



ANALYSIS OF STRONTIUM  
ISOTOPE RATIOS IN COLLECTED  
WATER SAMPLES FROM THE  
YUKON RIVER WATERSHED

## YUKON FISH AND WILDLIFE ENHANCEMENT TRUST – FINAL REPORT 2023

Natasha Ayoub – Fishing Around Research and Consulting  
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## Final Report – Project Activities

The request for funding for this project proposal was to support and assist those costs associated with the analysis of water samples. The water samples were collected in the Canadian portion of the Yukon River watershed during the summer and fall of 2023 and are a key part of field sampling for my PhD data collection and research work. For this research, I am collaborating with Yukon First Nation Salmon Stewardship Alliance. Through this collaboration, we worked to ensure that the water sampling site locations that were chosen were informed by Yukon First Nations (YFNs) government priorities, as well as YFN community knowledge holders. YFNs were asked to offer areas of interest and priority based on Traditional Knowledge of known juvenile Chinook habitats; areas where it would benefit to receive an analysis of existing baseline conditions for future salmon or freshwater fish habitat-related monitoring and/ or investigations were also included. Understanding baseline conditions is essential when responding to development assessment applications (through YESAB) and/ or planning for potential impacts associated with climate change.



PHOTO 1 & 2: Water sampling collection at Ross Creek, Ross River by project collaborators, Yukon First Nation Salmon Stewardship Alliance.  
PHOTO CREDIT: Marina Milligan, 2023.

The chemical analysis included (naturally occurring) strontium (Sr) isotope ratios, as well as conductivity and strontium concentrations. As mentioned above, the laboratory analysis of these samples was conducted as a component of my Ph.D. research work in fisheries biology at University of Waterloo. Funds received have contributed to the costs associated with the laboratory analysis of ~56 water samples (~56 @ 250ml bottle) that were collected to support our understanding of naturally occurring chemical elements (Sr isotope ratios) found across

freshwater habitats in the Yukon River watershed. The locations chosen for this field-based water sampling program were informed by Indigenous knowledge, local knowledge, and western science and the samples were analyzed to determine strontium isotope ratios for each of the 56 sites. For the 2023 field season, a total of 110 samples were collected at 94 individual sites; the collection program also included trip blanks and field replicates, as well as a percentage of duplicates re-sampled from 2022 sampling program locations.



PHOTO 3 & 4: Natasha Ayoub collecting water samples from the Yukon River watershed. PHOTO CREDITS: Sybil Robertson; Annie Morrison

One of the overall goals of my research project is to develop *a strontium isoscape* for the Canadian portion of the Yukon River watershed. This baseline mapping product is foundational for salmon and freshwater fisheries related habitat investigations. The analyses of these water samples (collected in both 2022 & 2023) directly contribute to the development of this mapping product.



PHOTO 5, 6, & 7: Yukon River watershed water samples being prepared for analysis at University of Waterloo – Environmental Isotope Laboratory. PHOTO CREDIT: Natasha Ayoub, 2023

One variance to the workplan in 2023 was that we increased the number of sampling collection sites. There were numerous factors that contributed to our decision to expand the sampling program in 2023 and these included: increased availability of sample bottles, collaborations with previously planned (unrelated) field monitoring trips which provided the opportunity to sample in some remote regions of the watershed, as well additional funding that contributed to the cost of analysis. This variance of increased sampling sites will contribute to the isoscape by providing more “point” values for this mapping product and will result in a more robust product.



PHOTO 8, 9, & 10: Natasha Ayoub, PhD student (University of Waterloo) – conducting the Yukon River strontium isotope water sampling field collection program in 2023. PHOTO CREDITS: Kay Linley, Sybil Robertson, Brian Douglas

## Communications

### *Information sharing*

The preparation and processing of the water samples is complete and the results from the analyses are expected soon from Environmental Isotope Laboratory at University of Waterloo. Once the results are received, I will analyse the data and begin mapping the strontium values to support the development of the isoscape. These results will be shared (directly) with Yukon First Nation Salmon Stewardship Alliance as they are project collaborators, however, academic research results must first be approved by my doctoral advisory committee before the results can be published or shared publicly. Every effort will be made to ensure that these results, as well as the completed isoscape, will be shared with fisheries-related management agencies, land use planning participants, or with those involved in the development assessment process in a timely manner.

### *Enhancement Trust acknowledgement*

The funding received from Yukon Fish and Wildlife Enhancement Trust has been greatly appreciated. Acknowledgement of this support has been made by including the YFWET logo at the end of presentations that I have given. Yukon Fish and Wildlife Enhancement Trust funding

support will be acknowledged when I present and/or share the isoscape with Yukon public, government agencies, etc. by either verbally acknowledging the Enhancement Trust support (in the case of in-person presentations) or by including the YFWET logo on any isoscape presentations that are in a format suitable to include acknowledgements.

It is my intention to develop a “communications poster” that I will use to communicate the goals and objectives of the research; I will also use the poster as an interpretive tool to highlight preliminary research results. All major funding support will be recognized by including an acknowledgements section which contains funder logos.

#### Contributions to the protection, enhancement or restoration of fish, wildlife, or their habitat

While my research focus is on juvenile Chinook salmon and their habitat use, a strontium isoscape can be used in other freshwater applications. The development of a strontium isoscape (by geographically mapping strontium isotope ratios according to sample site – using ArcGIS) will support future fisheries investigations of both anadromous and freshwater species, including Chinook salmon (*Oncorhynchus tshawytscha*), Chum salmon (*Oncorhynchus keta*), Lake Trout (*Salvelinus namaycush*), Inconnu (*Stenodus leucichthys*), Arctic Grayling (*Thymallus arcticus*) or Whitefish (*Coregonus* spp.) and will provide a key tool when investigating and identifying critical habitats for the resident and migratory species found in the Yukon River watershed. Indeed, Yukon First Nation Salmon Stewardship Alliance has a mandate to work towards a better understanding of important habitats required to support healthy populations of salmon and freshwater fish species. It is anticipated that the strontium isoscape will be used as a key tool to support this mandate regarding the identification of important fisheries habitats in the Yukon River.

The data analysis achieved by this work will be kept on file with Yukon First Nation Salmon Stewardship Alliance (YFNSSA) and will be made available to any Yukon First Nation Natural Resources Department/ Heritage Department, Yukon Government, Department of Fisheries and Oceans, and other fisheries managers and/ or scientists who are conducting alternate projects involving habitat investigations using strontium isotope analysis.

As mentioned above, there is broad support for this research project and the outcome from this research is expected to be beneficial to Yukon fisheries habitat investigations. This research work is thought to be valuable by increasing our ability to understand the juvenile Chinook freshwater life history stage. Additionally, we hope that this research will work to identify potential bottlenecks or habitat stressors which will inform future land use planning and the identification of key habitats that could be considered candidate areas for conservation and protection. Project collaborators, supporters, and/or contributors include Yukon First Nations, Whitehorse Rapids Fish Hatchery, Alaska Department of Fish & Game, Department of Fisheries and Oceans, Yukon Salmon Knowledge Hub, and Weston Family Northern Boreal Fellowship. As mentioned above,

an important collaboration has also been formed with Yukon First Nation Salmon Stewardship Alliance and the work to engage and involve Yukon First Nation governments could not have been done without their steadfast support and commitment to this project.