Nechako Research NEWSLETTER

June 2025 | Volume 7 | Issue 2

RIO TINTO RESEARCH CHAIRS

RioTinto | BC Works

NHG Northern Hydrometeorology Group

Freshwater Fish Ecology Laboratory | UNBC

UNBC

TERRITORIAL ACKNOWLEDGEMENT

Working on traditional First Nations territories in a scientific context is a humbling and deeply appreciated privilege. The opportunity to work hand-in-hand with Indigenous communities is a gift for which we are sincerely grateful. This collaboration not only enriches scientific understanding but also fosters mutual respect and cultural exchange. We are grateful for the trust and partnership extended to us, and we strive to approach this work with the utmost gratitude and responsibility. We acknowledge that our work takes place within the unceded traditional lands of 15 First Nations:

- Binche Whut'en
- Cheslatta Carrier Nation
- Lake Babine Nation
- Lheildli T'enneh
- Nadleh-Whut'en
- Nak'azdli Whut'en
- Nee-Tahi-Buhn Indian Band
- Saik'uz
- Skin Tyee Band
- Stellat'en
- Takla Lake
- Tl'azt'en
- Ts'il Kaz Koh (Burns Lake) Band
- Wet'suwet'en First Nation
- Yekooche First Nation

Netʃa koh (Nechako River) at Cottonwood Island Nature Park in Prince George

The Nechako River is referred to as Netʃa koh, meaning 'Big River' in the traditional language of the Dakelh Nations.

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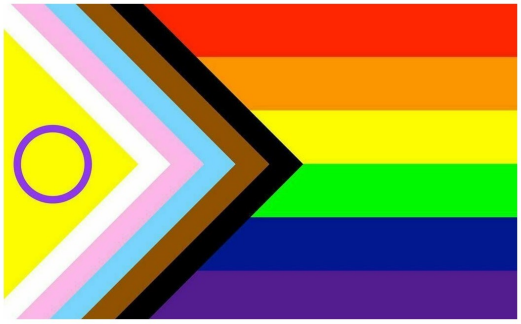

Happy Pride Month!

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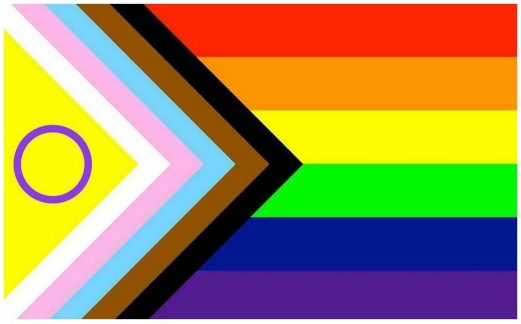


Happy Pride Month!

HAPPY SUMMER SOLSTICE!

Francois Lake—May 2025

With the arrival of the summer solstice we enter another warm season across the Nechako Watershed. This past spring, while somewhat cooler and wetter than the past two years, remained quite dry across the Nechako Watershed leading to a subdued spring freshet in our waterways. Prince George Airport, for instance, reported 89% of normal precipitation between March to May, while other parts of the watershed were even drier including the upper Nechako Watershed. Current long-term forecasts show above average air temperatures and near normal precipitation across north-central including the Nechako Watershed. With the El Niño Southern Oscillation (ENSO) now entering a neutral phase, we may expect average precipitation this summer, which hopefully will suppress wildfire activity across the Nechako Watershed.

The June 2025 issue of the Nechako Research Newsletter marks the conclusion of the NSERC / Rio Tinto Industrial Research Chair (IRC) on climate change and water security that began on July 1st, 2019. Consult the article later in this issue of the newsletter for a summary of our accomplishments, challenges and lessons learned through this 6-year program of research. With the inception of the two new Rio Tinto Research Chairs at UNBC held by my colleague Dr. Eduardo Martins and I, the Nechako Research Newsletter continues being published on a quarterly basis. As outlined in March 2025, contributions from both research groups are now being integrated into each issue of the newsletter. We welcome your feedback on the new format and layout for the newsletters.

Research contributions from the Northern Hydrometeorology Group (NHG) in this issue of the newsletter cover three topics. First, we report on the quality controlled water temperature database recently compiled by the NHG and deposited in a publicly accessible website at Zenodo. This is the culmination of a 6-year effort to improve water temperature monitoring across the Nechako Watershed. Accompanying the database is a peer-reviewed, open-access paper that describes the dataset. We encourage all users of our data to read this article to better understand how the dataset was created and quality controlled. Second, Dr. Tamar Richards-Thomas and former NHG member Dr. Bruno Sobral report on extreme flows and water levels in and around the Nechako Watershed associated with three exceptional atmospheric rivers that unfolded in 1952, 1978 and 2009. This shows how atmospheric rivers can lead to extreme, if not record, high flows in the upper Nechako Watershed thereby causing floods and other natural hazards such as landslides. Third, field crew members led by Dylan Broeke provide an update on progress thus far with field activities in the Nechako Watershed. This includes the recent deployment of weather stations at Francois Lake and Isle Pierre along with an expansion of our water temperature monitoring effort to the Blackwater (West Road) Watershed.

Stephen Déry

The outreach section of this newsletter provides information on three recent presentations I delivered on climate change in the Nechako and Stuart Watersheds and on the IRC program of research. In early May, I had the opportunity to summarize the accomplishments of the NSERC / Rio Tinto IRC at the True North 2025 Business Development Forum in Prince George, BC. I also then participated in a fireside chat emceed by Dr. Paula Wood-Adams, the UNBC Vice-President, Research and Innovation and involving panel members Andrew Czornohalan, Rio Tinto, Director of Energy and Watershed Partnerships, and my colleague Dr. Eduardo Martins, Rio Tinto Research Chair in climate change and freshwater fish ecology. Meanwhile, I delivered two presentations at the Nechako Watershed Roundtable's spring technical meeting in Fort St. James. One of the presentations focused on climate change in the Nechako and Stuart watersheds while the second highlighted recent progress by UNBC's Integrated Watershed Research Group on projects supported by the Nechako Environmental Enhancement Fund and the Canada Water Agency. You will also find a list of recent media interactions, links to several new publications and other community engagement activities our team has been involved in this past spring.

There are no new team members to report at the present time; however, we welcome back our trio of field technicians Kainen Parmar, Lynn Poeppelmann and Maria Tavares that is supporting field crew leader Dylan Broeke with summer field activities. We anticipate recruiting several new team members this summer and fall as we commence research in support of the new Rio Tinto Research Chair in climate change and water security including two new Master's students and one Research Associate. Finally, we wish Dr. Tamar Richards-Thomas all the best as she joins the University of Regina this summer as a new Assistant Professor. We are saddened to see Dr. Richards-Thomas leave the NHG but are very excited to hear she has secured a tenure-track faculty position at the University of Regina – all the best in your future endeavors Tamar, and sincere thanks for all of your contributions to the IRC program of research!

Wishing everyone a most pleasant summer!

Stephen Déry

THE TEAM

Meet the Rio Tinto Research Chair members from the Northern Hydrometeorology Group

Stephen Déry

Project Leader

Justin Kokoszka

M.Sc. Candidate

Maria Tavares

Database Administrator

Dylan Broeke

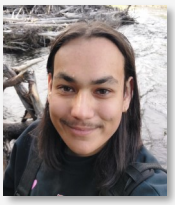
Field Crew Team Leader

Erica Lee

Research Manager

Mostafa Khorsandi

Post-Doctoral Fellow



Kainen Parmar

Undergraduate Research assistant

Lucas Moura

Research Assistant
Newsletter Editor

Lynn Poeppelmann

Undergraduate Research assistant

Farewell to Tamar

We express much gratitude to the Post Doctoral Fellow Tamar Richards-Thomas and we wish all the best in the new position as Assistant professor in the University of Regina.

THE NHG 2019—2024 WATER TEMPERATURE DATABASE

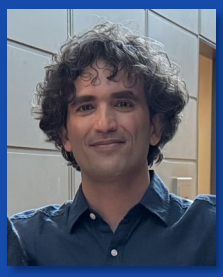
The Northern Hydrometeorology Group (NHG) at UNBC is pleased to report that we have now deposited our quality controlled water temperature data for the Nechako Watershed at Zenodo, a publicly accessible, online data archive. The dataset comprises time series of water temperature recorded at 15-minute intervals using automatic data loggers deployed across the Nechako Watershed. This monitoring effort was initiated in the summer of 2019 with support in part from the Natural Sciences and Engineering Research Council of Canada (NSERC), Rio Tinto and the Nechako Environmental Enhancement Fund (NEEF).

The archived data span 2019 to 2024 and cover 32 sites in total across the Nechako Watershed. The dataset and relevant metadata can be accessed at: https://zenodo.org/records/15053907 . The file package includes a "read me" file, a map of our field sites, and a corresponding PDF outlining the metadata (e.g., site coordinates, elevation, identification number, etc.) for each monitoring location and the outcome of our quality assurance / quality control (QA/QC) process. A manuscript describing the dataset can be accessed here. The dataset is also being uploaded to the Nechako Watershed Portal where the water temperature time series will also become available. We express our sincere gratitude to the many individuals and organizations who have supported this data collection effort that will continue during the 2025 field season.

The NHG's water temperature database contributes to a broader effort at monitoring water temperature in the Nechako Watershed. Indeed, private industry (e.g. Rio Tinto), provincial and federal government agencies (e.g. BC Ministry of Water, Land and Resource Stewardship (WLRS) and Water Survey of Canada (WSC)) and consulting companies, among others, also track water temperature across the Nechako Watershed. This therefore allows us to perform cross-validation with data collected by other organizations when in proximity to our sites. For example, Figure 1 and Table 1 provide comparisons between the data we collected during 2021 with those from the WSC and Rio Tinto (RTA) in relative proximity to four of our sites: Nadina River, Nechako River at Finmoore and at Vanderhoof, and Stuart River.

Justin kokoszka

Maria Tavares



Mostafa Khorsandi

Dylan Broeke

Stephen Déry

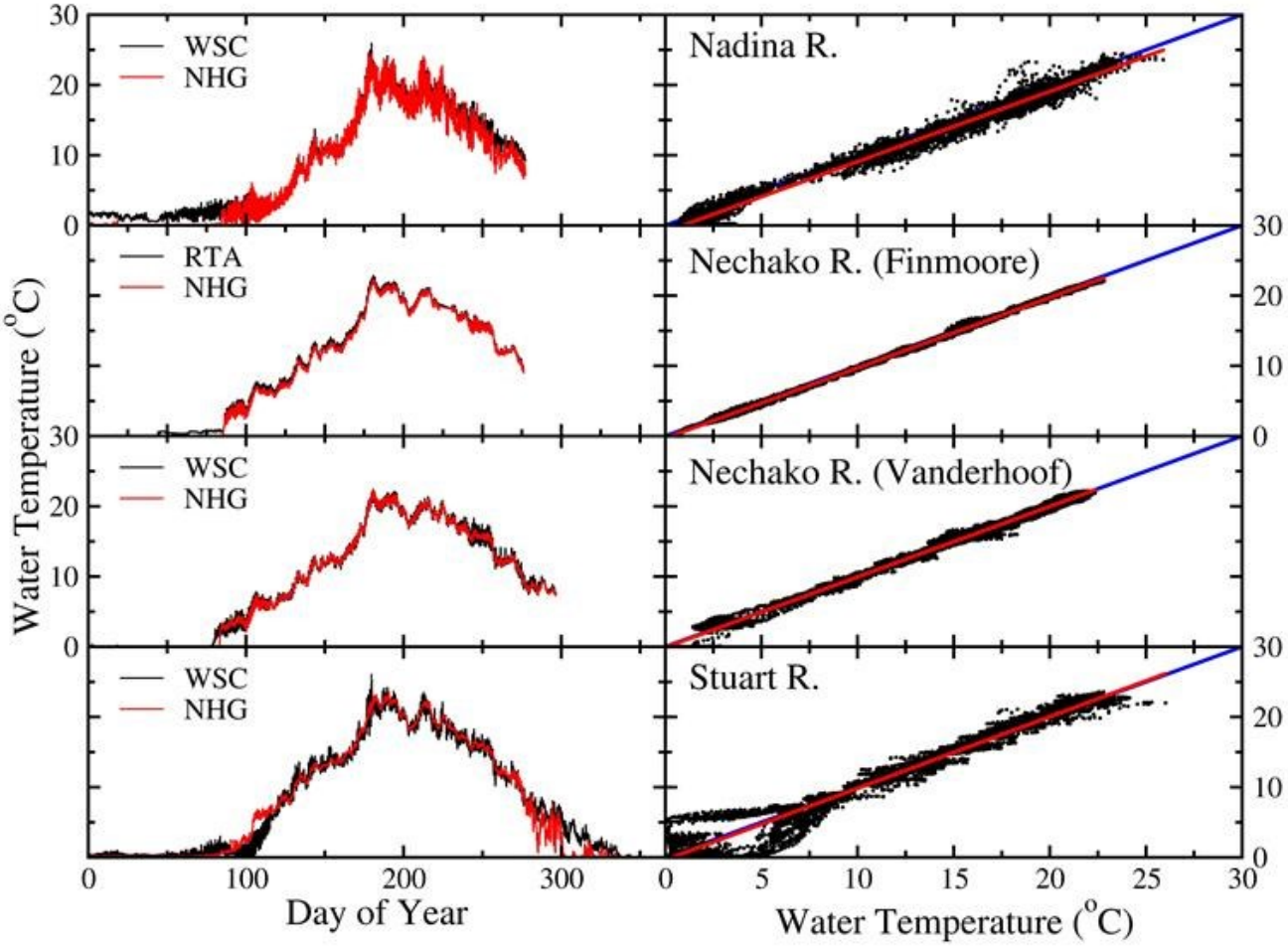


Figure 1: Intercomparison of hourly water temperature data during 2021 for the Nadina River, Nechako River at Finmoore, Nechako River at Vanderhoof and Stuart River. The left panels depict time series from 1 January to 31 December 2021 while the right panels represent scatter plots of the hourly water temperature data. On the right panels, the x-axis data are from WSC or RTA while the y-axis data are from the NHG, red lines depict linear regressions and blue lines denote 1:1 lines. Data are sourced from the Water Survey of Canada (WSC), Rio Tinto (RTA) and the Northern Hydrometeorology Group (NHG). Consult Table 1 for the statistics of the intercomparisons.

Table 1: Statistics of the intercomparison of hourly water temperatures during 2021 for four waterways across the Nechako Watershed. *R* denotes the Pearson cross-correlations of hourly water temperatures for the paired sites, MAD denotes the mean absolute difference, RMSD reports the root mean squared difference and n is the number of samples used in the intercomparison.

Waterway	Site 1 Agency/ID	Site 2 Agency/ID	*R*	p-value	MAD (°C)	RMSD (°C)	*n*
Nadina River	WSC 08JB008	NHG 01FW012	0.99	0.0	1.1	1.3	6659
Nechako River at Finmoore	RTA	NHG 01FW017	1.00	0.0	0.3	0.4	6446
Nechako River at Vanderhoof	WSC 08JC001	NHG 01FW013	1.00	0.0	0.3	0.5	7122
Stuart River	WSC 08JE001	NHG 01FW015	0.99	0.0	0.8	1.3	8726

This comparison demonstrates the strong correspondence between the hourly water temperature data we collected relative to those from other independent sources at four sites in the Nechako Watershed. Evaluation metrics between the time series show $R \geq 0.99$, MAD ≤ 1.1°C and RMSD ≤ 1.3°C (Table 1). Results are slightly poorer at the Nadina River and Stuart River where the WSC sites are just downstream of a lake, while our sites are further away from these water bodies. Nevertheless, this cross validation shows that our data compare favorably with those from other sources and can therefore be used reliably to assess spatio-temporal variability in water temperature across the Nechako Watershed.

HYDROLOGICAL RESPONSE TO EXTREME ATMOSPHERIC RIVER EVENTS IN THE NECHAKO WATERSHED AND SURROUNDING REGION

Tamar Richards-Thomas

Bruno Sobral

Stephen Déry

Copious amounts of precipitation often accompany landfalling atmospheric rivers (ARs) that, in turn, influence terrestrial rivers across the Nechako Watershed. Given the wide range of discharges throughout the Nechako and surrounding region caused by the diverse hydroclimate and hydrological network, observed discharge and water level data can be reported as percentiles for easier cross-comparisons. Here, we used observed hydrological data from the Water Survey of Canada and Rio Tinto for up to 33 sites, with periods of record that date back to 1930 and up to 2024. Two values of percentiles are then calculated for each available site for three extreme AR events identified through a set of five criteria (Sobral, 2025): 1) 12-14 October 1952, 2) 30 October to 1 November 1978, and 3) 29-31 October 2009. The first percentile value (called period of record or *PoR percentile*) is based on the entire period of record for a given site. The second percentile value (called *daily percentile*) relies on the period of record for each day of the year. For example, a site with a 50-year record has the PoR percentile value based on >18,200 daily observations, while the daily percentile value relies on 50 values for each day of the calendar year. Spatial plots are then generated to illustrate maxima in the two percentile values over the 2-week period from the onset of the three extreme AR events.

Values of the percentiles (PoR and daily) exceed 80% on the western and northwestern side of the Nechako Watershed, except for the daily maximum percentiles shown in Event 1 (Fig. 1a), near the eastern slopes of the Coast Mountains. The eastern side of the Nechako reports the lowest percentile values, suggesting less intense precipitation in Interior BC. The highest percentile discharges (>80%) represent overall maximum daily (Figs. 2a, c and e) and PoR (Figs. 2b, d and f) percentiles recorded for those stations during the specific events. These findings are consistent with those of Richards-Thomas & Déry (2025) on the upper Nechako Watershed. A consistency in the distribution of AR precipitation in the past (1952, 1978, 2009) and recent times (2021; Richards-Thomas and Déry, 2025) is attributed to the topography and proximity of the Nechako to the Pacific Ocean. The lower percentile discharges on the eastern side of the Nechako, where much of the population resides, may have significant implications for water resilience. Nonetheless, high percentile discharges on the western side of the Nechako suggest intense precipitation, which may be contributed from the Coast Mountain's spillover effects, to replenish water resources.

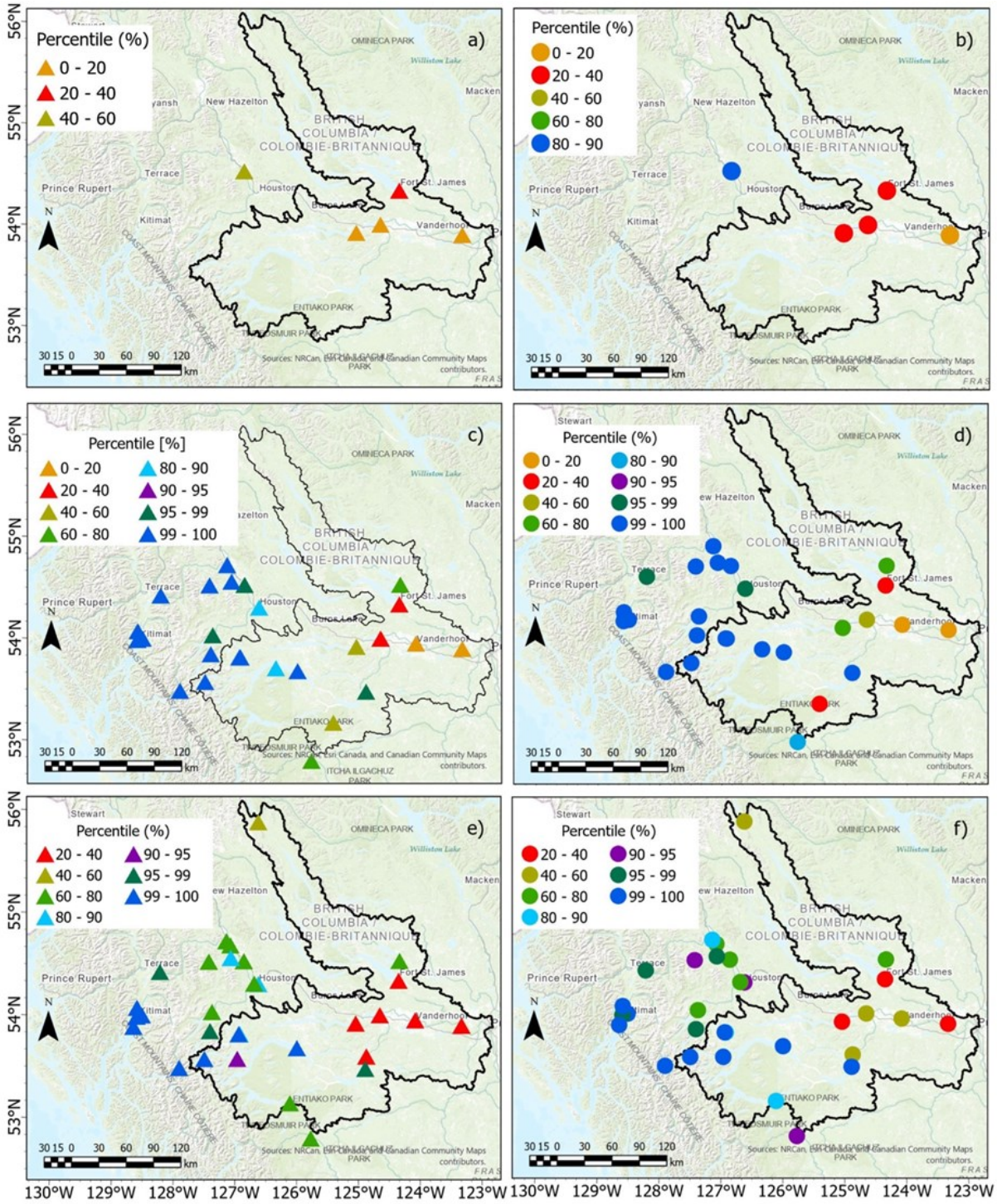


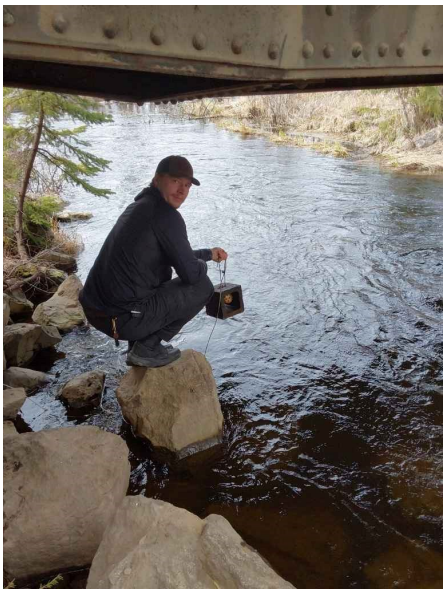
Figure 2: A map of the daily (left panels) and PoR (right panels) maximum percentile discharges or water levels across the Nechako Watershed over the 2-week period for (a, b) Event 1: 12-14 October 1952, (c, d) Event 2: 30 October to 1 November 1978, and (e, f) Event 3: 29-31 October 2009. Note the high number of sites in the top percentile bin during Events 2 and 3 in the western portion of the Nechako and nearby coastal areas. The lack of discharge observations during Event 1 hinders a more spatially complete analysis but suggests high flows on the Bulkley River.

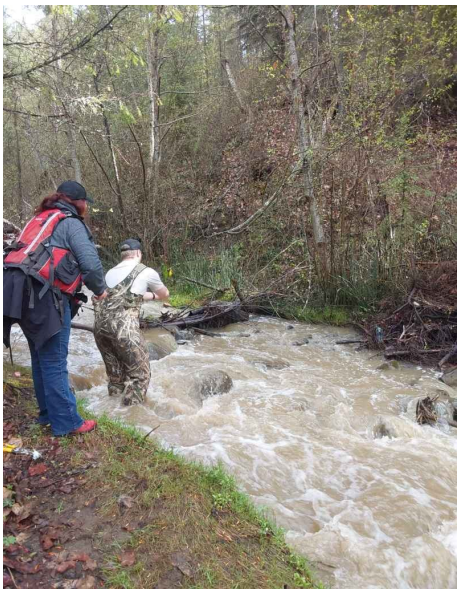
NHG FIELD WORK UPDATE

Maria Tavares

The 2025 field season is off to a strong start for our team - Lynn, Maria, Dylan, and Kainen - all returning this year as seasoned veterans! The field season started off with a two-week refresher training that included a data management workshop, field safety reviews (like bear safety and FSR driving), and hands-on equipment prep. The crew built a test weather station at Ness Lake to brush up on key field skills and to ensure gear was in working order. That test station has since been relocated and successfully set up at Francois Lake, on the traditional territory of the Cheslatta Carrier Nation.

Above: Field Crew at the test installation of a weather station—Ness Lake. Below: a few pictures of the field work.





Within just the first four weeks of the season, the team has already been active at numerous sites, including McMillan Creek, the Nechako River at Pulpmill Road and Miworth, and multiple monitoring sites in the Cheslatta Lake region. They have also had the privilege of engaging directly with members of the Cheslatta Carrier Nation and were honored to take part in a ceremony led by Stellat'en Elders for the blessing of the Stellako River. These moments of connection and collaboration with First Nations are deeply meaningful and central to the work done by the NHG.

With this experienced crew back in the field, strong momentum, and valued partnerships in place, we're looking forward to a productive and rewarding field season ahead!

Field Crew at the visit of Cheslatta Carrier Nation's office.

CONCLUSION OF THE NSERC/RIO TINTO INDUSTRIAL RESEARCH CHAIR (IRC) ON CLIMATE CHANGE AND WATER SECURITY: A BRIEF HISTORY OF THE IRC, ITS MAIN ACCOMPLISHMENTS, CHALLENGES AND LESSONS LEARNED

Stephen Déry

June 30th, 2025 will mark the conclusion of the NSERC / Rio Tinto Senior Industrial Research Chair (IRC) on climate change and water security. This program of research was initiated on July 1st, 2019 with the overarching goal to better understand and quantify the roles of climate variability, climate change, and water management on the long term water security of the Nechako Watershed. This article summarizes some of the key accomplishments, challenges and lessons learned over the past six years of this program of research supported by the Natural Sciences and Engineering Research Council of Canada (NSERC), Rio Tinto and UNBC. Beforehand, this article provides a brief history of how the IRC came about including the funding application process.

A brief history of the IRC

The idea for a new IRC position at UNBC supported by NSERC and Rio Tinto came about after a meeting held in early 2018 on the UNBC campus with representatives from UNBC's Office of Research and Innovation and Rio Tinto. There was consensus among the group that a new partnership between UNBC and Rio Tinto was of mutual interest and that funding should be pursued at NSERC to create an IRC in climate change and water security focused on the Nechako Watershed. Then began the protracted development of a funding application to NSERC's Industrial Research Chair program, which took nearly a year to prepare. The proposal was submitted in January 2019 on the final call for proposals to this opportunity as NSERC terminated this funding program thereafter. NSERC first conducted an internal review of the application and then approved a site visit to UNBC for further evaluation of the application.

A site visit committee (SVC) was assembled by NSERC and visited the UNBC campus in Prince George on April 24th, 2019 to interact with the principal investigator, Rio Tinto representatives, senior UNBC administrators, as well as other faculty members, graduate students and research staff. The SVC comprised five members: Dr. Nigel Roulet (Chair of the SVC) from McGill University, Dr. Steven Fassnacht from Colorado State University, Dr. Suzan Lapp from the BC Oil and Gas Commission (now with the BC Ministry of Water, Land and Natural Resource Stewardship), Dr. Philip Marsh from Wilfrid Laurier University and Dr. Amin Elshorbagy from the University of Saskatchewan. As well, a representative from NSERC, Isabelle Girard, coordinated the meetings with UNBC staff and the SVC's deliberations.

The site visit proved highly successful and the SVC recommended that NSERC support the IRC for a program of research spanning five years. The IRC position commenced on July 1st, 2019 although the official announcement was delayed until November 4th, 2019. A launch event was organized on the UNBC campus with representatives from Rio Tinto, UNBC and the community, an event that attracted considerable media attention. A media release was jointly issued by Rio Tinto and UNBC that day announcing the official launch of the IRC with many requests for media interviews following this.

Given the broad scope of the IRC program of research, the UNBC Office of Research and Innovation supported the creation of a Science Advisory Board (SAB) to oversee the IRC's progress. Five members joined the SAB in the fall of 2019 and have served in this capacity until present: Justus Benckhuysen (December 2019 - March 2021) and Andy Lecuyer (April 2021 to present) both the successive Rio Tinto representative, Dr. Ellen Petticrew (UNBC), James Rakochy (Cheslatta Carrier Nation), Chelton van Geloven (Lheidli T'enneh First Nation, formerly with the provincial government), and Dr. Francis Zwiers (Pacific Climate Impacts Consortium). Mark Barnes (now Interim Associate Vice-President, Strategy and Outreach) also attended SAB meetings as a representative from UNBC's Office of Research and Innovation. The SAB met with the project leader and the team of undergraduate and graduate students, post-doctoral fellows and other researchers every six months to assess progress with the IRC. The SAB then reported back to the UNBC Office of Research and Innovation with any feedback or concerns with the IRC's progress. The final meeting of the SAB is being held on June 23rd, 2025 and we sincerely thank all SAB members for their selfless commitment to the IRC program of research.

Accomplishments, Challenges and Lessons Learned:

To address its overarching goal, the IRC program of research developed three research themes: 1) hydrometeorological monitoring and data collection; 2) atmospheric and terrestrial rivers; and 3) water temperature and hydrological modelling. Significant progress was achieved under each theme with key accomplishments highlighted in the following paragraphs.

Theme 1 | Following a successful pilot project in 2019, we developed a network of 32 water temperature monitoring sites covering the entire Nechako Watershed. Data for all sites up to 2024 have been quality controlled and deposited at Zenodo, a publicly accessible data archive. We also expanded meteorological monitoring across the Nechako Watershed by adding seven new research-grade weather stations while also commissioning the "Monitoring Extreme Climate and Hydrometeorological Events" or MECHE observatory at Huckleberry Mines in the upper Nechako Watershed. In September and October 2021, we led the Tahtsa Ranges Atmospheric River Experiment" or TRARE, the first ever Canadian field campaign dedicated to studying the atmospheric river phenomenon. During TRARE, a team of 11 UNBC, UQAM and McGill graduate students and researchers recorded in-situ storm observations and collected high-resolution meteorological and hydrological data from six primary and nine secondary field sites over two months.

Theme 2 | Further research on atmospheric rivers focused on developing a climatology of these events for the Nechako Watershed including their frequency, intensity and seasonality. This effort revealed there has been no significant change in the number of landfalling atmospheric rivers near the Nechako Watershed and that they occur predominantly during autumn. Atmospheric rivers provide up to one quarter on the annual precipitation in the upper Nechako Watershed, replenishing critical water resources including the Nechako Reservoir. The temporal consistency of atmospheric moisture fluxes proved critical in bringing copious precipitation to the upper Nechako Watershed during three TRARE case studies. Extreme events such as the 28 October-1 November 1978 and 27-31 October 2009 events induced 38 cm and 23 cm water level increases, respectively, in the Nechako Reservoir. Elevated, if not record high, streamflows follow extreme atmospheric rivers in the western portions of the Nechako Watershed while impacts are attenuated eastward owing to flow regulation, remoteness from the Pacific Ocean and presence of large lakes. While the diversion of water from the upper Nechako Watershed diminishes downstream flows in the mainstem Nechako River, climate variability and climate change also play a significant role in the volume and seasonality of streamflows.

Theme 3 | Two computer models were applied to the Nechako Watershed to reconstruct historical and to project future streamflows and water temperatures in the basin. Building on prior efforts, the Variable Infiltration Capacity (VIC) hydrological model was implemented to the Nechako Watershed to first reconstruct historical flows of the Nechako River and its main tributaries. This was to explore how waterways in the Nechako Watershed are responding to climate change starting from 1950 up to present. This also allows to simulate the flows of the Nechako River's mainstem in the absence of regulation; in other words, this set of simulations mimics the system in a natural state with the absence of water management and flow regulation. The VIC model was then driven by climate change projections up to 2100 to explore potential future flows in waterways draining the Nechako Watershed. These simulations reveal the potential for drastic changes in the seasonality of flows with, for instance, high flows occurring in the fall instead of during the spring freshet as observed historically. Water temperatures will also rise significantly during summer in response to future climate change and may further threaten the up-river migration of anadromous fish species such as Chinook and Sockeye salmon.

Across all themes | As part of the IRC program of research, a comprehensive outreach and communication strategy was developed. Findings from the IRC program of research were shared broadly through a quarterly newsletter (such as this one), through public, conference and workshop presentations, lectures at UNBC, and through peer-reviewed publications, social media content and a dedicated website. Ten short Youtube videos were created by UNBC's Communication and Marketing Office focused on the TRARE field campaign and the atmospheric river phenomenon. Several media releases on our work have been issued over the past six years with nearly 100 interviews conducted since the inception of the IRC. We have also engaged actively in Rio Tinto's Water Engagement Initiative, the Fraser Basin Council's Nechako Watershed Roundtable, and other stewardship societies across the Nechako Watershed. This comprehensive communication and outreach strategy augmented the profile of the IRC program of research.

Finally, it is important to highlight the unique training opportunities offered to a very diverse group of undergraduate and graduate students and research staff. Indeed, the IRC program of research involved no less than 28 highly-qualified personnel who developed a wide range of skills sought after by employers or academic supervisors. Indeed, the success of the IRC program of research was truly a team effort and all contributed to the accomplishments highlighted in each of the three themes and our communication strategy.

Despite these key accomplishments, the IRC program encountered several challenges over the past six years. For instance, strike action by UNBC faculty led to a 3-week delay in activities during November and early December 2019. In March 2020, the COVID-19 pandemic unraveled across the planet and led to significant delays in our research and field activities as team members grappled with this unprecedented situation. For some, this led to delayed visa applications and starting dates for their positions while for others, the financial burdens and health issues proved especially challenging. Thankfully, NSERC, Rio Tinto and UNBC accommodated these delays by providing the team a one-year, no-cost extension to complete our program of research. The recruitment and retention of students and research staff proved at times difficult as our budgets did not anticipate the drastic inflationary pressures imposed by the global pandemic. Finally, dissemination of research via publications and conference presentations was also limited owing to external circumstances such as the COVID-19 pandemic.

Many lessons have been learned through this partnership with Rio Tinto. First, there is much to be gained when working collaboratively with an industrial partner. Indeed, Rio Tinto has always been very forthcoming with sharing data, resources and their knowledge about the Nechako Watershed, their infrastructure and operations. With the common goal of elucidating how climate change is impacting the Nechako Watershed, the IRC provides crucial information for the future management of its water resources. Second, engaging with the communities scattered across the Nechako Watershed including First Nations is essential in better understanding the geography and history of the region as well as defining local issues of concern. This ensured the IRC's program of research was better aligned with local priorities and filled major data and knowledge gaps while avoiding duplication of existing efforts. Traditional (ecological) knowledge is key in understanding the evolution of the Nechako Watershed with oral histories of the changing environment spanning many decades if not centuries or even millennia. Finally, working closely with many different partners, collaborators, practitioners, and knowledge holders is vital for the success of a large program of research such as the IRC in tackling massive issues such the climate crisis.

Conclusion

After six highly productive years, the NSERC / Rio Tinto Senior Industrial Research Chair in climate change and water security comes to a close on June 30th, 2025. The IRC program of research would not have been successful without the tremendous support of a dedicated team, a wide range of collaborators, partners and organizations. It is impossible here to thank everyone who contributed to the IRC program of research; however, I do wish to thank the following for their unwavering support:

Northern Hydrometeorology Group: Research Managers Jeremy Morris, Kelly Hurley, Justin Kokoszka, Lisa Rickard and Erica Lee, Outreach Coordinator Barry Booth, and all past and current undergraduate and graduate students, field technicians and research staff forming the IRC team.

UNBC Office of Research and Innovation: Mark Barnes (Interim Associate Vice-President, Strategy and Outreach), Former Vice-Presidents, Research and Innovation Drs. Geoff Payne and Kathy Lewis (Interim), Current Vice-President of Research and Innovation Dr. Paula Wood-Adams, and Research Project Officer Jacqueline Dockray.

IRC Science Advisory Board: Justus Benckhuysen (Rio Tinto)/Andy Lecuyer (Rio Tinto), Dr. Ellen Petticrew (UNBC), James Rakochy (Cheslatta Carrier Nation), Chelton van Geloven (Lheidli T'enneh First Nation), and Dr. Francis Zwiers (Pacific Climate Impacts Consortium).

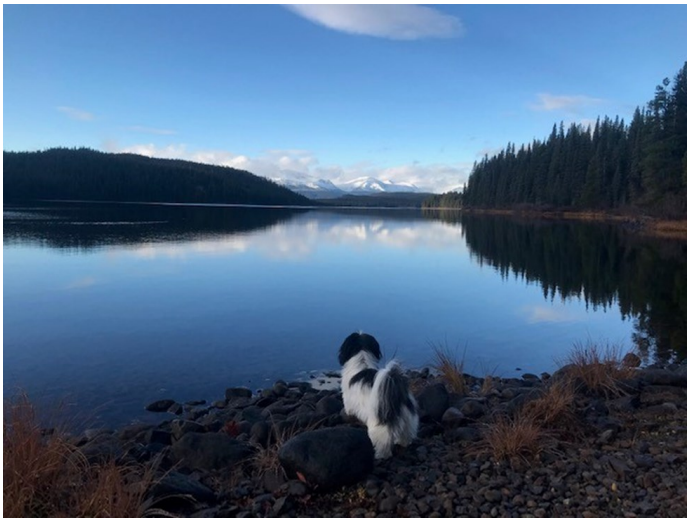
UNBC's Integrated Watershed Research Group: Drs. Eduardo Martins, Phil Owens, Margot Parkes and Ellen Petticrew.

Rio Tinto: Justus Benckhuysen, Andrew Czornohalan, Bruno Larouche, Andy Lecuyer, Alec Mercier and Lianne Olson.

Community Leaders and Partners: Wayne Salewski (NEWSS), Mike Robertson (CCN), Ray and Donna Klingspohn (NTLSS), Brad and Wendy Thompson (Nadina Lake Lodge), Kim Menounos and Tasha Peterson (Nechako Watershed Roundtable), and Marke Wong (Imperial Metals / Huckleberry Mines)

Last, but certainly not least, I wish to acknowledge the companionship of Angel, the beloved shih tzu, who passed away this past March. Angel acted as the NHG mascot and accompanied us for many site visits and field work, providing a distraction from the busy workdays.

Thanks to Rio Tinto, we are now embarking on a new phase of research on climate change and water security. Consult this and future issues of the Nechako Research Newsletter to track our progress as the climate crisis continues to affect our beautiful region. Thanks again to all of you for providing us with this unique opportunity and we look forward to continue engaging with all of you as our monitoring and research efforts expand in the coming years.



Ecohydrology of a managed river system: Improved hydrological and thermal modelling for informed management decisions by Doctoral candidate Habiba Ferchichi and Dr. André St-Hilaire

Given the increase in heat events due to climate change, rising river temperatures may alter the thermal habitat of salmon species (e.g., Sockeye, Chinook), cold-water fish that are sensitive to high water temperatures. In this project, we aim to improve thermal simulations in a model called CEQUEAU, already in use on the Nechako Watershed. Drainage basins such as the Nechako pose a challenge when water temperature simulations are required because of the presence of lakes and/or reservoirs.

The temperature of lakes/reservoirs has a potential impact on downstream river temperatures. Thus, improving thermal modelling in these watersheds requires better representation of interactions and physical processes between water bodies (lakes/reservoirs and rivers). To achieve this, a number of lake temperature models (e.g., Air2Water, MyLake, GLM) will be coupled to the existing CEQUEAU hydrological and thermal model and applied for modelling flows and temperatures in the Nechako Watershed.

The study area initially covers the Stuart River, a tributary of the regulated Nechako River, and will later expand to the entire Nechako Watershed. Improving hydrological and thermal modelling in the Nechako Watershed may contribute to better management strategies for rivers and aquatic habitats in the context of climate change.

For lake temperature modelling, long time series of surface lake water temperatures (LSWT) are required. LSWT were extracted from MODIS satellite data (May to September), providing the longest available daily time series at a coarse spatial resolution of 1 km × 1 km (2002-present). These data were validated with LSWT from Landsat satellite images (Figure 1) at finer spatial resolution (30 m × 30 m), available every 16 days. Figure 1 shows a strong correlation between MODIS and LANDSAT-derived LSWT with a coefficient of determination (R^2) > 0.9, a root mean square error (RMSE) about 1.27°C, and a Pearson correlation coefficient (R-pearson) > 0.9. A slight bias was observed when comparing MODIS data with LANDSAT LSWT. Consequently, the MODIS LSWT time series will be used in lake temperature modelling. The fieldwork of this summer will include installing a thermograph chain near the outlet of Stuart Lake and thermographs in the

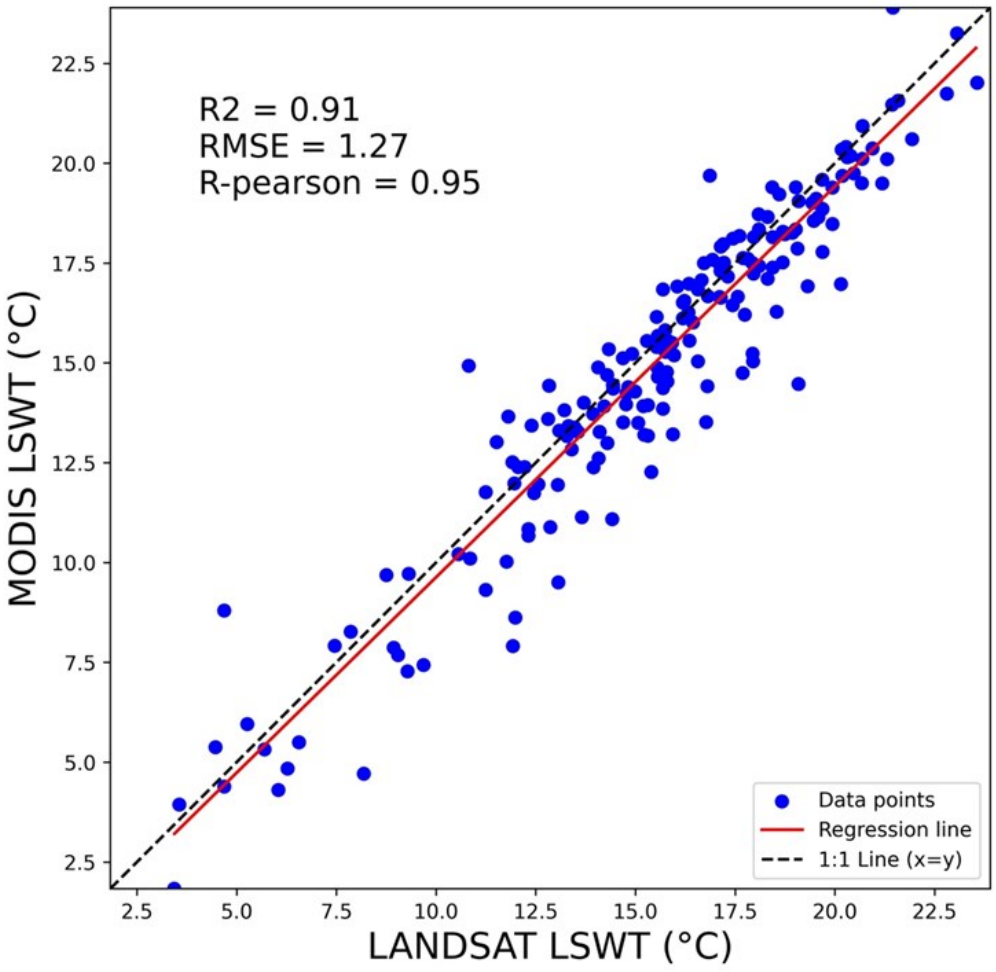


Figure 3: Validation of MODIS LSWT with Landsat LSWT. The x-axis represents LANDSAT LSWT (°C), while y-axis represents MODIS LSWT(°C), The red line shows the linear regression relationship between MODIS and LANDSAT LSWT, and the dashed black line represents the 1:1 reference line to visually assess the bias. A well-fitted linear model should show the regression line (red) closely aligned with the 1:1 line, and deviations from the reference line indicate biases that require corrections.

FFEL UPDATE

Eduardo Martins

It is hard to believe we're already in mid-June! The FFEL field season in the Nechako Watershed has been super busy, and our amazing graduate students are hard at work deploying equipment and tagging fish for their research projects. Avery spent several weeks going out with the crew from the Nechako White Sturgeon Conservation Centre (NWSCC) to capture and tag white sturgeon. She has also worked with the NWSCC to tag and sample juveniles in the hatchery before they were released into the Nechako River earlier this month. She and Melody are now working full time at deploying temperature data loggers to monitor the thermal habitats used by white sturgeon.

John has started the first field season of his project on Nechako Chinook salmon. With assistance from Eliseu, he has started preliminary thermal preference trials on juveniles Chinook salmon using a field-lab setup for a shuttlebox system. The water temperature in the system is essentially controlled by the fish, allowing them to maintain their body temperature within their preferred range. John and Eliseu have also deployed a number of temperature data loggers in some creeks to start mapping the thermal habitats available to juvenile Chinook salmon. At the end of May, we had an important update meeting related to Avery and John's projects with members of the Lheidli T'enneh, Stellat'en, Nadleh Whut'en, Saiku'z, and Nak'azdli First Nations, where we identified potential solutions to challenges with the implementation of the research on adult Chinook salmon. We are immensely grateful to the Saiku'z First Nation for welcoming us for this in person meeting in their traditional and unceded territory.

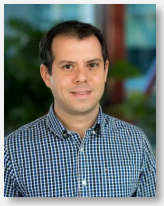
In this issue of the Nechako Research Newsletter, you will learn about an exciting project we have started this spring to investigate the thermal ecology of rainbow trout in the Stellako River. This research is critically important given the ongoing drought and recent heat waves we have had in our region. Indeed, research we completed recently using long-term (1988-2022) snorkel count dataset collected by the Ministry of Water, Land and Resource Stewardship, has shown that one of the main drivers of the decline in abundance of the population since the early 2000's is the impact of increased summer temperatures on survival of immature fish. Carly and Allie are the students leading the work in the field and have nearly completed the deployment of their monitoring equipment. They are now at full fish tagging mode with the help of numerous volunteers. We are immensely thankful to Trudi and Erwin from the Stellako Lodge for their hospitality and the Stellat'en First Nation for welcoming us to do this research in their traditional and unceded territory. Special thanks to Isaiah Reynolds for his immense support to our project.

Nechako River

THE TEAM

Meet the Rio Tinto Research Chair members from the Freshwater Fish Ecology Lab

Freshwater Fish Ecology Laboratory | UNBC



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M.Sc. student

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PhD Candidate

RAINBOW TROUT (*ONCORHYNCHUS MYKISS*) THERMAL HABITAT USE AND THERMOREGULATION IN THE STELLAKO RIVER

Allison Pugh

Carly Walters

Freshwater lotic thermal habitats are changing with increasing water temperatures. Cold-water fish such as rainbow trout (*Oncorhynchus mykiss*) are vulnerable to changing thermal regimes. They require thermal refuge for behavioural thermoregulation, particularly during periods when water temperature exceeds their preferred temperature range. This project explores how rainbow trout, an ecologically and culturally important species, respond to changes in water temperatures in the Stellako River. The intent of this research is to identify thermal habitats in the Stellako River and how rainbow trout navigate thermal habitats during the summer months, and to investigate thermoregulatory effectiveness and the energetic costs associated with thermoregulation.

Habitat Modelling

The thermal habitat of the Stellako River will be mapped using a drone-mounted thermal infrared (TIR) camera paired with an array of water temperature loggers. In May 2025, we installed 60 water temperature loggers throughout the Stellako River to monitor the temperature of the habitat utilized by rainbow trout. Drone imagery will be collected from June to September 2025 to map the thermal heterogeneity of the Stellako River. These data will be used to identify the cold-water patches rainbow trout use as thermal refuge, and to map the patchiness of thermal habitat to assess how it influences thermoregulation.

Figure 4: Field crew conducting Snorkel surveys in the Stellako River

Thermal Habitat Use

The second objective is to examine rainbow trout movement patterns during thermally stressful periods. This will be accomplished by tracking the movement of the trout using acoustic telemetry, snorkel surveys and underwater time-lapse cameras to determine how the fish will navigate changes in thermal habitats over the summer months. In June, a total of 47 rainbow trout will be inserted with acoustic tags that monitor internal temperature and depth to investigate their use of thermal habitats along the river and potentially movements into François and Fraser lakes.

Thermoregulatory effectiveness and energetics

Thermoregulatory effectiveness (the ability of a fish to maintain its internal temperatures within its preferred range, in contrast with external temperatures) and the energetic cost of thermoregulation will be monitored using radio telemetry. An array of six radio stations was installed along the Stellako River in May 2025. In June, a total of 50 rainbow trout will be inserted with radio tags that monitor internal temperature and overall dynamic body acceleration (ODBA), used as a proxy for the energetic costs of thermoregulation. We will investigate how body size and condition, time of day, water temperature, and thermal heterogeneity influence rainbow trout thermoregulation.

Figure 5: Installation of a Radio Telemetry Station.

OUTREACH

Communicating our findings through various means continues to be a top priority!

PRESENTATIONS

- Déry, S. J. Update on research on climate change and water security in the Nechako Watershed. True North 2025 Business Development Forum in Prince George, BC, 6 May 2025.
- Déry, S. J. Climate change in the Nechako Watershed. Spring Technical Meeting of the Nechako Watershed Roundtable, Fort St. James, BC, 2 June 2025.
- Martins, E. G. Update on research on climate change and freshwater fish ecology in the Nechako Watershed. True North 2025 Business Development Forum in Prince George, BC, 6 May 2025.
- Moura, L., Déry, S. J., Martins, E., Owens, P. and Parkes, M. Amplifying integrated watershed research in the Nechako River Basin: A progress update from UNBC's Integrated Watershed Research Group (IWRG). Spring Technical Meeting of the Nechako Watershed Roundtable, Fort St. James, BC, 3 June 2025.
- Walters, C., Pugh, A. and Martins, E. G. Stellako River rainbow trout population and thermal ecology. Polar Coachman Fly Fishing Club, Prince George, BC, 08 May 2025.

PUBLICATIONS

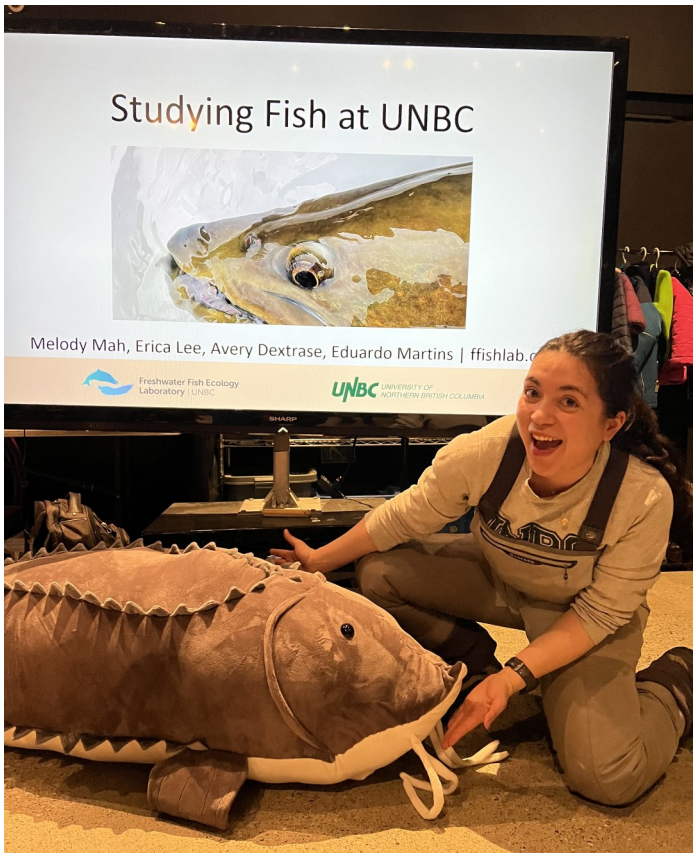
- Kokoszka, J. E., Broeke, D., Calder-Sutt, F., Khorsandi, M., Tavares, M. A. and Déry, S. J., 2025: Updating "Sub-hourly water temperature data collected across the Nechako Watershed, 2019-2021" to 2024 and with supplemental sites, Data in Brief, **61**, 111710. https://doi.org/10.1016/j.dib.2025.111710.
- Hurley, K. M., Morris, J. E., Cardinal, E., Gilbert, D. E., Kaveney, A. R., Sobral, B. S., Thompson, H. D., Thériault, J. M, and Déry, S. J., 2025: The Tahtsa Ranges Atmospheric River Experiment (TRARE): Experimental design and case studies, Discover Atmosphere, **3**, 12. https://link.springer.com/article/10.1007/s44292-025-00040-y.
- Richards-Thomas, T. and Déry, S. J., 2025: Moisture transport to British Columbia's Upper Nechako Watershed associated with three atmospheric rivers, *Discover Atmosphere*, **3**, 9. Full Document.

MEDIA INTERACTIONS

- 2025/03/21 - World Water Day 2025, CKPG News, CKPG (Prince George, BC)
- 2025/03/13 - Recent snowfalls in northern BC and potential for spring flooding, CKPG News, CKPG (Prince George, BC)

OUTREACH—PUBLIC EVENTS

During the end of March, PhD student Avery, along with Research Managers Erica and Melody, conducted youth outreach at Exploration Place's Spring Break Camp. Campers learned about the many ways fish are studied, as well as how and why we study fish in the FFEL. Highlights included leading youth through fish identification and radio tracking activities, guiding campers through our sampling equipment, as well as seeing sturgeon artists at work! The enthusiasm for fish radiated at this event. We are excited to see that the future is bright for fisheries science!



Check out our websites!

https://web.unbc.ca/~sdery/irc

https://www.ffishlab.ca/

OUTREACH—PUBLIC EVENTS

At the juvenile white sturgeon release event hosted by the Nechako White Sturgeon Recovery Initiative in Vanderhoof on June 6, 2025, PhD candidate Avery Dextrase, along with Freshwater Fish Ecology Laboratory (FFEL) managers Erica Lee and Melody Mah, hosted an interactive booth highlighting the lab's research on the Nechako River. Sturgeon spirit was abounding as students from the Nechako Lakes School District flocked to the event's many booths after releasing one of the sixty-three juvenile sturgeon raised at the hatchery to help maintain the wild population – each named by a classroom from the district! Throughout the day, the FFEL team shared with the nearly 1,000 students attending the ins and outs of Avery's research on Nechako white sturgeon. Students also put their fish identification skills to the test with a poster featuring the lab's other study species – including rainbow trout, burbot, chinook, and arapaima – and learned to measure, tag, and track fish using real scientific tools. Between watching the students take fork lengths, decode PIT (passive integrated transponder) tags, and create one-of-a-kind artwork at the FFEL colouring station, the FFEL team was inspired by the students' curiosity and excitement and can't wait for the next opportunity to engage the next generation of fisheries biologists.

Photos by Michelle Cyr-Whiting - UNBC

Check out our websites!

https://web.unbc.ca/~sdery/irc

https://www.ffishlab.ca/

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