Arctic Freshwater Biodiversity in Cambridge Bay
2018 field season report from lake sampling in Cambridge Bay

NRI license # 04 011 18R-M
Fishing additionally under the DFO license issued to Marlene Evans S-18/19-1021-NU

21.3.2019

Milla Rautio, PhD & Canada Research Chair in Boreal and Polar Aquatic Ecosystems
Université du Québec à Chicoutimi (UQAC)
Phone : (418)5455011 ext. 5084
milla.rautio@uqac.ca

Michael Power, Univ. of Waterloo, m3power@sciborg.uwaterloo.ca
Connie Lovejoy, Université Laval, connie.lovejoy@bio.ulaval.ca
Marlene Evans, Environment Canada, marlene.evans@ec.gc.ca
Joseph Culp, Environment Canada, joseph.culp@ec.gc.ca
Nicolas Derome, Université Laval, nicolas.derome@bio.ulaval.ca

Project summary and sampling in 2018

A field sampling campaign was carried out in 2018 in Cambridge Bay (Ekaluktutiak) in April and August 2018, with the aim to fill the knowledge gap in Canadian Arctic freshwater monitoring and to evaluate the ecosystem health of Arctic freshwaters. Additional aim was to study how hydrological connectivity among lakes determines productivity and biodiversity in lake food webs.

This work continued the research we had initiated with the Canadian High Arctic Research Station (CHARS) and was done under the NSRI license # 04 004 17R-M. The part of the sampling that included fish was done under the DFO licence to Dr. Marlene Evans. The 2017 research also contributed to our Polar Knowledge Canada supported project "Ecosystem Health of Arctic Freshwaters" and to the Circumpolar Biodiversity Monitoring Program (CBMP) that has been created in collaboration with all eight circumpolar countries. Each country aims to follow the same sampling protocol with the aim to provide high quality and comparable information of different environments in the Arctic and their biodiversity.

The primary aim of the 2018 sampling was to identify and quantify fatty acid and mercury (Hg) stocks and fluxes in the freshwater food webs in the lakes near the Ekaluktutiak community. Fatty acids are essential nutrients for animal growth, health and immune system, including humans, and their abundance and composition are considered as indicators of the ecosystem health. While being essential health substances they may also correlate with the abundance of Hg in the food web. The Hg in the aquatic organisms is bioaccumulated in Arctic char and lake trout which contribute substantially to traditional Inuit meals and can be a source of mercury and persistent organic contaminant

The results will provide tools for the Ekaluktutiak community to maintain essential ecosystem services (e.g. fishing) in the region.

The samples and analyses were largely based on recommendations outlined in the Arctic Freshwater Biodiversity Monitoring Plan for circumpolar Arctic freshwater biodiversity assessment to be carried out for all Arctic countries in five year intervals. Each analysis has been pointed out as a key variable indicating the environmental status of a given water body according to the Table1 below.

Table 1. Biotic and biochemical focal ecosystem components (FECs) for arctic lake ecosystems, as identified in Arctic Freshwater Biodiversity Monitoring Plan.

Analysis	**Justification as important Focal Ecosystem Component (FEC)**
Bacteria	Pelagic bacteria as important as indicators of change or stressor effects, related to processes such as metabolism and decomposition.
Phytoplankton	High importance because they are the base of the food web, sensitive to change, diagnostic of certain types of change, metrics have been developed to identify stressor effects, low variance within a system; some long term monitoring data available.
Benthic algae	High importance because they are the base of the food web, sensitive to change; data availability generally low, samples sporadic spatially, chl-a used as a measure of periphyton production; high feasibility due to high ease of sampling and low cost, potential for archival analysis
Macroinvertebrates	High importance because of high species richness, reflect local conditions, important to food web, sensitive to change.
Zooplankton	Food for higher trophic levels, important consumers and secondary producers in the food web; community structure reflects environmental changes; easy to sample and fairly easy to identify; some long term monitoring data available.
Lipids and their fatty acids/energy flow	Important for community function and biodiversity, useful to detect changes within and among systems, useful for assessment of targeted species to identify energy flow (benthic vs. pelagic); few data exist.
Seston dry weight, Dissolved organic carbon	High importance because indicators of overall productivity of the system, strong relationship with biodiversity; high feasibility of sampling due to ease of sample collection and low cost; data are spatially and temporally extensive

Sampling

Seventeen lakes, distributed in four lake chains, were sampled in the Greiner Lake watershed in August (Fig. 1-5). Additionally, six lakes of these lakes were sampled in winter for ice, water and plankton (Fig. 6, 7). Winter samples are very rarely collected in the Arctic and while winter is the longest season in the Arctic, it is the most unknown.

In each lake, measures of temperature, oxygen and conductivity were taken to understand the physical environment in Arctic lakes. The lakes were also sampled for nutrients, bacteria, phytoplankton, zooplankton, bugs and fish (Fig. 2-5).

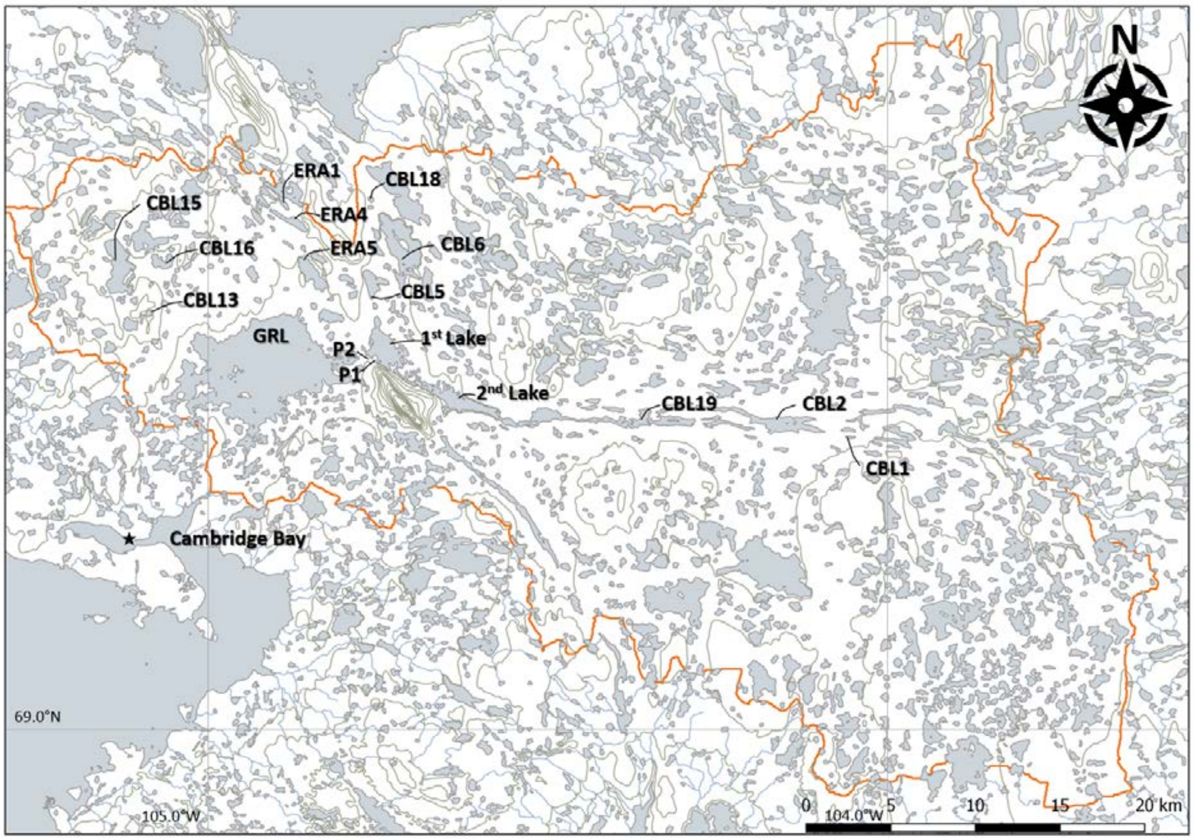

Fig. 1 Fig. 1. Sampling sites in the 17 lakes that were sampled in August 2018 to collect limnological and biological data. A subset of these lakes were sampled in winter for water and ice data (Greiner, First Lake, Second Lake, CBL5, ERA 1, ERA4).

Photos of sampling

Fig. 2 Lake sampling in August 2018. Lake water is sieved throughout a net to collect zooplankton. The water is then analysed to identify dissolved components, phytoplankton and bacteria.

Fig. 3 Zooplankton sampling with a 100 um net in a pond.

Fig. 4. View of the laboratory showing water filtration for environmental DNA, fatty acids, pigments and chlorophyll-a, and zooplankton and macroinvertebrate picking.

Fig. 5. Installing the fish net in First Lake.

Fig. 6. In winter, a tent was set up on the ice to be able to sample the lake under the ice.

Fig. 7. Taking measures from Greiner Lake in April 2018.

Results

The first results obtained from the 2018 sampling campaign were the physicochemical parameters that allowed us to get a limnological description of the lakes from the Greiner Lake watershed (Fig. 8). Large lakes were different from ponds in nutrients, organic and inorganic carbon and organic matter composition (Table 2) with higher values in small lakes or ponds.

Zooplankton production was very different in lakes compared to ponds. It was higher in ponds than in lakes (Fig. 9).

Phytoplankton diversity was determined by microscopy. Chlorophyll *a* was measured as an indicator of phytoplankton biomass. A total of 75 different taxa were identified in the 17 lakes and ponds, CBL 2 being the most diverse with 41 taxa present (Fig. 10). The highest values of biomass (chlorophyll *a*) were detected in small headwater lakes such as CBL 1 and CBL 18. ERA 5 had high biomass values due to its eutrophic condition (Table and Fig. 10).

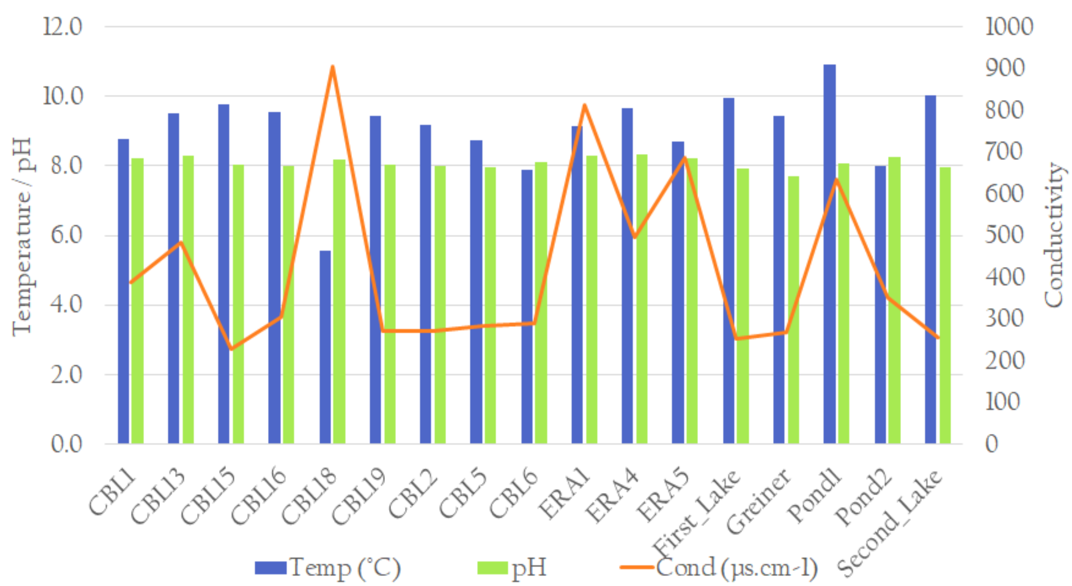

Fig. 8. Temperature, pH and conductivity in the 17 sampled lakes.

Table 2. SUVA (higher values indicate presence of terrestrial carbon in lake water) and a320 (indicator of algae). Dissolved Inorganic Carbon (DIC), Dissolved Organic Carbon (DOC), Total Nitrogen (TN) and Total Phosphorus (TP) data in the lakes of Greiner Lake watershed.

Lake	SUVA	a320	DIC	DOC	TN	TP
	$l.mg\ C^{-1}.m\text{-}1$	m^{-1}	$mg.l^{-1}$	$mg.l^{-1}$	$mg.l^{-1}$	$mg.l^{-1}$
CBL1	2.34	6.60	24.50	4.20	0.34	0.01
CBL13	0.95	3.17	30.50	4.00	0.41	0.01
CBL15	1.69	4.45	20.20	4.30	0.37	0.01
CBL16	1.67	5.11	22.00	5.50	0.42	0.01
CBL18 (pond)	2.00	20.42	39.60	17.20	1.17	0.01
CBL19	2.41	7.49	16.30	4.20	0.33	0.01
CBL2	2.47	7.08	16.40	4.20	0.31	0.01
CBL5	1.87	4.29	17.90	3.90	0.34	0.01
CBL6	1.55	3.82	18.50	4.30	0.31	0.01
ERA1	4.55	19.57	36.00	6.90	0.49	0.01
ERA4	1.57	5.00	31.80	6.00	0.44	0.01
ERA5	2.32	13.82	38.00	9.90	0.94	0.03
First Lake	2.33	6.57	15.50	4.20	0.33	0.01
Greiner	1.34	8.56	16.80	6.10	0.83	0.01
Pond1	2.04	26.04	36.20	19.70	1.18	0.01
Pond2	1.93	16.44	39.50	14.50	0.94	0.01
Second Lake	2.46	7.44	15.10	4.30	0.33	0.01

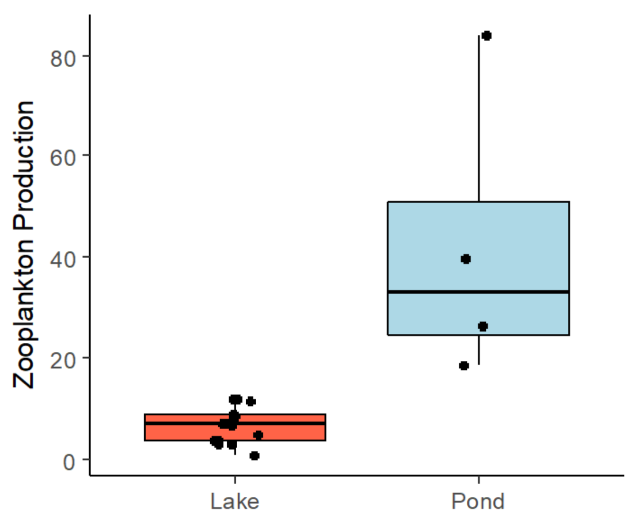

Fig. 9 Zooplankton production in lakes and ponds.

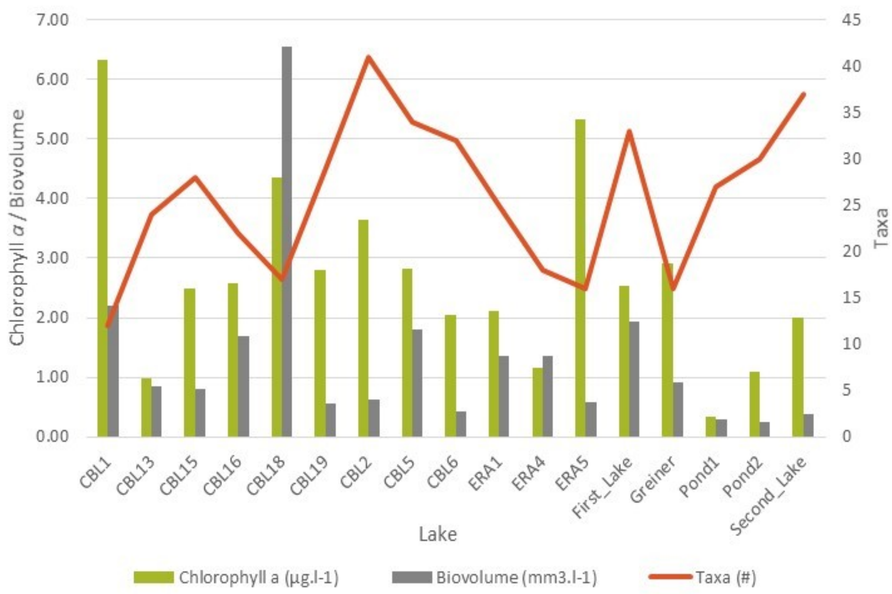

Fig. 10. Number of phytoplankton species (Taxa), biovolume and chlorophyll *a* in the 17 sampled lakes and ponds.

Consult and share knowledge

Preliminary results have been consulted to academic and northern communities. Two presentations and two posters were presented at the Arctic Net annual meeting in December 2018 in Ottawa (A poster rewarded as third best in the MSc category). One presentation and one poster have also been presented at the GRIL symposium in March 2019 (A poster rewarded as best in the PhD category). Two manuscripts have been submitted for publication in scientific journals.

Two Inuit girls visited UQAC in May 2018. During their one-week internship, we introduced them to a series of topics, such as ‘People and life in university’, ‘Life of a university researcher: teaching, research and collectivity services’, ‘What can be learnt by studying in university and where people work with a university degree?’ and ‘What is research?

Posters made and translated in Inuinnaqtun to present the project to the *Ekaluktutiak* community (see example below). The posters were designed according to the advice from the Ekaluktutial HTO how to best present scientific research questions to the locals.

Sampling plan for 2019

Lakes in Greiner Lake watershed will be sampled again in summer, fall and winter 2019. A total of 22 lakes or ponds will be sampled in August (Fig. 10). Most of the lakes have never been sampled before but we also continue to sample lakes, such as Greiner Lake and CBL, to evaluate the inter-annual variability in these lakes and to respond to the request from the Ekaluktutiak HTO. Some of the lakes will also be sampled in October-December to continue to increase our understanding of the winter ecology in Arctic lakes.

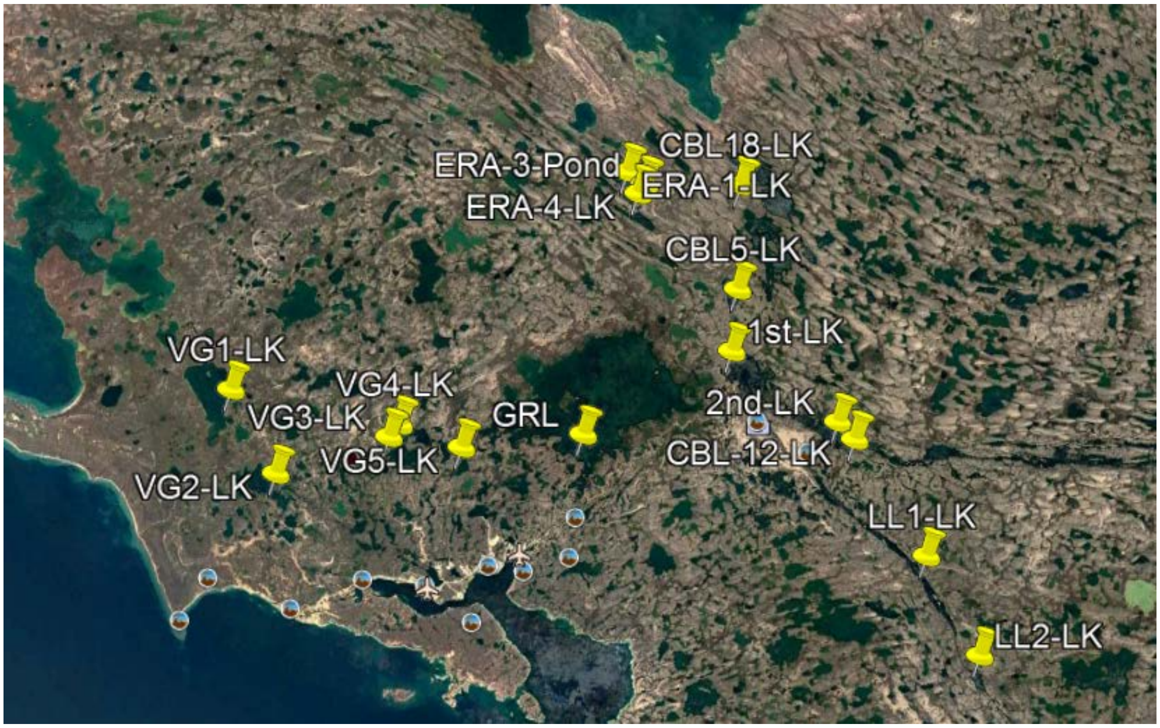

Fig. 10. Map of lakes that will be sampled in August 2019.

Nakooyot Nakoovalagittolloniit oghot okioktaktomi nikaoyonik: oghingonaktot oghot nikigiyaoyoni ekaloknilo enongnollo

GOOD AND BAD FATS IN ARCTIC FOOD WEBS: FATTY ACID SOURCES AND STOCKS FROM PLANKTON TO FISH AND PEOPLE

Guillaume Grosbois, Sarah Amaudrut, Paola Ayala, Milla Rautio

Université du Québec à Chicoutimi

NSERC CRSNG

Polar Knowledge Canada Savoir polaire Canada

Chaires de recherche du Canada Canada Research Chairs

ÉcoLac NSERC CREATE training program in Lake and Fluvial Ecology

UQAC Université du Québec à Chicoutimi

GRIL Groupe de recherche interuniversitaire en limnologie et en environnement aquatique

Canada

Designed by Elise Imbeau
eliseimbeau@outlook.com