PROJECT NAME: Changes in the function and composition of plants and soil microorganisms in the glacier foreland of a high arctic tundra ecosystem.

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WHAT :

Our team would like to conduct field studies of plants and soil in the glacier foreland on Ellesmere Island (Details of the sampling area are listed in the later part of this report).
Our main objectives are to investigate the biodiversity of tundra vegetation, as well as the microorganisms living in the terrestrial soil and tundra lakes/ponds bottom sediments (solid substances). We also plan to investigate the effects of climate warming on the tundra ecosystem with emphasis on plant and microorganisms. In order to accomplish these above-mentioned objectives, we plan to conduct the following investigations;

METHOD 1: Measurement and sampling of plant and soil.

The proglacial area near Oobloyah Bay, northern Ellesmere Island is chosen as our sampling area. The abiotic environment in this area possess high local heterogeneity and there are different types of vegetation patches created by the retreating glacier (see Photo 1). We plan to investigate the plant species

and soil properties in these areas using both non-destructive and non-disruptive methods.

Our field studies include collecting vegetation information through a survey of approximately 300 quadrants as well as measuring the soil moisture, temperature and depth. Each quadrant is 1 meter (39 inches) by 1 meter (39 inches). Photo 2 shows the sampling and data collection process for soil moisture, temperature and depth using non-destructive methods.

We will also sample 5-10 individual plants of each species and transport them to Japan to determine their morphological and chemical characteristics. A small amount of plant croppings (approximately 8 inch or 20 cm square) from each quadrant will be sampled to quantify the living plants within each area. A small amount of soil will be collected using plastic pipes (5 cm (2 inches) in diameter and 5 cm (2 inches) in height) from the cropped area in each quadrant for the investigation of soil microorganisms. We also plan to collect soil sample for the characterization of soil properties in Japan (carbon and nitrogen contents, and the potential of hydrogen (or pH)). The samples will be collected using a scoop of approximately 5 cm (2 inches) by 5 cm (2 inches) by 10 cm (4 inches) in-depth.

METHOD 2: To collect images of vegetation and geographical features using drones.

To gather the information about vegetation and geographical features over a larger area of approximately 3 km^2 , we plan to take ground surface images by drones (size: 25 cm (10 inches) by 40 cm (16 inches) equipped with cameras (RGB and multi-spectrum sensor cameras). The investigation will be conducted over an area with a variety of vegetation types.

METHOD 3: Measurement of the ecosystem carbon dynamics.

To gather the information about the ecosystem carbon dynamics, we plan to measure the carbon dioxide (CO_2) exchange between vegetation and the atmosphere, as well as between the ground and the atmosphere. We plan to place several chambers within each vegetation type (Photo 3) and monitor the CO_2 flux between the atmosphere and the vegetation/ground. We will also monitor temperature, humidity and light conditions during the measurement. The chamber size is about 45 cm (18 inches) square by 30 cm (12 inches). The temperature, humidity and light sensor sizes are 10 cm (4 inches) by 4 cm (2 inches). The data logger size is (10 cm (4 inches) by 15 cm (6 inches) by 3 cm (1 inch)).

METHOD 4: Measurement and sampling of lake water and sediment.

To gather the information about the biogeographical features and microorganism diversity, we are planning to collect a small amount of water and sediment samples from the bottom of a few lakes and ponds. We plan to collect samples (size: 10 cm (4 inches) in diameter by 50 cm (20 inches) in depth) from about three lakes/ponds using a clean core sampler (size: 20 cm (8 inches) by 120 cm (48 inches), Photo 4). The sampling area will be about 20 cm (8 inches) by 20 cm (8 inches) in each lake/pond. We plan to transport the samples to Japan for chemical and biological analysis.

WHY:

Objective # 1. Our study's first objective is to investigate the plant and microorganism biodiversity in the tundra ecosystem, as well as to understand the relationships between the biodiversity of the plant and soil microorganisms as well as with different environmental factors. Thus, we would like to reveal the taxonomical and functional diversity using the data obtained through METHODS 1 and 2.

Objective #2. Another goal is to estimate the changes in vegetation with relation to the ongoing climate warming in the Arctic area. We have historical data about plant diversity in the area (Mori et al. 2014 Oikos; https://onlinelibrary.wiley.com/doi/10.1111/oik.04345). By conducting additional analysis and comparing the data of this study and the past study, we would like to estimate the impact of this past decade's climate change on plant diversity in the study area.

Objective # 3. The third aim is to estimate the ecosystem carbon cycling process through biological activity in this area. Based on the data obtained through METHODS 1-3, we plan to reveal the carbon flow and biodiversity. We would also like to clarify the feedback effect from the biome to the atmosphere under climate change by comparing the results with those obtained from objectives 2 and 3.

We are also interested in the microorganisms living in the bottom of a lake or pond because there is almost no biogeographical and biodiversity information about microorganisms from this environment in this area. Using

this information we also like to clarify the relationships between the diversity of microorganisms in the sediments with other environmental factors, (including the climate condition, as well as the carbon and nitrogen contents of the sediments) using data obtained by METHOD 4.

WHERE:

We plan to conduct our field research in the proglacial area in the southern and front portion of Arklio Glacier in the Krieger Mountains near Oobloyah Bay, Ellesmere Island, Nunavut, Canada (80°52′N, 82°50′W). We have previously conducted long term research investigations in this region over a five year period (2002, 2003, 2004, 2007, 2008). We are planning to conduct our research primarily in the proglacial areas and lake sites. We will not carry out any research in protected areas. We plan to access the area by plane and move within the area by walking. A Canadian coordinator, Mr. Robert Howe, knows the area very well and will accompany us.

WHEN:

We would like to visit the study area from late July until the middle of August in 2022, 2023 and 2024.

We are always looking for ways to improve our research plans to have a lower impact on the environment. We want to provide a report to communities, and Nunavut organizations about our scientific surveys and findings by e-mail after the expedition and when the data analyses have been completed.

Photo 1. Research site.

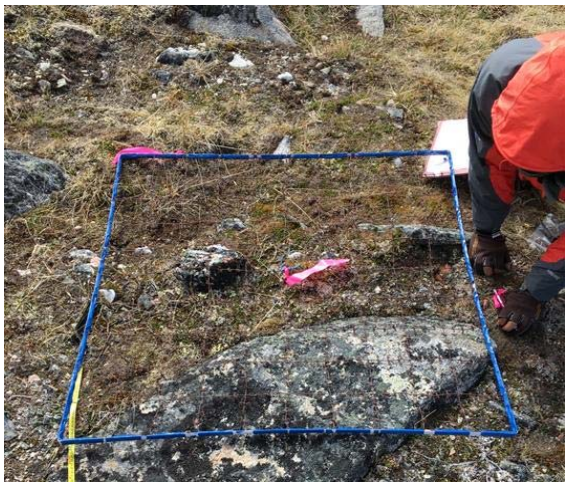

Photo 2. A non-destructive and non-disruptive vegetation survey.

Photo 3. A non-destructive and non-disruptive carbon dioxide flux measurement.

Photo 4. Core sampler for lake/pond sediment.