BEAUFORT SEA COASTAL RESTORATION PROJECT

2018 ANNUAL RESEARCH UPDATE

Project Summary

In 2017, the Aurora Research Institute (ARI) received $410,000 from the Coastal Restoration Fund (Fisheries and Oceans Canada) to study the impacts of permafrost thaw slumping on Kugmallit Bay and create a plan to mitigate these effects using local plant species. Over the 5-year project, ARI will try to answer four key questions:

- How quickly are permafrost thaw slumps forming (in # per year) and expanding (in metres per year)?
- How do permafrost thaw slumps impact the water quality of runoff to Kugmallit Bay?
- How do permafrost thaw slumps impact the water quality of nearshore Kugmallit Bay?
- Can local plant species be used to restore areas of the coastline impacted by permafrost thaw slumping?

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2018 Project Activities

- Delineated the coastline and thaw slumps around Kugmallit Bay using aerial photographs obtained in 1962 and 2004
- Completed drone surveys at each study site
- Collected water samples from both slump-impacted and pristine runoff channels at each study site
- Conducted seed collections at each study site and along the Inuvik-to-Tuktoyaktuk Highway

Peninsula Point

Choosing study sites...

In March 2018, Erika Hille, the Principle Investigator, travelled to Tuktoyaktuk to meet with members of the Tuktoyaktuk Hunters and Trappers Committee. The purpose of the meeting was to present the project, obtain feedback on the project design, and choose study sites. While she was in Tuktoyaktuk, Erika also met with the Inuvialuit Land Administration to discuss hiring Environmental Monitors to assist with fieldwork.

The location of study sites in the Kugmallit Bay region

Mapping the thaw slump activity ...

In summer and fall 2018, aerial photographs of Kugmallit Bay were used to determine the location, amount, and size of thaw slumps along the coastline of Kugmallit Bay in 1962 and 2004.

Recent RADARSAT2 imagery was obtained from Natural Resources Canada. In winter 2019, this imagery will be used to delineate the thaw slumps along the coastline of Kugmallit Bay.

The goal of this work is to determine the rate of thaw slumping along the coastline of Kugmallit Bay between 1962 and now.

Using Unmanned Aerial Vehicles to study site conditions...

In July 2018, each study site was surveyed using an eBee SenseFly Drone. The ARI field team was accompanied by two Environmental Monitors from the Inuvialuit Land Administration. The drone imagery is being used to create maps detailing the amount and type of vegetation, surface water, and ground temperature at each site. It will also be used to estimate the volume of each thaw slump and the ice content of the headwall. Drone surveys are planned for each summer the project is running (2019, 2020, and 2021).

The eBee SenseFly being launched

Assessing the impacts of coastal thaw slumps on water quality...

In August 2018, a ARI field team collected water samples from: i. water runoff from the thaw slump impacted terrain at each study site; and ii. water runoff from the unaffected terrain lying next to the thaw slump. The water samples were sent to Taiga Environmental Laboratories in Yellowknife, NT for analysis. No marine samples were collected in 2018.

In 2019, the team plans to collect water samples from the nearshore. Samples will be collected from: i. 100m off the shore of the thaw slump impacted terrain at each study site; ii. 100m off the shore of the unaffected terrain lying up-current of the thaw slump; and iii. 100m off the shore of the unaffected terrain lying down-current of the thaw slump. Water samples will be collected from the contributing landscape, as well.

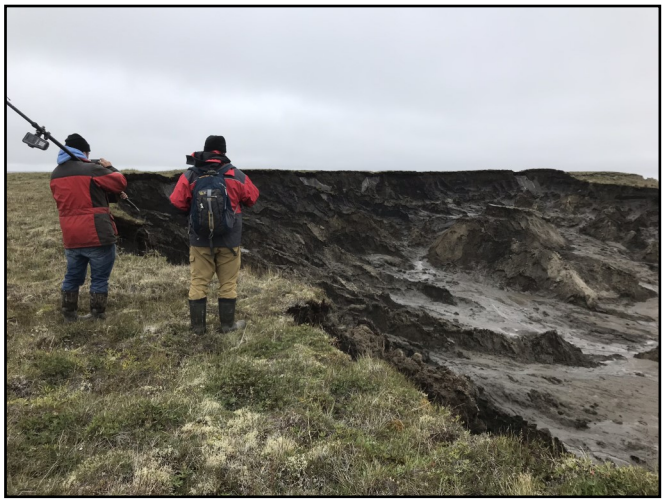
Early results from the 2018 field season suggest that runoff from coastal block failures and thaw slumps have:

- a higher conductivity and higher concentrations of total suspended and total dissolved solids than runoff from pristine terrain;
- higher concentrations of calcium, sulphate, and sodium than runoff from pristine terrain;
- higher concentrations of dissolved strontium (a trace metal), but lower concentrations of dissolved iron than runoff from pristine terrain; and
- higher concentrations of dissolved strontium (a trace metal) and dissolved iron than runoff from pristine terrain.

Data tables can be found on Page 4.

Water runoff samples collected at key study sites

Block failure off the coast of Pullen Island, NT



Thaw slump off the coast of Pullen Island, NT

Preliminary water quality data...

Table 1: Conductivity, total suspended solids, and total dissolved solids measured in run off from three terrain types (block failure, thaw slump, pristine terrain).

	Sample Size	Conductivity	Total Suspended Solids	Total Dissolved Solids
		$Mg.L^{-1}$	$Mg.L^{-1}$	$Mg.L^{-1}$
Block failure	7	879	52,919	813
Thaw Slump	6	1,153	816	1,023
Pristine	2	201	11	204

Runoff from coastal block failures and thaw slumps had a higher conductivity and higher concentrations of total suspended and total dissolved solids than runoff from pristine terrain. Runoff from coastal block failures had a substantially higher concentration of total suspended solids than runoff from coastal thaw slumps.

Table 2: Calcium, sulphate, and sodium measured in runoff from three terrain types (block failure, thaw slump, pristine terrain).

	Sample Size	Calcium	Sulphate	Sodium
		$mg.L^{-1}$	$mg.L^{-1}$	$mg.L^{-1}$
Block failure	7	46	115	79
Thaw Slump	6	160	513	24
Pristine	2	9	5	21

Runoff sampled from coastal block failures and thaw slumps had higher concentrations of calcium, sulphate, and sodium than runoff from pristine terrain.

Table 3: Total dissolved iron and strontium measured in runoff from three terrain types (block failure, thaw slump, pristine terrain).

	Sample Size	Iron	Strontium
		µg.L-1	µg.L-1
Block failure	7	112	222
Thaw Slump	6	146	561
Pristine	2	2190	43

Runoff sampled from coastal block failures had thaw slumps had higher concentrations of dissolved strontium and lower concentrations of dissolved iron than runoff from pristine terrain.

Table 4: Total suspended iron and strontium measured in runoff from three terrain types (block failure, thaw slump, pristine terrain).

	Sample Size	Iron	Strontium
		mg.L-1	µg.L-1
Block failure	7	193	1,837
Thaw Slump	6	24	608
Pristine	2	5	46

Runoff from coastal block failures had higher concentrations of dissolved strontium and dissolved iron than runoff from pristine terrain.

Revegetating coastal thaw slumps...

In winter 2018, a thorough literature review was conducted. The literature review focused on techniques for restoring permafrost terrain using local plant species.

In summer 2018, seed collections were conducted at each study site and along the Inuvik-to-Tuktoyaktuk Highway. Seeds were collected from over 20 species of plants local to the Tuktoyaktuk region. The seeds are currently frozen at the Aurora Research Institute in Inuvik, NT.

In winter 2019, the seeds will be cleaned and tested.

In Summer 2019, soil will be collected from disturbed terrain near Tuktoyaktuk (quarries and thaw slumps). This soil will be used, along with local plant seeds, to create vegetation mats that can be planted into recently stabilized sections of the thaw slumps at each study site. This will be done in 2020.

Vegetation islands in a thaw slump on Kugmallit Bay

Plans for 2019...

1. Use RADARSAT2 imagery collected in 2018 to delineate the location, amount, and size of thaw slumps along the coastline of Kugmallit Bay, in order to determine the rate of thaw slumping along the coastline of Kugmallit Bay between 1962 and now.
2. Survey each study site using the eBee SenseFly drone.
3. Collect water samples from: i. 100m off the shore of the thaw slump impacted terrain at each study site; ii. 100m off the shore of the unaffected terrain lying up-current of the thaw slump; and iii. 100m off the shore of the unaffected terrain lying down-current of the thaw slump
4. Collect water samples from the contributing landscape, using the same protocol that was used in 2018.
5. Clean and test the seeds collected in 2018.
6. Collect soil from disturbed terrain near Tuktoyaktuk (quarries and thaw slumps). This soil will be used with local plant seeds to create vegetation mats that can be planted into recently stabilized sections of the thaw slumps at each study site in 2020.

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http://nwtresearch.com/projects/environment/beaufort-sea-coastal-restoration