First inventory of Greiner Lake, Victoria Island: 2015 field season report

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The Canadian High Arctic Research Station (CHARS) at Cambridge Bay, Nunavut, will strengthen Canada's role as a leader in Arctic science and will allow for research that until now has not been possible or has been difficult to carry out in the North due to logistic constraints. The lack of state-of-art research facilities and common methodology to measure and monitor many environmental processes has hampered the ability to develop conceptual frameworks that could integrate how changes to Arctic landscapes are likely to be linked to the biodiversity and productivity of these systems.

As part of the initial step in addressing the knowledge shortfall a sampling campaign of the Greiner Lake near Cambridge Bay was carried out in the summer of 2015. Seasonal sampling from June to September was carried out to provide a baseline description of the ecological variability of water quality, microbial diversity, phyto- and zooplankton community composition, and indices of carbon fluxes ecosystem health. In addition, three about 50 cm long sediment cores were taken from the deepest point of the lake. They were sliced in 1 cm resolution and have or will be analysed for pigments and different carbon indices as well as for the subfossil remains of diatoms and chironomids as proxies of past aquatic communities and production in the lake.

The sampling contributes also to the Circumpolar Biodiversity Monitoring Program (CBMP) that has been created in collaboration with all the 8 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 sample analyses is taking place at the Laboratory of Aquatic Sciences (LASA) of UQAC and in Universté Laval.

Sampling

The sampling took place between June 10 and September 9, 2015. First two sampling times, including the sediment coring, were when the lake was still ice covered while the rest of the samples were taken from open water. In each sampling time the deepest site of the lake (10 m, Fig. 1) was sampled from three depths. Sampled of about 10 L of water were collected from each

depth for preliminary treatment in the laboratory immediately after the sampling. Additionally, zooplankton was sampled with a plankton net by pulling the net vertically from close to the bottom to the surface. The samples were brought to the Arctic College laboratory in Cambridge Bay where water was preserved nutrient analyses and filtered for microbioal RNA, carbon characterization, fatty acids and chlorophyll. A small aliquot (100 mL) was preserved with Lugol's solution for phytoplankton identification and counts. Zooplankton were a) preserved with formaldehyde for taxonomy and counts and b) without preservative for fatty acid analyses and frozen. One of the sediment cores was sliced already in Cambridge Bay while the two remaining cores were brought to the southern laboratories for further work.

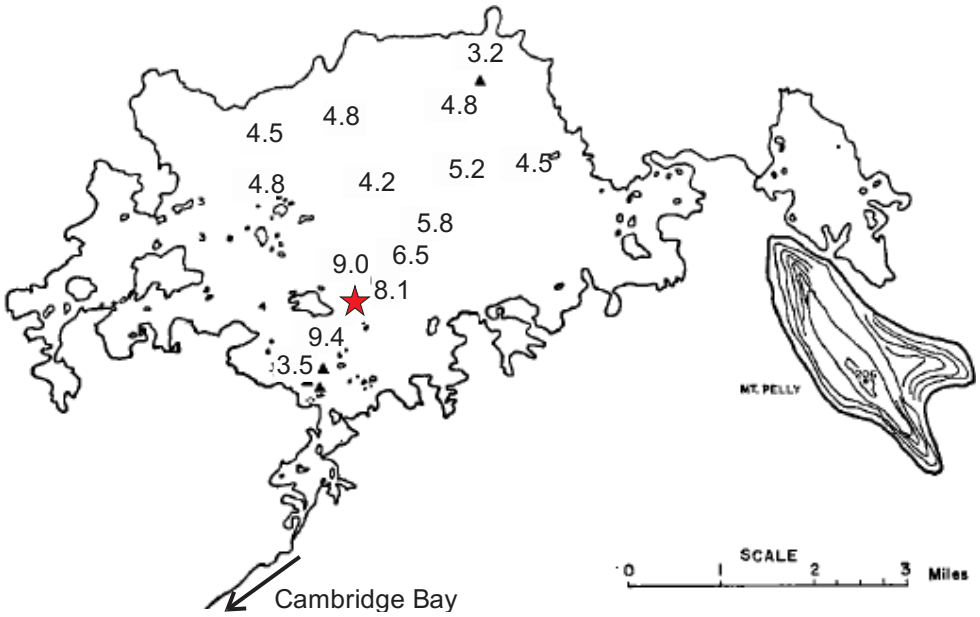

Fig. 1 Map showing the Greiner Lake with some depth indication. The star marks the approximate sampling location that was visited 8 times between June 10 and September 9, 2015.

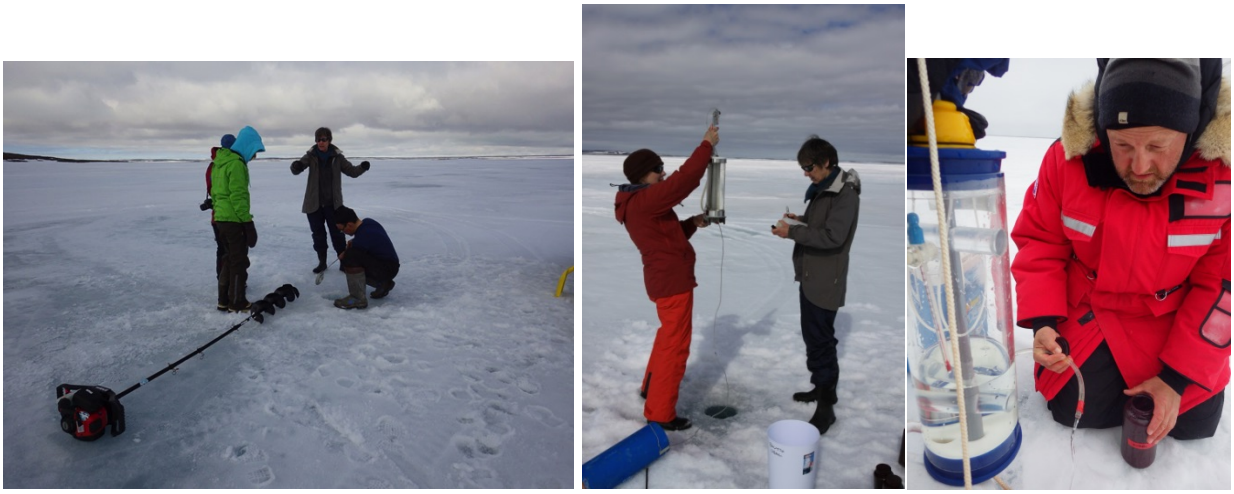

Fig. 2. Sampling Greiner lake on June 2015. Ice thickness up to 205 cm.

Analyses

The samples and analyses were based on recommendations outlined in the Arctic Freshwater Biodiversity Monitoring Plan for circumpolar Arctic freshwater biodiversity assessment. Each analysis has been pointed out as a key variable indicating the environmental status of a given water body.

Analysis	**Justification as important Focal Ecosystem Component (FEC)**
Temperature, conductivity, nutrients (TP), DOC/CDOM	Important for biota, related to climate change. Strong relationship with biodiversity. Indicators of overall productivity of the system. High feasibility of sampling due to ease of sample collection and low cost; data are spatially and temporally extensive
Microbial analyses (based on DNA and RNA)	May be important as indicators of change or stressor effects, related to processes as metabolism. General lack of knowledge and experts. Data availability generally low spatially and temporally. High ease of sampling but may be difficult to process. Could be important technique to identify source changes.
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
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.
Paleolimnology	Allow more extensive temporal analyses and can provide a strong assessment of long-term temporal trends.

*DOC= Dissolved organic carbon, CDOM = Chromophoric dissolved organic matter

Sampling dates and list of specific samples collected

June 9, 2015
June 15, 2015
August 11, 2015
August 18, 2015
August 25, 2015
August 31, 2015
September 9, 2015

Water column:
Conductivity and temperature profiles by CTD
DNA from organisms 3-50 µm and <3µm (on filters)
Chlorophyll-a as indicator of phytoplankton biomass (on filters)
Fatty acids from seston and zooplankton (on filters and tubes)
Phytoplankton pigments for HLPC analyses (on filters)
Total phosphorus (TP) (water samples)
DOC/CDOM (water samples)
Phytoplankton taxonomy, abundance and biovolume sample (water samples)
Zooplankton taxomony and abundance sample from integrated water column (concentrated water samples)

Sediments:
On June 9, 2015 three sediment cores (about 30 cm each) for pigments, diatoms, chironomids and carbon analyses.

Fig. 3. Filtration and other manipulation of sample water in the laboratory before freezing the samples for subsequent analyses at UQAC and at Université Laval.

Fig. 3. Sediment coring. The bottom photo shows a blue mussel found at the depth of 10-11 cm. According to 14C-dating the age of the mussel is 2000 years.

Table 1. Temperature and conductivity profiles in Greiner lake on June 10 when the lake had a 2 m ice cover, in August 11, approximately 10 days after the ice-out, and in September 9 that was the last sampling day for the 2015 season.

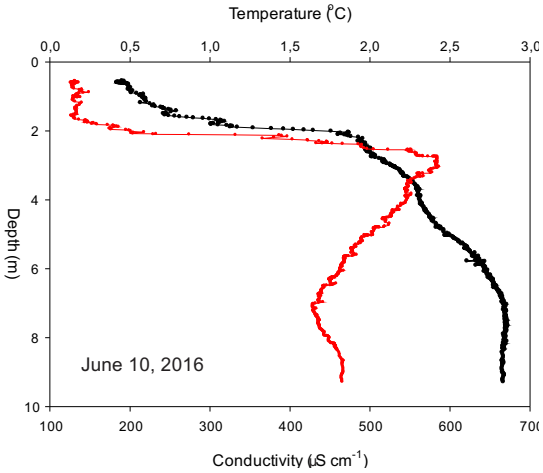

Fig. 4. Cambridge Bay landscape with Greiner lake behind on the right.

Summary and sampling plan for 2017

The lake samples collected in 2014-2015 have been processed, and some of the results will be included in a CBMP assessment of arctic biodiversity which will appear later this year as a special issue in Freshwater Biology. Two video podcasts were made of the sampling campaign to inform Northerners and the broader public of our work. The project has also been described in AANDC Publications by the writer Janet Hunter in 2015.

The monitoring for 2017 will build on the work by our team in 2014 and 2015 that addressed the knowledge shortfall of freshwater ecosystems on Victoria Island in the Greiner Lake watershed. Specifically, the sampling in 2017 will continue the monitoring of Greiner Lake as in 2015. Additionally, new sites (4-6 lakes) will be included in the baseline monitoring program. These will be located 5 km north of Grainier Lake in the CHARS experimental watershed.

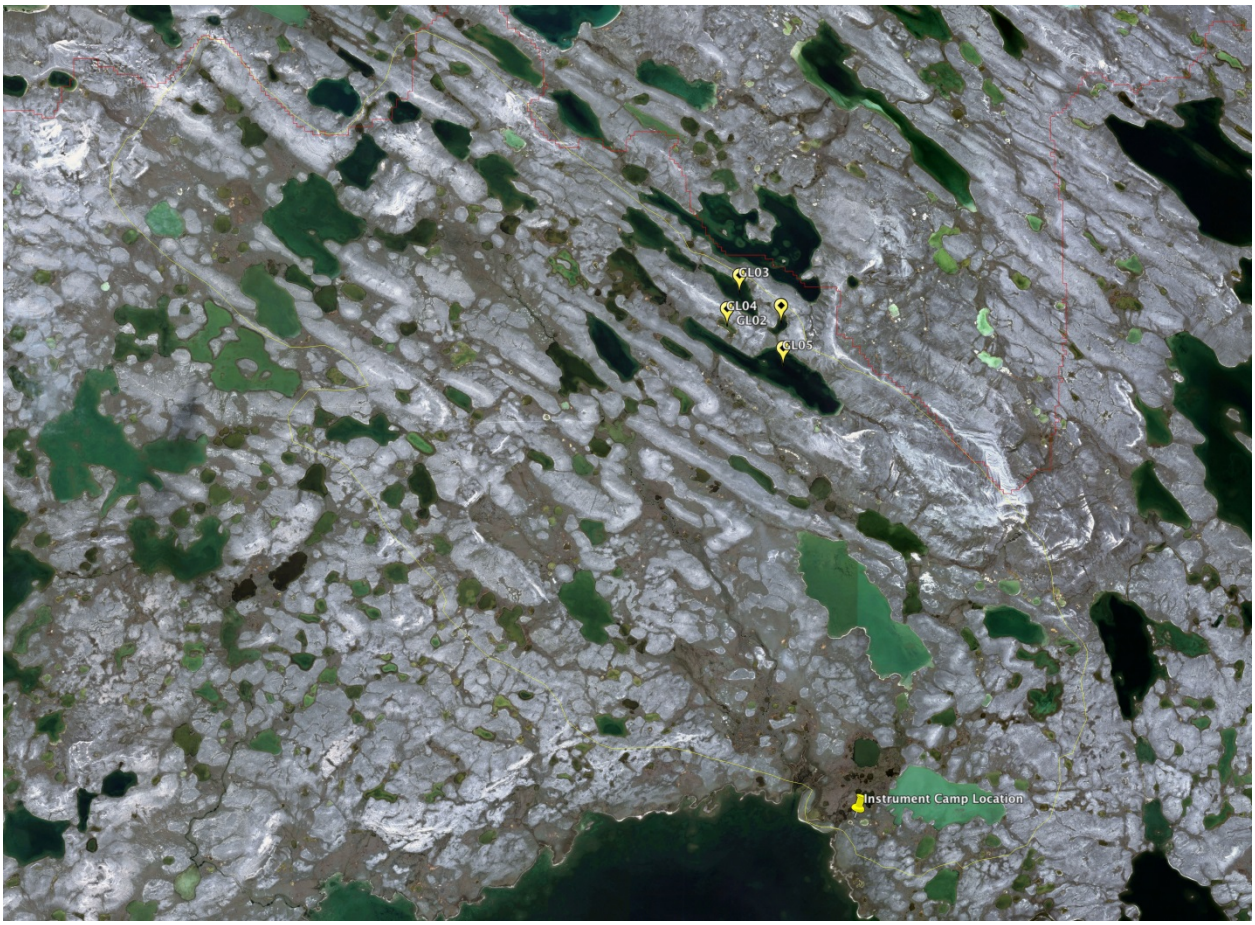

Fig. 5. Map showing the lakes to be sampled in 2017. The large lake in the bottom of the figure is Greiner Lake. The smaller lakes marked with yellow dots are lakes in the CHARS experimental watershed.