From climate change to water wealth: Inuit researchers advancing reseach capacity for Arctic water systems in Nunavut

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INTRODUCTION

Climate Change can impact water quantity and quality and can easily impact community source water. The protection of source water is critical to ensuring the sustainability of clean community drinking water and local ecosystem health and function. Yet there is an immense lack of knowledge with regards to source water landscapes, the hydrological regime, and water quality for most Nunavut communities as well as no current source water protection policies.

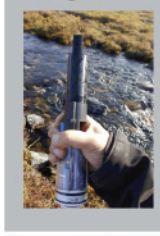
Building on a previous 2-year youth-based water monitoring project in Mittimatalik (Pond Inlet) piloted by Tim Anaviapik Soucie and supported by mentors from ARCTIConnexion and the academia, we wanted to expand into a project that would build the foundations for source water protection. We aimed to 1) advance local monitoring capacity by promoting youth skills development (*pilimmaksarniq*) and leadership (*nagligusuk*); 2) conduct integrated watershed-scale water monitoring by gathering local observations, field data, and satellite imager; and 3) build water quality indices and decision making tools to aid in community source water protection planning.

In parallel to these objectives, we also wanted to create strong connections between the research capacity of our team and the specific needs of community members, and be able to quickly respond to them. In the long run, we also hope for this project to become a model for other Arctic communities and particularly the youth.

METHODS

From mid-June (spring freshet) to Late September (freeze up) 2017, our local research team monitored five streams and two lakes for physico-chemical parameters (ph, dissolved oxygen, conductivity, and temperature), hydrological parameters (water level and flow), and microbial content, (fecal coliform indicators, and DNA markers). Data loggers were used to collect continuous water level, temperature, and conductivity measurements. Enterolert™ and Colilert™ reagents were used to test water samples for coliforms, ecoli, and enterolert which are fecal bacteria indicators (e.g. listeria, giardia, etc). Triplicate samples were incubated 24h at 35°C (Colilert), 41°C (Enterolert), followed by microbial counts (Most Probable Number of colony, MPN).

We used multiple linear regressions to determine the relationship of measured water parameters on microbial levels across various watersheds. We used ANOVA's and post hoc tukey tests to examine the differences in microbial levels among sites, months,and years.



RESULTS

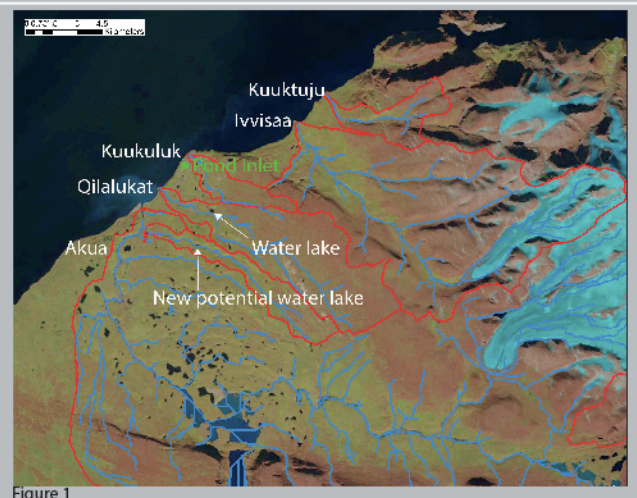


Figure 1

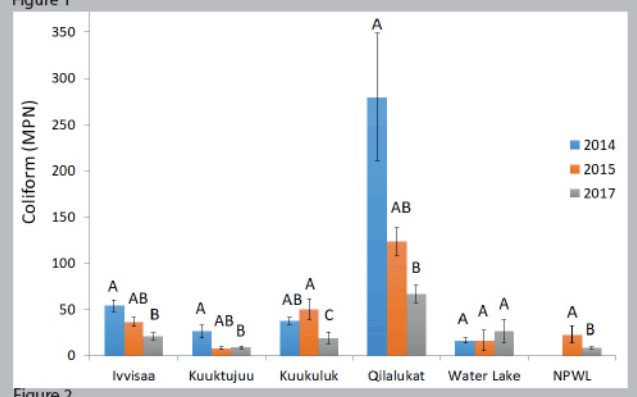


Figure 2

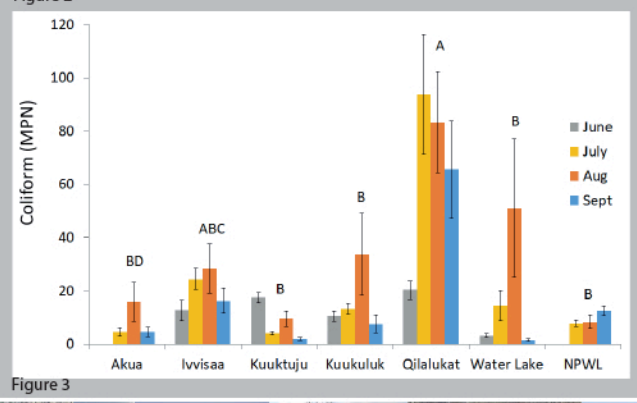


Figure 3

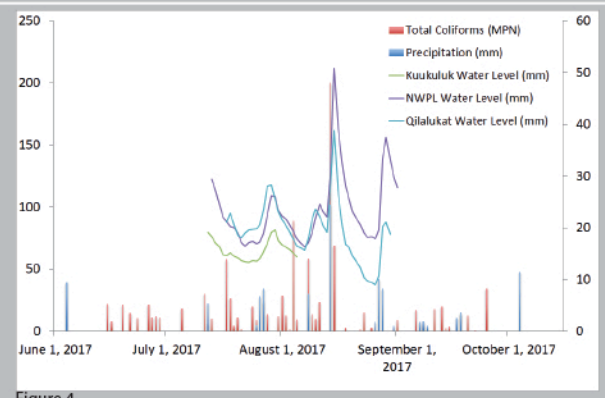


Figure 4

Fig.1) Pond Inlet Study Watersheds and Lakes with July 2016 Landsat 8 background
Fig. 2) Multi-year site analysis of mean Coliform count (MPN) variance . Letters (A, B,C) indicate statistically sig. (>0.05) variance.
Fig. 3) 2017 monthy mean Coliform count (MPN). Statistically sig. analysis of variance indicated by differnent letters (A,B,C).
Fig. 4) 2017 precipitation events (blue) along, total Coliform counts (MPN) (red) shown with responding water levels in three watersheds. Water level responds quickly to precipitation events.
Table 1) Multi-variate regession analysis results of specifc watershed mean Coliform count (MPN) and physico-chemical variables. Models with the highest R^2 are displayed· Correlation direction ('positive or negaitve') are given with the model predictors·
The sum of previous precipitation events are a comon perdictor· indicating Coliform have a lagged response to precipitation·

Table 1

Watershed	Predictors	R^2	p	Size of Watershed (km^2)
Akua	Total Past Precip (5d) (+) Conductivity (-) Total Past Precip (9d) (+)	0.87	<0.005	1476
Ivvisaa	Total Past Precip (11d) (-) Total Past Precip (8d) (+)	0.67	<0.005	137
Kuuktuju	Total Past Precip (11d) (-) Total Past Precip (5d) (+) Dissolved O2 (+)	0.85	<0.005	14
Kuukuluk	Total Past Precip (11d) (-) Conductivity (-) Total Past Precip (1d) (+)	0.62	<0.005	9
NWPL	Total Past Precip (9d) (+) Temperature (+) Total Past Precip (2d) (+)	0.89	<0.005	17
Qilalukat	Conductivity (-) pH (+0	0.39	<0.005	49
Water Lake	Dissolved O2 (-) Precipitation	0.5	<0.005	N/A

DISCUSSION

Statistical analysis indicates both positive and negative correlations between precipitation event lags and coliforms counts. There are significant variations in coliform counts both site to site and year to year, significantly impacting raw water sources. Given evidence of a lagged response there is a need to measure more parameters both physical and chemical. An increase in water quality sensors such as turbidity, conductivity, dissolved oxygen, temperature, and water level should be located in key watersheds. Bio-geochemical analysis of stream water for stable isotopes, DOC, and nutrients in conjunction with landscape contributions and remote sensing will help to determine what factors have may be contributing to the lag effect.

The monitoring has been important in illustrating the need for better understanding of Arctic fresh water systems, although still relatively pristine compared to the southern waters. The Arctic fresh water systems are an important source of raw drinking water for local communities. A changing climate can have varying impacts on water quality, for instance gastro illnesses to more serious giardia and crypto. Coliforms have been used as an indicator, in 2015 we found listeria and ecoli 157 during periods of precipitation showing a need for a better understanding of these important sources of water for the community of Pond Inlet.

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