



Nunavut Research Institute

License Holder Reporting requirements

For research undertaken in the 2025 calendar year (commencing January 01, 2025 and ending December 31, 2025)

Project Title:

Kitikmeot Sea Science Study

Project Leader(s): Full name, affiliation, and contact information (address, phone number, email) of each project leader (principle investigator and co-investigators)

Project Lead: Bill Williams, Fisheries and Oceans Canada, Institute of Ocean Sciences, Email: bill.williams@dfo-mpo.gc.ca

Co-PI: Kristina Brown, University of Manitoba, Email: kristina.brown@umanitoba.ca

Project Team: Full name, affiliation, and address (name of city/community and province/territory/state) of each member of the project team

Bodil Bluhm, University of Tromso, Norway, Email: bodil.bluhm@uit.no
 Eddy Carmack, Fisheries and Oceans Canada, Institute of Ocean Sciences, Email: Eddy.Carmack@dfo-mpo.gc.ca
 Seth Danielson, University of Alaska Fairbanks, Email: sldanielson@alaska.edu
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 Brent Else, University of Calgary, Email: belse@ucalgary.ca

Abstract: A concise summary of what was done, found, and concluded to date, and how the results/information will be used. This summary must be translated into the appropriate dialect of Inuktitut. Suggested length: 250-300 words. ***This section will be published in the NRI's annual compendium of licensed research and made available through the Isirvik research portal**

The Kitikmeot Sea is unique in the Arctic Ocean due to massive freshwater input from large mainland watersheds combined with shallow bounding sills that restrict the entry of salty, nutrient-rich oceanic waters into the basin. Low primary productivity results, as restricted inflow of nutrient-rich, salty water at the shallow bounding sills becomes confined underneath fresher, river-influenced surface waters. Our research builds on this basic description of the sea to understand the large-scale circulation and overall geochemical balance that supports the food web. We also focus on narrow and shallow tidal straits and near the mouths of rivers where we anticipate mixing provides nutrients that increase biological production locally.

Ongoing since 2015, the Kitikmeot Sea Science Study (K3S) has brought together an international team of oceanographers in collaboration with local Traditional Knowledge Holders to explore the Kitikmeot Sea in the southern Northwest Passage and to evaluate the sensitivity of its ecosystems to a changing climate. Our research program includes the collection of ship-based, moored, and community-led physical, geochemical and biological oceanographic observations with three core goals:

- i) To establish a baseline of year-round physical, biological and geochemical oceanographic information.
- ii) To develop the oceanographic understanding necessary to assess the impacts of climate change on Kitikmeot marine ecosystem processes.
- iii) To provide data and information to modellers and char fishery researchers, and assessments of environmental impacts.

Collaboration with local Traditional Knowledge Holders is a central component of this research and community organizations in Kugluktuk and Gjoa Haven, NU, have been engaged throughout, and are actively involved in our research program. As we have an overall goal of understanding the structure and function of the region's ecosystem, this research will provide the Nunavut Research Institute (NRI) and the Canadian High Arctic Research Station (CHARS) with a scientific basis for long-term ecological ocean monitoring and research.

Key messages: Concise, plain language summary of key take-away messages of work to date, findings and conclusions. Preferably 3-5 points, in bullet form.

1. The shallow sills of Dolphin and Union Strait and Victoria Strait restrict the inflow nutrient-rich, salty Pacific-origin water to the Kitikmeot Sea. Nutrient levels inside the Kitikmeot Sea are approximately half that of outside the Kitikmeot Sea.
2. Sunlight and nutrients are needed for phytoplankton to grow. In the Kitikmeot Sea, river inflow from large mainland watersheds, together with sea-ice melt, keeps the nutrient-rich salty water away from the surface, and so also away from the sunlight, leading to low biological production.
3. There is significant tidal mixing in the region which is focussed in straits and narrow passageways. These straits are locations where the tides mix nutrients towards the surface and are likely places of higher biological production.
4. We have found surprising amounts of kelp in the tidal straits in the region, and are progressively mapping its locations.

Objectives: Project objectives, preferably in bullet form.

We aim to develop an oceanographic understanding and conceptual model of the Kitikmeot Sea to characterize and quantify the factors that constrain marine ecosystem function and their sensitivity to ongoing climate change. K3S seeks to:

- i) develop a baseline oceanographic understanding and conceptual model of the Kitikmeot Sea that characterizes, and quantifies, the physical and geochemical factors that constrain marine ecosystem structure and function and their sensitivity to climate change, including cascading impacts on primary producers through to resident char and seal populations important to local subsistence fisheries.
- ii) characterize controls on ocean mixing and stratification across the region, including rivers, tides, wind and sea-ice, and their impact on nutrient distributions, phytoplankton, zooplankton, benthic invertebrates, and fish.
- iii) evaluate the importance of narrow straits as biological hotspots due to tidal mixing.
- iv) characterize the physical, geochemical, and biological impacts of the riverine freshwater flux to the coastal region, including the importance of terrestrially-sourced nutrients;
- v) provide data and oceanographic context to on-going char fishery research and modelling efforts to better predict the responses of the Kitikmeot Sea to a changing climate

Annual activities: A description of activities and methods carried out during the current reporting period. This section should answer the questions: What? Where? When? Who? How? Include dates team members conducted research at remote field sites or collected data (including interviews) in communities; append a map with locations and/or coordinates of remote field sites, if applicable.

Our ship-based oceanographic programs took place between 20 September and 30 September 2025 aboard the CCGS Sir Wilfrid Laurier. We carried out mooring recovery/deployment and water sampling activities across the Kitikmeot region, including: the Finlayson Islands, Coronation Gulf, Queen Maud Gulf, Victoria Strait, and northern Bathurst Inlet. This year we also carried out additional sampling activities in Eastern Queen Maud Gulf to conduct exploratory research in the "Ocean of Bearded Seal" to address community concerns brought up by Elders in Gjoa Haven.

Observational activities aboard the CCGS SWL included:

- a) recovery and re-deployment of long-term moorings;
- b) measurement of physical and geochemical properties of seawater via electronic instruments deployed from the ship and via water sample collection;
- c) sampling of zooplankton with nets; and
- d) bottom sediment and benthic organisms with a van veen sediment grab.

As described in our original permit, mooring instrumentation was mounted on recoverable sub-surface moorings that reach from the bottom to within 15m of the surface. Pairs of moorings include sensors for measuring currents and ice thickness and sensors measuring temperature and salinity and optically observed biological parameters (fluorescence, light intensity, turbidity, etc). Mooring recovery (2024) and deployment (2025) locations are illustrated in the Appendix.

Our Community-Based Oceanographic Sampling program was carried out year-round. As in previous years, we worked closely with the Kugluktuk Hunters and Trappers Organization and the Canadian Rangers Ocean Watch (CROW) program to collect physical and geochemical observations from the freshwaters of the Coppermine River into the marine waters of Coronation Gulf. This past year, CTD and water sampling transects were completed in January, February, March, April, May, September and December. This sampling program has contributed to training four (4) community members to collect water samples and deploy instruments from small local boats (summer) and from the sea ice (winter). Wintertime transects were conducted by snow machine and summertime transects were conducted by small boat. This program is overseen by the Kugluktuk Hunters and Trappers Organization.

We anticipate continuing our community-based oceanographic sampling activities and ship-based oceanographic activities aboard the CCGS Sir Wilfrid Laurier again in 2026 (as detailed in the Appendix). As our program covers the entire year, we request that our research license allow sample collection activities in the above-mentioned regions from January 2026 to December 2026.

Results and Achievements: Findings and results to date of the above activities, highlighting any key research achievements (see guide below for formatting tips regarding tables and figures).

Please see these 3 papers, upon which the Key Messages are based:

For the general oceanography of the Kitikmeot Sea:

William J. Williams, Kristina A. Brown, Lina M. Rotermund, Bodil A. Bluhm, Seth L. Danielson, Michael Dempsey, Fiona A. McLaughlin, Svein Vagle, Eddy C. Carmack; Processes in the Kitikmeot Sea estuary constraining marine life. *Elementa: Science of the Anthropocene* 3 January 2025; 13 (1): 00031. doi: <https://doi.org/10.1525/elementa.2024.00031>

Tidal propagation in the Kitikmeot Sea:

Rotermund, L. M., Williams, W. J., Klymak, J. M., Wu, Y., Scharien, R. K., & Haas, C. (2021). The effect of sea ice on tidal propagation in the Kitikmeot Sea, Canadian Arctic Archipelago. *Journal of Geophysical Research: Oceans*, 126(5), e2020JC016786. <https://doi.org/10.1029/2020JC016786>

Kelp distribution in the Kitikmeot Sea:

Bluhm, B. A., Brown, K., Rotermund, L., Williams, W., Danielson, S., & Carmack, E. C. (2022). New distribution records of kelp in the Kitikmeot Region, Northwest Passage, Canada, fill a pan-Arctic gap. *Polar Biology*, 45(4), 719-736. <https://doi.org/10.1007/s00300-022-03007-6>

Challenges/Obstacles: In this section, please comment on any challenges/obstacles (if any) that you experienced during this project year. If there were any actions to mitigate or resolve these challenges, please list them here. Were any concerns raised regarding the conduct of research team members or the impacts of the project?

We had planned to recover two (2) tilt-current meter moorings deployed in the shallow waters of Eastern Queen Maud Gulf in 2024. However, additional tasking by the CCGS Sir Wilfrid Laurier to support the cargo vessel Thamesborg which ran aground in Franklin Strait put additional strain on available timing for ship activities over our leg and meant that the tilt-current meter moorings were left in place. They will be recovered by the CCGS Sir Wilfrid Laurier during summer operations in 2026.

Expected Project Completion Date: Provide month and year of expected completion date of the project.

Ongoing

Project website (if applicable): If your project has a presence on the internet, including a website and/or social media page, please provide the link and/or account handle.

N/A

Citations: Please append a complete reference list if citations are used anywhere in the document.

POLICY RELEVANCE

Does this research support policy development or decision-making in Nunavut? If yes, please describe.

The Kitikmeot Sea is currently inadequately studied to make long-term assessments of the impacts of development in the region. Prior to K3S, oceanographic data from the region was largely limited to opportunistic sampling from transiting icebreakers and community-based efforts such as the Canadian Rangers Ocean Watch. By positioning the RV Martin Bergmann in Cambridge Bay, the Arctic Research Foundation provided, for the first time, cost-effective logistics to support interdisciplinary oceanographic programs in the Kitikmeot, enabling new, ecosystem-based information via K3S. Our ship-based (spatial) and mooring (temporal) observations provide critical data to characterize the seasonal and inter-annual cycles of the Kitikmeot Sea. These observations will be used to understand how climate change drives increased variability and change in the physical, geochemical and biological system. Observations collected as part of K3S support DFO ocean modelling activities (Dr. Steiner and Dr. Wu) and Arctic char fishery research (Dr. Harris), and have enhanced DFO's ability to predict the consequences of climate change and improve plans for sustainability of northern marine resources.

RESEARCH OUTCOMES: BENEFITS

Community engagement: Briefly list and describe any community consultation, engagement, collaboration and outreach activities that you have undertaken for the project; describe the role(s) that community members and/or specific organizations have played in research co-design and activities.

Activities carried out in Sherman Inlet and Sherman Basin were co-designed with the community of Gjoa Haven.

Spring Community Meetings (April 30, 2025): On April 30, 2025, Bill Williams and Kristina Brown presented the results from the 2024 field program aboard the RV Martin Bergmann to community members in Gjoa Haven, about 32 people were in attendance, including 14 Elders who were given honoraria for their insights and participation. As in previous years, the Arctic Research Foundation was instrumental in facilitating and supporting this meeting.

Community discussions focused on similar themes as previous meetings, including:

- concerns with environmental change, sea water temperature, currents, sea ice
- youth noted that the Elders say Sherman Basin is "special" and was their homeland,
 - o what makes it special?
 - o why are the seals so big and the fish so healthy?
 - o why are there so many caribou and muskoxen?
 - o is this going to change?

Community members also requested more information on microplastics in the region, as well as further discussions about oceanographic knowledge around Chantrey Inlet. A follow-up meeting was planned for September, when Bill and Kristina were back in Gjoa Haven to board the CCGS Sir Wilfrid Laurier for the 2025 K3S program. On September 19th, Bill and Kristina presented a summary of previous oceanographic work within Chantrey Inlet aboard the RV Martin Bergmann and shared microplastics research results from Dr. Liisa Jantunen from Environment and Climate Change Canada. Four (4) Elders and two (2) community members were in attendance. The Elders reinforced their interest in continuing to receive feedback on research results and maintain communication with the community as these research programs progress.

Community-based oceanographic sampling activities in Kugluktuk are coordinated and carried out by community samplers from the Kugluktuk Hunters and Trappers Organization, in collaboration with the Canadian Rangers Ocean Watch (CROW) program. Kristina Brown visited Kugluktuk Hunters and Trappers Organization in April 2025 to share results, switch out equipment for maintenance, and carry out research activities to support the community based monitoring program in the Coppermine River estuary.

Youth engagement: Briefly list and describe any outreach, school or classroom activities that you have undertaken for the project; describe the role(s) that youth have played in your research activities.

Activities carried out in Sherman Inlet and Sherman Basin were co-designed with the community of Gjoa Haven. Two youth from the community (Barbara Porter and Gibson Porter) have been leading collaborative activities within the community, liaising between the science team and community members.

Spring Community Meetings (April 30, 2025): Project team member Barbara Porter helped organize the community meeting, but was unfortunately unable to attend due to illness.

Training and Employment:

How many Nunavummiut received training from team members? Please describe training and/or compensation provided.

All training completed in 2025 was done by Nunavummiut, which included training one (1) new sampler to support the Kugluktuk Community Based Monitoring program.

How many team members received training from Nunavummiut? Please describe training received and/or what knowledge sharing and/or skills exchange took place.

One new sampler was trained by Nunavummiut in Kugluktuk to support the Kugluktuk community based monitoring of the Coppermine River.

How many Nunavummiut received employment? Please describe employment type and length, role(s) and responsibilities, and compensation provided.

Six (6) Nunavummiut are directly employed through this research. Two translators were hired to translate during community meetings in Gjoa Haven in April and September, 2025. Four samplers were employed in Kugluktuk to carry out sampling in 2025, they are employed year-round through the Kugluktuk Hunters and Trappers Organization and complete sampling activities over 3-day intervals, 5 to 6 times per year.

How many Nunavummiut received honoraria as research participants? Please describe method of participation (interview, observation, sample, survey, etc.), including compensation provided.

Honoraria was provided to fourteen (14) Elders for their participation in community meetings and discussions of results from the RV Martin Bergmann program (April 30, 2025); and four (4) Elders were given honoraria for the follow-up community meeting to address questions raised in the April meeting and seek their input in advance of the 2025 CCGS Sir Wilfrid Laurier (Sept 19, 2025).

Please explain how the project directly benefited Nunavut organizations and/or businesses (e.g., through contract services, local purchases, equipment donations, etc.)

Community organizations who were contracted with for the use of facilities, accommodations, or to oversee community based monitoring activities in 2025 included: Kugluktuk Hunters and Trappers Organization, Gjoa Haven Hamlet, Betty Kogvik & Jimmy Arqviq (translation services), Gjoa Haven Co-op & Northern Store (community meeting food & beverages), and the Enokhok Inn in Kugluktuk (accommodations).

OPTIONAL: Nunavut Team Members, hires, and/or trainees (excluding research participants e.g., interviewees)

The NRI is creating an inventory of Nunavummiut who are skilled and/or interested in research. The information provided below will not be shared publicly but will support long-term capacity sharing by connecting local and visiting researchers with research talent in each community.

Name	Expertise/skills	Training/interest areas	Contact Info	Community
Eric Hitkolok	water sampling, fish sampling, CTD	fish ecology, water quality	kugluktuk@krwb.ca	Kugluktuk

Academic Mobility

If you are affiliated with an academic institution, please answer the following question: For which Level of Project(s) will the data be used? (Check all that may apply)

- ☒ Research
- ☒ Post-Doctoral Research
- ☒ PhD Thesis
- ☐ Masters (Major Research Paper)
- ☒ Masters (Thesis)
- ☐ Graduate Course Project
- ☒ Staff/Administration Research
- ☒ Undergraduate Honours Thesis

Other

BUDGET

Please complete the table below to detail your projected and actual research expenditures during the reporting period.

Category	Planned/Approved Expenditure	Actual Expenditure
Travel and Accommodation		\$39,186
Equipment, Materials and Supplies		\$14,795
Salaries/Wages for Nunavut residents		\$9,610
Salaries/Wages for non-Nunavut resident researchers		\$40,000
Professional Fees and services in Nunavut		\$3,511
Professional Fees and Services outside of Nunavut		\$60,000
TOTAL EXPENDITURES		\$167,102

*Note: Here and below we have included only the budget for the field portion of the program, including technician salaries. Non-Nunavut resident researcher salaries (DFO, UM) have not been included

List the total \$ amount of funding from each funding source for your full research program, including in-kind support

Fisheries and Oceans Canada, 2025 CASH = \$36,485
Fisheries and Oceans Canada, 2025 In Kind [salaries \$40K + shiptime \$60K] = \$100,000
National Geographic Explorer Fund, 2025 CASH = \$15,176
NSERC Northern Research Supplement = \$3,058
NSERC Discovery Grant ECR Fund CASH = \$12,383

RESEARCH OUTPUTS / REPORTING TOOLS

What research outputs were generated? Please list below and append copies of each. Specify which outputs (if any) may be made public on the NRI research licensing database.

Williams, WJ, et al. 2025. Processes in the Kitikmeot Sea estuary constraining marine life. Elem Sci Anth, 13: 1. DOI: <https://doi.org/10.1525/elementa.2024.00031>

Have peer-reviewed manuscripts been published as a result of your project? If Yes,
complete the following table:

Full citation	Publicly accessible/ free to access (Y/N)	Link (if available) and DOI (if available)
Williams, WJ, et al. 2025. Processes in the Kitikmeot Sea estuary constraining marine life. Elem Sci Anth, 13: 1.	Y	DOI: https://doi.org/10.1525/elementa.2024.00031

If No, do you intend to submit a manuscript (or manuscripts) for peer reviewed publication?

Future manuscripts are currently in preparation.

Were non-peer reviewed materials produced to either communicate or synthesize results to the public? Examples of these materials include (but are not limited to): websites, reports, brochures, podcasts, webinars, presentations, non-peer reviewed publications, etc.

If Yes, complete the following table:

Title	Description of Materials	Link (if available)	DOI (if available)
Investigating Freshwater-Driven Stratification, Mixing, and Biogeochemistry in the Arctic	Poster Presentation, ArcticNet AGM		

Did your project develop a communications plan? Please describe communications/reporting tools used, and list the target audience for each and/or who requested which.

How were Nunavummiut credited and/or acknowledged in all project outputs, such as co-authorship, participant biographies, article acknowledgements, etc.

Co-authorship & Acknowledgment on presentations; Acknowledgment in published materials. Future publication of our research program in Sherman Inlet and Sherman Basin will include youth co-leads of the program as co-authors, and will include Elders and Youth from Gjoa Haven in the results interpretation process.

DATA AND INTELLECTUAL PROPERTY

Did you enter into a research agreement, data-sharing agreement and/or intellectual property rights agreement with a community and/or designated Inuit organization (DIO)? If yes, please explain.

Do intellectual property rights apply to your research? If yes, please explain.

Who owns the data? Has the raw data been shared with the appropriate community and/or DIO? If yes, how? How is data security and storage handled by community-based co-owners?

Observations collected and data generated from this research is owned by the Federal Government of Canada, and is publicly available upon request, or as described below.

Where is the data stored and will the data be destroyed within a set timeframe?

- Raw instrument data will be stored and processed data will be placed in the DFO-IOS Ocean Science Division data archive
- Physical samples (e.g., zooplankton, water samples) that are not analyzed in-house will be stored at the Institute of Ocean Sciences until analysis at off-site labs is possible
- Biological data will be archived at the Norwegian Marine Data Center (<https://dataverse.no/dataverse/uit>).
- Benthic biological samples will be stored in archives at UiT, Norway

Is the data trackable and/or available in a public data repository? If yes, please provide the appropriate information and/or link to ensure the findability and accessibility of the data.

Physical and geochemical data are available from Fisheries and Oceans Canada's Marine Environmental Data Section Archive (<https://meds-sdmm.dfo-mpo.gc.ca>) by request at: <https://isdmm.gc.ca/isdmm-gdsi/request-commande/form-eng.asp>

Please append a copy of your data management plan.

CLIMATE CHANGE

Is your research about climate change (causes, impacts, mitigation, adaptation, etc.)? If yes, explain.

Our research uses a suite of oceanographic tools and year-round moorings to investigate the oceanography of the Kitikmeot Sea, including the flow of river water to the sea, and the tidally influenced narrow straits. Our primary objective is to develop a baseline oceanographic understanding and conceptual model of the Kitikmeot Sea that characterizes, and quantifies, the physical and geochemical factors that constrain marine ecosystem structure and function and their sensitivity to climate change, including cascading impacts on primary producers through to resident char and seal populations important to local subsistence fisheries. Observations gathered as a part of this research will be used to understand how climate change drives increased variability and change in the physical, geochemical and biological system, in particular supporting DFO ocean modeling activities and Arctic char fishery research. Overall results from this study will better position DFO to predict the consequences of climate change and improve plans for sustainability of northern marine resources.

PHOTOGRAPHS

If possible, please provide high-resolution photos of licensed research activities that NRI may use in communication materials, organizational reporting, and other promotional purposes. Please also complete the table below for each photo provided and submit to NRI along with all required NRI photo release forms. The photographer/owner will be credited in all uses of the photograph(s).

File Name	Location	Description	Subjects	Photographer/Owner	Date