

## **Annual permit report from Brown, UofT, “Lake Ice in the Canadian High Arctic”**

### **TO:**

**Canadian Wildlife Service and Sulukvait ACMC** multiyear licence NUN-NWA-16-03;  
**Nunavut Research Institute** licence 02 014 17R-M (to be renewed spring 2018)

### Project Overview:

Lake ice is an important part of the cryosphere and recent projections suggest a pan-arctic reduction by the end of the century in ice duration (ranging from 20 to >100 days) and thickness (ranging from 30 cm to > 1 m). Since the majority of ground based ice observations in Canada ceased by the 1990s, recent changes in ice regimes have been primarily noted through modelling and remote sensing. Observation data, essential for validating both remote sensing and modelling research, is currently inadequate though some volunteer monitoring efforts have emerged since the decline of Canada’s monitoring network and have been utilized for ice research. As changes are noted in ice regimes, we need to fully understand the implications and response in terms of water and energy balance and their effects on other areas of research (e.g. limnology, transportation). To achieve this, in situ data of lake ice in Canada is being collected across a latitudinal gradient (temperate, sub-Arctic, High Arctic). The field data will be used to improve the effects of snow cover on modelled ice thickness, as well as to isolate how the duration of the modelled ice break-up season is affected by the shape/size of the lake. Resolute and Polar Bear Pass provide ideal locations for the High Arctic portion of this study and data collection is underway.

### Summary of 2017 Arctic Field Work, July 23 – Aug 4:

This year, my field party consisted for 4 members: Myself, Sarah Ariano (MSc student – now complete), Alexis Robinson (PhD student, year 2) and Alicia Dauginis (BSc student, year 5). Our group spent 10 days working from PCSP in Resolute, with 2 brief trips over to Polar Bear Pass, Bathurst Island (approximately 3 hours on the ground between the two trips). Two arctic hares were observed during our time in the National Wildlife Area, but two caribou, several (~20) muskox, and three walrus were observed further south and while passing over Cornwallis Island during our flights.

We landed with the helicopter beside the cabin to service the existing weather station on trip #1, and then landed on the NE ridge overlooking Hunting Camp Lake (75.73N, -98.42W) to service the existing outdoor digital camera on trip #2 (Figure 1). The camera structure was kindly checked on by the CWS researchers working from the cabin again this summer, who notified us of a frayed power cable, which we were then able to repair. The camera sustained some minor damage over the winter, but was replaced successfully and repairs to the power wires were secured in blue plastic tubing (which will be replaced next summer with different tubing, to be less noticeable in the landscape). I hope to maintain the location of the camera long term as funding allows creating a data set of the spatial variation of ice cover on the lake. Moving forward, I would be happy to hear from anyone who is familiar with the lake, or who might be heading over to the area next spring, and/or might have some first-hand observations on the timing of when the ice over formed/retreated in previous years. I plan to continue to use Hunting Camp Lake as a representative lake for the area in terms of modelling, as there is an existing climate record and snow cover data available.



***Figure 1. Outdoor digital camera and solar panel in place at Polar Bear Pass, and example picture collected showing the view of the lake ice on Hunting Camp Lake.***

The outdoor camera in place near Resolute at 3 Mile / Small Lake was set up behind an existing barrel on the north end of the lake (Figure 2), and was replaced this season with a more durable model to hopefully endure many seasons. While we were in Resolute this summer we were in contact with the community (Mayor’s office) and were given permission to install another outdoor camera, this one overlooking Resolute Lake. We have been in contact with the Resolute Hunters and Trappers Association, the Mayor’s office and the Principal of the local school, and we are hoping to be able to hire someone (potentially a student) willing to change the batteries for us on the new camera overlooking Resolute Lake sometime in the spring before melt.

Following the advice from the Sulukvait ACMC last year, I opted not to place the ice thickness sensor in Hunting Camp Lake as planned (likely too shallow) and instead placed it in 3mile / Small Lake (74.75N, -95.05W) in 4.5 m deep water. The sensor had a power issue and is currently in storage at PCSP until summer 2018, when I aim to put it back into 3 mile/Small Lake to record the ice thickness through 2018/19.



***Figure 2. Outdoor camera in place at Small Lake and example of the images collected.***

### Overall Project Progress and plans for 2018:

Field data collected (imagery) is now being analyzed and some ice formation and melt dates are posted on my website: <http://sites.utm.utoronto.ca/brown/content/lake-ice-cover-dates>. The climate data from the Polar Bear Pass and the Resolute weather stations are being used for lake ice modelling work, simulating the ice cover for as far back as the climate records allow (1953 for Resolute, 2006 for Polar Bear Pass). Initial modelling results were presented at the Canadian Geophysical Union annual meeting (citation at end of report) and several departmental seminars/presentations. My PhD student Alexis Robinson is currently preparing a poster about this data for the school in Resolute (as part of the Researcher Profile program they are running). The modelled ice formation/decay dates are being compared to historical ice dates from the Canadian Ice Database (1960s-1990s), as well as the recent years to satellite imagery (>2000, primarily from the MODIS sensor). The satellite data portion of this project will focus more heavily on Resolute Lake as the size allows for better identification of ice in the imagery, with data from Small Lake and Hunting Camp Lake acquired whenever possible.

We aim to return to both Resolute and Polar Bear Pass in 2018 during the summer to download/reprogram the cameras, re-install the ice thickness sensor for the next season, and service/download the weather tower data. We also hope to measure the depths of the study lakes in more detail.

It will likely be one more field season before scientific publications are prepared using this data, although the initial ice thickness and field observations from May 2016 are included in a publication in preparation focusing on Ontario ice cover and how it differs greatly in thickness and composition (types of ice) from Arctic ice cover; the first publication from the overall Canada-wide project. I aim to have my group presenting results from the field campaigns throughout 2018, with intended presentations at the Canadian Geophysical Union Student meeting (likely early 2018), University of Toronto Mississauga Graduate Student Research Colloquium (spring 2018) and Canadian Geophysical Union Annual meeting (June 2018).

Presentation related to this project this year:

Robinson A, and Brown L. Lake Ice modelling of two High Arctic lakes. Canadian Geophysical Union Annual Meeting, Poster Presentation, Vancouver, May 29 2017.