This document provides additional information in support of our application for a Scientific Research License to conduct coastal ecosystem research in the Qikiqtarjuaq region. It summarizes the background, objectives, methodology, community engagement activities, and anticipated benefits of the proposed **sclerochronological organism collection and growth monitoring** program. Thank you for your consideration of this application.

Broader context

We are a research team based at Université Laval and affiliated with Takuvik Joint International Laboratory, a larger research group within the institution that has been actively engaged in research activities in Qikiqtarjuaq since 2015 and led the development of the Qikiqtarjuaq Research Centre, which has been operational since 2025.

The project presented here builds on the scientific objectives supported through the recently funded Transforming Climate Action project and aligns with the Research Centre's objective of developing local research and diving capacity in Qikiqtarjuaq.

Clams, Coralline algae, background and rationale

Coralline red algae, often mistaken for corals or pink rock, are in fact macro-algae with a special adaptation of having mineralized cell walls. Similar to coral reefs, they provide habitats for small critters such as mollusks, sponges and brittle stars. However, for scientists interested in understanding past environments they represent a valuable archive. As these algae grow, they produce new layers of calcified cells which build-up forming annual rings, similar to tree-rings. The thicknesses of annual layers have been shown to be useful to reconstruct past sea ice condition and temperature, while the geochemistry has been shown to respond to ocean chemistry, including shifts related to phytoplankton dynamics. Clam shells can be used similarly however their chemistry is linked to a mix of ocean chemistry and their diet which includes phytoplankton. Therefore, their combined use can be used to confirm long-term changes in hydro-ecological conditions.

Since they are responsible for some of the greatest carbon fluxes on earth, understanding phytoplankton dynamics is critical to reducing uncertainties related to carbon budgets. However, remaining questions related to their long-term variability, coastal dynamics, and seasonal differences (especially polar night-early spring transition) limit our ability to fill data gaps required to quantify their contributions in ocean carbon cycle pathways. Without these data, we risk misinterpreting short-term fluctuations, underestimating the pace of change, and making poorly informed mitigation and adaptation decisions.

One way to fill this data gap is the use of environmental archives such as the shells of clams and coralline red alga, *Clathromorphum compactum*. This project aims to develop analytical methods in order to quantify how climate change and sea-ice loss on the coasts of Baffin Bay have impacted phytoplankton dynamics.

Our objectives

This project aims to answer a few key questions:

Q1. How do the targeted geochemical and growth markers in clam shells and coralline algae crusts vary in response to phytoplankton dynamics and sea-ice fluctuations?

Q2. Does a calibration of geochemical data from clam shells and coralline algae to instrumental data from local monitoring programs and remote-sensing-based oceanographic data replicate known phytoplankton dynamics or does it reveal variability not yet quantified?

Q3. How has primary productivity varied near Qikiqtarjuaq over the past few hundred years at a sub-annual temporal scale?

We will answer these questions through the completion of the following objectives:

O1. Collect thicker (older) *C. compactum* crusts and clam shells (e.g., *Serripes groenlandicus* – Greenland cockle, *Mya truncata* – truncated soft-shell clam, and *Astarte borealis*) to later analyze and obtain proxy information of phytoplankton dynamics, and thinner (younger) C. compactum crusts to monitor their growth over 1-year.

O2. Monitor growth of C. compactum over 1-year through a fixed underwater platform. In-situ continuous data loggers installed on the platform during the length of the experiment will be used to calibrate coralline algal geochemical data after analysis. C. compactum will be collected and loggers exchanged on near-monthly dives.

O3. Produce a multi-centennial proxy record of primary productivity variability by analysing 3 of the oldest coralline algal samples with regular growth from the 2026 collection, integrating previously analysed geochemical timeseries from samples from 2014, and producing quantitative phytoplankton

dynamics proxy chronologies (via calibration) of the most promising geochemical markers.

Methodology

1. Coralline algae collection integrated within distribution and thickness surveys:
This component will involve initial drop-down camera surveys to localize sites and quadrat-based surveys conducted by divers at multiple kelp sites (within a ~110 km radius of Qikiqtarjuaq) to quantify species composition, density, and thickness of *C. compactum* crusts. An initial collection will be obtained during these surveys targeting especially thick specimens. Collection methods are simple involving removal by hand or assisted with hammer and chisel and transport back to boat with hand-held net. Based on these surveys, the sites for thinner algal crusts will be selected for the establishment of a long-term monitoring platform within a 45-minute skidoo ride from Qikiqtarjuaq.

2. Coralline algae growth monitoring platform:
Once site has been identified through surveys, a semi-permanent underwater platform with fixed coralline algae and data loggers will be attached to the seafloor at a 15-20 m depth. Prior to platform installation, a maximum of 120 algal crusts will be collected near the platform site, brought to the Qikiqtarjuaq Research Station, placed in Alizarein dye solution for 3 days, cemented onto tops that will be screwed into acrylic or PVC plates, which will be secured to the bottom with rods in the sediment or cemented into cracks with stainless steel rods. On a near-monthly basis, 5-10 algae samples will be collected from the platform composed of scattered algae-cemented plates covering a bottom surface 5m x 5m with environmental sensors (e.g., light, temperature, pH, salinity, photosynthetic active radiation). These sensors will provide data for periods that diving is not planned or possible. The PVC plates and sensors will be removed at the end of the experimental period.

3. Clam collection:
Opportunistically, clams (e.g., *Serripes groenlandicus* – Greenland cockle, *Mya truncata* – truncated soft-shell clam, and *Astarte borealis*) will be collected for their shells in a 75 km radius from Qikiqtarjuaq. No more than 10 bivalve shells of each species will be retained per collection, with a maximum of 120 bivalve shells per species and site over a 1-year period.

4. Water and sediment collection:
At time of clam or coralline algal collection, additional water (less than 1L) and sediment (less than 1L) will be collected to contextualize growing conditions with nutrient, carbonate and composition information.

5. Analysis off-site:

After collection, clam shells and coralline algal crusts will be cleaned of any remaining tissues, and shipped to analytical facilities, where their shells will be analyses biogeochemically. Analyses include stable isotopes, compound specific nitrogen isotope amino acids, and trace elements. These will be used to reconstruct the variability of ocean chemistry influenced by micro-algae (phytoplankton) over the last few decades to centuries.

Fieldwork calendar

Fieldwork will take place in the greater Qikiqtarjuaq area and will begin in mid-August 2026.

The first phase will last approximately one month: 10 days to conduct initial regional surveys and select the monitoring platform site, followed by 20 days where coralline algal crusts will be collected in tandem with other projects already approved by NRI. In late September and August 2026, the platform will be installed with local engagement, assistants and guides.

Subsequent monitoring of coralline algal growth will be on a near-monthly basis, with retrieval of 8-10 crusts and replacement of instruments by local divers.

We aim to train a local team to participate in these activities. Our goal is to foster sustained local engagement so that community divers can continue monitoring the sites over time and share observations locally. Because the recovery of clams and coralline algae may extend beyond the duration of this project (even if it is renewed for an additional four years), maintaining community involvement will help ensure that monitoring continues and that observations remain shared with the community.

We will oversee and participate in these operations for a minimum of three years, including four open-water seasons (with the intention of remaining involved for longer). This effort will provide robust data on climate and food-web dynamics.

Short term and long-term objectives

Short-term objectives include establishing baseline estimates phytoplankton dynamics in coastal Baffin Island region through the analysis of clam shells and coralline algae crusts.

Long-term objectives are to assess trends in changing ecosystem dynamics such a predicting tipping points.

Progress to date & capacity building

We first contacted the Nattivak HTA in December 2025 where we spent a significant 3 month period establishing communities ties. After attending two Nattivak HTA meetings, we welcomed HTA representatives to the Research Centre for a formal presentation and discussion of the project.

Participants showed interest in the potential of these organisms to tell a story of ocean change, and a particular interest in clams which are abundant around Qikiqtarjuaq and commonly harvested. They shared knowledge about potential locations and traditional uses for coralline algae which were previously unknown by researchers. The Nattivak HTA expressed support for the project and encouraged the hiring and training of community members, noting that this opportunity would likely generate strong local interest.

Inuit involvement is central to this effort. In Qikiqtarjuaq, local divers trained in monitoring can become first-hand witnesses of environmental change. The specimens, underwater photographs, and videos they document - at a time when Inuit communities are widely interconnected through social media - can help foster a collective understanding of the richness and vulnerability of local marine habitats. Through Inuit and federal organizations, this knowledge may resonate beyond Qikiqtarjuaq and support northern communities facing decisions about coastal development.

We are also in contact with Sammy Qappik, a highly experienced local diver, to explore his interest in leading the community team. In March 5 2026, during a meeting for the broader Baseline project with the HTA, participants reiterated their interest in having local divers trained.

Funding has already been secured by collaborator Camille Lavoie from Québec Ocean and Transforming Climate Action funding programs. Accordingly, we will be inviting additional community members to participate and hire a dive instructor to travel to Qikiqtarjuaq. We will partner with a PADI-certified dive school in Ottawa and plan to return to Qikiqtarjuaq soon to meet potential divers recommended by Sammy Qappik.

Recruitment

Recruitment will prioritize community guidance. The research team will first meet with the Nattivak HTA to present the project needs and follow their recommendations regarding recruitment strategies.

Additional outreach may include announcements on local Facebook groups (in English and Inuktitut), radio announcements in Inuktitut, and public presentations at the Research Centre, the Hamlet office, or the Northern store. Visual materials used during these outreach activities will be available in both English and Inuktitut.

Interested individuals will be invited to meet with the research team at the Research Centre for informal discussions and interviews. Recruitment may also occur through existing community networks, including individuals already involved in scientific activities and their extended teams or families.

Data management

The project follows principles of transparency, community access, and responsible stewardship of knowledge generated in Nunavut. Project updates, summaries, and results will be shared regularly with the Nattivak HTA, the Hamlet, and the community through presentations at the Qikiqtarjuaq Research Centre, school outreach activities, and updates on the Research Centre's communication platforms.

All ecological and environmental data collected during this project (e.g., species observations, growth measurements, environmental sensor data, photographs, and experimental monitoring results) will be recorded following standardized field and metadata protocols to ensure traceability and long-term usability. Data will be stored securely on institutional servers at Université Laval and backed up regularly.

At the completion of the project, research data and associated metadata will be deposited in open-access, long-term repositories such as the Polar Data Catalogue or Dryad to ensure accessibility and long-term preservation. Recognizing that internet access can be limited in northern communities, copies of datasets, reports, and publications will also be archived locally at the Qikiqtarjuaq Research Centre. Handouts and printed copies of reports and manuscripts will be provided to the Nattivak HTA and the Research Centre.

All specimen collections will be catalogued and deposited in recognized scientific collections (e.g., the Canadian Museum of Nature), with associated metadata maintained and made accessible through institutional databases. A catalogue of seaweed press specimens will also be made available to the community at the Research Centre. The project does not involve the collection of personal or sensitive information from individuals.

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Throughout the project, we will maintain open communication with local partners regarding how information is collected, stored, and shared, and will ensure that knowledge generated through the project remains accessible to the community.

Research outputs

The project will generate several research outputs, including peer-reviewed scientific publications, conference presentations, technical reports, and educational materials. Results will also contribute to academic training and may support graduate theses associated with the project.

In the community, results will be shared regularly with the Hamlet and the Nattivak HTA through annual reports and presentations during each field visit. We also hope to involve local community partners in the dissemination of results. These meetings will provide opportunities to discuss findings, receive feedback, and validate interpretations with community partners. Outreach activities will also be offered at the school when possible.

Final project results will be presented during a formal meeting with the HTA and shared through printed reports made available at the Qikiqtarjuaq Research Centre.

To broaden accessibility across Nunavut and Inuit Nunangat, we will also engage with regional media and partners - Nunatsiaq News, CBC North, and Oceans North - to explore coverage of the project and its outcomes.

Within the academic community, preliminary and final results will be presented annually at national and international conferences, including ArcticNet, the Canadian Geophysical Union, and the European Geophysical Union. When possible, we hope to travel and present alongside community members involved in the project.