Results Summary for Community Organizations and Contributors

IMALIRIJIIT:

those who study water

Community-based environmental monitoring program of the George River watershed, Nunavik (2017-2018)

Presented to the Northern Village of Kangiqsualujjuaq
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By José Gérin-Lajoie, Gwyneth MacMillan, Émilie Hébert-Houle, Mathieu Monfette, Justine-Anne Rowell, Cloé Fortin, Jan Franssen, Marc Amyot, Thora Herrmann, Jean-Pierre Dedieu, Esther Lévesque.

How the Project Started

A science land camp involving youth, Elders and local experts was co-initiated and co-funded by the community of Kangiqsualujjuaq (Nunavik) and university-affiliated researchers in 2016. Following a consultation with the main local organizations, the community decided to focus on the water quality of George River due to the possibility of a rare earth element (REE) mining project in its upper watershed. Kangiqsualujjuamiut were concerned about this mining project as the river is essential to the traditional activities of fishing, hunting and gathering. The community wanted its own independent and long-term community-based environmental monitoring program (CBEM) to have reference data before any disturbance in the watershed and to promote local capacity-building in water quality data sampling and natural sciences. The science land camps evolved into a community-based environmental monitoring program named IMALIRIJIIT ("those who study water") by the youth participants in 2016. The land camp program uses a hands-on and land-based approach.

What we did in 2017-2018

Science land camp 2017

In 2017, the science land camp took place from July 21st to 30th. The team included 29 people: six researchers, 11 youth from 13 to 17 years old (seven boys and four girls), four guides, one assistant, two cooks, two Elders, one local coordinator and two children. All youth participants were new recruits.

A local youth coordinator was chosen by the community and an educational program coordinator was chosen from within the group of researchers. Together, they organized pre-camp activities for three days before the youth's departure, including visiting a geologist camp near the community. The rest of the scientific team went to set up the camp and collect a substantial part of the water quality data before the youth's arrival, so that they could be more focused on the educational goals with the youth during the camp. In this second year, the educational program was more diverse and formally-structured. It was oriented towards a variety of fields of natural and physical sciences (hydrology, geology and sedimentary processes, geomorphology, plant ecology, botany, entomology, invertebrate zoology, physical chemistry, mapping and GPS, biomonitoring). It also aimed to provide opportunities for the youth to connect with Inuit knowledge while traveling on the river and being out on the land with local experts and Elders.

Water Quality Monitoring

In 2017, 10 sites were sampled along the river, including the same five from 2016 and five additional sites (See Map, Page 8). Local knowledge and satellite images helped to select the location of the sampling sites.

Water physico-chemistry variables were measured on the river with manual kits (LaMotte) by the youth as well as with an electronic probe (YSI Pro Plus).

Temperature: temperature changes can affect physical, chemical and biological processes in rivers such as oxygen availability, pH, conductivity, salinity and water circulation by influencing density.

pH: pH allows us to determine if the water sample is acid (<7, like a lemon), basic (>7, like bleach) or neutral (=7, like distilled water). pH is an important variable to measure in rivers as it affects nutrient availability for living organisms and the toxicity of some metals.

Conductivity: Conductivity is the water's capacity to conduct electricity and depends on the concentration of mineral salts and the temperature. Conductivity is linked to the local geology. Values are relatively stable for a given environment.

Dissolved oxygen: As oxygen is an essential gas for most living organisms, the measurement of dissolved oxygen in water is important. Oxygen concentrations between 7 and 11 milligrams per liter (mg/L) are ideal for most fish species.

Turbidity: Turbidity is a measure of the water cloudiness, or of how much light can pass through the suspended particles in the water. Some waters are completely clear while others are full of particles and cloudy, varying from less than 1 Jackson Turbidity Unit (JTU) to 50 JTU. Variations are mainly due to the erosion of the river's shoreline and to heavy rainfall.

Hardness: Water hardness is linked to conductivity, as well as the concentration of mineral salts, calcium and magnesium. Very soft water contains between 0 and 30 milligrams per liter (mg/L) of mineral salts and very hard water contains over 160 mg/L of mineral salts. Water hardness affects whether soap will lather or not. Water hardness can influence the availability and/or toxicity of metals.

Colour: Three main components affect the water colour in natural environments: 1) phytoplankton (microscopic algae) or chlorophyll; 2) non-algal matter, such as fine soils (chalk); and 3) dissolved coloured matter, mainly substances originating from land and aquatic plants. Water colour can be measured by transparency using the Forel-Ule scale (as on the picture) or with the help of a Secchi disk.

Water samples were collected (unfiltered and filtered) for laboratory analyzes of nutrients, dissolved organic carbon, major ions, chlorophyll-a, trace metals and rare earth elements (REEs). A member of the Parks Nunavik team joined us to learn the water sampling protocols in order to better share this work in the future. Some guides were interested in learning about sampling techniques and also attended the youth's training activities.

Major ions: Major ions play an important role in aquatic ecosystems. They are present in the water in concentrations between 1 and 10 000 mg/L. They include calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K).

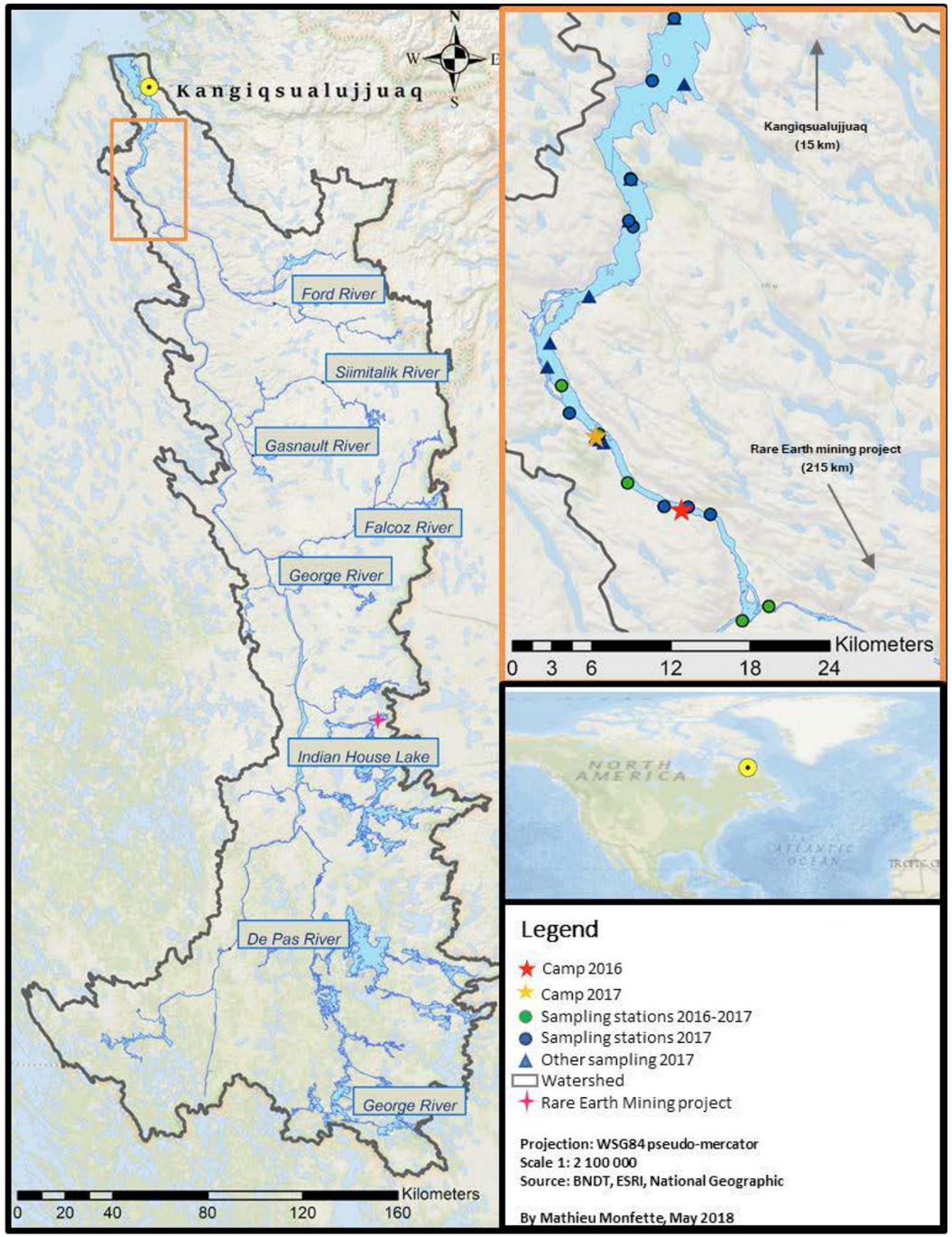
Chlorophyll-a: Essential for capturing the energy of the sun during photosynthesis, chlorophyll-a is a green pigment found in plants and algae. Chlorophyll concentration can be related to the abundance of phytoplankton (microscopic algae) living in water. If concentrations are lower than 3 micrograms per liter (µg/L), the productivity (or plant growth) of the water body is low.

Trace metals: Trace metals are naturally present in the environment at very low concentrations depending on local geology and volcanic inputs. Human activities, including transportation and mining, have been responsible for increased trace metal concentrations in many ecosystems. Depending on the concentration and on other physico-chemical characteristics of the environment, some of these metals can be toxic to living organisms.

Rare earth elements: Rare earth elements (REEs) are a group of 17 metals. Despite their name, REEs are not particularly rare. REEs have very similar chemical properties which make them difficult to extract and isolate from each other. REEs are strongly attached to soils, consequently they can have low mobility in water. They make good magnets and are used in many high-tech products such as solar panels, wind turbines, electric vehicles, mobile phones and computers.

Water quality guidelines (WQG) are acceptable levels of substances (e.g. for metals or pesticides) established to protect the health of lakes and rivers. They are established by federal and provincial governments and there are different criteria for drinking water and for the protection of aquatic life. WQG exist for trace metals, but no criteria exist in Canada for REEs as there is a lack of scientific data on their behaviour, fate and toxicity in natural ecosystems.

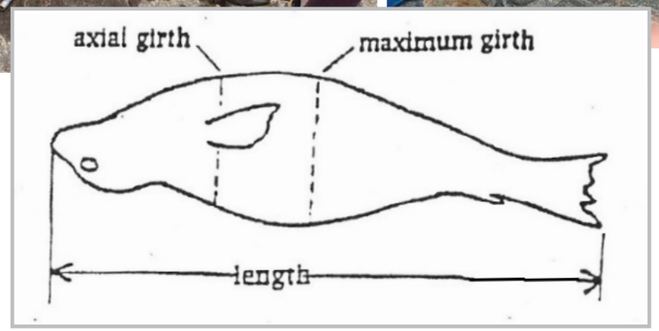
George River, Nunavik, Canada



Biological Sampling (or Biomonitoring)

In 2017, a monitoring survey examining the food quality in the George River watershed began in collaboration with a local coordinator from the Hunter's Support Program. The goal was to measure country food quality before any major environmental disturbances in the watershed. Inuktitut and English sampling kits were prepared for fish, seal and caribou. Additional kits for ptarmigan and hare were prepared in March 2018. Hunters followed sampling protocols and filled out forms with identification, measurements and tissue collection details for a financial compensation. One young bearded seal was harvested and sampled during the 2017 land camp near a sampling station. We have currently collected 27 whitefish, 4 sculpins, 2 cods, 4 seals, 17 ptarmigans and 1 hare. In 2017-2018, the caribou were far from the community and therefore we have not yet collected any samples. In addition, 13 lichen samples and 3 sediment and biofilm samples were collected during the science land camp for biomonitoring.

The samples were frozen and later processed and analyzed at the University of Montreal (Laboratory of Dr. Marc Amyot) for analysis of trace metals, mercury and rare earth elements.



Macroinvertebrates

Macro-invertebrates are small animals (like shrimps) that live in freshwater ecosystems for at least part of their lifecycles. Their abundance and diversity can be used to provide insight into the health of lakes and rivers. In 2016 and 2017, a macro-invertebrate inventory was completed at the mouth of a tributary brook, following the MDDEFP (2013) sampling protocol for rocky riverbeds. A D-shaped net was used to collect the organisms. Sorting and identification took place at the camp for a whole afternoon with the help of many participants including youth, guides, local coordinator and children!

Hydrology and Remote sensing

A study of environmental change at the watershed scale is ongoing and will rely on remote sensing (images taken from satellites). Two databases for optical remote sensing will be used from available and free satellite archives: Landsat-5, 7, 8 (NASA) from 1984 (resolution 15 m), Sentinel-2 (European Space Agency) from 2015 (resolution 10 m). Ice onset and breakup, as well as snow melt, will be documented from these images for a period of 30 years, as these two parameters influence runoff, discharge and water quality. This work focuses on three water quality parameters: chlorophyll-a (pigment found in plants and algae), salinity (salt concentration) and turbidity (water cloudiness). Surveys were completed during the land camps in 2016 and 2017 to map water depths in the river. We will also assess environmental change including vegetation growth, landslides, as well as channel erosion and sedimentation in the coming year.

Local Knowledge and Interactive Mapping

Local knowledge was also used as a tool to document land use by Inuit, plant and animal ecology, the river's movements and processes as well as the observed changes (vegetation growth, landslides, etc.) in the George River watershed. Elders who participated in the science land camps were interviewed and five additional semi-structured interviews with local guides/hunters were conducted in the community with the help of interpreters Henry Ittulak (2017) and Louisa Minnie Etok (2016). A total of 20 interviews with 14 interviewees were analyzed, including interviews conducted in 2007 and 2008 by Alain Cuerrier and José Gérin-Lajoie with Annie Baron and Mary Etok as interpreters. The interviewees talked about their life stories, land uses, distribution of animal and plant species, local toponymy, changes in the river watershed, broader environmental changes, as well as other stories linked to the river. These interviews were made with map support, under an Ethics Certificate from UQTR (CER-16-225-07.14).

Interactive Mapping Training Workshop

An Interactive Mapping Workshop was organized by José Gérin-Lajoie and Thora Herrmann in Montréal, on March 27th to 29th 2018 at the University of Montreal (Geography department). Victoria Cooper from Kangiqsualujjuaq, Kabimbetas Noah Mokoush from the Naskapi Nation of Kawawachikamach, and Clara Morrissette Boileau from Parks Nunavik in Kuujjuaq attended the training workshop which was given by geographers Hadrien Bois Von Kursk and Émilie Hébert-Houle. The trainees learned how to build an interactive map using the uMap platform. The 3-day training included learning about map features, integrating pictures, GPS coordinates, audios and videos, organizing data and layers on the maps, discussing ownership of data and map sharing, and completing exercises to create new maps.

This training fostered a potential collaboration between the Kangiqsualujjuaq Inuit community and the Naskapi Nation of Kawawachikamach for sharing local knowledge and land use related to the George River watershed.

What we learned about working together

"It is important to have the George River be environmentally monitored especially being the traditional and fishing/harvesting lands of our people. Our community doesn't have means or tools to be able to know how the George River would be affected if ever there was a mining development in the area. This monitoring project brings also an educational value by involving our youth from the community."

Maggie Emudluk, President of Qiniqtiq Landholding Corporation

Together we learned that successfully working together depends on building trust and respectful relationships, as well as on the sharing of knowledge and perspectives between different groups and cultures. We have traveled, camped, eaten and laughed together. Collectively, we are focusing not just on **what** is measured but on **how** it is measured and **who** which data is important and decides of its use. Working with the community in a participatory way on equal footing from the outset and throughout the IMALIRIJIIT program was essential for building trust and to maintain the community's involvement. Together we organized the science land camps, struggled over budgets and funding, discussed the scientific sampling and outcomes, wrote proposals, and gave oral presentations.

We learned to listen to the local experts. Inuit knowledge (IK) was used in this study to identify the study area, the sampling sites and the target species for the country food monitoring. Local knowledge was very helpful for the interpretation and validation of remote sensing data at the watershed scale (e.g. for sedimentation and hydrological processes). Thus, IK helped to fill gaps in the scientific knowledge of the George River watershed.

The IMALIRIJIIT program uses a hands-on and land-based approach that allows the community and researchers to merge Inuit ways and scientific procedures. These methods help us highlight similarities between the scientific method and the Inuit hunting and gathering culture such as curiosity, observation, analysis and problem solving which are required in both knowledge systems.

We learned that it was important to have an official youth coordinator among the researchers to organize pre-camp activities that helped us gain trust and establish stronger relationships with the youth. Over the duration of both science land camps, the youth gained confidence in their capacity to participate in scientific activities and displayed a sense of pride in their work. Initially, the youth were not interested in spending time in the "Science tent" and wanted to be left alone in their own tents. However after a few days, they were constantly saying "Let's go to the Science Tent" and were willing (even excited) to participate in scientific activities like sorting benthic invertebrates.

The science land camp also fostered opportunities for local knowledge holders to transmit land skills to youth while traveling on the river, such as how to "read the river". In both 2016 and 2017, we observed a strong interest from some guides in the scientific activities, data collection and scientific protocols. Upon return to the community, some of the guides went on the local radio to say that they had appreciated their experience and that the involvement and training of the youth was important, as well as the relevance of the environmental protection of the river and the pride of seeing Inuit doing scientific activities. We learned that hiring local coordinators from the community for both the science land camp and the country food collection by hunters was very effective. We realized that we need to invest more resources in building local capacities in environmental sciences, not only with the youth, but also with the active hunters.

"Imalirijiit project has involved many Inuit youth and elders and it has been a successful project. It is a project that monitors water quality in the George River. It has stimulated interest in science and on the land programs amongst Inuit youth. Also, it has provided educational hands on learning experiences that made youth eager to learn more and expanded their interest to become involved in scientific projects."

Hilda Snowball, mayor of Kangiqsualujjuaq.

Working together, we have learned how to successfully write grant co-applications with inputs from both researchers and the Kangiqsualujjuaq Northern village. At least three grants have been successful (Polar Knowledge Canada, Makivik, Northern Contaminants Program) and two others are pending (Indigenous and Northern Affairs Canada and Plan Nord). Our complementary expertise allowed us to apply both to scientific grants and to community-based monitoring grants. We will have to define jointly how the Imalirijiit program will be sustainable in the future.

We learned the importance of good communication within the scientific and local communities.

- In December 2017, the mayor Hilda Snowball gave a joint oral presentation with J. Gérin-Lajoie at the Arctic Change Conference in Quebec City. The structure of the presentation was different than the usual scientific presentations. It was designed as a conversation between an Inuk stakeholder and a researcher, mutually asking questions such as: How you expect researchers to work with your community? Does it make a difference for you as researchers to work on a project proposed by the community? How do you see the future of Imaliriit program? The formula was very well-received by the audience.
- Researchers have also learned how to share information with the community and to be transparent. They have come to understand the importance of frequently returning to the community to discuss plans, funding, and to share research results in relevant and understandable ways (for example, the comic strip on REEs included with this report).

We have also learned that the interactive mapping platform uMap is user friendly and easy to teach to community members, thus a good tool for capacity building. The workshop's trainees were very interested to learn all the possibilities offered by this platform for designing maps but especially for displaying traditional knowledge and land use with audiovisual content. They already plan to teach how to use uMap to other community members. Interactive mapping will contribute to display the collective body of knowledge around the George River watershed in a creative and evolving way. This workshop also taught us that there was interest in collaboration between Inuit and Naskapi for interactive mapping.

This collaborative, multicultural and multidisciplinary initiative is contributing to the scientific, educational and community objectives, for the benefit of researchers, local community and regional organizations (see Table 1).

Table 1. Scientific, educational and community objectives of Imalirijiit program

Scientific objectives	Educational objectives	Community objectives
Baseline data for water quality of George River	Mentoring with an Inuk researcher in water quality	Monitoring the water quality of George River
Remote sensing analysis to study depth, turbidity, Chl-a, and vegetation change	Sparking Inuit youth's interest in natural sciences	Long-term environmental monitoring, at a larger scale
Analysis of contaminants in key species in theGeorgeRiver watershed	Training local people in biomonitoring	Protection of natural resources and traditional food (country food)
Monitoring REEs in northern environments	Introduction to geology, chemistry, ecotoxicology, natural sciences	Independence from the mine
Hydrological characterization of the river	Hands-on learning, land-based approach	Training the youth in water quality monitoring
Development of an interactive map as outreach	Intercultural and intergenerational sharing	Archiving of local knowledge, accessibility of the results
Multidisciplinary approach	Adapted protocols and diversified tools	Multi-stakeholder approach for collaborative work

What we learned about the George River

Water Quality Monitoring

In general, the 10 different sampling sites showed relatively similar physico-chemical signatures, indicating that the river water is very well-mixed. The George River water quality data was similar to the data collected in 2015 for a neighbouring river, the Koroc (see Table 2). During the sampling period in July, the river water had a temperature of 16°C, neutral pH (therefore not acidic or basic), well oxygenated waters, with low electrical conductivity. The water was also very soft (low levels of $CaCO_3$) - so will lather easily! The George River is oligotrophic, which means showing low levels of nutrients like nitrogen and phosphorus). It also has low chlorophyll concentrations, meaning that there is not much algal (or plant) growth in the water.

Table 2. Water quality parameters in George River (2016 and 2017) and Koroc River (2015)

Parameter (average)	George River July 2016 n=5	George River July 2017 n=10	Koroc River August 2015 n=4
Temperature (°C)	16	12.5	N/A
pH	7.05	7.07	6.60
Dissolved oxygen (mg O2/L)	10.57	10.88	8.62
Conductivity (µS/cm)	13.5	12.53	28.88

The levels of trace metals and REEs in the George River are very low and all measurements were under the existing Canadian water quality guidelines. Note: guidelines do not currently exist for REEs.

Biomonitoring:

Metals and REEs were sampled in lichens to monitor the quality of the atmosphere, as lichens take up all their nutrients from the air because they have no root system. Lichen samples collected from near the community and from the George River watershed showed higher levels of metals than surface waters, indicating that they could be used as a good bio-indicator of air quality. As some metals can potentially accumulate in plants and animals, we are currently studying the levels of these metals (and mercury) in fish, seals, caribou, hare and ptarmigan. These data are currently being analyzed in the laboratory and will provide us with a general portrait of the metals present in the George River watershed, allowing us to monitor the impacts of environmental changes on water, plants and animals.

Macro-invertebrates

The dominant macro-invertebrate groups in the samples collected in a tributary brook were **Ephemeroptera** (e.g. mayflies), **Plecoptera** (e.g. stoneflies) and **Trichoptera** (e.g. caddisflies), along with **Diptera** (e.g. blackflies, mosquitoes) and **Hydracarina** (water mites). The first three groups are indicators of good water quality while the abundance of black flies and mosquitoes during the sampling period may explain the abundance of **Diptera**.

Hydrology

We estimated that the flow rate of the George River at the Lac de la Hutte sauvage station was approximately 560 m^3/s in late July 2016 and 645 m^3/s in late July 2017. Based on historical records, the late July flow rates for both 2016 and 2017 were below average. Analysis of historical flow records for the George River indicates that there has been a slight but significant decrease (nearly 1%) in mean annual discharge since the mid-1970s. This de vcreasing trend is associated with reduced flow during the summer period. Winter flow rates appear to be stable. We do not yet know the factors responsible for this downward trend in summer flows; further analysis of hydrologic and climate factors will be required to determine causes.

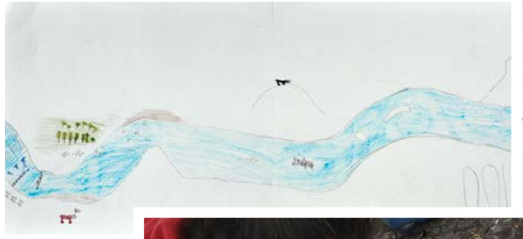
Remote sensing

We have explored the potential of two different satellite platforms to assess the current and historical water quality of the George River. The two platforms are: (i) the Landsat TM series of satellites operated since 1984 by the United States government (NASA); and (ii) the A & B Sentinel-2 platforms in operation since 2015 by the European Space Agency. These satellites capture routine images of the George River watershed at intervals of 7 to 9 days (Landsat 8) and between 5 to 13 days (Sentinel-2) and thus provide an ongoing image record of the watershed.

As there are no historical records of water quality for the George River, the data available from these satellite platforms provides the only current scientific means of determining long-term trends in water quality. There are several important challenges in using satellite imagery to develop a historical record of water quality: (i) the obstruction of the Earth's surface by cloud cover which reduces the frequency of images valuable for analysis; and (ii) the development of strong relationships between the satellite images and specific water quality parameters. To date, our results are encouraging for the following parameters: river depth, turbidity (water cloudiness), and salinity (salt concentration in water).

Inuit knowledge

Interviews, discussions and activities gathering youth, elders and guides took place several times during the science land camp to encourage intergenerational knowledge transfer, such as Inuit knowledge related to the George River, observations of hydrological changes and navigational skills. A mental mapping activity was organized at the beginning of the camp where the youth had to draw their representation of the river and its various components in groups of two or three.



The observations by elders and local guides/hunters confirm that the climate is changing in the Kangiqsuallujuaq area, becoming more and more unpredictable and directly impacting the George River's ecosystem in various ways. The observations show that the diversity, distribution, abundance, and biology (fur, fat and reproduction) of plant and animal species are being affected by environmental change. Land-based activities, including travelling routes, craft supplies and hunting/fishing/gathering are also affected. This can threaten a way of life and valuable traditional knowledge.

Observations on the river

"More rocks are showing. The river makes the rocks go down, making the river more dangerous. [...] The river is getting smaller than before, and the water level is lower. Back then, there was no low tide. [...] We used to go upriver without motors, just paddling. We used to put sail on umiaq (boat); the water was less shallow."

- Minnie Mae Annanack, interviewed on July 25th 2016

"I go upriver pretty much every year. Go pretty much all year round, during winter and during summer. Best time to go is when the ice just breaks and the water is pretty high. That is when you don't have worries hitting rocks and shallow water. [...] Around beginning of June, that is always a good time. [...] You can go upriver pretty much all summer. But in the fall people go fishing up there and there is more chances hitting a rock. Less water. [...] When it's full moon time, the water goes higher and the river is like higher tide. [...] after the full moon, the tide goes pretty low and the rapids, the rocks are showing more. It's riskier trying to go down the rapids when the tide is low. [...] It's about one week after the full moon."

- Jaiku Arnatuk, interviewed on August 3rd 2017

"The movements of the sand, under the water. Some spots are deeper and some spots are shallower. So we see all the differences every year. It varies, like more ice flow, when there is more water, high water, it flows faster and the sand is brought down, further. [...] Like some spots, where there used to be no sand, it used to be all rocks, it's covered in sand too. Around here, [...] you see like the differences. When we hit the sand bank, I never expected to hit the sand. I used to drive from the camp to the rapids, with no worries. But when we passed last time, we hit the sand. It was shifted by the current."

- Jaiku Arnatuk, interviewed on August 3rd 2017

Observations on ice

"When ice is slowly freezing, there is some fresh water ice that is breaking up from the river up there and going to our community here. And even though in our bay over here, even though it is salt water, that ice, first ice chunks, are piling down to the area here. And when it is skidoo time, or shoreline walking time. And when you see that nice blue ice, it means it is fresh water, even though we are in the salt water area here. They collect it and keep it by the house. [...]"

- Tooma Etok, interviewed on August 3rd 2017

Observations on plants

"Plants grow bigger and there are more. The shrubs are more big, abundant and tall along the river. [...] When I went berry picking, I noticed a lot more urpik (willow). The trees are getting bigger; it's harder to walk. The ground is spongier than before."

- Minnie Mae Annanack, interviewed on July 25th 2016

"In the areas with trees, the trees are bigger now."

- Mary Elisapee Annanack, interviewed on July 23rd 2016

"All along the river, there are berries, kigutangirnait (blueberries), paurngait (black crowberries), kimminait (cranberries), arpik (bakeapple) and mirqualik (skunkcurrant)."

- Joshua Annanack, interviewed on August 4th 2016

"Now the plants are growing faster than before, like shrubs. At the camp we were staying at, we had to cut shrubs down to access the site."

- Joshua Annanack, interviewed on August 4th 2016

"I have seen new plants. Like plants I had never seen before. Even here, there is like a tree that I don't know if it is a white spruce or a white birch, along this area. Like different kind of trees. I do not really know the kind, but there is a bunch of them over there. It is like a southern tree."

- Jaiku Arnatuk, interviewed on August 3rd 2017

Observations on animals

"There used to be lots of salmon back then, there is less now."

- Minnie Mae Annanack, interviewed on July 25th 2016

"Belugas go all the way up too to Helen Falls. [...] The belugas can go across the rapids, I have never seen the belugas further than Helen Falls. They go up to Sarvakallak, to the camping areas, because I have some old pictures of my brother that passed away. He got old pictures of a beluga killing in the Sarvavakallak area. But the problem is fresh water, bad maktak."

- Tooma Etok, interviewed on August 3rd 2017

"Right now [August], the fish are starting to go up the river from the ocean. The salmons are going up too and will stay until spring at the Pyramid mountain camp and stay mostly in the river, I do not know if they reach any lakes. The char go up to lakes they go through streams and some of the chars don't go to the lakes, some stay in the river. During winter they stay in the lakes, but when it is starting to melt they go down to the ocean, all of them."

- Joshua Annanack, interviewed on August 4th 2016

"[In the fall, people from town go fishing] mostly arctic chars, brook trouts and lake trouts [...] by fishing rods and nets. In the fall, there is also caribou. [...]"

- Jaiku Arnatuk, interviewed on August 3rd 2017

"More bugs too, butterflies also (saralikitak). There was always bumble bees around. Sometimes we see wasps too, with the yellow jacket. We see them more. [...] More species of birds, there is more different of birds, of which we had never seen before too. More in the river, mostly birds."

- Jaiku Arnatuk, interviewed on August 3rd 2017

Observations on the way of life

"We were bathing in the river when everybody else was gone hunting. [...] I'm not a swimmer, back then, we had too many things to do."

- Minnie Mae Annanack, interviewed on July 25th 2016

"We used to go get the water from the river and cutting wood, like a man."

- Minnie Mae Annanack, interviewed on July 25th 2016

"During the summer, after ice break up, [the families] moved near the sea."

- Mary Elisapee Annanack, interviewed on July 23rd 2016

"I did not know nothing about this river, I never used it. I learned to use it. All I know is because there was a guy one time, always on the move, he taught me all about this river, how it can be dangerous, some part of it. And he told me about the 1st rapid and second rapid and also he said all the way up to Helen Falls and so on. So I have a good knowledge because of this guy who was telling me, not only about the river, but all the land that is close to George River. It's Jusipie Sam Annanack. I used to travel with him when I was a very young man, 22-23-24 years old, used to go out with him a lot. I came here the first time when I was 17 years old."

- Paul Jararuse, interviewed on August 3rd 2017

"I got my first boat in my early twenties. And before that we used to go upriver with friends, getting to know the river. [...] I learned from my father and my friends. I used to follow up my father and my friends. Whoever asked you to follow, student camps or stuff like that we learn as we go places. So, if you go through the river more often, you gain more knowledge, like hot spots and the shallow water, the deeper streams or just pretty much the whole river, like the animals in it. I started as a little kid."

- Jaiku Arnatuk, interviewed on August 3rd 2017

Jaiku Arnatuk

Joshua Annanack

Minnie Mae Annanack

Mary Elisapee Annanack

Paul Jararuse

What will we do next

Science camp 2018

Our third annual science land camp will take place from June 18th to 25th 2018. The Northern village (NV) will be the local partner in charge of the project, with paid coordinators, including the support of the CEN Research station's manager. We hope to have higher water levels, fewer bugs and a new tupiq (Inuit tent) to sleep and work in! We hope to have a mix of new and returning youth participants, as well as an excellent group of guides, elders and coordinators to make this third science camp a success!

For the Imalirijiit Program to be sustainable in the future, we will need to decide on the frequency of the science land camp, establish long-term monitoring, and continue to promote local training and job creation in the community.

Long-Term Environmental Monitoring

We are planning to hold a community consultation in June 2018 (during Parnasimautik) to co-construct a research agreement, as well as to select simple environmental indicators and protocols for use in long-term monitoring. We plan to share ideas about the community's research needs and interests within the local and research communities, using a participatory action research (PAR) methodology.

CEN Research Station

The Center for Northern Studies or Centre d'Études Nordiques (CEN) has built a brand-new research station which will be opening its doors this year! A local manager will be hired and will help collaborate with Imalirijiit project.

A scientific committee with representatives from the CEN and local organizations has been nominated to help co-define local research needs and interests, negotiate research agreements and assess future research projects.

Conclusion

This project is unique due to its strong participatory nature, with scientists and community members collaborating from the get-go and the broad scope which includes both scientific and community-based objectives. The main objectives are to implement a sustainable and collaborative water quality monitoring program of the George River, which involves both scientific data collection and the training of youth through science land camps. This project can serve as a model for other communities by showing how to shift from top-down environmental monitoring by academic scientists to establishing community-based monitoring programs that include community stewards. This is a good example of a project that is grounded in solid environmental science but that integrates indigenous knowledge (IK) and community needs for education, as well as data for decision-making. Going forward, academic institutions and researchers should stay in a supportive role and accompany the community in establishing a sustainable environmental monitoring program. Long-term commitment of financial and human resources will also be needed both northern institutions, as well as municipal, provincial and federal governments.

Who was involved

Research Team:

José Gérin-Lajoie, Université du Québec à Trois-Rivières
Hilda Snowball, NV Kangiqsualujjuaq
Emilie Hébert-Houle, UQTR
Gwyneth Anne MacMillan, Université de Montréal
Mathieu Monfette, Université de Montréal
Justine-Anne Rowell, Université de Montréal
Tim Anaviapik Soucie, Hamlet of Pond Inlet
Élise Rioux-Paquette, Nunavik Parks
Esther Lévesque, Université du Québec à Trois-Rivières,
Marc Amyot, Université de Montréal
Jan Franssen, Université de Montréal
Thora M. Herrmann, Université de Montréal
Jean-Pierre Dedieu, Université de Grenoble-Alpes

Land Camp Planning Committee:

Kangiqsualujjuaq Youth Committee:

Eleonora Townley
Jeannie Annanack
Qaajui Baron
Francine Emudluk
Hika Emudluk
Anita Annanack
Jessica Emudluk

Land Camp Participants:

2016

Youth
Lise Morgan, Vanessa Snowball, Vanita Weetaltuk, Clara Unatweenuk, Sarah Unatweenuk, Eli Annanack, Morgan Annanack and Rupert Annanack.

Elders
Mary Elisapee Annanack and Minnie Mae Annanack

Guides
Paul Jararuse, Alex Noah Morgan, Joe Etok, and Joshua Annanack

Cooks
Louisa Minnie Etok with Qipita, Mary Annanack and Julianne Imbeault

2017

Youth
Alvarez Chevrier, Ronnie Tuglavina, Marc Annanack, Alan Emudluk, Justin Assevaq, Jack Etok, Matthew Etok, Annie Annanack, Tania Morgan, Jane Annanack, Ikenia Annanack, Tyler Ittulak, Nicodemus Jararuse, Turiisia Emudluk

Local Coordinator
Mary Emudluk

Elders
Mary Elisapee Nakulak Annanack and Minnie Mae Annanack

Guides
Paul Jararuse, Henry Ittulak, Jaiku Arnatuk, Victoria Cooper and Jason Etok

Cooks
Kitty Annanack and Eva Morgan

Other boat drivers and assistants
Johnny Etok
Mark R Annanack
Sammy Unatweenak
Jean-Jacques Séguin
Joshua Annanack
Don Annanack
Joas Emak
Nicodemus Jararuse

Kangiqsualujjuaq Hunters that contributed to biological sampling:

Kenny Angnatuk
Leevan Etok
Tooma Etok
David Annanack senior
Johnny Emataluk
Johnny Thomas Annanack
Paul Jararuse
Elijah Snowball
Norman Snowball
Eva Snowball
Adamie P. Etok
Paul Toomas
Jack Annanack
David Emudluk
Tommy Snowball
Bobby Annanack junior

Laboratory Analyses

Eliane Grant, Université de Montréal
Dominic Bélanger, Université de Montréal
Xiaowa Wang, Environment and Climate Change Canada
Derek Muir, Environment and Climate Change Canada
Reinhard Pienitz, Université Laval

Interviews

2016
Mary Elisapee Annanack
Minnie Mae Annanack
Paulosie Jararuse
Joshua Annanack

2017
Mary Elisapee Annanack
Paulosie Jararuse
Jaiku Arnatuk
Tooma Etok

Interactive Mapping Workshop Participants:

Victoria Cooper
Kabimbetas Noah Mokoush
Clara Morrissette Boileau
Émilie Hébert-Houle
Hadrien Bois Van Kursk
Thora M. Herrmann
José Gérin-Lajoie

If we have missed anyone or misspelled someone's name, please contact us!

NAKURMIIMARIALUK

Thank you:

A great thank you to the Youth Committee.

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Contact:

If you have any comment or questions about this report, or the Imalirijiit project, please contact José or Hilda so that we can follow up with you directly.

Hilda Snowball
819-337-5271 ext: 23
hsnowball@nvkangiqsualujjuaq.ca

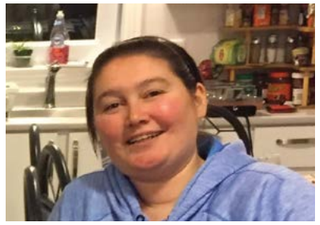
José Gérin-Lajoie
819 376-5011 ext 3369
jose.gerin-lajoie@uqtr.ca

Field Team


Hilda Snowball


José Gérin-Lajoie


Émilie Hébert-Houle


Eleonora Townley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Mathieu Monfette


Justine Anne Rowell


Élise Rioux Paquette

Professors


Jan Franssen


Marc Amyot


Thora M. Herrmann


Esther Lévesque


Jean-Pierre Dedieu

A Mussel in a coal mine

Rare earth elements are a group of metals used in high-tech products, including for renewable energy.

They are not "rare" nor are they "earths".

Darn! I bought this earth for my garden...

Rare earths

Garden

And you probably have some on you right now...

My tomatoes are dead! :-(

A average cell phone contains from 6 to 16 different rare earth elements.

- Neodymium in the speakers and headphones
- Cerium, Europium and Gadolinium for the screens
- Cerium and lanthanum in the batteries

Etc!

They are called "rare" because they do not concentrate at the earth's surface and are hard to extract. The mining techniques cause a lot of pollution.

Waste H_2O

Acid

Gas

About 97% of rare earth elements are extracted in China, creating pollution problems in mining areas. But mining projects are appearing elsewhere, including at least 200 under review in Canada, notably in the Arctic.

This a cause for concern in Nunavik, Northern Quebec, as the toxicity of rare earth elements is poorly understood.

So the Inuit of Kangiqsulujjuaq started to collaborate with scientists to measure the natural levels of rare earth elements in their environment.

Puvirnituq

Kuujjuaq

Kangiqsualujjuaq

Currently, we have very little information about the natural levels of rare earth elements in northern ecosystems or about how they move around.

Take Nord

Water toxic

I'm changing careers!

Before the start of mining operations, it's better to have an understanding of the natural state of the environment.

I'll be rich!

With this data in hand, we will be able to better evaluate the pollution from new mining activities.

What's that?!

Er... that was already there!

Our data shows the opposite!

L'Illustre recherche
FAECUM

Inuit community members collected a large number of living organisms to measure naturally-occuring rare earth elements.

Caribou

Ringed Seal

Snowshoe Hare

Arctic Char

Common Eider

Blue Mussel

Sea Urchin

Crustaceans

Plankton

Plants

Lichen

Results: all these living creatures naturally contain small amount of rare earth elements. But it is the smallest ones who accumulate the most over time.

Rare earth elements concentration are not amplified when passing to higher levels of the food web, unlike other chemicals like mercury or organic pollutants.

These results tell us about the natural levels of rare earth elements in the environment and allow us to detect any increase.

Monitoring Centre

The organisms that naturally accumulate higher levels of rare earth can act as bio-indicators of rare earths levels in the environment.

How are you feeling?

Terrible!

A little like the canary in the coal mine, they can warn us about any toxic emissions from rare earths mining.

My head hurts!

Blood tests

Now that we know about these "whistleblowers", we can better understand the possible effects of future rare earths mining projects on the environment.

Cheep! Cheep!

GRRRAKKA!

KKA!

KKA!

KKAKKAKKA!

I'm starting to feel dizzy!

But the best solution is probably just to reduce our consumption of rare earth elements...

Hello?

The doctor convinced me not to upgrade my cell phone...

Gwyneth Anne MacMillan and Martin PM

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Funded by the Government of Canada
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