USING POLYCYCLIC AROMATIC HYDROCARBONS TO DETERMINE POST-WILDFIRE CONTAMINATION AND SEDIMENT SOURCES IN A LARGE WATERSHED IN CENTRAL BRITISH COLUMBIA, CANADA

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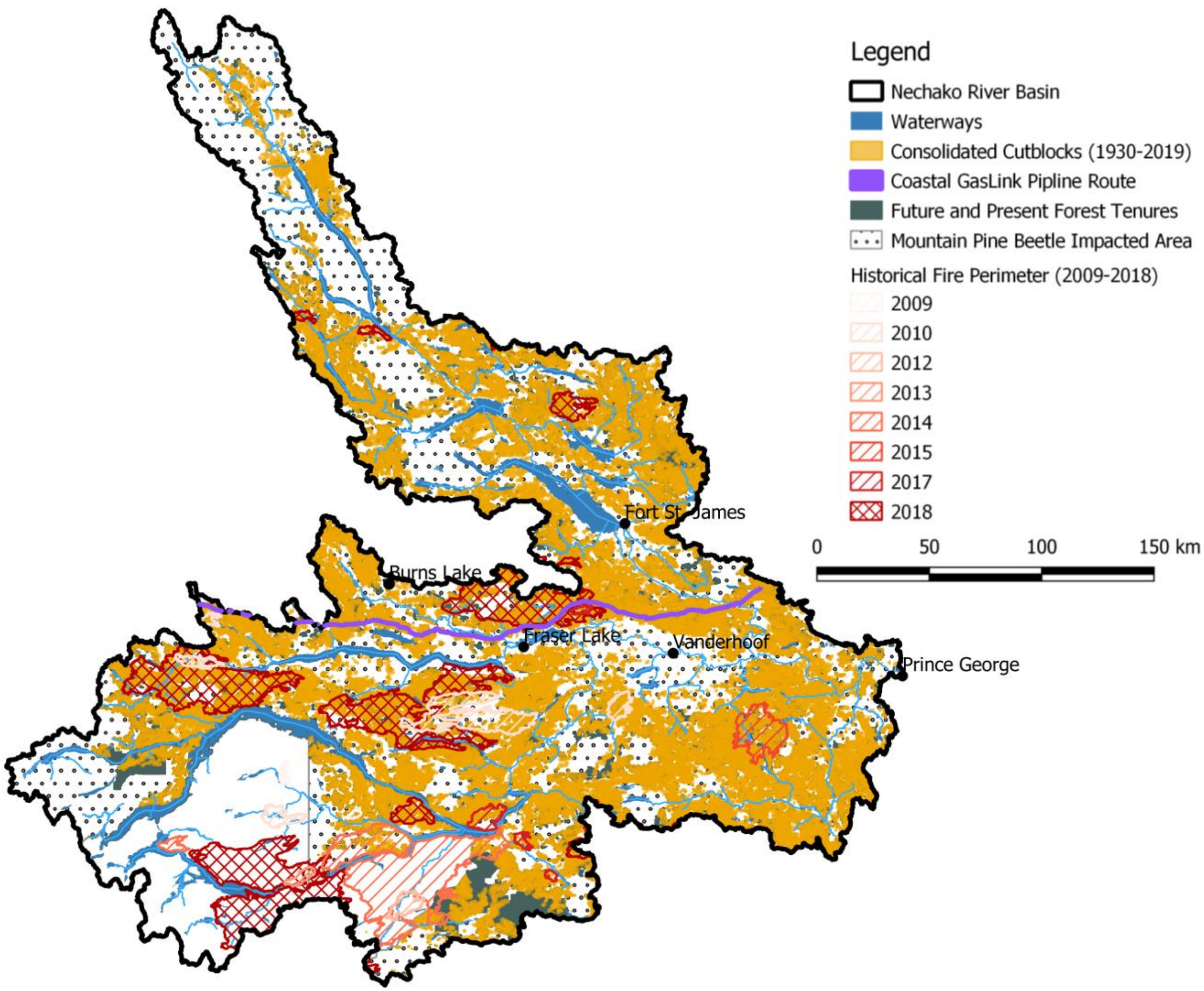


NECHAKO RIVER BASIN

Drainage area: 47,200 km^2

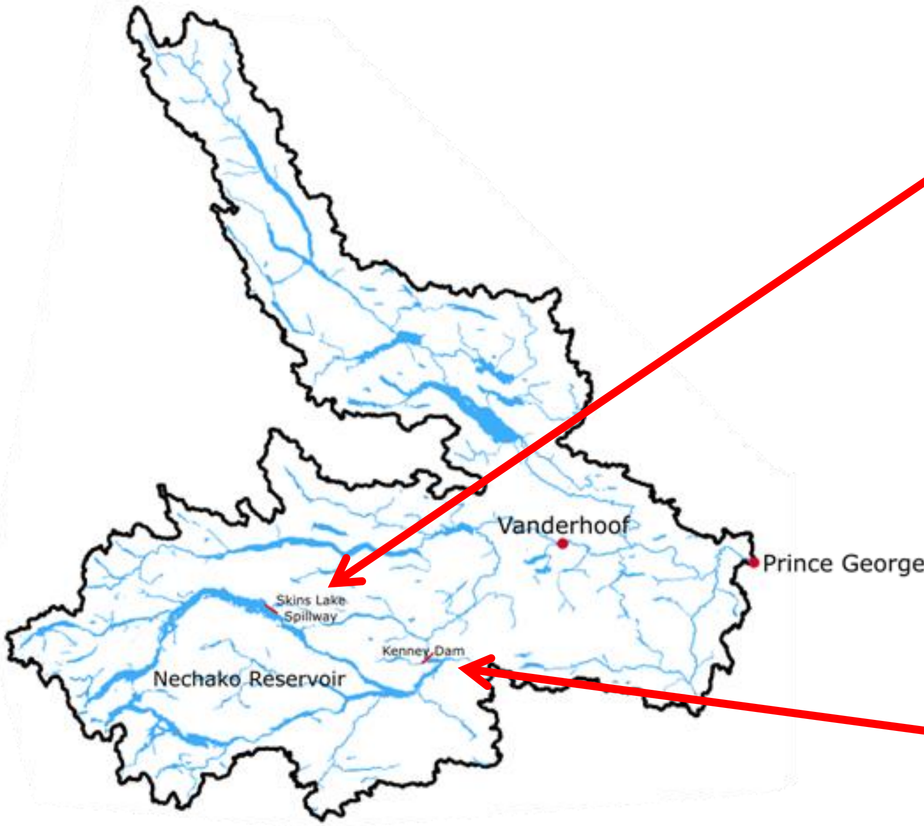
Reservoir area: ~910 km^2

Second largest tributary to the Fraser River (drainage area: 234,000 km^2)

Major industries: Forestry, agriculture

Construction of the Kenney Dam and Skins Lake Spillway in 1950's have altered hydrology of system

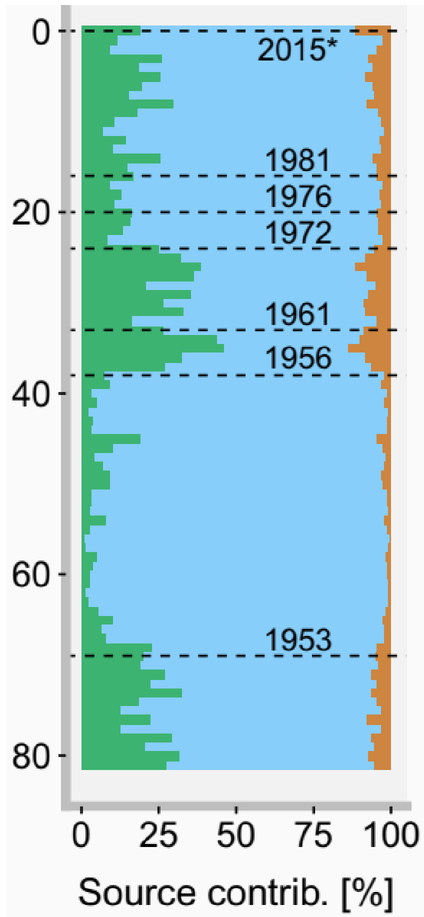
KENNEY DAM AND SKINS LAKE SPILLWAY

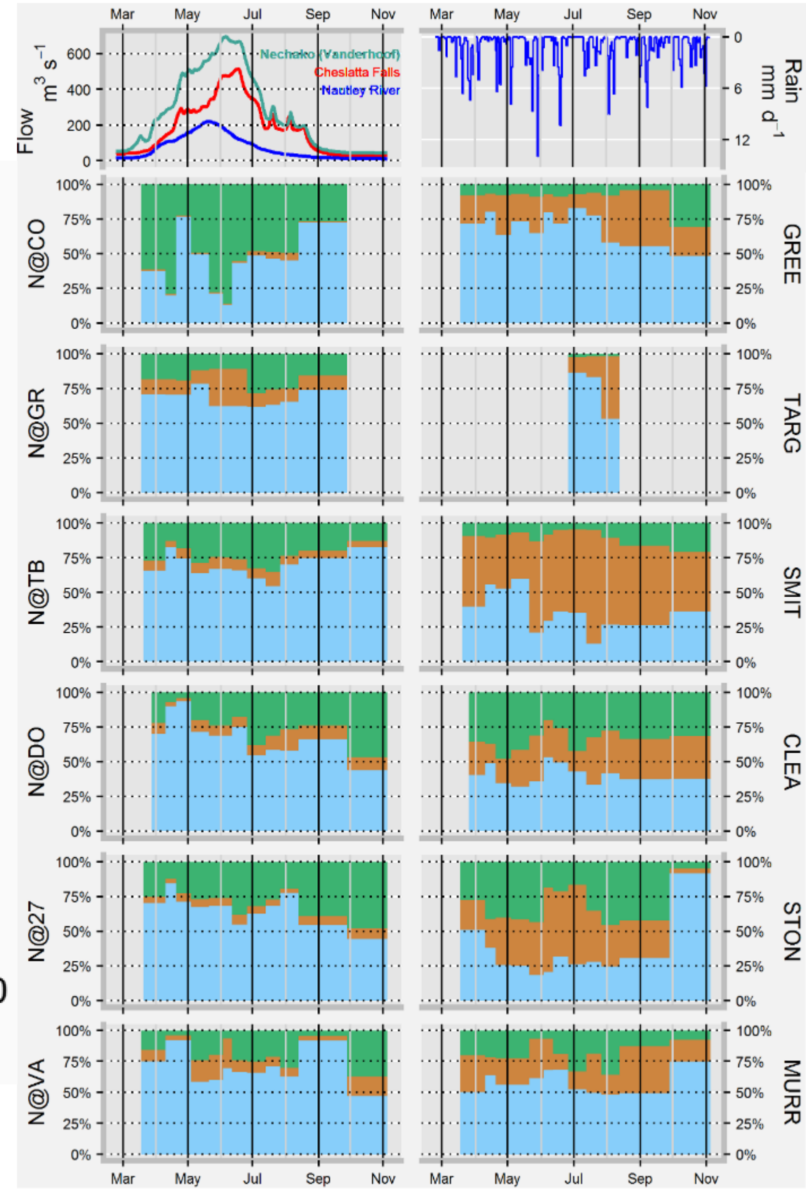


- The summer temperature monitoring program (STMP) runs from July 20- August 20 each year
- Flow at the spillway is increased significantly to reduce river temperature for migrating salmon, causing significant sediment resuspension)

DETERMINING CONTEMPORARY SOURCES OF SEDIMENT

- The **dominate source** of sediment has been **banks,** though prior to the construction of the Kinney Dam (1950), forestry was a significant contributor
- Throughout the 1960s and from the 1980's to present **forestry is becoming a significant contributor** of sediment to the Nechako River



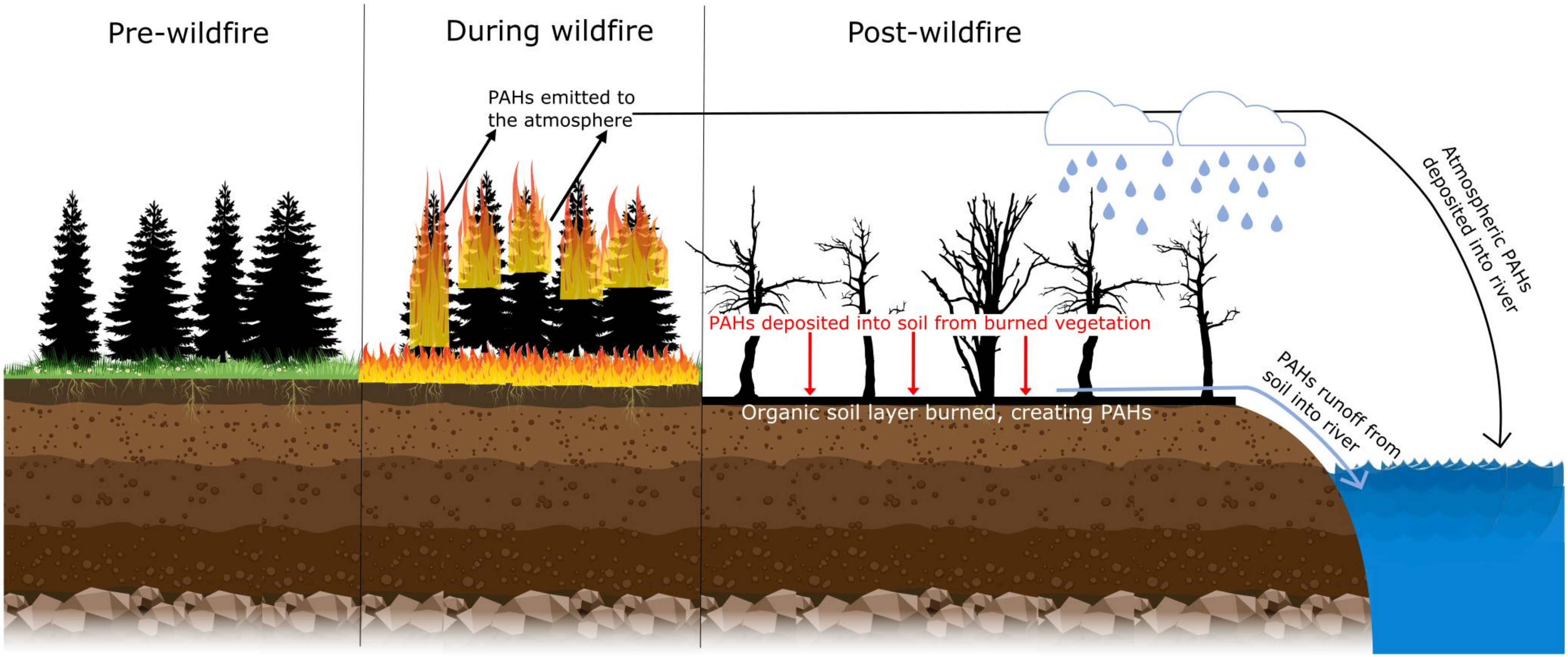


Source: Gateuille et al., 2019

TRACING THE 2018 SHOVEL LAKE WILDFIRE USING POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)

1. Determine the **spatial extent** of the PAH signal in tributaries and the mainstem
2. Determine if wildfire **burned areas contribute more sediment than unburned** areas
3. Determine **temporal duration** that PAHs persist in the sediments within the aquatic and terrestrial environments

TRANSPORT OF PAHS TO WATERWAYS



SOURCE SAMPLING

Year	Depth	Site type (# samples)
2018	Ash	Burned (5)
2018	Topsoil	Burned (5) + Unburned (5)
2018	Subsoil	Burned (5) + Unburned (5)
2020	Topsoil	Burned (5)
		Total = 30 samples

Samples analysed for 16 EPA priority PAHs

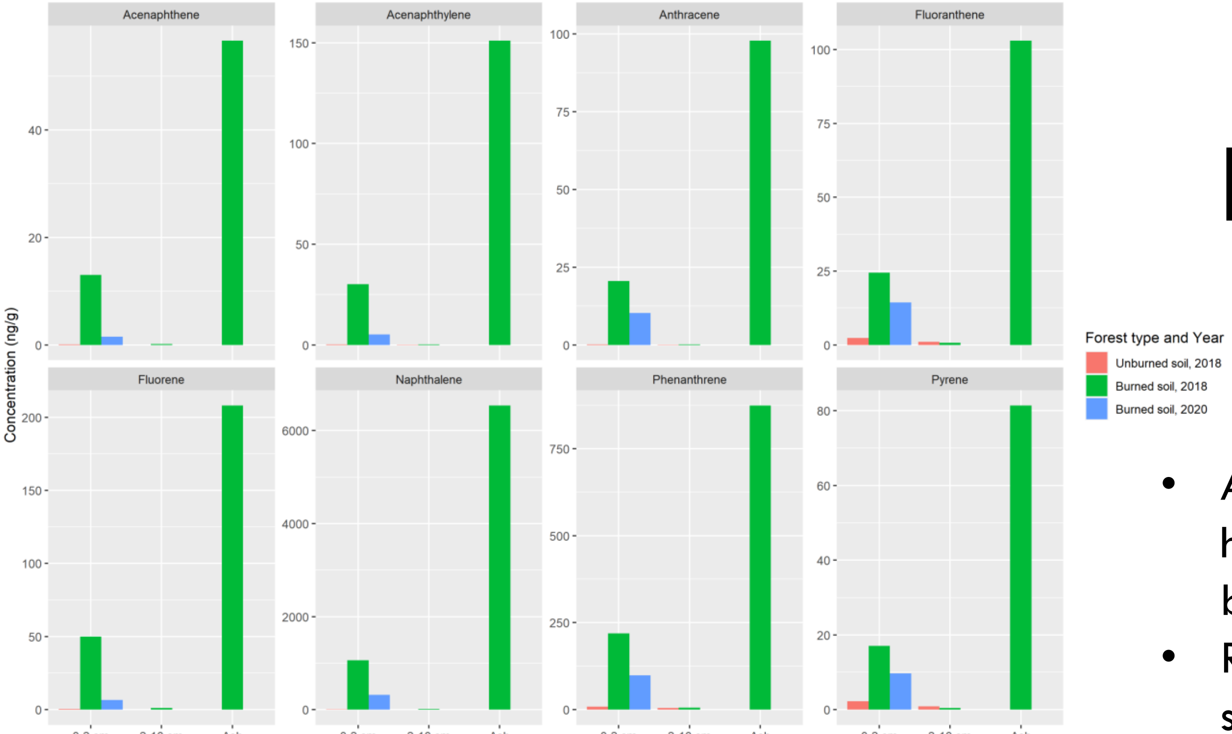
Photos from Barry Booth

Photos from Barry Booth and Kristen Kieta

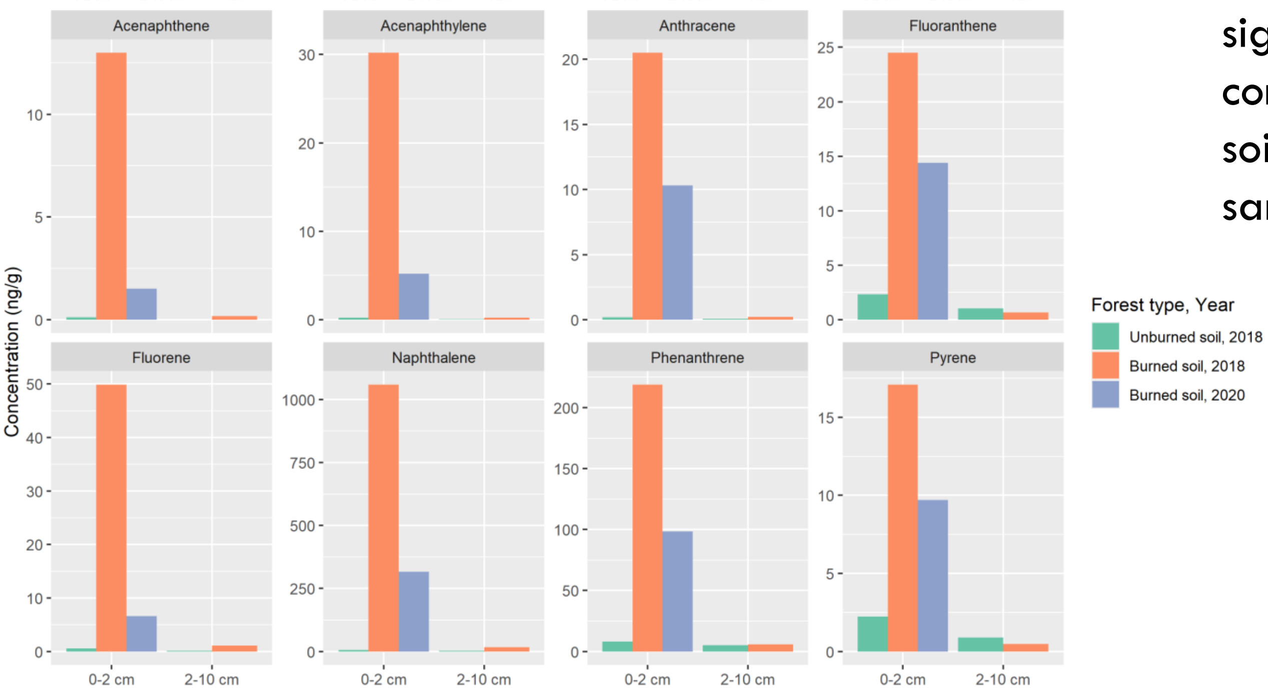
SEDIMENT SAMPLING

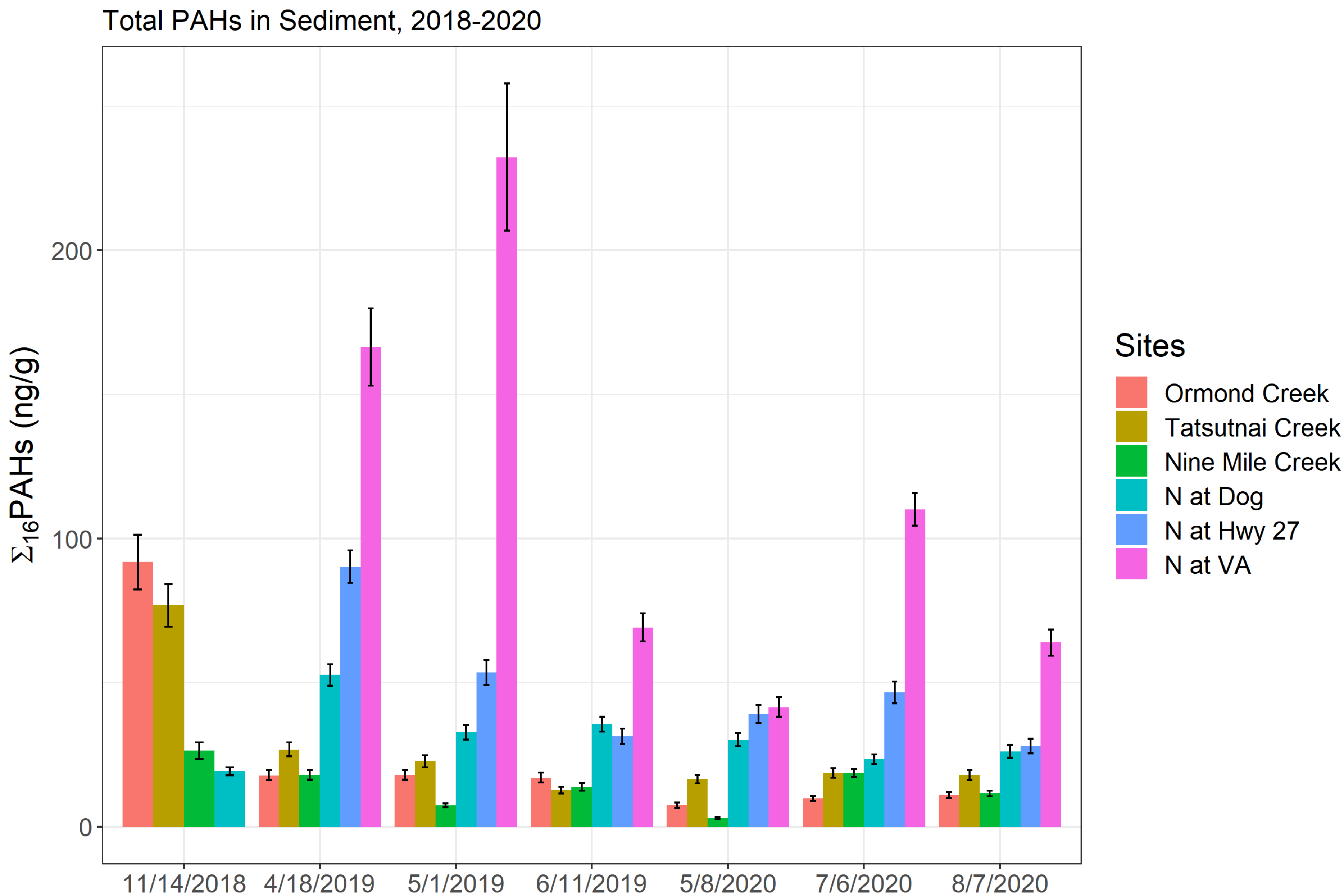
- Sampling period: October 2018 – November 2020 (ice-free period)
- Total of six sites:
  - Three tributaries impacted by wildfire
  - Three mainstem Nechako sites
- Time Integrated Passive Samplers
- Samplers emptied and re-deployed every two weeks
- Samples analysed for 16 EPA priority PAHs, mineral magnetism and colour

Results – Sources



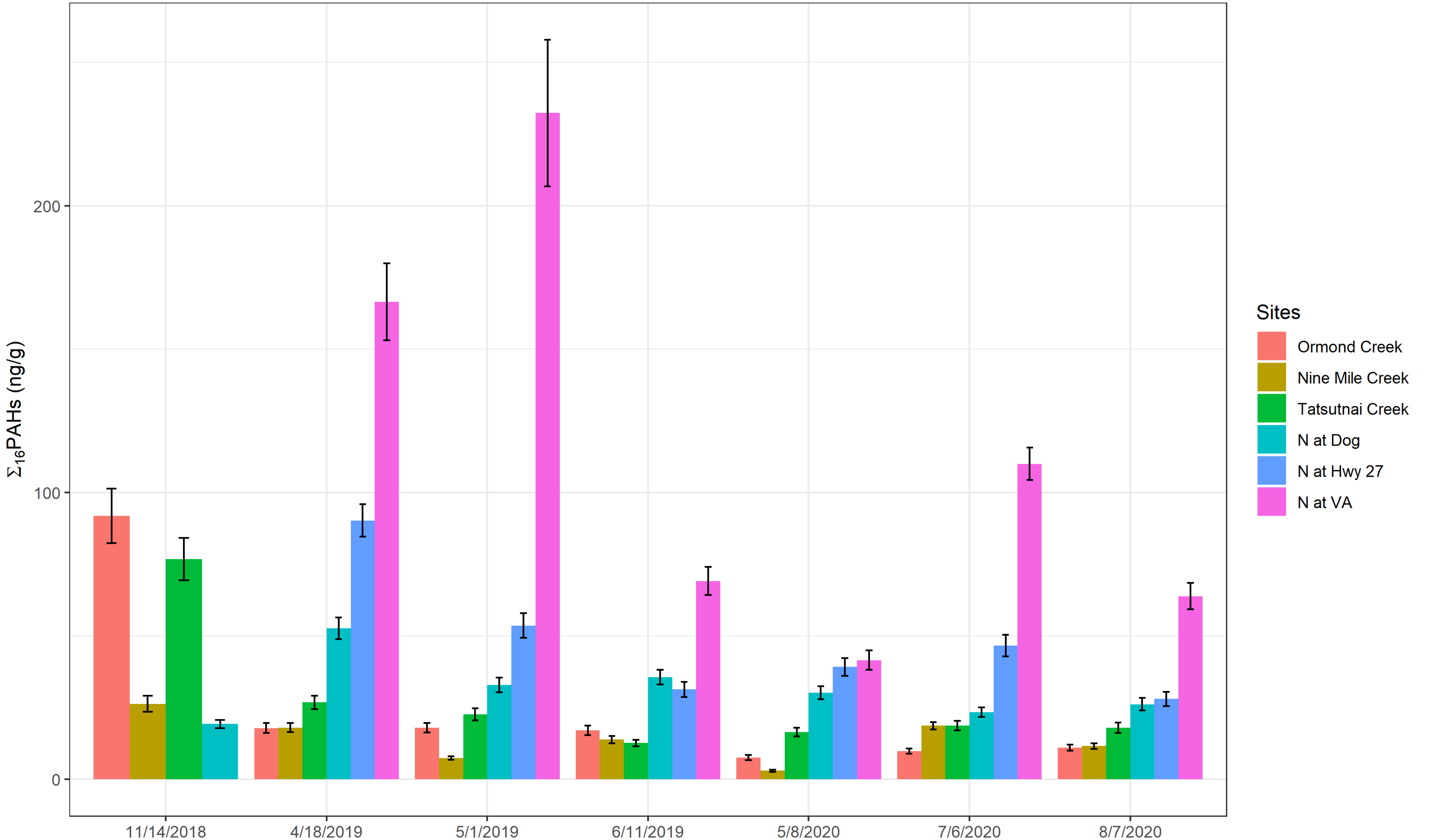
- Ash samples are significantly higher in parent PAHs than burned topsoil or subsoil
- Removing ash samples, burned soils from 2018 have significantly higher concentrations than unburned soils and burned soils re-sampled in 2020





All samples fall below Canadian soil quality guidelines

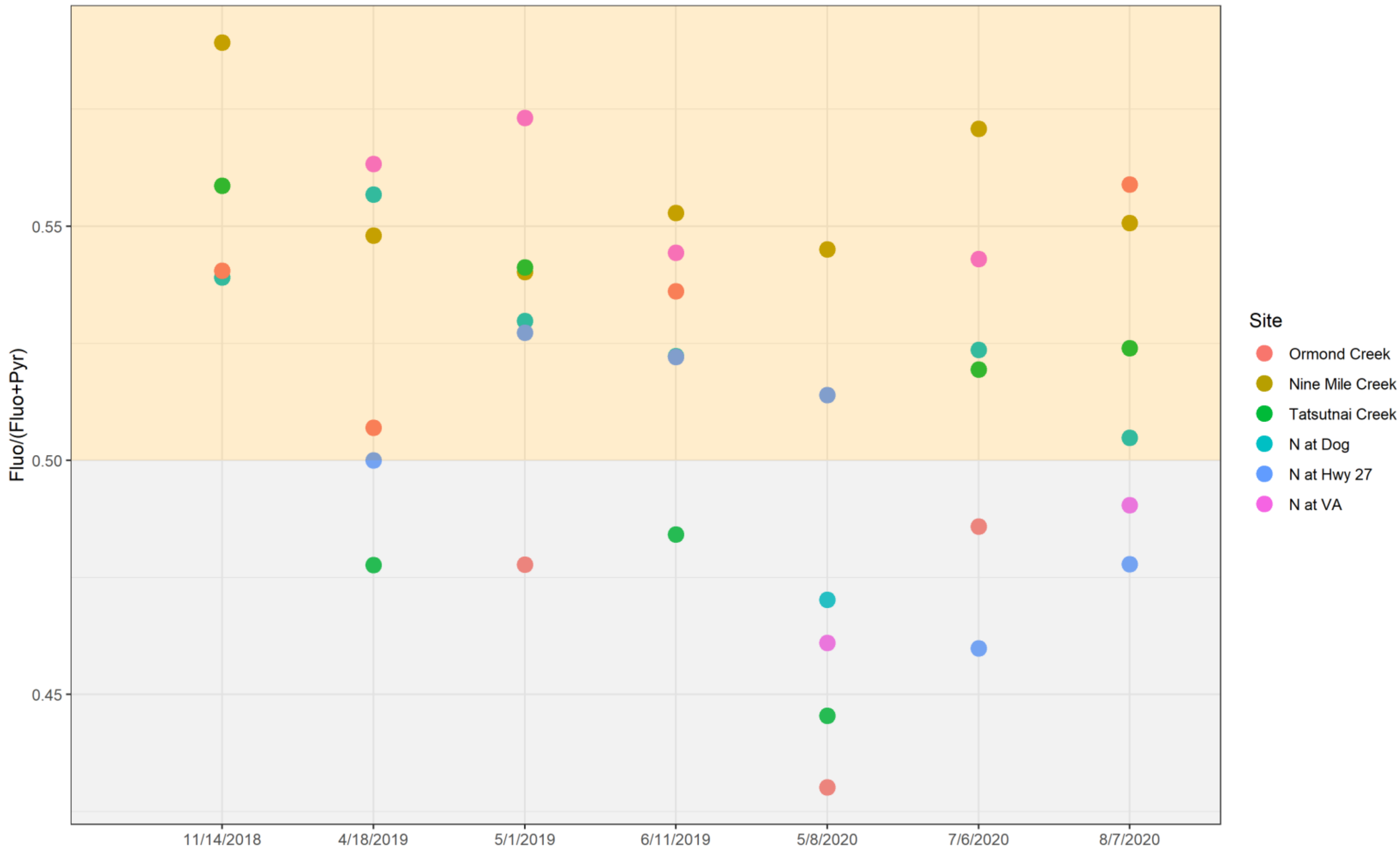
Results from suspended sediment samples, 2018 - 2020



Threshold Effect Level = 1,610 ng/g

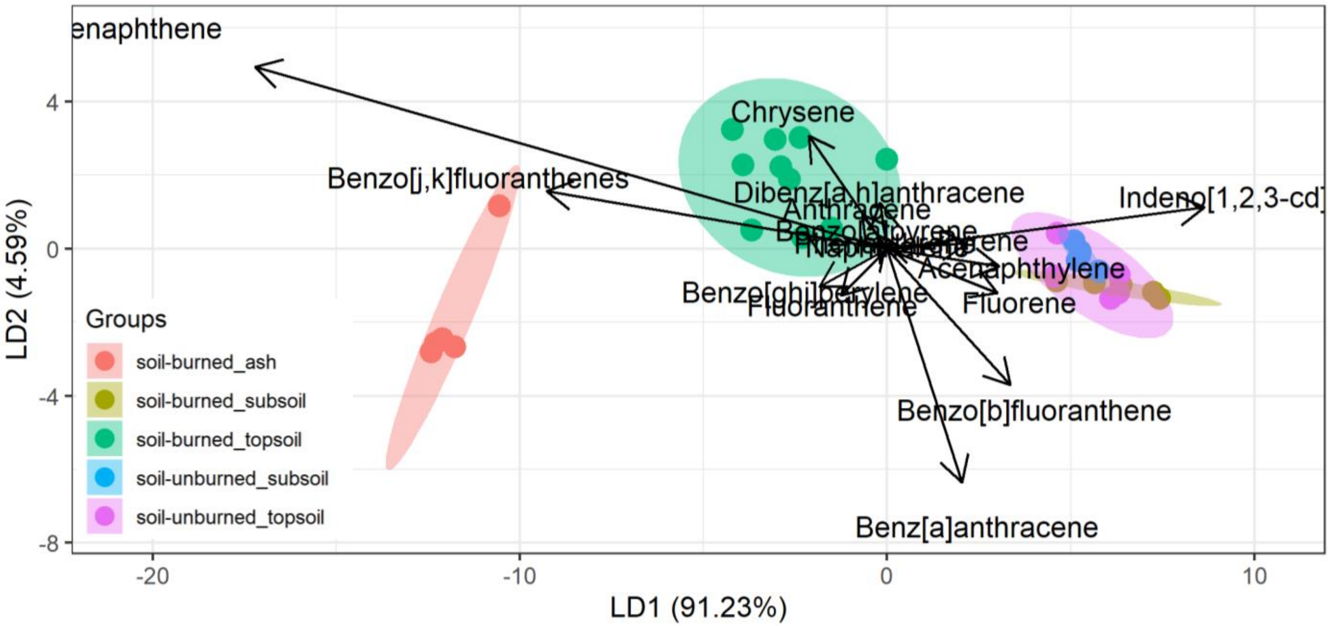
Probable Effect Level = 22,800 ng/g

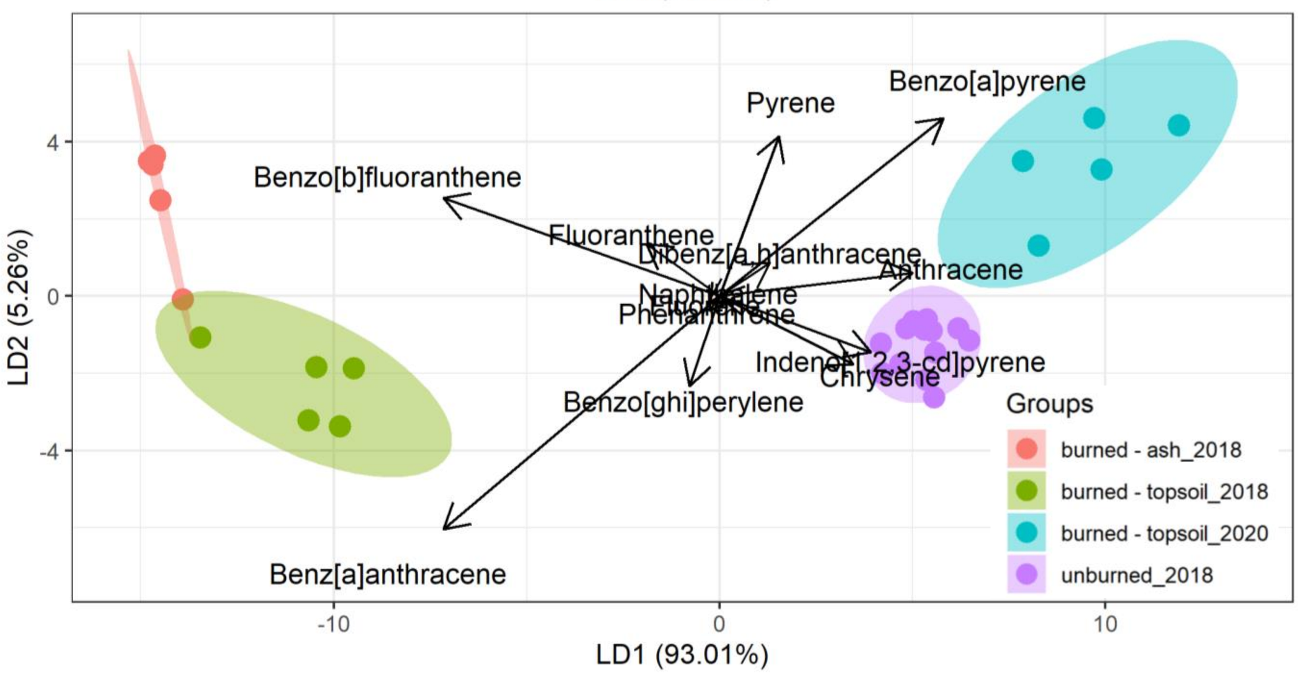
How do we know these are PAHs from wildfire?



Samples falling above 0.50 are derived from wildfire sources, those below 0.50 are derived from a mix of pyrogenic sources (i.e., wildfire, burning fossil fuels)

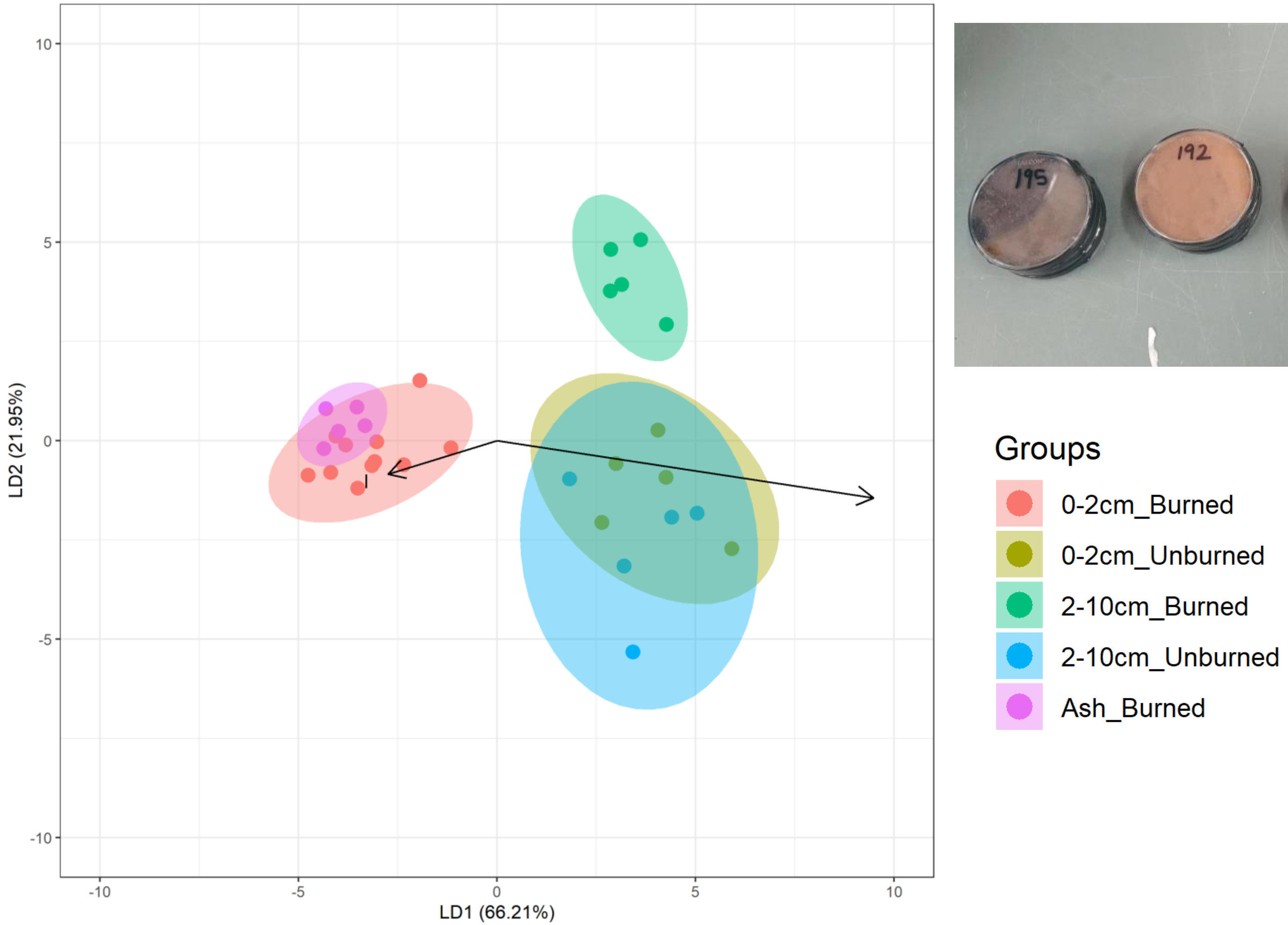
PRELIMINARY RESULTS OF LDA





- Parent PAHs that passed both a range test and Kruskal-Wallis H test were used in a LDA to differentiate sources
- Selected PAHs could not differentiate burned subsoil from unburned topsoil and unburned subsoil

USING COLOUR AS A SECONDARY TRACER



CONCLUSIONS AND IMPLICATIONS

- Concentrations of PAHs in the soils of **burned areas are still above pre-fire concentrations,** but have significantly decreased since November 2018
- All PAH **concentrations are below sediment quality guidelines** for adverse impacts on aquatic organisms
- **PAHs are an understudied** but important source of aquatic pollution after severe wildfire
- Future work will use **colour** and **PAHs** to determine **proportion** of contributing sources
- Under future climate change scenarios, increased incidence of wildfire will lead to landscape degradation and **increased sediment pollution**

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