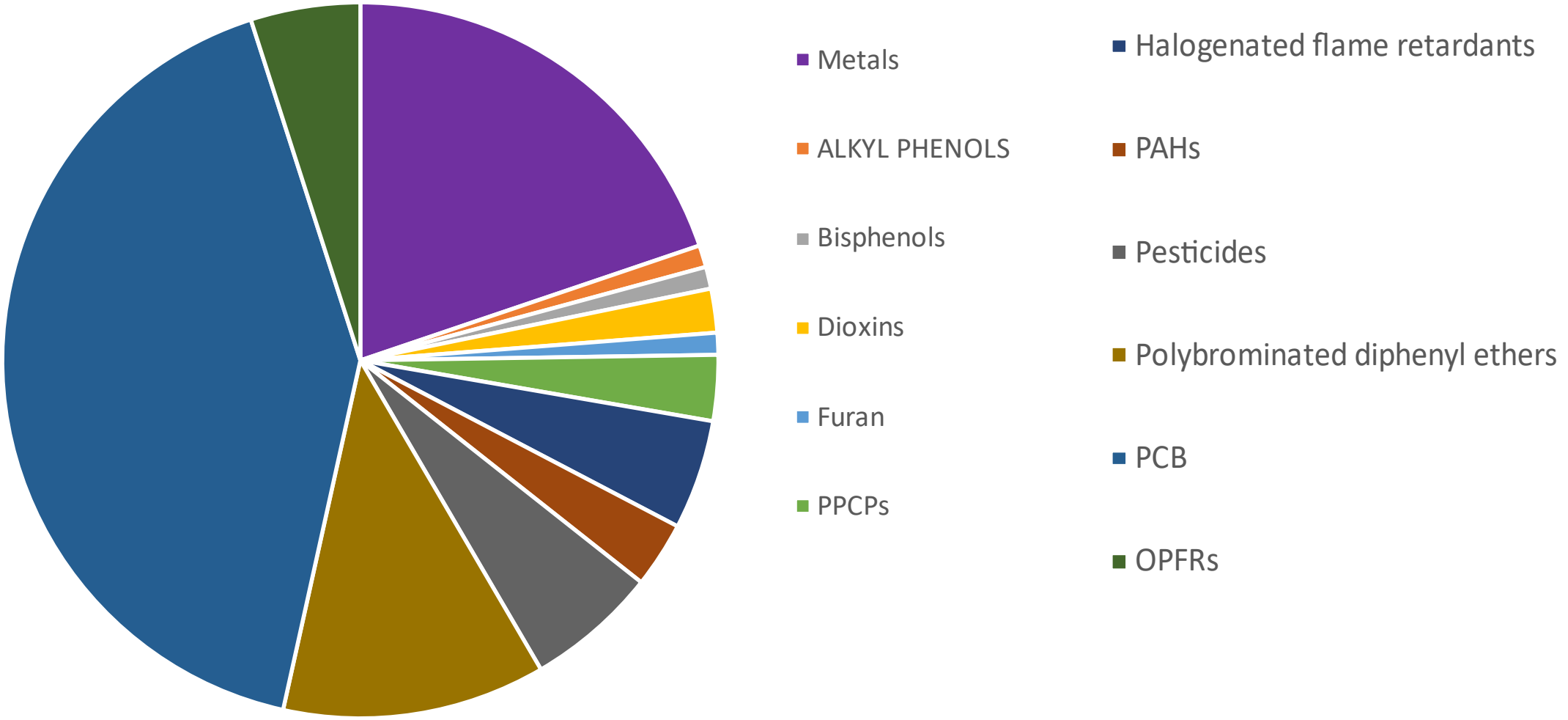


*** Maximum concentration used across all sites;*

*** Sites and Chinook seasonal exposure scenarios.*



>182 analytes detected at all sites (out of 714)



1) Risk characterization ratio (WQG)

- Only 86/714 (12%) of the analytes measured have WQGs (60 organics & 26 metals)

- Exceedances include:

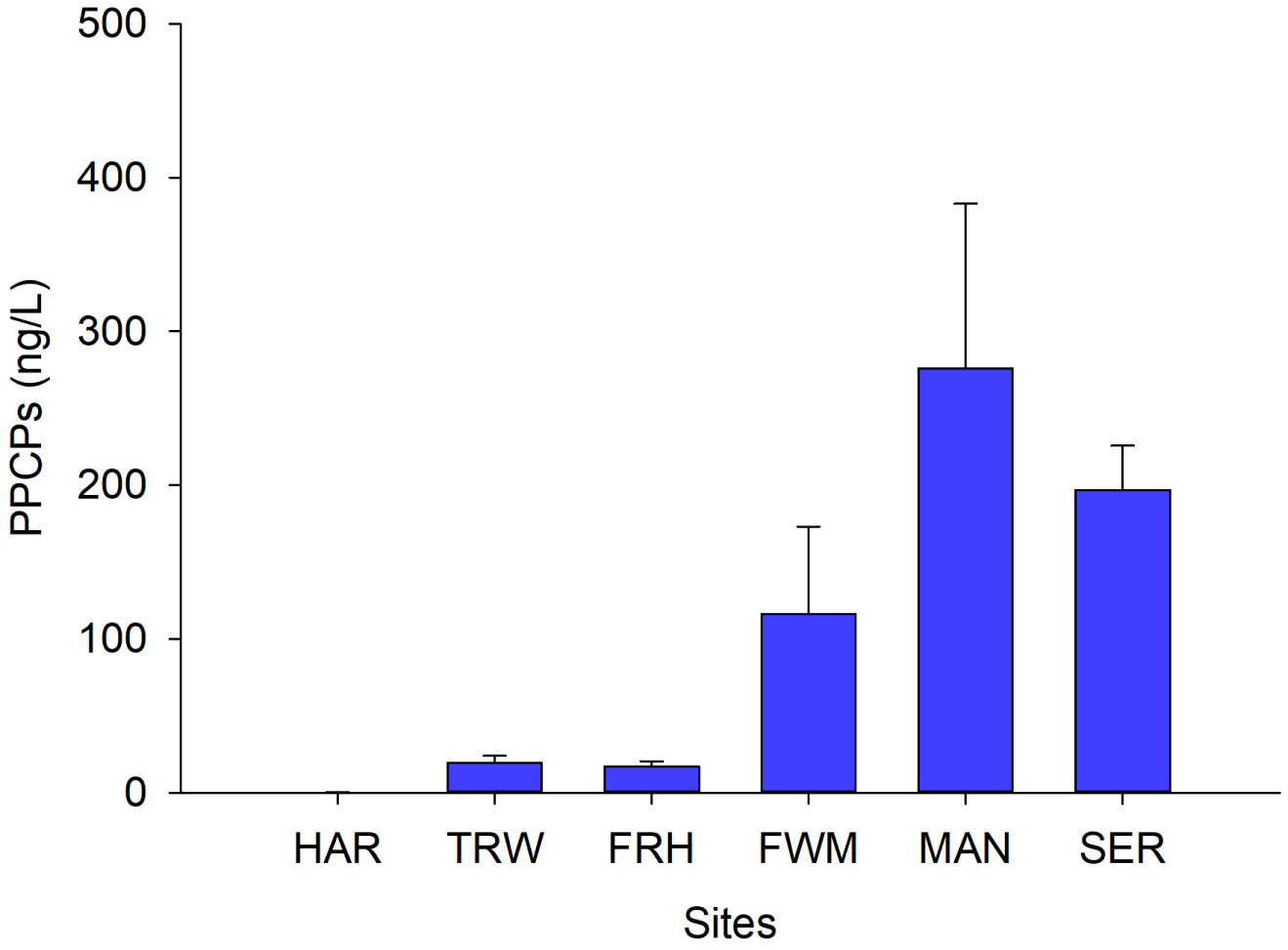
Organics (18%)

- ∑159PCBs
- PCB 105
- BENZO(GHI)PERYLENE (PAH)
- CHRYSENE (PAH)
- PERYLENE (PAH)
- CHLORPYRIFOS (Pesticide)
- DIAZINON (Pesticide)
- METOLACHLOR (Pesticide)

Metals (30%)

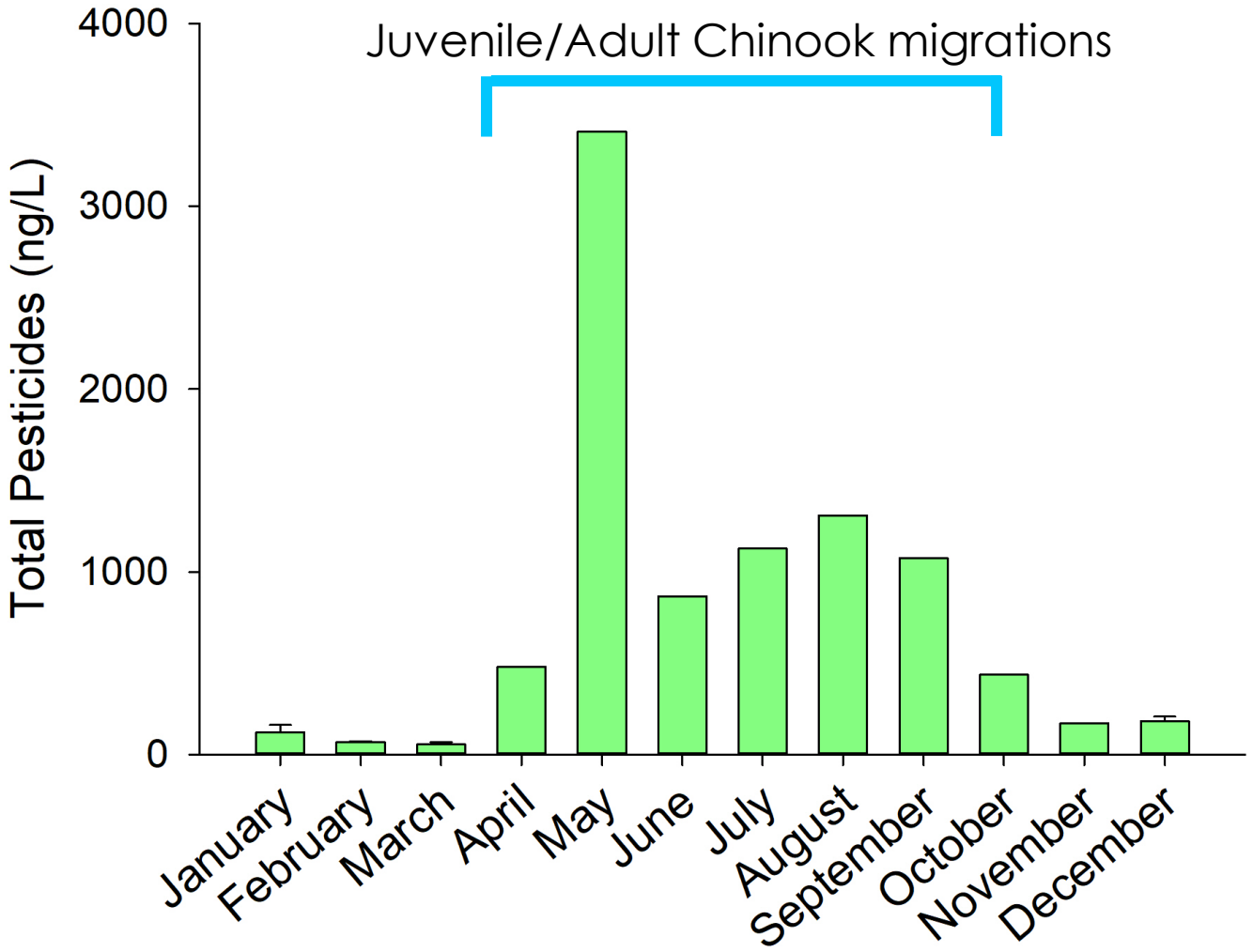
- Aluminum
- Cadmium
- Cobalt
- Copper
- Lead
- Zinc
- Mercury
- Boron
- Iron
- Beryllium
- Vanadium

Pharmaceuticals (PPCPs) decreased with distance from WWTPs and urban areas



- Concentrations were 2.5- and 16-fold greater near WWTPs;
- Of 140 PPCP analytes only 6 have WQGs;
- None of the water samples exceeded WQGs for PPCPs.

Pesticide concentrations appear to be highest during maximum occupancy of Chinook in the Serpentine River



Conclusions

- up to 30% of the water samples had a least one analyte that exceeded WQGs;
- Proximity to urban developments and WWTP explained higher concentrations of some analytes;
- Higher pesticide concentrations during peak Chinook salmon occupancy raise concerns about impacts.

Next Steps

- Complete effects threshold- and ToxCast Assay- related risk characterization;
- Rank chemicals of concern across all sites;
- Risk characterization for chemicals with data from multiple lines of evidence;
- Assess risk for juvenile and adult Chinook across seasons.

Thank you

Tsawwassen First Nation – Krystal Lockert

Musqueam First Nation

ECCC – Brett MacKinnon, Jilisa Chernecki

Raincoast Conservation Foundation - David Scott

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TSAWWASSEN FIRST NATION