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Tracing sediment sources after wildfire using polycyclic aromatic hydrocarbons

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The Nechako River Basin, located in central British Columbia, Canada is a 52,000 km^2, regulated basin that has been significantly impacted by large-scale landscape changes. These changes began with the construction of the Kenney dam in 1952 but are evidenced primarily by the Mountain Pine Beetle epidemic, industrial forestry and agriculture, and sizable and severe wildfires. In 2018 wildfires burned 3,682 km^2 within the basin and due to the severity of the fires, much of the burned area was completely denuded of vegetation. The NRB is important for chinook and sockeye salmon as well as the Nechako White Sturgeon and thus, potential changes to the sediment regime as a result of increased erosion after the aforementioned landscape changes and exacerbated by wildfire could have deleterious effects on fish health and populations. In particular, sediment is known in the NRB to clog spawning habitat, leading to reduced juvenile success. Therefore, this study aimed to use polycyclic aromatic hydrocarbons (PAHs), compounds that are produced during the combustion of organic material, to trace sediment sources in the Nechako River and its tributaries that were most impacted by the 2018 fires. Additionally, this research aims to determine the utility of PAHs as a novel tracer for future source apportionment studies.

Soil sampling was undertaken in autumn 2018, immediately post-fire at five sites that were burned and five sites that were unburned. Samples at the unburned sites consisted of the topsoil (0-2 cm) and subsoil (2-10 cm), while burned sites included the burned organic layer, burned topsoil layer, and the subsoil layer. Bank samples from the mainstem and tributaries were collected in 2020 and 2021, along with resampling of the topsoil at the burned sites. Additionally, because the burning of fossil fuels also produces PAHs, road deposited sediment was collected in 2021 as another potential source. Sediment samples were collected biweekly from autumn 2018 to autumn 2021 throughout the ice-free period (generally May-October), using time-integrated passive samplers. Both the soil and sediment samples were sieved to 1 mm and analysed for loss on ignition, particle size, colour, and the 16 priority PAHs as outlined by the US EPA. Using MixSIAR, source apportionment results showed that on the Nechako River mainstem, the primary source of sediment was unburned material, and more specifically, bank material. This follows findings from recent research undertaken in the basin, but further modeling is being undertaken to determine if these findings match those using colour as the primary tracer. Ultimately, the use of PAHs as a novel tracer, particularly in wildfire prone areas, seems promising, though more studies are needed. Additionally, because PAHs are known to be toxic compounds, there is an added benefit in their use as a tracer to also determine their spatial and temporal pervasiveness post-wildfire, particularly with respect to the

health of the aquatic ecosystem.