AURORA RESEARCH INSTITUTE
AURORA COLLEGE

ECHYDR11
Annual Progress Report

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For Environment Canada G&C "Arctic Research and Monitoring"

1. PROJECT BACKGROUND

In 2010, the Aurora Research Institute (ARI) partnered with Environment Canada (EC) on their long-term Water Quality and Aquatic Ecosystems Health project, entitled *The Hydro-Ecology of Noell Lake*. This agreement enables staff at the Western Arctic Research Centre (WARC; a division of Aurora Research Institute) to provide scientific/technical support to EC researchers working on this project in the Western Canadian Arctic, using WARC as their operational base.

EC researchers are assessing the effects of climate change and resource development on the hydrology, geochemistry and ecology of freshwater systems in the Western Canadian Arctic. Information gathered by this research program will be used to obtain baseline information in support of regional environmental and cumulative effects assessment processes.

In 2010, a fully-automated instrumented buoy and subsurface mooring system was put into Noell Lake, to monitor the physical, geochemical, and biological conditions of the lake. The overall objective of this system is to improve knowledge on lake ice and its effects on food webs and productivity in small Arctic lake systems. The buoy system measures lake ice (initiation; growth over winter; breakup in spring; and ice characteristics), water quality, and productivity, logs data year-round, and transmits project data to project partners via satellite. The buoy and mooring system is composed of two parts; (1) a lake buoy with instruments on top, to measure weather conditions (net radiation, wind speed, wind direction, air temperature, relative humidity, and air pressure), and (2) a subsurface mooring system, which includes a tethered array of sensors, measuring under-water conditions (light penetration, water quality and productivity) at various depths down to the lake bottom. The subsurface mooring system also includes an ice profiler sensor, to measure the development, growth, and decay of lake ice cover through the cold season.

In July 2012, the fully-automated instrumented buoy was permanently removed from Noell Lake. The subsurface mooring system, along with the tethered array of sensors, was left in the lake.

In November 2012, a second subsurface mooring system, also with a tethered array of sensors, was installed in the lake.

The buoy and two subsurface mooring systems were designed and developed by AXYS Technologies Inc. and the Water & Climate Impacts Research Centre (W-CIRC), at the University of Victoria and Environment Canada. It is currently owned and operated by WCIRC. WARC staff, from ARI, provide technical support, routine maintenance, budgeting and project management.

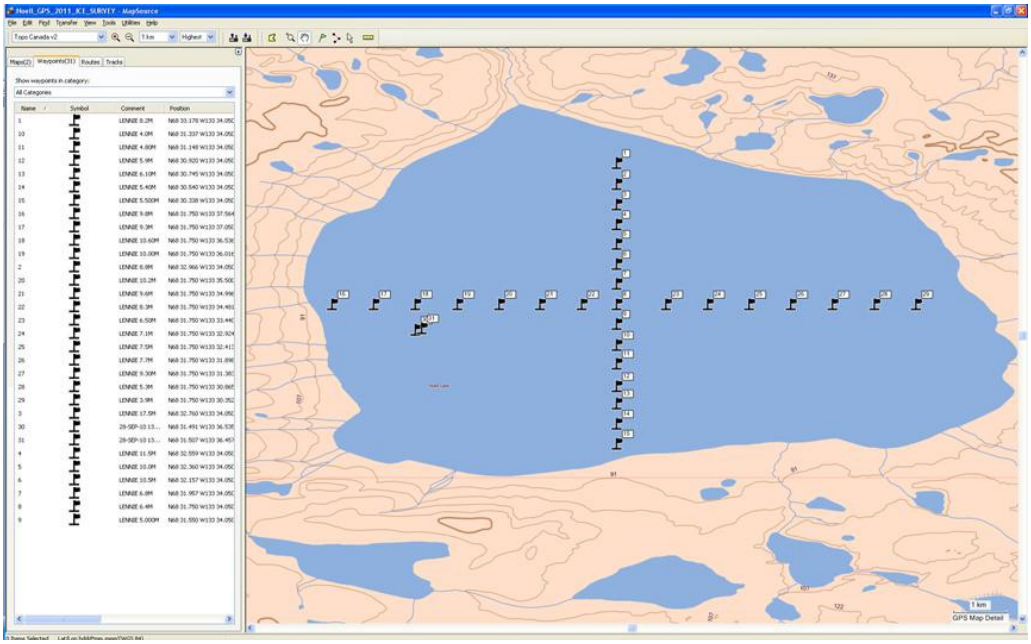
The following report details the work done by WARC staff, in support of the Hydro-Ecology of Noell Lake project, in the 2013/2014 fiscal year.

2. PROJECT ACTIVITES

2.1 Ice Surveys

On **May 7th**, William Hurst (ARI) and Donald Ross (ARI) travelled via snow machine to Noell Lake to carry out the 2013 annual late-winter ice survey, which measures late-winter ice conditions on Noell Lake (i.e., thickness of white/black ice and hydrostatic pressure). Unfortunately, at the 7th site, the auger blade was lost, preventing William and Donald from surveying anymore sites. To make the most of their time and to make drilling/surveying easier the next day, they spent the rest of the day shoveling snow off of the remaining 29 sites.

On **May 8th**, William and Donald returned to Noell Lake with a new blade and proceeded to survey the remaining 29 holes.



A map of Noell Lake identifying each of the 36 sites that make up the annual late-winter ice survey

Donald Ross starting the 2013 annual late-winter ice survey

2.2 Under-Ice Sampling

On **May 13th**, William, Donald, and Erika Hille (ARI) travelled by helicopter to Noell Lake to visit 7 pre-determined sampling sites (Sites 3, 4, 13, 19, 25, and 27). At each site, water chemistry, water chlorophyll, and plankton samples were collected. A YSI Profile was also taken at each site. The team completed 5 of the 7 sample sites before returning to Inuvik.

Environmental Notes: *There was a considerable amount of melt water underneath the snowpack. This in conjunction with the softness of the ice made shoveling and augering very difficult.*

On **May 14th** and **May 15th**, William, Donald, and Erika were unable to fly to Noell Lake due to weather.

On **May 16th**, William, Donald, and Erika travelled by helicopter to Noell Lake to sample the remaining 2 sites. After the first site was complete, William had to be flown back to

Inuvik for medical reasons. Jolene Lennie (ARI) flew to Noell Lake to take his place. By 2pm, the team had successfully completed the remaining 2 sample sites.

After the sampling was complete, Donald, Jolene, and Erika headed towards the location of a homemade buoy that was installed in the lake the previous summer. The coordinates marking the location of the homemade buoy were provided by Cuyler Onclin's group in December, who had seen the orange marine floats on their way to Trail Valley Creek. Since December, there had been a lot of snow, which was likely covering the orange marine floats. The team shoveled out a 20m radius around the GPS coordinates marking the floats, but was still unable to locate them.

Environmental Notes: *The overflow from May 13th had now frozen, making the ice approximately 6ft thick. This made augering even more difficult. It took the field team approximately 2 hours (per site) to make a hole in the ice large enough to sample through.*

Donald, Jolene, and Erika at Noell Lake

2.3 Retrieving the home-made buoy and two AXYS subsurface mooring systems

On **July 3rd**, Donald, Ben Paquette-Struger (UVic), and Peter diCenzo (EC) travelled to Noell Lake via helicopter to retrieve the home-made buoy that was installed in the lake the previous summer. The team was successful.

On **July 4th**, Jolene, Donald, Erika, Ben, and Peter travelled to Noell Lake via helicopter to retrieve the two subsurface mooring systems designed by AXYS Technologies and WCIRC.

The team travelled to the GPS coordinates marking the first subsurface mooring system, using an ARI boat and motor that had been left at the lake the previous summer. Unfortunately, the subsurface mooring system had drifted away from its original location and the orange marine floats marking it could not be seen from the boat. The team decided to take the boat along transects, crossing by the GPS coordinates that marked the original location.

At the end of the day, the team had no luck finding either of the subsurface mooring systems.

On **July 5th**, Donald, Erika, Ben, and Peter travelled back to Noell Lake via helicopter to continue looking for the two subsurface mooring systems.

The team still had no luck finding either of the subsurface mooring systems.

On **July 6th**, Donald, Erika, Ben, and Peter travelled back to Noell Lake via helicopter to continue looking for the two subsurface mooring systems.

Success! The team located the first subsurface mooring system. Once the subsurface mooring system was located, the team hooked onto it and dragged it to shore, exposing

the top. Then, they hooked the long line from the helicopter to the top of the subsurface mooring system and had it slung to shore.

On shore, the team removed the array of YSIs tethered to the mooring system. The YSIs were placed in protective carrying cases, which were put inside of the helicopter. The helicopter then slung the subsurface mooring system, along with the YSIs, back to the Great Slave Helicopters hanger.

While the subsurface mooring system was being taken back to Inuvik, the team travelled to the coordinates marking the second subsurface mooring system. The team quickly found the second subsurface mooring system, hooked onto it, and dragged it towards shore, exposing the top. Similar to above, they hooked the long line from the helicopter to the top of the subsurface mooring system and had it slung to shore.

Once again, the team removed the array of YSIs tethered to the subsurface mooring system. The YSIs were placed in protective carrying cases, which were put inside of the helicopter. The helicopter then slung the subsurface mooring system, along with the YSIs, back to the Great Slave Helicopters hanger.

Both subsurface mooring systems were taken back to ARI, where they were stored in cold storage. The YSIs were stored in warm storage, located in the ARI loading bay.

2.4 Open Water Sampling

On **July 15th**, Erika and Jasmine Brewster (ARI) travelled to Noell Lake to collect water chemistry, water chlorophyll, and zooplankton samples. Samples were collected off of helicopter floats at 7 sites on Noell Lake, as well as at 2 nearby lakes (Lake 5A and Lake 5B). After the first 4 sites, the helicopter had to go back to Inuvik to refuel. After refueling, Erika and Jasmine returned to Noell Lake and sampled the remaining 5 sites.

All of the samples were transported back to ARI in a cooler at 4 °C. Back at ARI, Erika preserved each zooplankton sample using 95% ethanol. Jasmine filtered each 1L

surface water sample for chlorophyll, using Whatman GF/C filters. The labelled filters were then stored in the walk-in freezer at ARI. All of the water chemistry samples were packed into coolers and shipped to the National Laboratory for Environmental Testing.

Jasmine and Erika having lunch on the shore of Noell Lake.

September 30th

On **September 30th**, Jolene, Erika, Donald, and William were scheduled to travel to the Noell Lake area: i) to collect water chemistry and water chlorophyll samples from 10 small lakes (5A, 5B, 4B, 3B, NSCL-13, NSCL-11, NSCL-3, B1, B2, and B3) located within the Noell Lake catchment; and ii) to retrieve one of the ARI boats, which was being stored near Nellie's cabin, on the shore of Noell Lake.

The original plan was to have Jolene and Erika head to Noell Lake, pack the boat into a sling, and have the helicopter pilot sling it back to Inuvik, where William and Donald would be waiting to take the boat back to ARI. Unfortunately, due to weather, the helicopter was unable to sling the boat back to Inuvik.

In the meantime, Jolene and Erika proceeded to collect the water chemistry and water chlorophyll samples. At the end of the day, the weather still had not cleared up. When the sampling was complete Jolene and Erika returned to Inuvik.

All of the water samples were transported back to ARI in a cooler at 4 °C. Back at ARI, Erika filtered each 1L surface water sample for chlorophyll, using Whatman GF/C filters. The labelled filters were then stored in the walk-in freezer at ARI. All of the water chemistry samples were packed into coolers and shipped to the National Laboratory for Environmental Testing.

2.5 Retrieving the Boat from Noell Lake

October 17th

On October 17th, William, Donald, and Erika travelled to Noell Lake to retrieve the ARI boat being stored near Nellie's cabin, on the shore of Noell Lake. The team successfully had the boat slung back to the Gwich'in Helicopters hanger. The boat was then brought back to ARI.

2.6 Crating/Shipping the Ice Buoy and Mooring Pieces

On **September 24th**, Vern McLeod, of Midnight Sun Contracting, was hired to crate and ship the fully-automated ice buoy, which was being stored at Aklak Canadian Helicopters, and the two subsurface mooring systems, which were being stored in one of the cold storage warehouses at ARI, to AXYS Technologies in Sidney, BC.

On **October 17th**, the work was completed. Midnight Sun Contracting had successfully shipped the ice buoy and subsurface mooring systems.

2.7 Shipping samples to W-CIRC

On November 1st, Erika Hille packed up the Ekman Grab, Ponar, and Zooplankton samples that were being stored in the walk-in fridge at ARI. The samples were shipped

via road by Manitoulin Transport to W-CIRC in Victoria, BC. Shipping costs were charged to the ECHYDR11 G & C.

2.8 Shipping two pallets in the loading bay

In August, Fred Wrona (EC) and Peter packed up the YSIs, taken off of the subsurface mooring systems, onto two pallets. The two pallets were stored in the ARI loading bay. On January 16th, Manitoulin Transport came to pick up the two pallets and shipped them to W-CIRC in Victoria, BC. Shipping costs were charged to the client number provided by Gary Zacharias, National Hydrology Research Centre, Environment Canada.

3.0 MAIN CHALLENGES

1. In mid-May, there was a considerable amount of overflow on top of the ice. When you're standing in overflow, it makes it much harder to use the ice auger.
2. After the pre-melt period in mid-May, the temperature near Noell Lake dropped below 0 °C, causing the overflow on the ice to freeze. As a result, the total ice thickness was almost 6 feet. Once we had augered 6-holes, which was required for the plankton net, we had to use a hand ice saw to remove the ice. On average, each site took us between 2 and 3 hours to complete.

4.0 RECOMMENDATIONS

Under-ice sampling should take place in late-April, at the latest, prior to the spring freshet.