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Polar Continental Shelf Program

SCIENCE REPORT

2020, 2021 and 2022

LOGISTICAL SUPPORT
FOR LEADING-EDGE RESEARCH
IN CANADA AND ITS ARCTIC

Canada

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Polar Continental Shelf Program – Science Report 2020, 2021 and 2022: Logistical support for leading-edge research in Canada and its Arctic

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Top: Collecting microbes from cryoconite holes in the Ward Hunt Ice Rise, Nunavut
Bottom: Preparation of a drone's flight above a debris-covered glacier

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MINISTER'S MESSAGE

The North is an integral part of Canada's national identity – Inuit have inhabited the region since time immemorial and it is home to valuable ecosystems and biodiversity. In our increasingly uncertain world, it is also an area of vital strategic importance for Canada, its partners and allies. That is why it is important that we continue to further our understanding of the North through rigorous research.

Since 1958, the Polar Continental Shelf Program (PCSP) at Natural Resources Canada has played an essential role in increasing our understanding of Canada's North by providing whole-of-government logistics support for science projects, which in turn contribute to informed decision making on issues including climate change, the environment, sustainable communities, natural resources and infrastructure development, preservation of Indigenous traditional knowledge, and cultural history and the exercise of Canada's Arctic sovereignty.

In 2020–2021, the PCSP's operations and services were interrupted by the global COVID-19 pandemic. Throughout this challenging period, the PCSP was able to adjust their activities to continue the facilitation of Arctic science managing to provide support to upwards of 170 projects spanning over 150 qualified organizations for the 2021 field season. Operations have rebounded to near normal numbers in 2022.

The difficulties of conducting fieldwork in remote and inhospitable locations across the Canadian Arctic are compounded by the scientific reality of climate change, which is changing the nature of operating in the North, as well as the lives of those that call this region home.

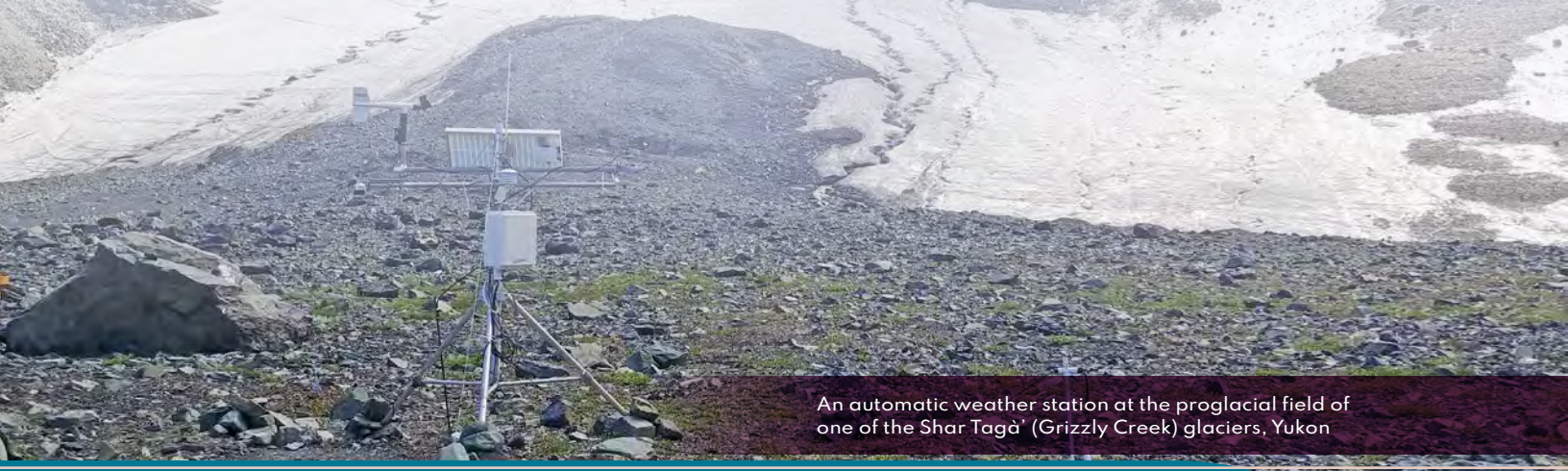
The PCSP is providing essential support to enable the continuation of critical research by supplying cost-effective logistics organization as well as offering access to a constructive workspace, laboratory and accommodations. The PCSP enables the realization of many research projects in areas that would be inaccessible or cost-prohibitive without the Program's expertise in the field of Arctic logistics.

The success of the PCSP under the circumstances of the changing arctic environment and the COVID-19 pandemic is commendable, considering the pre-existing challenges to work and travel in the remote regions of Canada's North. It is a testament to the skill and dedication of Arctic science researchers who adapted to these changing conditions, continuing their vital work in increasingly challenging circumstances.

Natural Resources Canada is proud to support Canadian Arctic scientific and Indigenous research, with the PCSP fostering continued collaboration and engagement, and the use of science and evidence-based decision-making. With an unwavering focus on delivering results, we will continue to work constructively with Indigenous communities and Northern partners to adapt to new realities and to develop more effective ways to address the challenges confronting the Canadian North and the Arctic.

I am confident that this PCSP Science Report will provide readers with an in-depth look at the Program, the research being conducted, and reflects the Government of Canada's commitment to prosperity and sustainability in our North.

The Honourable Jonathan Wilkinson
Minister of Energy and Natural Resources



An automatic weather station at the proglacial field of one of the Shar Tagà' (Grizzly Creek) glaciers, Yukon

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ᐅᑭᐅᖅᑕᖅᑐᖅ ᐃᓚᒋᔭᐅᓪᓚᕆᒃᐳᖅ ᑲᓇᑕᐅᑉ ᓄᓇᓖᑦᔪᐊᖑᓂᖓᓄᑦ ᖃᐅᔨᒪᔭᐅᒍᑎᖏᓐᓄᑦ - ᐃᓄᐃᑦ ᓄᓇᖃᖅᑳᕐᓯᒪᔫᑦ ᑕᒫᓂ ᑕᐃᒪᙵᑦ ᓱᐊᕈᐊᓗᓂᒃ ᐊᒻᒪᓗ ᐊᖏᖅᑲᓇᔭᐅᓪᓗᓂ ᐊᑐᖅᓯᖅᑐᓪᓚᑎᓐᓄᑦ ᓱᓇᑐᐃᓐᓇᕆᔭᐊᓄᑦ ᐊᑦᑐᐊᖅᑎᕆᑦᑐᓄᑦ ᐊᒻᒪᓗ ᖃᓄᐃᑦᑐᑐᐃᓐᓇᖅᓄᑦ ᐆᒪᔪᖅᓄᑦ. ᐱᕙᓪᓕᐊᑐᐃᓐᓇᑎᓪᓗᒥᑦ ᖃᐅᔨᒪᓇᓐᖏᑦᑐᑦ ᓄᓇᕐᔪᐊᒥ, ᑕᒪᓐᓇ ᓄᓇ ᐱᕕᔾᔪᐊᖑᕗᖅ ᖃᓄᐃᓕᖓᓗᓯᐊᕈᑎᖏᓐᓄᑦ ᐱᒻᒪᕆ-ᐅᓂᖓ ᑲᓇᑕᒧᑦ, ᑲᒪᖅᑎᒋᔭᖏᓐᓄᑦ, ᑕᐱᑕᔭᖏᓐᓄᑦᓗ. ᑕᐃᒪᐃᒻᒪᑦ ᐱᒻᒪᕆᐅᓚᕿᕗᖅ ᐅᕙᑦᑎᑦ ᑲᔪᓯᑎᒋᐊᓪᓚᕆᐊᖅᑲᖅᓂᐊᖅᑕᐅᓂᕈᑎᓐᓂᒃ ᐱᕆᐊᓪᓚᑲᓐᓂᖅᓯᐊᖅᓂᖅᒥᒃ ᑐᑭᓯᒪᓂᑦᑎᓐᓂᒃ ᐅᑭᐅᖅᑕᖅᑐᒥᒃ ᐱᓕᕆᐊᕕᔾᔪᐊᓇᐊᖅᓂᒃᑯᑦ ᖃᐅᔨᓴᕆᐊᓇᐊᓪᓚᓂᒃ.

ᑕᐃᒪᙵᑦ 1958ᒥᓂᒃ, ᓄᓇᕐᔪᐊᑉ ᑲᔫᓪᓚᕆᓐᑐᓂᒃ ᓄᓇᕕᒻᒥᓂᒃ ᑲᒪᔨᖅᑲᖅᖃᓯᐊᖅᑐᑦ ᑕᐃᑲᓂ ᓄᓇᒦᓐᓛᖅᑐᓂᒃ ᐊᑐᖅᓂᖅᑲᖅᑐᓚ-ᕆᔾᔭᒃᑯᓂ ᑲᓇᑕᒥ ᑲᒪᖅᑕᐅᓯᒪᕗᑦ ᐊᑐᖅᓂᖅᑲᓪᓚᕆᑦᑐᓂᒃ ᑲᒪᒋᒋᐊ-ᓚᓐᓂᒃ ᐱᕙᓪᓕᕈᖅᑯᓪᓗᒍ ᑐᑭᓯᒪᓂᕗᑦ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᖓᓂᒃ ᐃᒫᒃ ᐱᑎᑦᓯᖅᑲᑦᑕᖅᓯᑎᒃ ᐊᑕᖅᑭᖅᑐᓂᒃ-ᑖᒃᑯᓇᓐᖓᓪᓚ-ᒪᕙᒪᒃᑯᓐᓂᒃ ᓇᒍᓐᖓᓇᐊᓚᓐᓂᒃ ᓴᐳᔾᔨᓯᒪᓂᒃᑯᑦ ᓇᓗᓇᖅᑐᓪᓚᓇᓐᓂᒃ ᖃᐅᔨ-ᓴᓯᐊᖅᑐᖏᑦ ᑲᒪᔪᐅᒨᖅᑐᐊᖅᑐᓂᒃ, ᑕᒪᒃᑯᐊᓗ ᐃᑲᔪᖅᓯᓪᓚᖅᐸᑦᓯᑎᒃ ᑐᑭᓯᒪᑎᖃᐃᓂᖅᒥᒃ ᐋᖅᑭᑦᑕᐅᒥᐊᓚᓐᓂᒃ ᑕᒪᒃᑯᓂᖓ ᐊᕙᐊᕈᑎᓄᑦ ᐃᓚᒥᔭᐅᓪᓗᓂ ᓯᓚᐅᑉ ᐊᓯᔾᔨᕿᓪᓚᐊᓂᖓ, ᐊᕙᑎᒥᔭᕗᑦ, ᒪᕿᒪᔭᐊᕈᑎᖅᓯᓂᒃ ᓄᓇᓕᓐᓄᑦ, ᓄᓇᒦᓐᓛᖅᑐᓂᒃ ᐊᑐᖅᓂᖅᑲᖅᑐᓚ-ᓇᓂᖅ ᐊᒻᒪᓗ ᓱᓇᖅᑯᑎᒻᒪᓇᐅᔪᑦ ᐱᕙᓪᓕᐊᔭᐅᓂᖅᑲᖅᓄᑦ, ᐱᐅᓚ-ᔭᐅᓯᒪᓂᕆᖅᓄᑦ ᓄᓇᖅᑲᖅᑳᖅᓯᒪᔪᑦ ᓯᐊᕿᖅᓂᖓᐃᑦ ᖃᐅᔨᒪᔭᐅᑦᑎᖅᑯᑦ ᐊᒻᒪᓗ ᐃᓚᖅᑯᓯᖅᑭᖅᓄᖅᓚᔪᓂᒃ ᓯᐊᕈᐊᓗᓂᒃ ᐊᒻᒪᓗ ᐱᓪᓚᑕᐅᑎ-ᑕᐅᓂᖅᓚᓄᑦ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᖓ ᑲᓇᑑᖅᓚᕆᐊᖅᓚᓂᒃ.

ᐃᓗᐊᓂ 2020-2021ᒥᓗ, ᑖᒃᑯᐊ ᓄᓇᕐᔪᐊᑉ ᑲᔫᓪᓚᕆᓐᑐᓂᒃ ᓄᓇᕕᒻᒥᓂᒃ ᑲᒪᔨᖅᑲᖅᖃᓯᐊᖅᑐᑦ ᐊᐅᓚᓂᕆᔭᖅᑎᑦ ᐊᒻᒪᓗ ᐱᕋᔨ-ᕋᕐᓂᖅᑎᑦ ᓄᖅᑲᖓᑎᑕᐅᓚᐅᖅᑯᑦ ᒪᕐᔪᖓ ᓄᓇᕐᔪᐊᑎᓐᓂ ᓄᐊᓐ-ᓇᕐᔪᐊᒧᑦ ᓇᒥᓕᒻᖅ. ᑕᑉᐱᒥᖓ ᐊᑦᔨᕈᓐᓇᖅᑐᖅᑲᖅᑐᒥ ᐊᖅᑯᑎᖅᑲᖅᑎᓪᓗᑕ, ᑖᒃᑯᐊ ᓄᓇᕐᔪᐊᑉ ᑲᔫᓪᓚᕆᓐᑐᓂᒃ ᓄᓇᕕᒻᒥᓂᒃ ᑲᒪᔨᖅᑲᖅᖃᓯᐊᖅᑐᑦ ᐱᔪᓐᓇᓚᐅᖅᑐᑦ ᐋᖅᑭᐊᓇᓪᓗᑎᒃ ᑲᒪᔨᑲᑦᑕᖅᑕᒥᓐᓂᒃ ᑲᔪᓯᔪ-ᖁᑦᓗᑎᑦ ᐱᕕᖅᑎᑕᐅᓂᖅᑎᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ ᓇᓗᓇᖅᑐᓂᒃ ᖃᐅᔨᓴᕐᓂᐅᔪᑦ ᐱᔪᓐᓇᑎᓯᓚᖅᑭᓚᐅᖅᑯᑦ ᓴᐳᔾᔨᑎᓯᓂᕐᒥᒃ ᑎᑭᑦᓯᔪ 170ᓂᒃ ᑲᒪᔪᐃᑦᑐᐊᓚᓐᓂᒃ ᓱᐊᒻᒪᑎᑕᐅᓪᓗᑎᒃ ᐅᖓᑖᓄᑦ 150 ᐱᔪᓐᓇᖅᑎᑕᐅᔪᑦ ᑎᒥᐅᔪᑦ ᑕᐃᑦᓯᒪᓂ 2021ᒥ ᓄᓇᓕᓐᓂᕐ-ᒨᕐᖓᔪᓂᒃ ᐱᕕᖃᕐᓇᐅᓂᖓᓂ. ᐊᐅᓚᓂᐅᔪᑦ ᐅᑎᖅᓯᒪᓕᖅᑐᑦ ᖃᓂᒋᔭᕆᓂᒃ ᐊᐅᓚᒍᓯᐅᖃᑦᑕᕐᔪᓄᑦ ᓈᓴᐅᑎᕆᓂᑦ 2022ᒥ.

ᐱᓴᕐᓇᐊᕈᒍᑎᐅᔪᑦ ᑲᒪᒋᔭᐅᓂᕐᒥᒃ ᓄᓇᒦᑦᑐᓂ ᖃᓂᒋᔭᕆᑦᑐᒥ ᐊᒻᒪᓗ ᓱᓇᑕᖃᖅᑐᒦᑦᑐᓂ ᓇᒦᕙᒋᔭᐅᔪᒥ ᓇᒥᑐᐃᓐᓇᖅ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᖓᓂ ᑕᒪᓐᓇ ᐱᕆᐊᓪᓚᑲᓐᓂᖅᑐᑎᒻᒪᐅᑉ ᒪᓯᒪ ᓇᓗᓇᖅ-ᑐᖅᑕᓂᐅᑉ ᐱᓪᓚᑕᐅᓂᖓᓄᑦ ᓯᓚᐅᑉ ᐊᓯᔾᔨᕿᓪᓚᐊᓂᖓᓄᑦ, ᑕᒪᓐᓇ ᐊᓯᔾᔨᕿᓪᓚᓪᓚᑦ ᓄᓇᐅᑉ ᓯᓚᐅᓪᓗ ᐊᐅᓚᓂᖓᓂ ᐅᑭᐅᖅᑕᖅᑐᒥ, ᐊᒻᒪᓗᑦᑕᐅᖅ ᐃᓅᓯᖓᓐᓂ ᑕᒪᒃᑯᐊ ᑕᓯᕙᒃᑐᑦ ᑖᕙᓯᒪᒻᒪᕆᑦ ᓄᓇᒥᒃ ᐊᕐᓂᕐᖃᖅᑲᕙᐊᒥ. ᑖᒃᑯᐊ ᓄᓇᕐᔪᐊᑉ ᑲᔫᓪᓚᕆᓐᑐᓂᒃ ᓄᓇᕕᒻᒥᓂᒃ ᑲᒪᔨᖅᑲᖅᖃᓯᐊᖅᑐᑦ ᐱᑎᔪᕙᑦ ᐊᑐᓪᓚᑎᑐᓂᒃ ᓴᐳᔾᔨᓂᒥᒃ ᐱᔾᔪᓇᖅᑯᑦᑐᐱ ᑕᒪᒃᑯᐊ ᑲᔪᓯᒪᓂᖅᑕᐅᓂᖅᑦ ᐱᓪᓚᑕᐅᔪᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᑦ ᐃᓕᒃ ᐱᑕᖃᕐᓂᖅ-ᑎᓯᓂᑯᑦ ᐊᑭᑦᑐᓂᒥᒃ-ᐊᑲᐅᓈᖅᓯᒪᔪᒥᒃ ᓇᒧᓐᖓᓚᐅᖅᑐᓄᑦ ᑎᒥᐅᔪᓄᑦ ᐊᒻᒪᓗᑦᑕᐅᖅ ᐊᐃᑦᑕᐅᓂᖅᑎᓯᓂᑯᑦ ᐱᔭᕆᐊᖃᕐᓂᑯᑦ ᓴᓇᒪᔪᓂᒃ ᐃᖅᑲᐃᔭᕐᕕᒃᓴᔪᓂᒃ, ᖃᐅᔨᓴᕐᕕᒃᓴᓂᒃ ᐊᒻᒪᓗ ᑐᔪᕐᒥᕕᒃᓴᓂᒃ. ᑖᒃᑯᐊ ᓄᓇᕐᔪᐊᑉ ᑲᔫᓪᓚᕆᓐᑐᓂᒃ ᓄᓇᕕᒻᒥᓂᒃ ᑲᒪᔨᖅᑲᖅᖃᓯᐊᖅᑐᑦ ᐱᔪᓇᑎᓯᔪᑦ ᐱᓪᓚᑕᐅᖅᑎᑕᐅᕙᓪᓕᐊᓂᒃ ᐊᒥᓱᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᑦ ᑲᒪᔪᐃᑦᑐᐊᓚᓐᓂᒃ ᓄᓇᒦᑦᑐᑦ ᑕᒪᒃᑯᐊ ᐅᑲᓕᖅᑲᐅᓯᒪᕙᓚᐅᖅᑐᑦ ᐅᕙᑦᑎᓐᓂᒃ

The Honourable Jonathan Wilkinson
Minister of Energy and Natural Resources

ᐅᐱᓐᓇᖅᑐᖅ ᔫᒪᓐ ᐅᐃᐅᑭᓴᓐ
ᑲᓇᑕᐅᑉ ᒥᓂᔅᑕ ᓄᓇᓂᓪᓚᖅᑯᖅᓯᒪᔪᓂᑦ ᐊᑐᐃᓐᓇᐅᔪᓯᐊᑦ

ᐊᑭᕐᕆᓇᓂᓪᓗ-ᓄᖅᑲᖓᑎᑕᐅᓯᒪᖅᑐᑦ ᐱᑕᖃᖅᑲᕐᐸᑕ ᑖᒃᑯᐊ ᑲᒪᔨᒍ-ᓘᕐᓂᐊᖅᑕᕆᑕ ᖃᐅᔨᓴᖅᓯᒪᓪᓚᕆᐅᓂᖅᑕᕆᓂᕐᓄᑦ ᓄᓇᒥᐅᑕᓂᒃ ᐅᑭᐅᖅᑕᖅ-ᑐᒥ ᓇᒧᖓᓪᓚᑦᑕᓇᐊᖅᑐᑕᓂᕐᒥᒃ.

ᑖᒃᑯᐊ ᑲᔪᓯᔪᐊᕐᓂᕆᑦ ᓄᓇᕐᔪᐊᑉ ᑲᔫᓪᓚᕆᓐᑐᓂᒃ ᓄᓇᕕᒻᒥᓂᒃ ᑲᒪᔨᖅᑲᖅᖃᓯᐊᖅᑐᑦ ᐊᑦᑖᓐᑐᓂ ᖃᓄᐃᓕᖓᓂᓕᖅᑕᖅᑎᓂᒃ ᐊᓯᔾᔨᖅᑲᐅᑎᑦ ᐅᑭᐅᖅᑕᖅᑐᑉ ᐊᕙᑎᒥᔭᖓ ᐊᒻᒪᓗ ᓄᓇ-ᓇᕐᔪᐊᑉ ᑕᒪᓐᓇ ᖁᕝᕙᖅᑎᑦᓯᔪᐃᔪᖅ, ᐃᓱᒪᒋᓗᒍ ᐱᑦᑕᖅᓯᐅᑎᒋ-ᓯᒪᓂᖓ-ᓯᕗᓂᐊᒍᑦ ᐊᑦᓯᕈᓇᖅᑐᑦ ᐃᖅᑲᐃᔭᕐᕕᒋᔪᒪᔭᖅᑲᐃ ᐊᒻᒪᓗ ᐃᓐᓂᕐᓯᕙᒋᔭᐅᒋᐊᖅᑲᒥ ᑖᕙᓂ ᐅᖓᓯᖕᑐᖅ ᓄᓇᒥ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐ-ᖑᓂᖓ. ᐃᓚᐃᑉᐸᑦ ᓇᓗᓇᐃᖅᑕᐅᔪᑎᖃᖅᑯᑦ ᐱᔾᔪᓇᕐᓂᖃᓐᓇᐊᖅᑐᑦ ᐊᒻᒪᓗ ᐱᓕᕆᐊᖅᓯᒪᐅᕆᐊᖅᑐᓂᒃ ᐅᑭᐅᖅᑕᖅᑐᒧᑦ ᓇᓗᓇᖅᑐᓂᒃ ᖃᐅᔨᓴ-ᕆᐊᖅᑎᒪᓇᑦ ᑕᒪᒃᑯᐊ ᐊᓯᔾᔨᓇᐊᖅᑲᐊᖅᑲᓗᐃᖅᑐᖅᑐᓂᒃ ᑕᒪᒃᑯᓄᖓ ᐊᓯᔾᔨᖅᓯᒪᓕᖅᑐᓂᑦ ᖃᓄᐃᓕᖓᓕᖅᑐᓂᖅᑦ, ᑲᔪᓯᑦᑐᓂᒃ ᐱᒻᒪᕆ-ᐅᔪᓂᒃ ᐃᖅᑲᐃᔭᕐᕕᒃᓴᒥᒃ ᐃᓗᐊᓂᖅᑎᑦ ᐱᕙᓪᓕᐊᑎᓯᒐᓐᓇᖅᑐᓂᒃ ᐊᓯᔾᔨᖅᓯᒪᓕᖅᑐᓂᒃ ᓴᐳᔾᔨᓚᐅᖅᑕᖅᑐᓂᒃ.

ᓄᓇᒥᓐᓂᕐᒥᒃ ᐊᑐᖅᓂᖅᑲᖅᑐᓇᖅᑯᑦ ᑲᓇᑕᒥ ᐅᐱᒍᓱᒃᐳᑦ ᓴᐳᔾᔨᓂᕐᒥᒃ ᑲᓇᑕᒥᐅᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ ᓇᓗᓇᖅᑐᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ-ᑐᖅᑕᓂᕐᒥᒃ ᐊᒻᒪᓗ ᓄᓇᖅᑲᖅᑳᖅᓯᒪᔪᓄᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᑦᑐᖅᑕᓂᕐᒧᑦ, ᑖᒃᑯᐊᓗ ᓄᓇᕐᔪᐊᑉ ᑲᔫᓪᓚᕆᓐᑐᓂᒃ ᓄᓇᕕᒻᒥᓂᒃ ᑲᒪᔨᖅᑲᖅ-ᐊᖅᑐᑦ ᐱᓕᕆᐊᖅᑲᕈᓐᓇᖅᑐᑦ ᑲᔪᓯᑦᑎᐊᕐᓂᖅᑐᒥᒃ ᑲᒪᒃᑎᖅᑎᑦᓯᓂᕐᒥᒃ, ᐱᓕ-ᕆᐊᖅᑎᒃᑎᓂᑦᓯᓂᕐᒥᒃ, ᐊᒻᒪᓗ ᐊᑐᕐᑎᓯᓂᕐᒥᒃ ᓇᓗᓇᖅᑐᓂᒃ ᖃᐅᔨᓴ-ᕆᐊᖅᓯᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐱᑦᑕᓇᖅᑐᓂᒃ-ᑐᖅᑕᓕᕕᒃᓴᖅᑐᓂᒃ ᐊᖅᑯᑎᖅᑲᐃᓂᑦ-ᐊᖅᑯᑎᖅᑲᐃᓂᕐᒧᑦ. ᐊᓯᔾᔨᖅᓯᒪᓪᓗᑕ ᐱᓕᕆᐊᖃᖅᑎᖅᑐᑦ ᐱᑎᔪᕙᑦᓯᒪᔪᓂᒃ ᐱᔭᐅᔪ-ᒪᕐᔪᓂᒃ, ᐅᕙᑦᑎᑦ ᑲᔪᓯᒪᓪᓚᕆᒍᑎᑦ ᐃᖅᑲᐃᔭᕐᓂᖅᓂᒃ ᐱᓪᓚᑕᐅᖅᑎᑕᐅᓯᒪᔪᓂᒃ ᑲᒪᒋᔭᐅᑎᖅᑎᖅᑐᑦ ᓄᓇᕐᔪᐊᑦᑕ ᐱᑎᔪᕙᑦᓯᒪᔪᑦ ᐊᑦᑐᐃᓯᒪᔪᓂᑦ ᓱᓇᕐᒥᒃ ᐊᒻᒪᓗ ᐅᑭᐅᖅᑕᖅᑐᒥᒃ ᐱᓪᓚᑕᐅᓂᖅ ᐊᒻᒪᓗ ᓄᐃᑦᑎᑦ ᐱᑕᖃᖅᑐᒥᒃ ᐊᓯᔾᔨᖅᓯᒪᔪᒥᒃ ᓴᐳᔾᔨᒐᓱᖃᑦᑕᓚᐅᖅᓯᒪᔪᓂᒃ ᐅᖓᓯᒃᑐᒥ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᒥ.

ᓇᓗᓈᖅᑕᖓ ᑖᒃᑯᐊ ᓄᓇᕐᔪᐊᑉ ᑲᔫᓪᓚᕆᓐᑐᓂᒃ ᓄᓇᕕᒻᒥᓂᒃ ᑲᒪᔨᖅᑲᖅᖃᓯᐊᖅᑐᑦ ᓇᓗᓇᖅᑐᓂᒃ ᖃᐅᔨᓴᕐᓂᐅᔪᑦᑐᖅᑕᓂᕐᒥᒃ ᑐᓴᕐᓴᓚᐊᖅᑲᔭᖅᑎᑦ ᐱᑎᔪᕆᐊᖅᑎᑦ ᐅᖃᓪᓚᒃᑐᓄᑦ ᓇᓗᓇᐃᔭᐃᔭᕐᓂᖅᑐᓂᒃ-ᖃᐅᔨᓴᕐᓂᐅᔪᑦ ᑕᑯᑎᓯᓪᓗᑎᒃ ᑕᒪᒃᑯᐊᓗ ᑲᒪᒋᔭᐅᖃᑦᑕᖅᑐᓂᒃ, ᖃᐅᔨᓴᖅᑕᐅᕙᒃᑐᑦ ᖃᓄᐃᑦᑐᓂᕐᓂᒃ, ᐊᒻᒪᓗ ᑕᑯᑎᓯᓪᓗᑎᒃ ᒪᕙᒪᒃᑯᕐᓂᒃ ᑲᓇᑕᐅᑉ ᐱᓪᓚᑕᐅᓂᖅᑎᖅᓯᒪᓕᖅᑎᖅ-ᕈᒪᓂᕐᓂᒃ ᒪᕿᒪᔭᐊᕈᑎᖅᓯᓂᒃ ᐊᒻᒪᓗ ᓄᕗᔪᐊᖅᑐᒥᖅᑕᓚᒪᓂᒥᒃ ᑕᑉᐸᓂ ᐅᐊᓇᒥᐅᕐᒃᑯᑎᕆᔭᖅᑎᖅᓂᒃ.

ᐅᐱᓐᓇᖅᑐᖅ ᔫᒪᓐ ᐅᐃᐅᑭᓴᓐ
ᑲᓇᑕᐅᑉ ᒥᓂᔅᑕ ᓄᓇᓂᓪᓚᖅᑯᖅᓯᒪᔪᓂᑦ ᐊᑐᐃᓐᓇᐅᔪᓯᐊᑦ

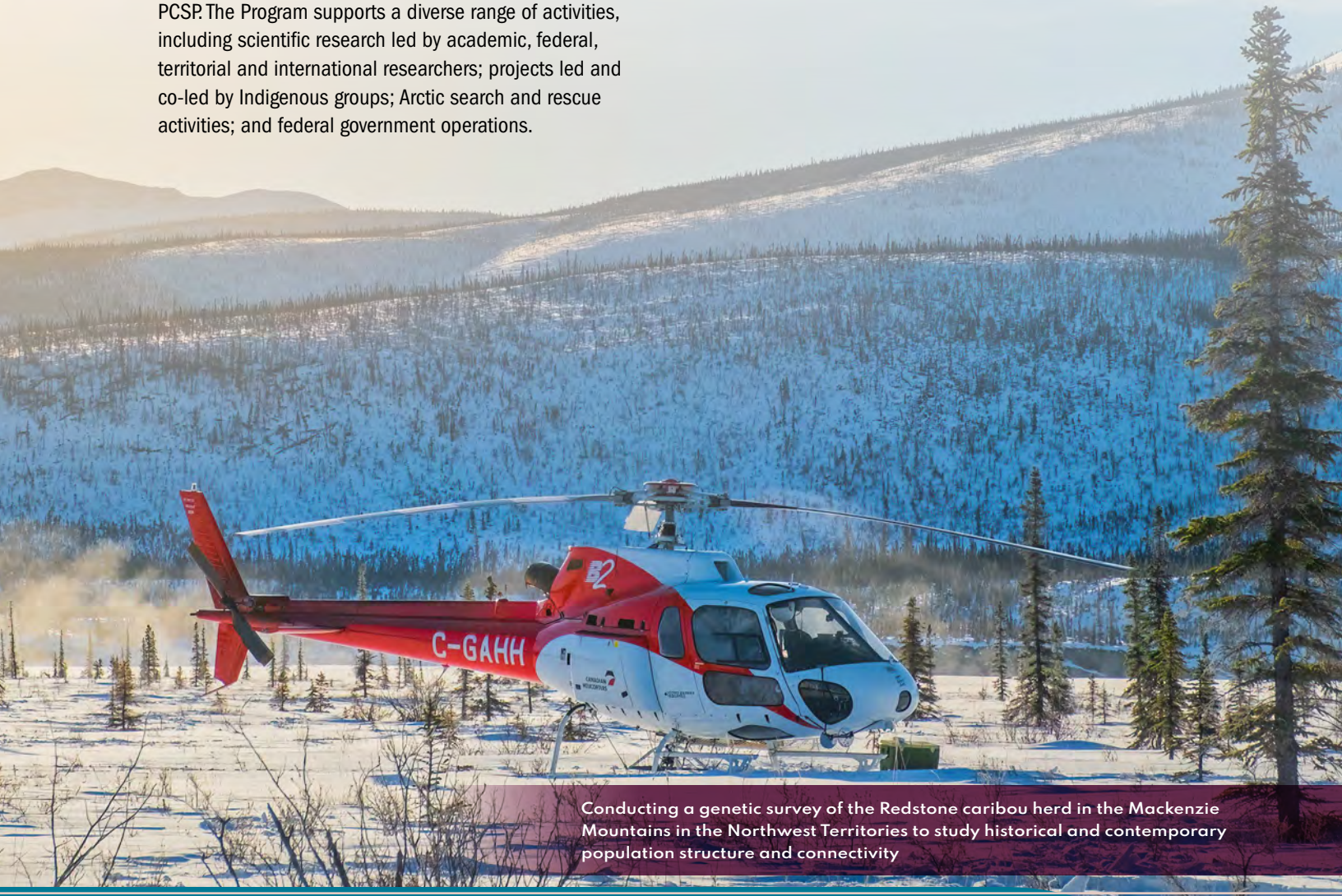
POLAR CONTINENTAL SHELF PROGRAM

The Polar Continental Shelf Program (PCSP) at Natural Resources Canada (NRCan) has provided safe, efficient and cost-effective logistics in support of scientific research and government operations in the Canadian Arctic since 1958. Through its work, the PCSP continues to contribute to increased knowledge of the Canadian landmass and the impacts of climate change, economic and social development, and the exercise of sovereignty in the Canadian North.

The logistics support provided by the PCSP is essential for conducting fieldwork in remote locations. It enables clients to focus on their research and carry out their operations while leaving the details of coordinating the logistics to the PCSP. The Program supports a diverse range of activities, including scientific research led by academic, federal, territorial and international researchers; projects led and co-led by Indigenous groups; Arctic search and rescue activities; and federal government operations.

Partnerships with other federal departments and agencies enable the PCSP and partner organizations to function more efficiently and reduce costs and duplication.

For example, the partnership with the Department of National Defence (DND) has brought many benefits to the PCSP and its clients, including upgraded accommodations and workspaces and the cost-sharing operation of the facility. As a result, the PCSP can direct more funds to support research in the Arctic. In return, DND benefits from using the PCSP's facility in the High Arctic for their training activities and from using the PCSP's logistics expertise, eliminating the need to run and manage their own facility or coordinate their own logistics.



Conducting a genetic survey of the Redstone caribou herd in the Mackenzie Mountains in the Northwest Territories to study historical and contemporary population structure and connectivity

A researcher and pilot fly into a forested river valley to sample fire history sites.

The logistics planning and coordination assistance provided by the PCSP includes:

- air transportation to remote field sites across the Arctic
- fuel for aircraft and field camps
- field equipment for loan to use across Canada and in the Arctic
- accommodations and meals in Resolute, Nunavut
- logistics advice for fieldwork in Canada
- communication and safety networks across the Arctic
- support to search and rescue operations in the Arctic
- a presence in the North, in support of sovereignty

During the 2020 and 2021 field seasons, these services were interrupted by the COVID-19 pandemic. The PCSP recognized the serious impacts that the COVID-19 virus was having on remote Indigenous and Northern communities with limited health care and infrastructure services. In consideration, the PCSP scaled back its operations – in some cases suspending delivery of logistics services.

Where possible, the PCSP leveraged resources for science and government operations projects conducted in the North with the help of Northern residents. As a result of such collaborative efforts, the PCSP was able to support 41 projects in 2020 and 127 projects in 2021.

In 2022, PCSP operations returned to near pre-pandemic levels. With the support of its partners, the PCSP recovered from the challenges of the COVID-19 pandemic, and the number of total supported projects rose to 232 in 2022. The total number of hours flown by the PCSP across the Canadian Arctic increased by 65% from 2021.

The PCSP's commitment to Indigenous participation and economic reconciliation also persevered. During this period, the total dollar value awarded to Indigenous-owned companies through the PCSP continued to increase, by 56% from 2021 and by 156% from 2020.

BREAKDOWN OF PCSP-SUPPORTED PROJECTS IN 2020, 2021 AND 2022

2019*

2020

Servicing a time-lapse camera that overlooks the terminus of Sverdrup Glacier, Devon Island, Nunavut

2021

127 PROJECTS

- 62 Federal government
- 45 Canadian universities
- 12 Northern organizations
- 6 Canadian Armed Forces Arctic Training Centre (DND)
- 1 International and independent groups
- 0 Canadian Arctic-Antarctic Exchange Program***
- 1 Indigenous Knowledge Program**
- 0 Search and rescue

2022

232 PROJECTS

- 128 Federal government
- 74 Canadian universities
- 16 Northern organizations
- 7 Canadian Armed Forces Arctic Training Centre (DND)
- 2 International and independent groups
- 3 Canadian Arctic-Antarctic Exchange Program***
- 1 Indigenous Knowledge Program**
- 1 Search and rescue

*The 2019 statistics are included to provide reference values from before the COVID-19 pandemic.

**Indigenous Knowledge Program projects are those that are focused entirely on preserving the knowledge of Indigenous Peoples in the Arctic and the North, including First Nations, Inuit and Métis.

***Canadian Arctic-Antarctic Exchange Program projects are those that include collaboration among Canadian researchers working in the Arctic and international researchers working in the Antarctic. For these projects, the international researcher accompanies the team to the Canadian Arctic and the Canadian researcher accompanies the international researcher to the Antarctic.

HIGHLIGHTS OF THE 2020, 2021 AND 2022 FIELD SEASONS

*The 2019 statistics are included to provide reference values from before the COVID-19 pandemic.

2019*	2020	2021	2022
39%	41%	27%	41%

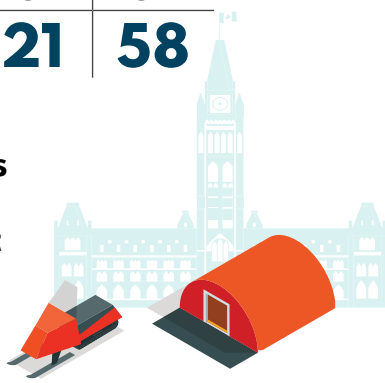
Percentage of **Arctic projects** that transited through the PCSP Arctic Logistics Hub in Resolute

2019*	2020	2021	2022
168	25	105	171

Arctic science and **operations projects** supported

2019*	2020	2021	2022
53	13	21	58

Federal projects that used only **field equipment** across Canada



2019*	2020	2021	2022
64	34	65	72

Aircraft under contract

Total aircraft hours flown

2019*	2020	2021	2022
4,650	768	2,704	4,450

2019*	2020	2021	2022
$10.6 million	$2.4 million	$7.4 million	$10.4 million

Total value of the aircraft hours flown

2019*	2020	2021	2022
$5.7 million	$1.5 million	$2.5 million	$3.8 million

Total dollar value awarded to **Indigenous-owned companies**

2019*	2020	2021	2022
41,699	18,884	20,783	25,377

Meals served
at the PCSP Arctic Logistics Hub in Resolute

2019*	2020	2021	2022
57%	48%	51%	54%

Percentage of total **projects that used field equipment**

2019*	2020	2021	2022
570	389	92	148

Canadian Armed Forces Arctic Training Centre participants accommodated at the PCSP Arctic Logistics Hub in Resolute

2019*	2020	2021	2022
499 tonnes	79 tonnes	249 tonnes	221 tonnes

Weight of the equipment and fuel shipped to Nunavut

2019*	13,546
2020	6,423
2021	7,188
2022	8,686

Nights of accommodations provided at the PCSP Arctic Logistics Hub in Resolute

2019*	2020	2021	2022
8	12	13	8

Indigenous-owned companies awarded contracts

2019*	2020
125	140

2021	2022
145	143

Peer-reviewed publications that acknowledged support from the PCSP

PCSP PARTNERSHIPS

Canadian Armed Forces members participating in the PCSP stop to check their gear during a reconnaissance trip near Resolute Bay, Nunavut, during Operation NANOOK–NUNALIVUT.

Much of the fieldwork in the Canadian Arctic is conducted in remote locations where transportation and communications services are limited, specialized and complex to organize.

Working with more than 15 federal and territorial government departments and 25 Canadian universities, the PCSP creates efficiencies by combining the requirements of multiple groups, thereby saving costs and optimizing the use of limited resources.

As the primary fieldwork logistics provider for the Government of Canada, the PCSP helps government departments and agencies conduct research and operations across the country and maintain Canada's sovereignty in the Arctic. Wherever possible, the PCSP establishes multi-year partnership agreements with federal departments and organizations to facilitate multi-year planning, reduce duplication of efforts and deliver on areas of shared interest.

The COVID-19 pandemic had a significant impact on PCSP operations over the 2020 and 2021 field seasons by severely restricting travel for research purposes. Despite these interruptions, the PCSP continued to work with existing federal partners. This included continuing to provide access to infrastructure and logistics support for DND and the Canadian Armed Forces Arctic Training Centre (CAFATC) at the PCSP facility in Resolute, Nunavut.

During this period, the PCSP also continued to provide limited logistics support to Polar Knowledge Canada (POLAR) at the Canadian High Arctic Research Station (CHARS) in Cambridge Bay, Nunavut, and across the Arctic.

As Canada's primary point of contact within the circumpolar knowledge community, POLAR is a key strategic partner for the PCSP. Through this relationship, the PCSP and POLAR promote developing and advancing Arctic knowledge, improving Canada's economic opportunities and strengthening Canada's leadership on Arctic issues.

Throughout the COVID-19 pandemic, the PCSP also continued to work with its long-standing partner, ArcticNet. ArcticNet is a large-scale research network that brings together Arctic researchers, Inuit organizations, Northern and Indigenous communities, and other collaborators. The network's aim is to direct research efforts toward the social, environmental and economic impacts of climate change in the coastal Canadian Arctic.

The PCSP continues to explore opportunities for new collaborations. This effort has included supporting the Canadian Forest Service as it expands its research focus northward to study the impact of forest fires on permafrost in the Yukon.

The PCSP is also looking at opportunities to better coordinate with Canadian Coast Guard operations in its new Arctic region because both organizations support work in the North.

Supporting NRCan shipping and receiving during COVID-19

During the COVID-19 pandemic, the PCSP Field Equipment Unit took on the extraordinary task of supporting the delivery of critical services at NRCan's Booth Street Complex and the PCSP's field equipment warehouse in Ottawa, Ontario. The team helped distribute personal protective equipment (PPE) to NRCan work sites nationwide to enable a safe return to the workplace for critical NRCan employees. Masks, disinfectant wipes, hand sanitizer and other PPE were received and distributed through the PCSP warehouse in Ottawa.

In 2020 and 2021, nearly 600 shipments were made across Canada, including moving 423,533 individual PPE items weighing 1 tonne (2,200 lbs). In total, the team has contributed over 180 working hours to support the delivery of PPE items to help keep NRCan employees and Canadians safe.

Canadian High Arctic Research Station, Cambridge Bay, Nunavut

IN MEMORIAM

On the evening of Sunday, April 25, 2021, a tragic helicopter crash occurred on Griffith Island, Nunavut. The crash took the lives of three people: 30-year-old helicopter engineer, Benton Davie, 36-year-old helicopter pilot, Steven Page and 55-year-old wildlife biologist, Markus Dyck. All three were closely associated with the PCSP, and their loss is profound and widely felt, but their legacy and impact on Arctic research will always be remembered.

Operating in the North is not without risk, and tragic accidents like this are felt throughout the Arctic. This event is a reminder of the importance of paying tribute to those who have lost their lives. We honour their memory by reflecting on the positive impact that they had as champions for Arctic science in Canada.

BENTON DAVIE (1991–2021)

Passionate about the North, Benton Davie was a 30-year-old helicopter engineer at Great Slave Helicopters and a proud citizen of Yellowknife, Northwest Territories. While working at Great Slave Helicopters, he completed a four-year Aircraft Maintenance Engineer apprenticeship program through Red River College in Manitoba.

Benton was the eldest of three brothers. His maternal grandfather arrived and raised his family in Yellowknife in the late 1950s. Benton always felt at home in the North, and his love of animals and helicopters brought him joy. Benton was thrilled to accompany Markus and Steven on this research trip. He lost his life while taking part in what he loved the most.

He enjoyed his job immensely and had the opportunity to participate in various wildlife surveys with biologists, including those involving caribou and polar bears.

On April 25, 2021, communities in the North lost in Benton Davie a friend, a comrade and a dedicated helicopter engineer with a promising future.

Cryoconite holes in the Ward Hunt Ice Rise, Nunavut

STEVEN PAGE (1985–2021)

On the day of the helicopter crash, a 36-year-old helicopter pilot, Steven Page, left behind a large family. That includes his parents, three elder sisters, and three elder brothers, along with their respective families, comprising sixteen of his nieces and nephews in Australia and New Zealand. Steven also left many loving and close friends from both his school days and working life, and his new Canadian partner and her two boys.

Steven was originally from Queensland, Australia, and had moved to Canada five years earlier. He was known for being an outstandingly positive, adventurous and motivating individual who enjoyed life to the fullest. The trip that took his life, and whose purpose was to carry out an excursion to survey the Lancaster Sound polar bear population, was one of many manifestations of Steven's fondness for life, discovery and the great outdoors.

In Steven Page, the Arctic science community lost a cherished and skilled navigator of the North.

MARKUS DYCK (1966–2021)

Markus Dyck was a great polar bear advocate and a valued member of the scientific community. Born in Riedlingen, Germany, Markus made his way to Canada in 1990 while working for the German military. From his first encounter with polar bears while visiting Churchill, Manitoba, he was captivated. This chance encounter led him to change course and dedicate his life to becoming a polar bear biologist.

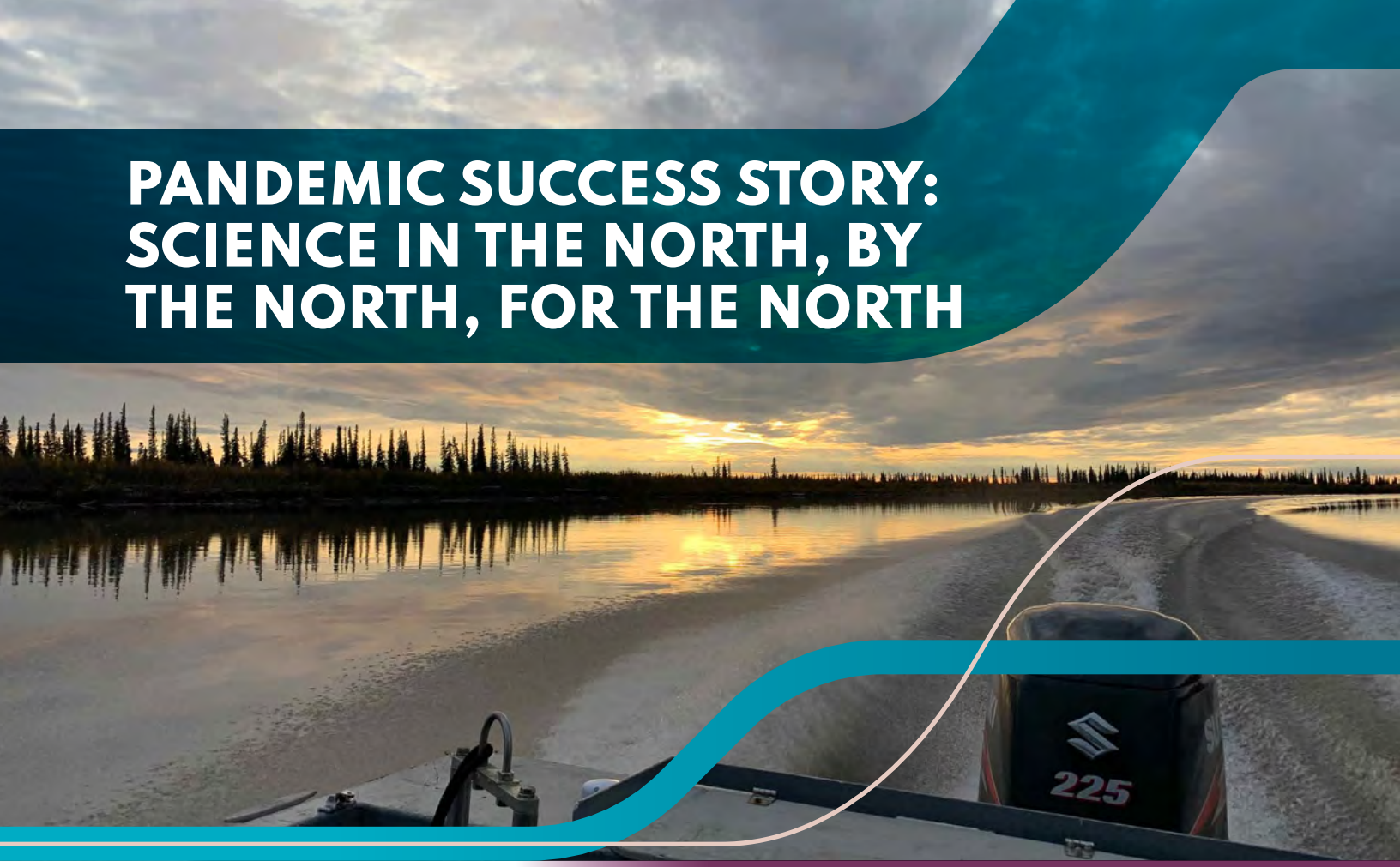
Early in his career with the Government of Nunavut, he managed and tracked the largest polar bear harvest program in the world and developed Nunavut's first bear-human conflict management plan. While at the Department of Fisheries and Oceans, he used Inuit Qaujimajatuqangit (IQ or Inuit Traditional Knowledge) to document the first account of polar bears actively fishing for Arctic char. As a senior instructor with the Nunavut Arctic College Environmental Technology Program, he left a lasting imprint by leading research teams to find less invasive ways to study polar bears.

Following this, Markus landed his dream job as the Senior Polar Bear Biologist for the Government of Nunavut and led the polar bear research and management program that represents more than half of the world's polar bears. He led or participated in numerous research programs to find less invasive methods to study polar bears, conducted surveys on 10 out of 12 of Canada's bear subpopulations. Markus also spent years in the field collecting data on thousands of bears.

Markus was a significant member of the Arctic research community within Canada and internationally, and he is profoundly missed by all who knew him.

We wish for the honouring of these individuals to underscore the significance and value of all contributing members of Arctic development, discovery and exploration.

PANDEMIC SUCCESS STORY: SCIENCE IN THE NORTH, BY THE NORTH, FOR THE NORTH



A view of a lake at dusk on the way back to Inuvik, Northwest Territories after a successful day of sampling

Featured story location on the map: 1

The impacts of the COVID-19 pandemic have been felt across the Arctic science community. Restrictions to in-person gatherings and remote work situations, along with limited travel to, and within the North, have had significant impacts on research programs across the country. However, some researchers have seen these disruptions as an opportunity to develop and solidify relationships with local partners and build capacity within Northern and Indigenous organizations and community members to carry out field activities.

One research program that has had particular success in this area is the Beluga Habitat Program. It is a collaboration involving the following groups:

- Department of Fisheries and Oceans
- Natural Resources Canada
- Northern and Indigenous communities and organizations, including
  - Inuvialuit Joint Secretariat
  - Munaqsiyit Monitoring Program
  - hunters and trappers organizations of Aklavik, Inuvik and Tuktoyaktuk
  - Aurora Research Institute
  - a local outfitting company (see the list of collaborators below)

Since 2011, the Beluga Habitat Program has conducted acoustic monitoring in the Mackenzie Delta in the western Canadian Arctic using acoustic recorders and oceanographic sensors on the seabed and at coastal weather stations. Acoustic monitoring is critical to understanding the impacts of climate change on the ecosystem in this region.

The Tarium Niryutait Marine Protected Area, located in the Mackenzie estuary, is a key gathering point for beluga whales following the spring break-up of sea ice. The turbid waters and remote location of this area make it challenging to study the beluga population using visual observations. Consequently, acoustic monitoring is an important tool for understanding how belugas use this area. Continuous monitoring is crucial; missing just one year of data is detrimental to understanding patterns and the drivers that affect how belugas use this habitat in a changing climate.

The COVID-19 pandemic altered fieldwork plans for the Beluga Habitat Program by preventing southern-based scientists from travelling to the Northwest Territories to join their Northern collaborators in 2020 and 2021. In previous years, researchers from Manitoba and Nova Scotia joined local technicians and community members to deploy seabed equipment and install and maintain weather stations. With restrictions on travel, the Beluga Habitat Program research team saw the opportunity to expand the collaboration and prevent interrupting the collection of critical data for this long-term monitoring program.

The Beluga Habitat Program research team adapted by expanding the roles of the collaborators to conduct the components of the fieldwork that would otherwise have been completed by southern-based scientists. Field equipment and protocols were modified to enable the deployment of monitoring instruments by local community members. New training modules were created and shared with community members by video conference. The program also received technical and logistics support from the Aurora Research Institute, based out of Inuvik, Northwest Territories, to program instruments, assemble moorings, ship and receive gear, and conduct weather station checks.

Data and results obtained through this work are co-owned and accessible to community partners to help make decisions on local travel, in addition to serving to monitor whale behaviour. The project developed an interface to improve community access to live data including wave height, temperature and wind. Results are presented to the Fisheries Joint Management Committee (FJMC) annually, and discussions take place to address questions on the study of the Tarium Niryutait Marine Protected Area with community partners throughout the year.

Support from the PCSP also contributed to the success of the program during the COVID-19 pandemic, with field equipment shipped to the Aurora Research Institute from the PCSP warehouse in Ottawa and chartered aircraft coordinated by the PCSP logistics team. Using companies, aircrew and field teams located in the Northwest Territories allowed fieldwork to proceed while following all public health orders and travel restrictions. The logistics support provided by the PCSP helped partners at the Aurora Research Institute install and maintain weather stations along the coast. In addition, the PCSP-issued field equipment contributed to the success of fieldwork conducted through a partnership with the Tuktoyaktuk Community Corporation and the Ulukhaktok Hunters and Trappers Organization.

The continuation of the Beluga Habitat Program throughout the COVID-19 pandemic would not have been possible without the program's established relationships. Partnerships with local communities and organizations are integral to conducting effective research in the North and the challenges brought on by the pandemic further emphasized the importance of these relationships. Northern and Indigenous partners will continue to play an integral role in current and future data collection and research in all stages of the Beluga Habitat Program.

> *Thanks to partnerships with local communities and the PCSP, this program was a success and highlights the importance of working collaboratively with partners in Arctic-based research.*
>
> **Lisa Loseto,**
> Research Scientist, Fisheries and Oceans Canada and Associate Professor at the University of Manitoba

Collaborators on the Beluga Habitat Program:

Fisheries and Oceans Canada

Lisa Loseto
Kevin Scharffenberg
Laura Murray
Shannon MacPhee

Natural Resources Canada

Dustin Whalen

Aurora Research Institute
(mooring assembly and weather station installations and repairs)

Joel McAlister
Edwin Amos
Greg Elias
Ryan McLeod
Eli Nasogaluak

Aklavik Hunters and Trappers Committee
(Niaqunnaq mooring deployments)

Jordan McLeod
Manny Arey
Tyler Sittichinli
Cody Kogiak
Matthew McLeod
Cecilia McLeod

Tuktoyaktuk Hunters and Trappers Committee
(Kittigaryuit mooring deployments)

James Keevik
James Keevik Jr.
Dale Panaktalok
Christopher Panaktalok
Riland Keevik

Inuvik Hunters and Trappers Committee + Only Way Outfitting (Okeevik mooring deployments)

Jimmy Kalinek
Zayden Maring
Norman Day
Alexandria Day
Larry Day

Inuvialuit Joint Secretariat
(logistics support and mooring deployments)

Chukita Gruben
Kirt Ruben
Jen Lam

Munaqsiyit Monitoring Program
(Okeevik mooring deployments)

Max Kotokak Sr.

A mooring deployment at Shingle Point, Northwest Territories

SUPPORTING INDIGENOUS RESEARCH AND PRIORITIES

Indigenous Guardians (Joseph Tobac and Twyla Edgi Masuzumi pictured) were key partners in water monitoring and helped to ensure that Dene laws were respected.

Through its operations and the research it supports, the PCSP is working to deepen its relationship with Northern and Indigenous partners and generate regional economic benefits. The PCSP supports research projects focused on Indigenous Knowledge and encourages greater participation and inclusion of Indigenous partners in all stages of the research – from project creation, fieldwork, and analysis to publication and dissemination of results.

Since the 1990s, the PCSP has been supporting research focused on preserving the rich repository of Indigenous Knowledge of Arctic and Northern Indigenous Peoples, including First Nations, Inuit and Métis. Through the Indigenous Knowledge subprogram, the PCSP supports community-led initiatives focused on sharing Indigenous Knowledge that is handed down through generations and builds capacity within the community.

Through the years, these projects have focused on research related to harvesting, the environment, socioeconomic well-being and cultural practices. In 2021 and 2022, the PCSP provided logistics support to Indigenous-led research projects, such as the *Nío Nę P'ęné – Trails of the Mountain Caribou: Renewing Indigenous Relationships in Conservation* project. This project is led by the Sahtú Renewable Resources Board, the Tulít'a and Norman Wells Renewable Resources Councils, and the Ross River Dena Council. More information on this project can be found on page 34.

The PCSP also supports projects that provide opportunities to Inuit youth to develop the skills needed to work in the field on scientific research projects. The PCSP provides support to the Inuit Field Training Program from Environment and Climate Change Canada. This program provides Inuit youth from remote communities with opportunities to acquire skills and employment as wildlife monitors and field assistants in Arctic field-based research. Following the work with youth from Coral Harbour, Nunavut, the training program is exploring options to grow this collaboration and bring training opportunities to more Inuit communities.

The PCSP has long played a role in connecting researchers with local Indigenous communities – including Indigenous Hunters and Trappers Associations, Knowledge Holders, wildlife monitors, and field assistants. Fostering greater collaboration between PCSP-supported researchers and Indigenous Peoples enriches research and strengthens existing relationships.

Supporting greater participation and inclusion in research and building strong relationships with Northern and Indigenous communities and businesses are integral to the federal priorities of reconciliation and self-determination. The PCSP will continue to support research based on Indigenous Knowledge, work toward greater inclusion of Indigenous Peoples in all aspects of research, as well as encourage opportunities for training and economic development in the North.

Increasing business with Inuit-owned firms

The Government of Canada's 2019 *Directive on Government Contracts, Including Real Property Leases, in the Nunavut Settlement Area* is designed to increase the participation of Inuit-owned firms in the bidding process for government contracts and business opportunities in the Nunavut Settlement Area. The government-wide approach aims to provide Inuit-owned firms with improved capacity to submit bids on federal contracts. The PCSP has increased its impact by establishing a standardized procurement process and bidding opportunities for small and medium-sized Inuit-owned firms within the Nunavut Settlement Area.

Initial results have been significant, with the PCSP awarding 20 contracts to nine Inuit-owned firms in 2020 – more than doubling the number of the previous year. These contracts included procuring plumbing, health and safety, janitorial, hardware, electrical, office and vehicle maintenance supplies, as well as equipment for IT systems. The process has continued to be successful in 2021 and 2022, resulting in another significant increase in contracts awarded to Inuit-owned firms (59 in 2021 and 48 in 2022).

The PCSP has held a contract with the Tudjaat Co-op for procuring food for the PCSP facility in Resolute since 2019. The presence of the PCSP in Resolute, Nunavut, and the continued need for procuring goods and services to maintain the facility and support operations have positively impacted economic development in the North.

The grand opening of a new retail store, Koomiut Co-op, in Kugaaruk, Nunavut

PERMAFROST RESEARCH: INFORMING ADAPTATION POLICY IN CANADA'S NORTH

Collecting sediment samples along Willow River in the Mackenzie Delta near Aklavik, Northwest Territories

Permafrost can be found below approximately 50% of Canada's land mass. Permafrost is ground that remains frozen for at least two years. It extends across the Arctic, but its characteristics and properties are highly variable throughout the region. The Canadian Arctic is currently warming two to four times faster than the global average, and with warming air temperatures comes the increased risk of permafrost thaw. Understanding how permafrost will respond to climate change will help predict the impacts at a local and regional level.

The impacts of permafrost thaw are not uniform across the Arctic. Permafrost thaw results in changes to vegetation, waterways and ground stability, which are of particular importance to adaptation for Arctic communities. The International Panel on Climate Change indicates that by 2050, 70% of Arctic infrastructure will be at risk because of permafrost thaw and ground instability, resulting in an unprecedented need for increased infrastructure resilience in these regions, particularly in northwestern Canada where much of the permafrost is close to 0 °C.

As permafrost degrades, changes to landscape and waterways can decrease the availability of food and water sources, increase the incidence of food and waterborne diseases, and increase the risk of injury on unstable terrain. Long-term changes will have a significant impact on Indigenous livelihoods and cultures by disrupting hunting and fishing activities.

At a global scale, permafrost thaw has the potential to increase greenhouse gas emissions through the release of carbon stores, thereby further exacerbating climate change. The variability of these changes and the severity of their potential impacts on Northern infrastructure and the livelihoods of Indigenous Peoples highlight a growing need for more local and regional field studies related to permafrost in the Canadian Arctic.

PCSP support is already being leveraged to meet this need by ensuring researchers can access remote locations throughout the Arctic. Through this support, researchers can conduct studies that bring a richer understanding of changes to permafrost conditions.

Each year, the PCSP supports approximately 25 science projects related to permafrost in the Yukon, the Northwest Territories and Nunavut. This research is led by scientists from federal and territorial governments, as well as Canadian universities. It is helping advance scientific understanding of the effects of a warming climate on permafrost thaw and its subsequent effects on landscapes, ecosystems, greenhouse gas emissions, infrastructure, and the lives of Northern and Indigenous communities. Additionally, results from this research inform the development of climate change adaptation measures and lead to the improved resilience of Northern infrastructure.

Supporting fly-in First Nations communities during the COVID-19 pandemic

Each year, the PCSP contracts and coordinates chartered aircraft to fly hundreds of scientists and their gear to some of the most remote places in the Canadian Arctic. In March 2020, the PCSP, in collaboration with Indigenous Services Canada (ISC) and Public Services and Procurement Canada, temporarily transformed this service to meet a new need. They helped healthcare workers travel to isolated communities amid the disruption of commercial airline service caused by the COVID-19 pandemic.

The PCSP helped ISC by providing guidance and expertise to coordinate chartered aircraft to move frontline healthcare workers safely into isolated northern First Nations communities in Ontario, Manitoba and Alberta. The chartered aircraft contributed to delivering urgently needed healthcare to Indigenous communities while allowing workers to avoid high-traffic airports. Through this collaboration, the PCSP supported moving more than 1,000 nurses and other essential healthcare providers to communities in need. This collaboration ensured that ISC could continue to provide access to healthcare for these communities until travel restrictions eased and commercial air travel resumed.

MONITORING AND MAPPING PERMAFROST LANDSCAPE CHANGE IN THE WESTERN ARCTIC, NORTHWEST TERRITORIES

Collecting georeferenced photographs of polygonal-patterned terrain during an aerial survey of permafrost landforms in the Northwest Territories

Steve Kokelj (Northwest Territories Geological Survey, Government of Northwest Territories) and the Thermokarst Mapping Collective

Featured story location on the map: 2

Climate-driven thaw of ice-rich permafrost is causing some of the most rapid landscape changes in the world. The Thermokarst Mapping Collective (TMC), initiated by the Northwest Territories Geological Survey (NTGS) in collaboration with government, academic, and Indigenous partners, aimed to develop a systematic approach for mapping sensitive permafrost terrain across the Northwest Territories. This research project was designed to fill a significant knowledge gap in understanding variation in the permafrost conditions that characterize Canada's North. The largely northern-based team was able to operate through much of the COVID-19 pandemic.

Since 2019, the TMC research team has developed methods to inventory the different types of thermokarst activity across the territory. Thermokarst is a type of climate sensitive permafrost terrain that is composed of marshy hollows or small ponds and raised areas known as hummocks and is a result of thawing ice-rich permafrost.

With support from the PCSP, the team was able to conduct aerial surveys of thermokarst and permafrost landforms across more than 37,000 km of survey lines across the Northwest Territories, resulting in over 7,700 permafrost landform type and attribute observations. In addition to these observations, about 30,000 associated georeferenced images were obtained.

Using a combination of field-based investigations, drones and satellite imagery, the team validated new broad-scale permafrost maps that aim to predict thaw-sensitive permafrost terrain. The publication of the attributed landscape photographs will enable scientists and the public to explore the diversity of the northern landscape. The development of maps that outline sensitive permafrost terrain and geo-hazards caused by permafrost thaw will assist Canada's North in providing the knowledge and tools to assess community vulnerabilities, infrastructure adaptation, carbon stocks and impacts on ecosystems.

The TMC project has provided a valuable opportunity to expand existing and develop new collaborations with Indigenous organizations such as the Inuvialuit Land Administration, Łíídlı̨ Kų́ę́ First Nation, K'ahsho Got'ı̨nę, and Gwich'in Renewable Resources Board. The flexibility of this project in supporting workshops, Indigenous-led fieldwork, and aerial surveys and the informing mapping strategies by Northern partners have extended its reach and relevance.

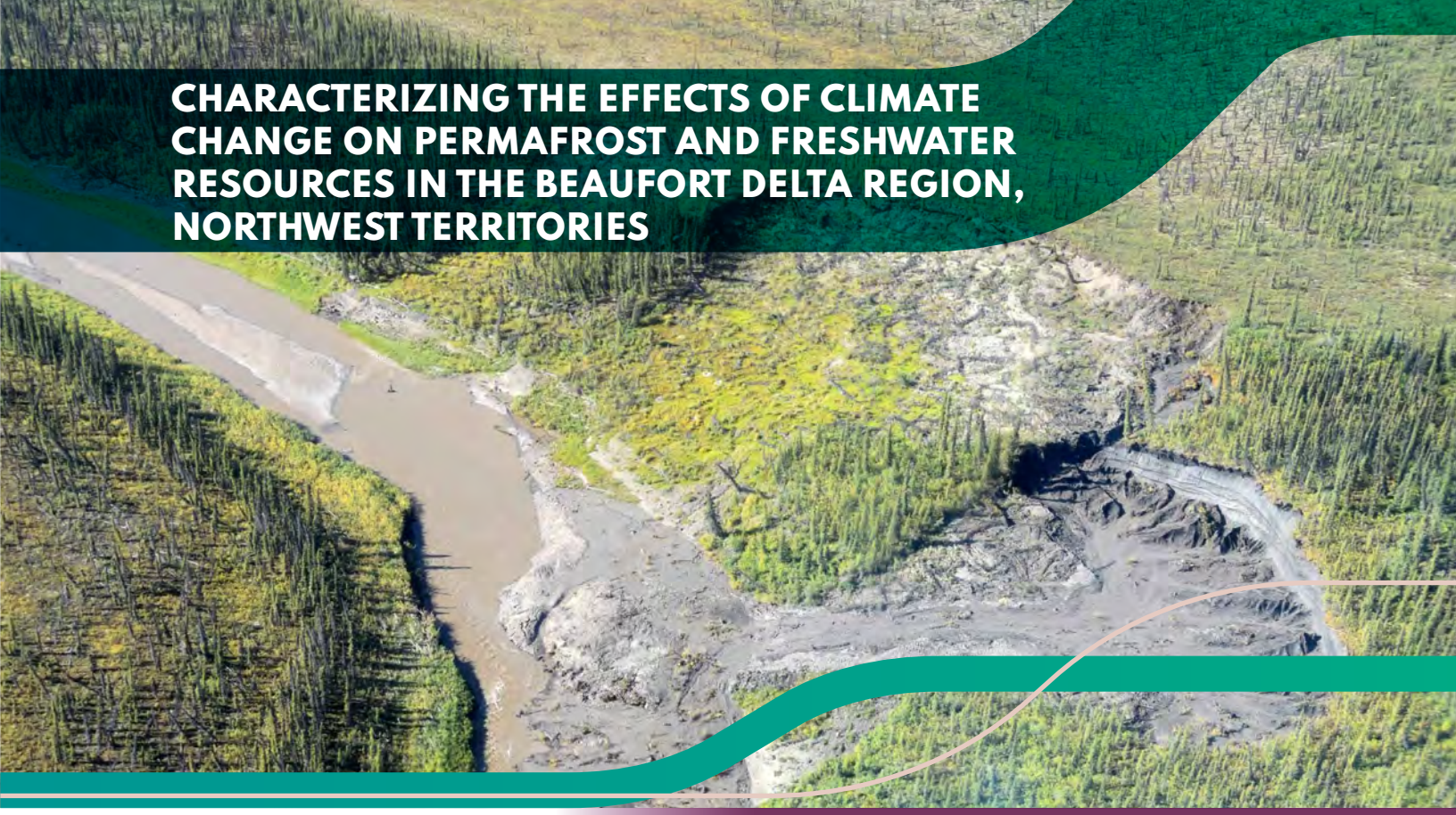
Ongoing outreach has supported numerous discussions on permafrost-driven landscape change, areas of community interest, and the development of Indigenous-led monitoring programs, providing the TMC with valuable insights on observations of change and research priorities.

The TMC will complete mapping across the Northwest Territories and continue field monitoring and model validation by fostering the co-development of permafrost knowledge. As climate change impacts the dynamic and changing landscape of the North, this approach and the resulting knowledge base become increasingly critical to support Northern land and infrastructure management as well as community adaptation toward a resilient North.

Drilling a borehole for a thermistor in a revegetated thaw slump in the Beaufort Delta region of the Northwest Territories

> *The project would not have been possible without PCSP support. Aerial inventories and field-based terrain assessments support mapping validation, provide a ground-based reality to broadscale mapping, build collaborations with academic collaborators, and facilitate engagement with Indigenous partners on fieldwork in their traditional territories.*
>
> **Steve Kokelj,**
> Northwest Territories Geological Survey

CHARACTERIZING THE EFFECTS OF CLIMATE CHANGE ON PERMAFROST AND FRESHWATER RESOURCES IN THE BEAUFORT DELTA REGION, NORTHWEST TERRITORIES



The debris tongue of an active mega slump that is partially blocking the main channel of the Miner River, Yukon

Erika Hille (Aurora Research Institute, Aurora College) and Alice Wilson (Northwest Territories Geological Survey, Government of Northwest Territories)

Featured story locations on the map: 3

The western region of the Canadian Arctic is generally more sensitive to thaw-driven landscape changes because the permafrost is particularly ice-rich. As permafrost thaws, materials held in frozen soil are released and transported into aquatic systems. Understanding the relationship between land, permafrost conditions and water quality is crucial for informing the management of northern water resources. Predicting how thawing permafrost will impact aquatic systems and water quality is complicated because of the variability in type and size of landscape changes in these regions.

Alice Wilson (Northwest Territories Geological Survey) and her collaborator, Erika Hille (Aurora Research Institute, have been sampling permafrost and using drones in the Beaufort Delta Region of the western Canadian Arctic to describe and map thaw-sensitive permafrost features. Recent permafrost temperature monitoring sites (2018–2021) and sites dating back to the early 2000s are also being established, used and maintained, all of which are of interest to Northern governments and local communities.

Through their combined work, Wilson and Hille's research uses information about the land to explain permafrost thaw-related changes in the water quality of streams and rivers. The team is collecting water samples in a range of permafrost landscapes to improve understanding of regional variability in water quality from permafrost thaw.

Specifically, they are investigating how rivers affected by thaw slump mobilize sediment downstream and how this influences water chemistry and aquatic health.

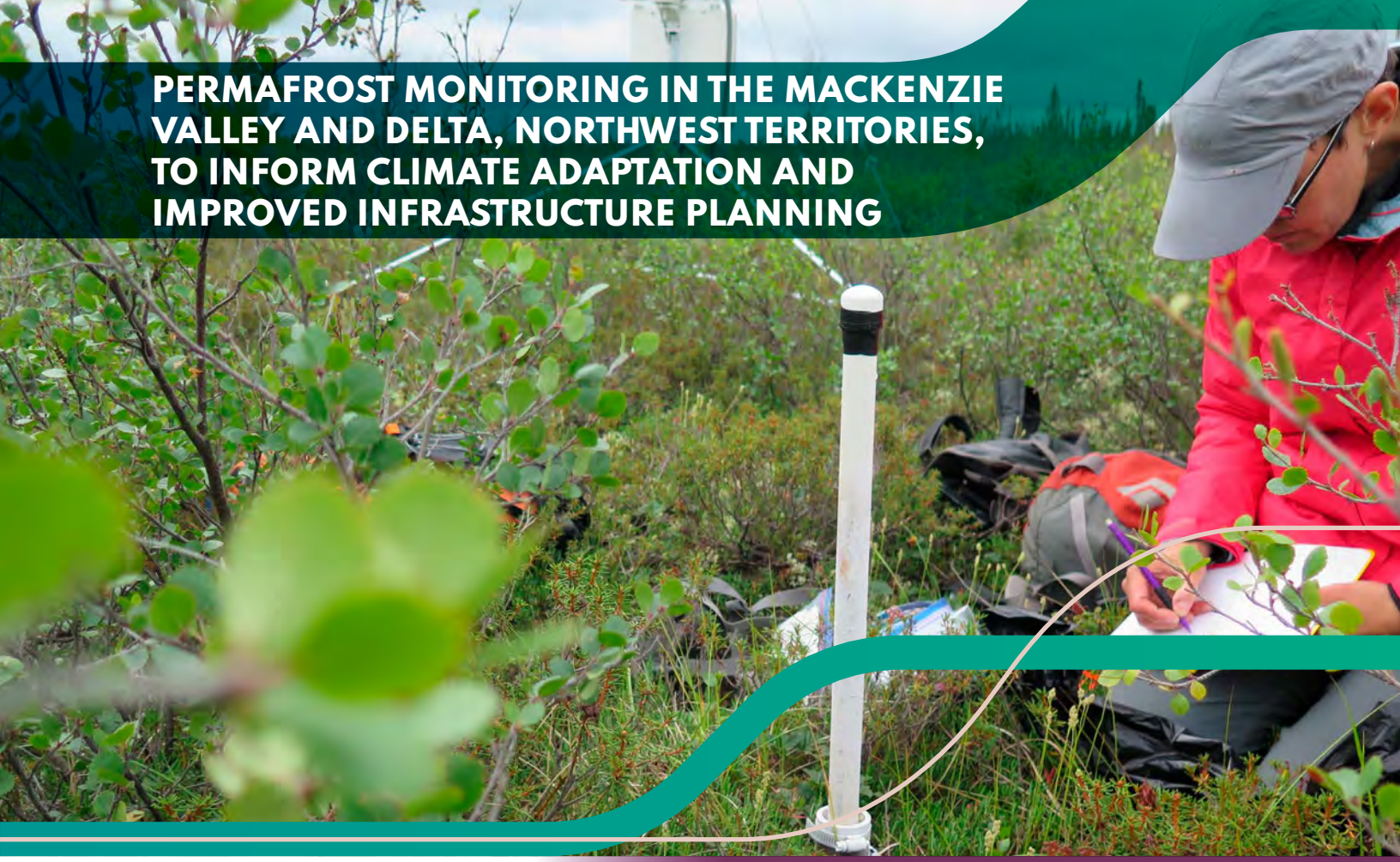
In addition to mapping and sampling, they will be installing conductivity sensors at various locations along the Miner River, Northwest Territories, to examine seasonal changes in water quality. They are also making use of water chemistry techniques to investigate the sources of recent emergences in winter stream discharge at select sites along the Dempster Highway. They propose that the thickening of permafrost active layers (the ground near the surface that thaws and freezes annually) is leading to the development of thaw layers that act as a path for groundwater flow into streams and rivers in the winter.

Data collected is contributed to the Northwest Territories Geological Survey permafrost network and used to create high-quality land models of sensitive landscapes that help highlight the importance of permafrost thaw. This, in turn, informs regional water quality research and monitoring initiatives led by the Aurora Research Institute.

The health and safety of Northern people depend on this type of work. For this project, environmental monitors were hired through the Inuvialuit Land Administration, Inuvik Hunters and Trappers Committee, and Inuvik Community Corporation. The PCSP's provision of aircraft services since 2018 has been essential for the team to access their study sites throughout the seasons.

Thaw slump on the Miner River, Yukon. The river is very slow and meandering, so it deposits sediment on the bottom and sides of the channel instead of moving it downstream. The sediment makes the channel narrow and shallow, making boat navigation difficult.

PERMAFROST MONITORING IN THE MACKENZIE VALLEY AND DELTA, NORTHWEST TERRITORIES, TO INFORM CLIMATE ADAPTATION AND IMPROVED INFRASTRUCTURE PLANNING



Monitoring the active soil layer near the Inuvik airport, Northwest Territories

Sharon Smith and Caroline Duchesne (Natural Resources Canada)

Featured story locations on the map: 4

Active layer thickness and permafrost temperature are key environmental and climate indicators that Geological Survey of Canada (GSC) researchers Sharon Smith and Caroline Duchesne, with other GSC colleagues and territorial government collaborators, are measuring throughout the Mackenzie Valley and Delta, Northwest Territories. The research aims to improve assessments of climate change impacts on infrastructure and on the natural environment, and to inform decisions related to northern development and climate change adaptation.

The team is gathering information from a regional permafrost monitoring network that has been maintained by the GSC since the 1980s. The information they are collecting contributes to the Global Terrestrial Network for Permafrost of the World Meteorological Organization's Global Climate Observing System.

Research results have shown that rates of permafrost warming within the Mackenzie Valley range from less than 0.2 °C per decade in the central and southern regions of the valley and to more than 0.5 °C per decade in the northern part. The differences in rates of permafrost warming between the north and the south are consistent with Arctic amplification (the accelerated rate of warming occurring in the Arctic compared to other regions).

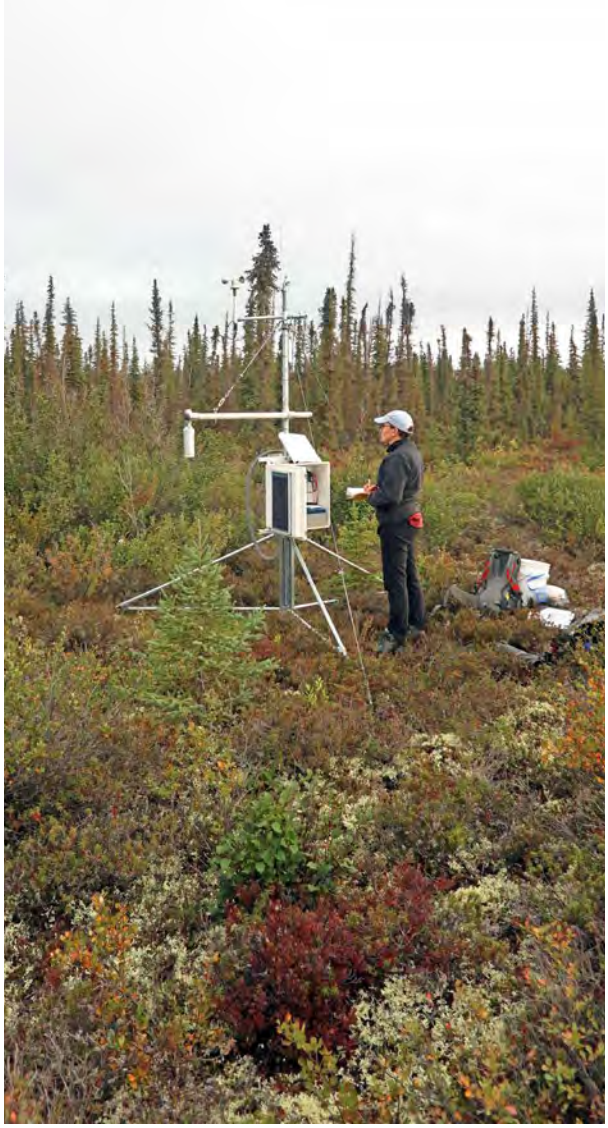
In addition to considering deeper ground temperatures that reflect longer-term changes in climate, the research also includes observations of thaw penetration near the surface that reflects shorter-term variations in climate. Observed changes in ground temperature and thaw depth highlight the implications of permafrost warming and thaw on the integrity of natural and built environments, including infrastructure.

Through continuous monitoring in the region, the project generates updated information on permafrost conditions informing improved planning for infrastructure design and climate adaptation strategies where major infrastructure developments such as all-season highways are anticipated.

Local Inuvik resident, William Modeste, has provided valuable guiding services to support the team's permafrost monitoring activities for over 15 years. Moreover, through involvement in the project's field activities in the Inuvik vicinity, training opportunities have been provided to students from the Gwich'in Renewable Resources Board and the Aurora Research Institute.

Data collected through this research is publicly available in GSC publications and disseminated to community and land management organizations throughout the Mackenzie corridor for use in decision making. In the future, the research team plans to pursue research to attribute the causes of change in permafrost conditions, such as the role of vegetation and the impact of depth, timing and duration of snow cover.

Without the aircraft services provided by the PCSP, essential maintenance and data acquisition activities performed by the team in remote regions of the Mackenzie Valley would not have been possible.



Annual maintenance of a small weather station near the Inuvik airport, Northwest Territories

TO LEARN MORE ABOUT

the Global Terrestrial Network for Permafrost, visit the website: https://gtnp.arcticportal.org/

Without PCSP support, our monitoring activities in the Mackenzie Valley would not be possible. The majority of sites are only accessible by helicopter and PCSP support has been critical for site maintenance and data acquisition.

Our group has also relied on PCSP support for current and past work in other regions that have contributed to our monitoring efforts. We have also appreciated the logistical support provided for field equipment, shipping arrangements, and exchanging data loggers at our sites in Resolute.

Sharon Smith,
Natural Resources Canada

On the rock glacier in Shar Tagà' (Grizzly Creek), Yukon

FIELD SITES SUPPORTED BY THE POLAR CONTINENTAL SHELF PROGRAM (2020, 2021 AND 2022)

0 100 200 300 400 500 Km

Scale: 1: 10 500 000

Projection: Vertical Near Side Perspective, centered at 81°N 90°W, altitude 10 000 000 m.

Produced in partnership: Canada Centre for Mapping and Earth Observation (CCMEO) and Polar Continental Shelf Program (PCSP), Natural Resources Canada. © His Majesty the King in Right of Canada, as represented by the Minister of Energy and Natural Resources, 2024.

Sea Ice Information: Median sea ice extent for September (2000-2019) compiled by Canadian Ice Service, Environment and Climate Change Canada, 2020.

Geographical Names: Canadian Geographical Names Data Base (NRCan.gc.ca), Natural Resources Canada, 2021.

Land Cover Data: 2015 Land Cover of Canada, Canada Centre for Mapping and Earth Observation, Natural Resources Canada, 2020.

Legend

- 2020 Field Sites
- 2021 Field Sites
- 2022 Field Sites
- Featured Story Location
- Polar Continental Shelf Program Facility
- IQALUIT — Capital
- Nain — Community
- Eureka — Weather station or Place of interest
- Auyuittuq — National Park
- Marine Protected Area
- Median sea ice extent

Land Cover

- Barren land
- Ice and Snow
- Tundra
- Forest
- Transition Forest
- Farm Land/ Grasslands

Air Distance in Kilometres

					St. John's	5069
				Resolute	3611	3217
			Ottawa	3408	1770	3581
		Inuvik	4119	1502	4847	2292
	Iqaluit	2845	2100	1581	2044	3659
Edmonton	2794	1971	2857	2527	4216	895
Alert	3621	2100	2287	4172	1098	3903	4275

Sampling the water in Ward Hunt Lake, Nunavut for giant viruses

SCIENCE HIGHLIGHTS FROM THE 2020, 2021 AND 2022 FIELD SEASONS

Introduction

The COVID-19 pandemic caused disruptions to scientific research across the Arctic and around the world. To ensure the safety of staff, clients and northern communities, the Polar Continental Shelf Program (PCSP) suspended its operations in Resolute in 2020 – an unprecedented closure since the Program began supporting science and sovereignty activities in 1958. Operating in accordance with public health guidelines, the PCSP was able to deliver logistics support remotely to a limited number of projects led by northern-based researchers who were able to operate safely within these guidelines and travel restrictions and with community approvals.

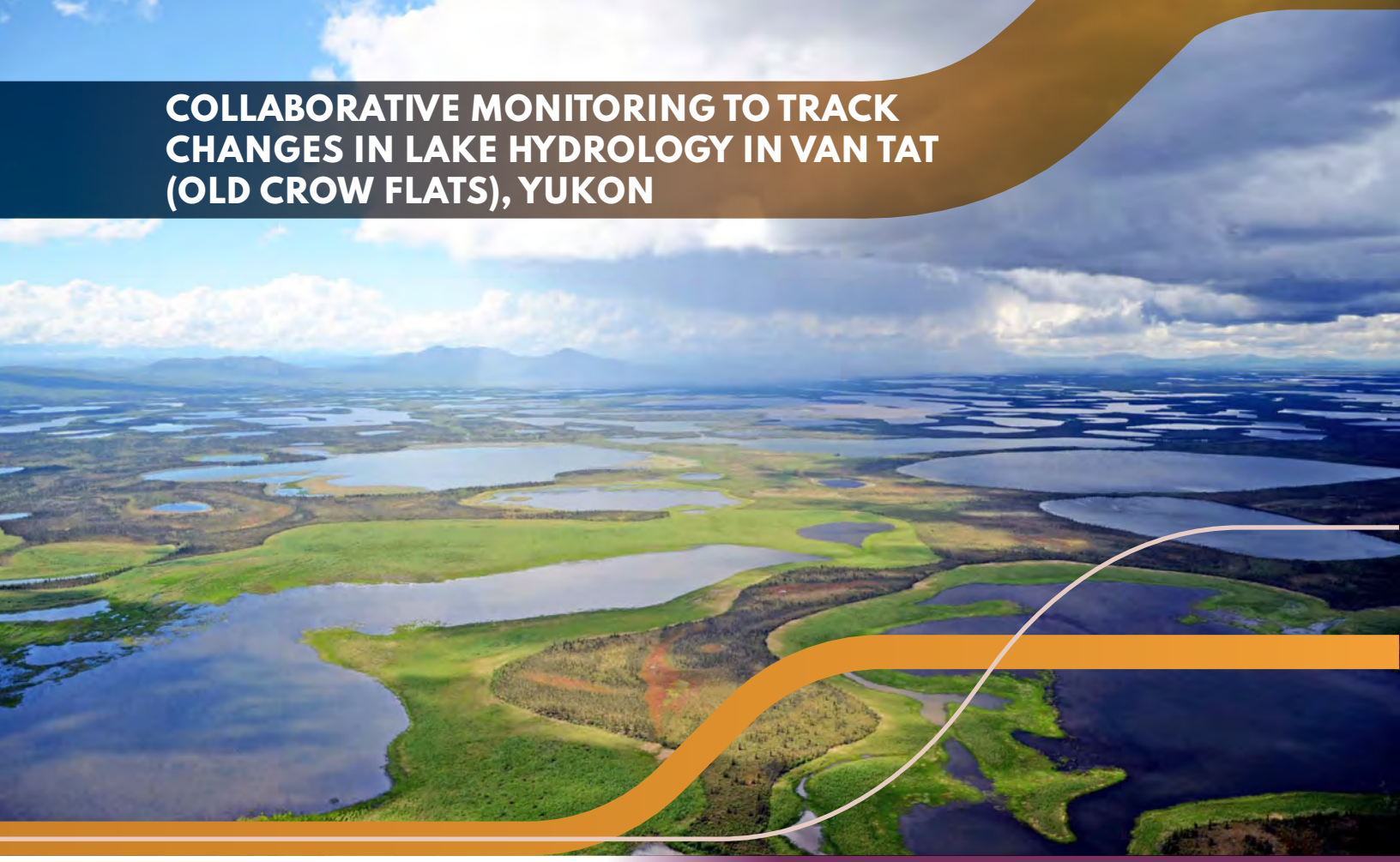
Prior to the COVID-19 pandemic, the PCSP was supporting upwards of 250 projects per year, including those requiring aircraft support in the Canadian Arctic and those using PCSP-issued field equipment all across Canada. In 2020, the PCSP supported 41 projects, followed by 127 in 2021, and approaching pre-pandemic numbers at 232 in 2022.

The following 10 featured science stories highlight some of the research activities supported by the PCSP during the 2020, 2021 and 2022 field seasons. These projects cover a broad range of topics from the impact of climate change on Arctic hydrology and forest fires to caribou conservation and habitat protection.

Refer to the featured story location number to view the project's field location(s) on the field sites map (page 28 and 29).

Crossing an open wetland on the way to sample trees

COLLABORATIVE MONITORING TO TRACK CHANGES IN LAKE HYDROLOGY IN VAN TAT (OLD CROW FLATS), YUKON



Van Tat (Old Crow Flats) in Northern Yukon

Ian McDonald (Parks Canada), Kevin Turner (Brock University), Roland Hall (University of Waterloo) and Brent Wolfe (Wilfrid Laurier University).

Featured story locations on the map: 5

Van Tat, otherwise known as the Old Crow Flats, is a sprawling network of over 8,700 shallow lakes and ponds in northern Yukon. The wetland covers an area approximately the size of Prince Edward Island (5,600 km^2) and is recognized as a Wetland of International Importance because it contains critically important wildlife habitat and is integral to the subsistence economy and cultural identity of the Vuntut Gwitchin First Nation. Van Tat is protected by the Old Crow Flats Special Management Area, which includes Vuntut National Park.

During the past few decades, members of the Vuntut Gwitchin First Nation have observed changing water levels in Van Tat and have raised concerns about the impact this could have on the region's ecology and their traditional lifestyle. With ongoing logistics support from the PCSP, a collaborative monitoring program has tracked changes in lake water balance in Van Tat since 2007. The monitoring program brings together partners from the Vuntut Gwitchin Government, the North Yukon Renewable Resources Council, Parks Canada, the University of Waterloo, Wilfrid Laurier University and Brock University.

Each summer, researchers access 14 long-term monitoring lakes in Van Tat via helicopter chartered by the PCSP to collect water samples, measure lake depth and record surface water characteristics. Water isotope tracers are used to determine the influence of evaporation on lake water levels over time and to classify the monitoring lakes as either rainfall-dominant, snowmelt-dominant or evaporation-dominant, depending on the main hydrological processes affecting their water balance.

A recent synthesis of climate and water isotope data from Van Tat has led to two important findings (MacDonald et al., 2021; Environmental Research Letters). The first is that Van Tat is getting warmer and wetter and that rainfall during the open-water season is driving this increase in

precipitation. The second is that the hydrology of the lakes has shifted since studies began in 2007. All 14 lakes are receiving more rainfall and likely receiving water from thawing permafrost.

The findings from this study indicate that increased rainfall, and potentially thawing permafrost, may cause the lakes in Van Tat to be more susceptible to draining, with far-ranging implications for biogeochemical cycling, wildlife and traditional use of the region.

This study demonstrates the value of long-term, water isotope–based monitoring programs for understanding the hydrological consequences of climate change in northern lake-rich permafrost landscapes. The collaborative team will continue to build on this already valuable 15-year water isotope data record with continued annual monitoring. The team will also develop additional techniques for measuring changes to lakes in Van Tat, including the use of lake algae to assess impacts to aquatic food webs and data loggers to track fluctuations in water levels during the open-water season.

Measuring the surface water characteristics of a lake in Van Tat (Old Crow Flats), Yukon

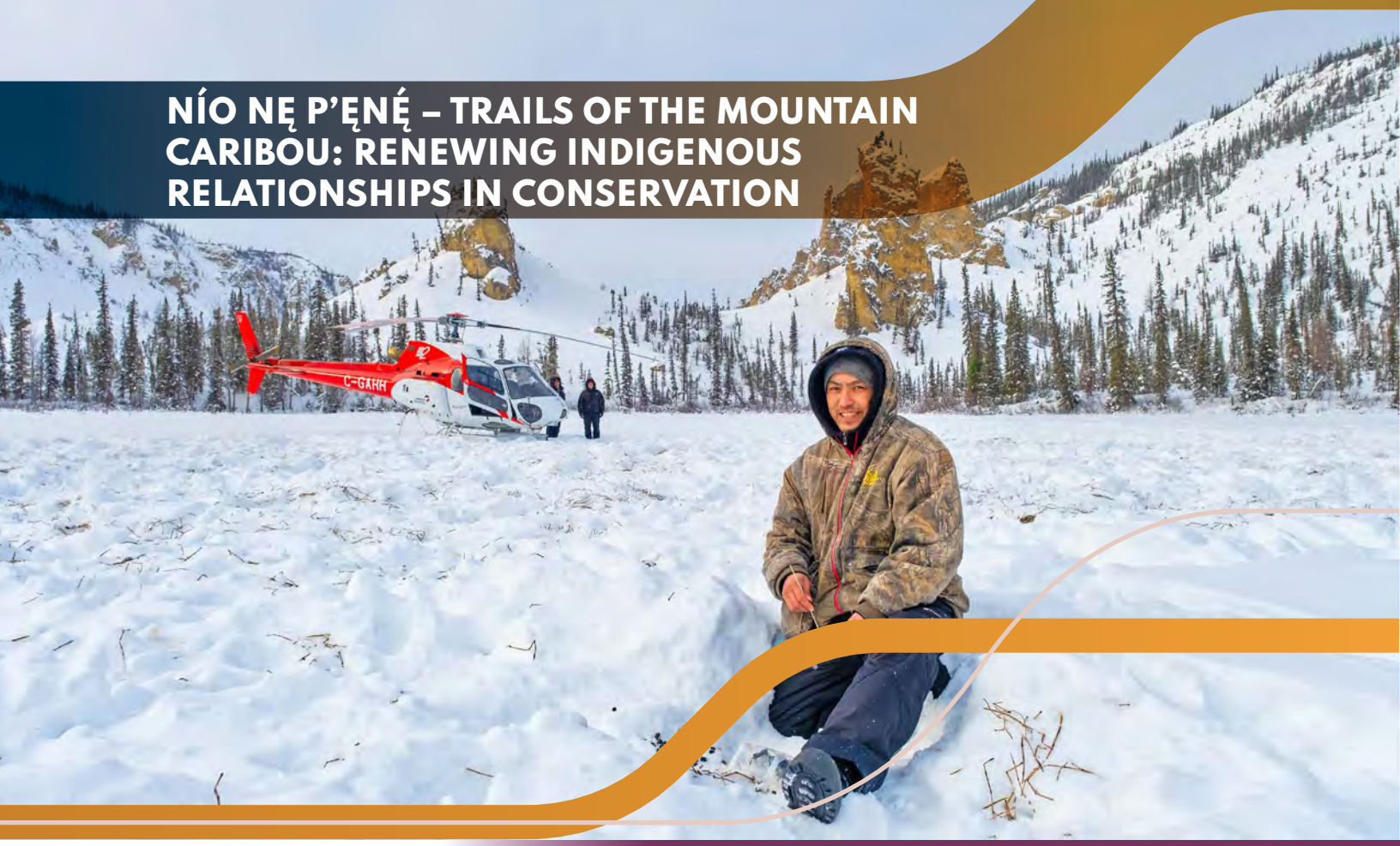
> *The PCSP has provided logistics support for this project since 2007. This support has been crucial to successfully conducting fieldwork in this remote region of northern Yukon and for ensuring the sustainability of this long-term monitoring program.*
>
> **Ian McDonald,**
> Ecologist Team Leader, Parks Canada

Updates to the PCSP facilities during the COVID-19 pandemic

As the COVID-19 pandemic continued, the PCSP's Arctic logistics support was suspended to help prevent the spread of the virus to vulnerable remote communities – including to the PCSP facility in Resolute, Nunavut. When conditions permitted a safe return to the workplace in the fall of 2020, maintenance activities at the facility resumed, with the Resolute site re-opening with restricted access in January 2021.

Improvements to both the Resolute and Ottawa facilities included updated signage and directional markings to ensure physical distancing, enhanced cleaning protocols, and limited access to common areas and workspaces. In addition to mitigating the risk of COVID-19, the PCSP completed permanent upgrades to help reduce greenhouse gas emissions – including installing programmable thermostats, humidifiers, LED lighting, motion sensor light switches and return air ducts.

NÍO NĘ P'ĘNÉ – TRAILS OF THE MOUNTAIN CARIBOU: RENEWING INDIGENOUS RELATIONSHIPS IN CONSERVATION



Collecting samples at cratering sites during the genetic survey of the Redstone caribou herd in the Mackenzie Mountains in the Northwest Territories

Leon Andrew, Manisha Singh and Deborah Simmons (Ɂehdzo Got'ı̨nę Gots'e Nákedı – Sahtú Renewable Resources Board), Cory Fournier and Micheline Manseau (Environment and Climate Change Canada and Trent University)

Featured story locations on the map: 6

The Nío Nę P'ęné area is in the Mackenzie Mountains and straddles the Sahtú Region in the Northwest Territories and Ross River in the Yukon. The Nío Nę P'ęné has been a gathering place for people and caribou for thousands of years and to the Mountain Dene of Tulít'a, Norman Wells Dena and the Tu Łidlini Dena, it encompasses all of nature.

In 2020, these three communities partnered to develop a plan for research, monitoring and land protection to sustain the Dene language, ways of life and law, in coexistence with caribou. Led by Indigenous community members from the Tu Łidlini Dena Council, Tulít'a and Norman Wells Renewable Resources Councils, and Sahtú Renewable Resources Board, the project combines Indigenous methodologies and knowledge with respectful, non-invasive science-based caribou population research. The goal to produce a body of evidence about the bio-cultural significance of the Nío Nę P'ęné area, as well as a framework for caribou conservation and habitat protection, will address key knowledge gaps identified by the Mountain Dene.

The Dene are First Nations Peoples whose northern and Arctic communities have existed for time immemorial. They speak one language with many dialects including Gwich'in, Sahtú, Deh Cho, Tlicho and Akaitcho. The Nation also spans British Columbia, the Canadian Prairies and the southern United States, and they refer to their homeland in the Northwest Territories as "Dene Nę́nę́", translated as homeland.

Central to their essence is a strong commitment to advocating for the rights and well-being of Indigenous Peoples. Lingering concerns span various domains: revitalizing caribou populations, ensuring food security and the vital importance of maintaining a forward-thinking approach to prevent these issues from fading into the background. Looking ahead is crucial – precautions and considerations must extend beyond the current time, resonating purposefully with the aspirations of generations to follow.

With chartered aircraft support from the PCSP, the 2021 and 2022 fieldwork involved collecting genetic data from caribou fecal samples over a large part of the winter range of the Redstone Mountain Caribou. Researchers drew survey flight lines extending from the communities of Norman Wells, Tulít'a and Wrigley into the mountains following river valleys. The fieldwork was conducted by a team based in the Northwest Territories, which included staff from the Sahtú Renewable Resources Board, knowledge holders and youth from the Shúhta Ne K'édike (Keepers of the Mountains) and Indigenous Guardian Programs, as well as a photographer and videographer, and a graduate student from Trent University. The team was of varying age groups and strived for balance across genders.

With the flights originating out of the Northwest Territories communities of Norman Wells, Tulít'a, and Wrigley, the week-long surveys collected more than 600 samples that were shipped to Trent University for genetic analysis to determine population structure and dispersal of the Redstone Mountain Caribou in the area.

Collaborative interpretation by the project participants is ensuring that the results of the study are meaningful to both the scientific and Indigenous communities. Results are being presented at national and international conferences.

Following on the success of these surveys, the team is planning to conduct additional fecal pellet collections in 2023 within the summer range of the Redstone Mountain Caribou herd, both in the Yukon and over the northern part of the winter range in the Northwest Territories.

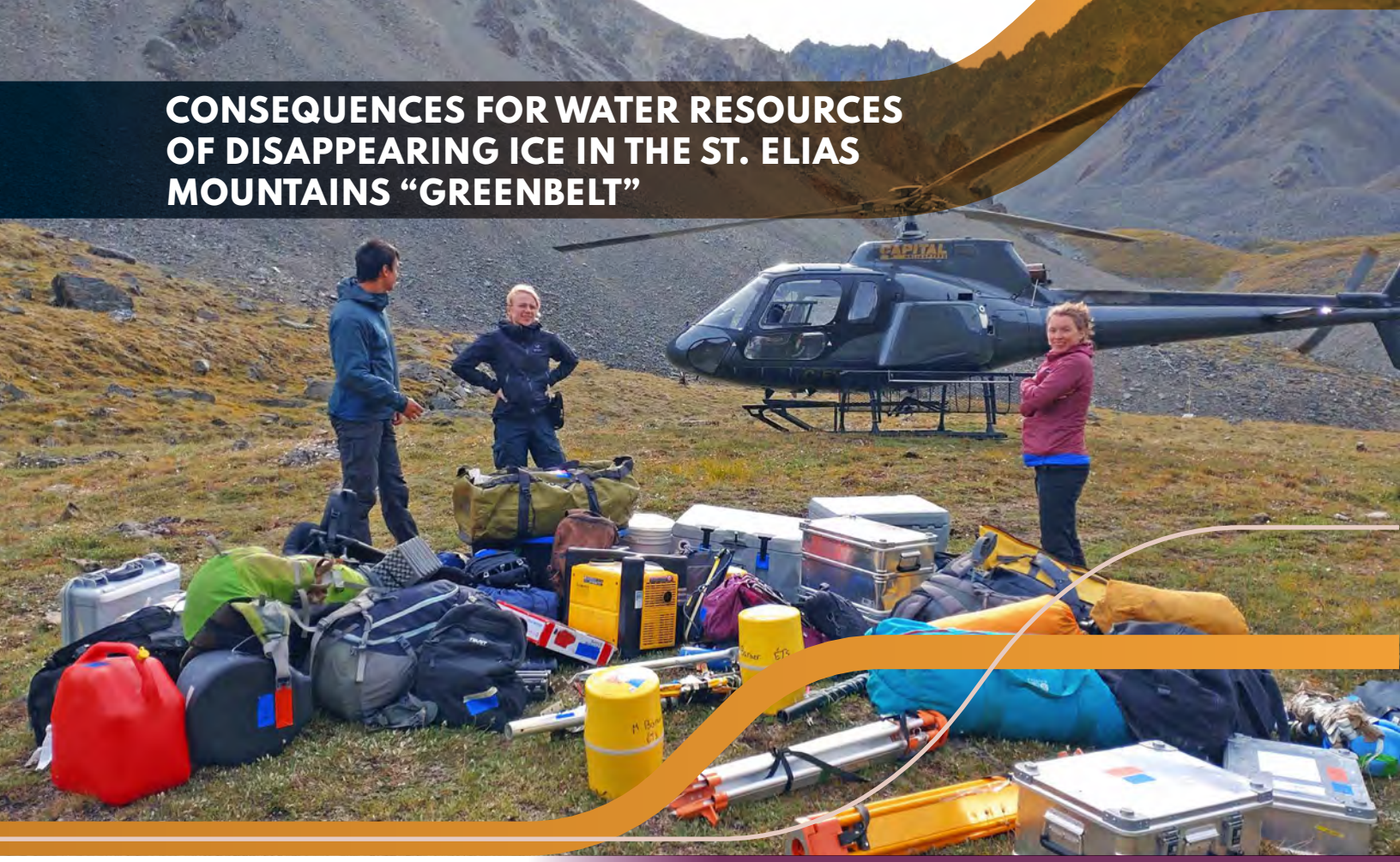
This research owes its realization to the generous support of the PCSP, the Canadian Mountain Network, Environment and Climate Change Canada, Yellowstone to Yukon, and Nature United.

This research aims to continue to support community initiatives that strengthen biocultural integrity, food security and Indigenous governance in the Nío Nę P'ęné area. With community members involved in all stages of the research – participating in the development of research questions and methods, and the interpretation and mobilization of the results – the project is also building capacity and leadership.

Labelling samples during the genetic survey of the Redstone caribou herd in the Mackenzie Mountains in the Northwest Territories

> *This project would not have been possible without the support of the PCSP. It not only covered the flight costs, but also provided significant logistics support in attributing the contract and overseeing the work of the helicopter company. PCSP staff also provided guidance on safety protocols.*
>
> **Micheline Manseau,**
> Research Scientist, Environment and Climate Change Canada

CONSEQUENCES FOR WATER RESOURCES OF DISAPPEARING ICE IN THE ST. ELIAS MOUNTAINS "GREENBELT"



Setting up camp

Michel Baraer (École de technologie supérieure) and Jeffrey McKenzie (McGill University)

Featured story location on the map: 7

Ongoing environmental changes in the subarctic have serious implications for water resources, infrastructure and ecosystems. Changes in water quality, water temperature, sediments and extreme hydrological events are expected in the coming decades because of climate change. Adapting to these changes requires studies based on models that represent key hydrological processes in these watersheds.

Shar Tagà' (Grizzly Creek), situated in the territory of the Kluane First Nation in Yukon, is a glacierized catchment (an area with glaciers where runoff water is collected) with several glaciers, snow and buried ice, rock glaciers and permafrost. Particularly sensitive to a changing climate, many of the effects of climate change on these areas are still unknown. To fill this knowledge gap, researchers at École de technologie supérieure (ÉTS) and McGill University designed a research program focused on producing quantified assessments of climate change impacts at Shar Tagà'.

In 2021, the four-person research team travelled to Shar Tagà' to collect data, check instruments and conduct maintenance. Accessing the field site on a PCSP-chartered helicopter, the team installed a set of new sensors and tested three innovative exploration methods.

Two of these methods used drones, the first of which used drone-based ground-penetrating radar to detect buried ice and estimate debris layer thickness. The second method used a drone-based infrared camera to spot cold water intrusions into the creek, which could be potential outflow from a rock glacier. A third method used terrestrial light detection and ranging (LIDAR) to measure distances using a laser for the purpose of measuring the development of aufeis. Aufeis is a sheet-like mass of layered ice that forms when water emerges from the ground under freezing conditions, often during winter, and is a common feature in the Arctic and subarctic.

Preliminary results are promising, with the drone-based infrared images helping researchers locate areas of cold-water intrusion that may be contributing to aufeis formation in the winter. Timelapse images revealed that aufeis formation appears to vary from one winter to another, both in size and duration. Additional analyses will determine how ice growth is driven by weather and environmental factors.

Future fieldwork will involve both aufeis coring and groundwater sampling. Drone-based ground-penetrating radar will also be used to better measure the thickness and flow processes of the debris-covered glacier. Monitoring equipment will be deployed to study the infiltration of snowmelt and to measure stream levels. As well, drone-based photo surveys will be conducted to produce new digital elevation models for the site. Along with previous years' data, the resulting multi-year dataset will be used to calculate yearly ice losses.

Involvement of local communities continues to be a priority of the research program. These collaborations have resulted in co-writing a conference paper with the Champagne and Aishihik First Nations and producing a report on wildlife sightings for the national park officers after each field season.

The 2019 report was of particular interest to the national park because of reports of a cougar and several mountain caribou offspring. The research team is regularly invited to share field observations and to participate in discussions about ongoing climate-related challenges facing the regional communities.

The team was recently awarded a grant from the Geotop Research Group to facilitate exchanges on water-related issues with the Indigenous communities of the St. Elias Mountains area. The research team will continue discussions with these communities to ensure the planned research addresses local interests and priorities.

> *We wouldn't be able to access our fieldwork site without PCSP support, as helicopter costs cannot be covered by regular research grants and our team does not have the expertise to optimize the expedition logistics. Even more, being supported by PCSP is a safety asset, as it lends us emergency tools such as a satellite telephone and a complete first aid kit.*
>
> **Michel Baraer,**
> Professor, Department of Construction Engineering, École de technologie supérieure

The team's camp in Shar Tagà' (Grizzly Creek), Yukon

THE IMPACT OF FOREST FIRES ON WETLAND WATER QUALITY IN TS'UDE NILINE TUYETA

Using a 206 LR float helicopter to access remote sites to study changes in water quality related to changes on the land

Kirsty Gurney (Environment and Climate Change Canada)

Featured story location on the map: 8

The diverse wetlands of the Sahtú Settlement Area in the Northwest Territories are highly valued for their unique ecological and cultural significance. To better understand the effect of forest fires on the health of these ecosystems, Environment and Climate Change Canada (ECCC) has been working with community members to study changes in water quality in the protected area of Ts'ude Niline Tuyeta (Ramparts Wetlands) near Rádeyı̨lı̨kóé (Fort Good Hope). Measuring water quality helps to determine if water is safe for drinking and to evaluate habitat quality for plants, insects, fish and wildlife.

Between 2017 and 2019, partners from Rádeyı̨lı̨kóé and ECCC collected water samples from 49 wetlands and lakes in Ts'ude Niline Tuyeta via a chartered helicopter coordinated by the PCSP. The wetlands were chosen based on their forest fire histories: recently burned (within the past 10 years) or no recent burn (within the past 60 years).

To understand how forest fires affect water quality in the protected area, the team measured chlorophyll a (an index of the amount of algae in the water), dissolved organic carbon, conductivity and metals in water samples. Together, levels of chlorophyll a and dissolved organic carbon (which affects how light enters the water) help describe the productivity of the wetland – that is, the food sources it can provide for aquatic life. Conductivity, a more general measure of water quality, is related to dissolved solids and can help identify if the health of the water body has been disturbed. Specifically, significant changes in conductivity can indicate that a recent discharge has entered the aquatic resource.

Wetlands in the recently burned sites had higher chlorophyll a levels, lower dissolved organic carbon levels and lower conductivity compared to sites without recent burns. The impacts of fire varied, however, depending on when the water samples were collected. Regardless

of burn history, toxic metals, including cadmium, lead and mercury, were rarely detected (and only at very low concentrations) in water samples from Ts'ude Niline Tuyeta.

Continued monitoring of wetland water quality will help in making informed decisions about water management in Ts'ude Niline Tuyeta, with the goal that study locations and sampling protocols identified in this project will be used in long-term, community-based monitoring of wetlands by Rádeyı̨ı̨kóé Guardians.

Future research plans include sediment coring to help identify historical changes in water quality related to forest fires. This involves extracting a core of sediment from under a lake while being careful to preserve the individual layers for analysis. With climate warming potentially causing more forest fires in the region in the future, this work will provide key information on how changes in water quality might impact the health of wetland ecosystems.

> *PCSP has been critical in helping me deliver on co-developed research objectives for Indigenous Water Programs in northern Canada, not only by facilitating access to safe transport, but also by providing key safety equipment and financial support. Our collaborative programs in Fort Good Hope would not have been possible without such assistance.*
>
> **Kirsty Gurney,**
> Research Scientist, Environment and Climate Change Canada

Studying the effects of fire on water quality

EXPLORING THE GEOLOGICAL AND BIOLOGICAL SIGNIFICANCE OF METEORITE IMPACTS IN NORTHERN LABRADOR

Using an Air Borealis Twin Otter to transport supplies and people to the camp near the Mistastin Lake impact structure in the Labrador region of Newfoundland and Labrador

Gordon Osinski (Western University)

Featured story location on the map: 9

In the last couple of decades, the scientific community has come to realize the role played by the impact of asteroids and comets on the geological and biological evolution of the Earth and other planetary bodies. With the impact event 66 million years ago resulting in the extinction of the dinosaurs and over half of all species on Earth, these impacts are often viewed as destructive forces.

Scientists are now examining the role of these impacts in the creation of geological and biological structures, such as the production of hydrothermal hot springs that may have played a role in the origin of life on Earth and the creation of economic ore deposits at craters, such as those in Sudbury, Ontario.

Studying Earth's impact craters also provides insight into other planetary bodies. Meteorite impacts provide an opportunity to study the interior of other planetary bodies. The impact exposes material that would normally be hundreds of metres to kilometres deep and deposits it on the surface of the Earth.

Impact craters are the most common geological landform on the Moon. With the expected return of humans to the Moon after more than 50 years, there is opportunity to further study the role of impact features on the geological evolution of our closest neighbour. Understanding the impact process and the rocks affected and produced by impacts will contribute to maximizing the scientific return of future missions to the Moon.

The Kamestastin (or Mistastin) Lake impact structure in northern Labrador offers a unique site to learn about the impact cratering process and its products and represents an ideal analogue and training ground for the Moon. The Kamestastin Lake impact structure is one of only two craters on Earth with a substantial amount of anorthosite in their rocks. While relatively uncommon on Earth, anorthosite is the bright white rock that makes up much of the Moon's surface.

The Kamestastin crater also contains some of the best-preserved impact melt rocks on Earth, which are some of

the highest priority samples that future astronauts to the Moon will want to find and collect. Because of this, Canadian astronaut Joshua Kutryk and American astronaut Matthew Dominik were brought along to participate in this research.

Kamestastin Lake is part of Innu Territory and holds cultural and historical significance to the communities of Natuashish and Sheshatshiu. The research team from Western University worked with the Innu Nation to gain permission to conduct fieldwork at this site. In the field, the researchers were accompanied by two Indigenous Guardians from the community of Natuashish and an archeologist appointed by the Innu Nation.

Equipped by the PCSP with field gear and a chartered Twin Otter, the team discovered occurrences of a mysterious black glass produced by the impact that resembles obsidian produced in volcanic eruptions.

At the end of their fieldwork, the research team shared their findings through presentations to the Mushuau Innu Natuashish School in Goose Bay and Sheshatshiu community centres and discussions with community members. With plans to return to this site in 2023 to carry out additional scientific studies, the researchers will be able to offer more training to Canadian and American astronauts.

A close-up of impact melt rock in which large white crystals of plagioclase feldspar are visible

> *PCSP support was fundamental in enabling this project and without it, this project likely would not have occurred.*
>
> **Gordon Osinski,**
> Western University

RECONSTRUCTING FIRE HISTORY IN KLUANE NATIONAL PARK AND RESERVE USING TREE RINGS

A crew ready to travel to a field site on the first day of the season

Ellen Whitman (Canadian Forest Service, Natural Resources Canada)

Featured story locations on the map: 10

The forest area of the Yukon's Kluane National Park and Reserve has undergone substantial change over the years because of a lack of wildfire and an extensive spruce bark beetle outbreak. Parks Canada and the First Nations that cooperatively manage the park share the goal of restoring fire to the land to improve the resilience of local forests. The forests in the park comprise predominantly white spruce trees.

In the summers of 2021 and 2022, Ellen Whitman from the Canadian Forest Service along with collaborators from Parks Canada, Champagne and Aishihik First Nations, Kluane First Nation, and a summer student from Yukon University conducted fieldwork in and around Haines Junction, Yukon. Accompanied by land guardians, wildlife monitors, and other staff from Indigenous governments, researchers exchanged information about cultural resources, what to look out for in the forest and field protocols for the project. The team continued to work with employees from the First Nations while in the field – collaborating on field protocols, gathering data and sharing resources so that local governments could access remote areas of interest.

The goal of this research is to provide baseline data about historical forest disturbances by identifying burned areas from the early 1900s and dating these events using dendrochronology methods (the study of tree rings to understand annual growth and disturbances). The data collected will be compared to current land cover and recent disturbances to understand how human-induced fire use in the past has influenced forests of today.

This baseline data is vital to guide the reintroduction of wildfire to this landscape as a forest management tool and can help researchers anticipate future forest changes within a changing climate.

The fieldwork involved cutting down both dead and live trees, taking full cross sections called "cookies" from those with fire scars and using borers to extract cores from live trees that did not have fire scars. Tree cookies and cores were then used to date the years in which fires occurred and determine the age of the forest. At road-accessible sites, temperature loggers (instruments that record temperature over time) were installed to better understand

impacts of the forest fire history on microclimate. With PCSP-coordinated helicopter support, the team successfully sampled 97 tree communities, which included collecting 161 tree cores and 128 tree cookies. They also installed 59 temperature loggers.

Initial observations suggest that the recent outbreaks in the park were more extensive and lethal in tree communities that had not experienced fire for a long time. It is important to note that while the spruce bark beetle is native to the park, the main concern is how widespread these outbreaks have become. They also found many fire scars on the trees, which was unexpected because white spruce trees display limited adaptations to wildfire. Their observations also revealed unlikely evidence of fire having occurred in areas close to glaciers, where fire weather is typically less severe.

Following the processing and analysis of their 2021 samples, the team returned to Kluane National Park and Reserve in 2022 to complete forest history work by collecting data from approximately 130 more sites. Preliminary results obtained in 2021 and 2022 were presented via a workshop to Parks Canada as well as members of the Champagne and Aishihik First Nations and the Kluane First Nation.

With the analysis of fire history data and documentation of current and historical fire frequency within the area, patterns will be related to current forest vegetation and forest health. Findings will help inform the development of a new wildfire management plan for the park. Moreover, with plans to engage more directly with community members and build mutually beneficial relationships, the team of researchers aim to enhance their understanding of local priorities and observations while they share their discoveries.

> *Kluane National Park and Reserve has extremely limited road access, and the interior can only be reached by small aircraft or by boat. Without the support of PCSP, we would not have been able to visit and sample the interior so extensively and efficiently. The park includes the Traditional Territories of two self-governing First Nations and land managers who are responsible for and manage the entire park. To be able to provide them with fire history information from the whole forest area, thanks to PCSP support, is very exciting.*
>
> **Ellen Whitman,**
> Forest Fire Research Scientist,
> Natural Resources Canada

The role of wildfire in Yukon's Kluane National Park and Reserve

The wildfire deficit observed in Yukon's Kluane National Park and Reserve has likely been influenced by historical policies, including the Government of Canada's creation of the Kluane Game Sanctuary in 1943.

These policies suppressed natural fire and removed Indigenous cultural practices and access to the land. This denied First Nations access to participating in their cultural practices such as hunting, fishing and trapping in a significant portion of their traditional territory. In addition, the traditional uses and relationships to fire were interrupted and altered the cycles of fire on the landscape.

The occurrence of fire is a vital component of Canadian forests, as it plays an important ecological role in maintaining healthy forests. Fire is a natural process that assists in rejuvenating and creating biodiversity within Kluane National Park and Reserve's boreal forests as well as minimizing damages to forest health from other disturbances, including the spruce beetle.

A landscape that contains a variety of fire severity and resulting forest successional stages may help adapt to and absorb impacts from climate change and other stressors. A forest mosaic comprising a variety of stand ages and plant communities is generally more resilient in the face of major insect infestations, including the spruce beetle, and catastrophic fire events. The ongoing challenge that exists is how to manage fire to protect human values and ways of life while still allowing fire to play its critical ecological role in maintaining healthy forests.

EXPLORING THE IMPACTS OF MELTING GLACIERS ON HIGH ARCTIC COASTAL MARINE ECOSYSTEMS

Measuring glacial discharge in the Grise Fiord area in Nunavut

Tragically, the researcher featured in the following article, Dr. Maya Bhatia, passed away on August 16, 2023, while conducting fieldwork near Grise Fiord, in Nunavut. It is a tremendous loss to the northern science community. The PCSP offers our deepest condolences to Dr. Bhatia's family, friends and colleagues. An In Memoriam piece will be featured in our next science report.

Maya Bhatia (University of Alberta), Erin Bertrand (Dalhousie University), Stephanie Waterman (University of British Columbia), Paul Myers (University of Alberta), David Burgess (Natural Resources Canada), Jimmy Qaapik (Grise Fiord), Terry Noah (Grise Fiord), Eric and France Brossier (S/Y *Vagabond*), and Graduate Students and Research Associates: Andrew Hamilton, Patrick Williams, Megan Roberts, Maria Cavaco, Patrick White, Jenifer Spence, Claire Parrott, and Ana Heras Duran

Featured story location on the map: 11

Glaciers in the Canadian Arctic Archipelago are vulnerable to climate change. With many of them ending in the ocean (marine-terminating glaciers), they deliver large quantities of freshwater, sediment, carbon and nutrients into the coastal ocean as they melt. This discharge of freshwater and material promotes the production of organic matter by marine algae.

In this first assessment of glacier-ocean biogeochemical interactions in the Canadian Arctic Archipelago in 50 years, Maya Bhatia and her collaborators used Jones Sound, a waterway in Qikiqtaaluk, Nunavut, as a natural laboratory. The aim was to demonstrate that ocean surface waters near marine-terminating glaciers have enhanced summertime concentrations of vital nutrients that promote the growth of marine algae. Jones Sound – home to the Inuit community of Ausuittuq (Grise Fiord) – is a marine region surrounded by glaciers draining large ice fields and caps on Ellesmere and Devon Islands.

Working in close collaboration with the community of Ausuittuq, this research project began in 2019 and has been developing community relationships through extended

visits, formal meetings, fieldwork expeditions and year-round informal communications to advance its objectives. Initial community consultations revealed that the marine-terminating glaciers in the region are rich in wildlife, providing hunting grounds for residents.

Through regular, sustained engagement and knowledge exchange, research sites as well as two research questions were identified for the project. The first question investigated why ocean waters near marine-terminating glaciers are often full of life, making them preferred hunting grounds. The second question investigated whether increased glacial meltwater runoff, glacial retreat and sea ice loss affect these sites. With support from the Natural Sciences and Engineering Research Council of Canada (NSERC) Ship Time Program (a grant that provides funds for research using ships) and Polar Knowledge Canada, the team engaged their community-based partners to lead year-round sampling and monitoring.

In 2019, the team began measuring concentrations of essential macronutrients (nitrate, silica, phosphate – nutrients that are found in higher quantities) and metal micronutrients (iron, manganese – nutrients generally available in lower quantities) in Jones Sound coastal areas with and without glaciers. Results showed elevated concentrations of nutrients in marine waters with glaciers. The source of the macronutrients was found to be from deep marine waters that were carried to the surface by glacial meltwater entering the ocean below the surface, whereas micronutrients originated from the glacial meltwater itself.

> *Currently, a data gap exists in understanding ocean properties in nearshore and coastal regions, yet the coast is where Inuit communities live and harvest. The PCSP provides us the support to access our field site in Ausuittuq (Grise Fiord) and to conduct helicopter surveys and sampling campaigns in our glacier watersheds. With PCSP's support of our project, we are able to help fill this gap, thereby contributing to a self-determined and sustainable Canadian North by cooperatively exchanging knowledge to promote the collection of scientific data by Inuit, for Inuit.*
>
> **Maya Bhatia,**
> University of Alberta

Movement of the macronutrient nitrate closer to the ocean surface is important for local coastal algae growth, while the addition of metal micronutrients may be disruptive to the natural nutrient cycling in Jones Sound and may impact water flowing into the North Atlantic. The way glaciers cause the movement of nutrients is likely to change as the climate continues to warm.

Understanding this process will help predict changes in marine ecosystems, both locally in the Canadian Arctic Archipelago and in nearby regions of the North Atlantic. Since these nutrients often impact marine algae growth, which are at the base of the food web, this new data is critical for understanding the implications of melting glaciers on coastal marine ecosystem health.

Publications to date describe data collected during the 2019 field season, with forthcoming publications exploring changing marine algae and bacteria group dynamics in regions with and without glaciers, ocean circulation and freshwater variability. While continuing their work in Jones Sound, the team is also collecting year-round observations of the region in collaboration with the local Inuit hamlet of Ausuittuq. The team now has a four-summer dataset and a growing set of fall, winter and spring observations that they hope to continue building into a long-term record.

Developing a sampling plan aboard the SY *Vagabond*

TESTING ELECTROMAGNETIC MONITORING METHODS TO DETECT CARBON CAPTURED AND SEQUESTERED IN THE WESTERN CANADIAN SEDIMENTARY BASIN

Laying out the transmitter wire

Jim Craven (Natural Resources Canada)

Featured story location on the map: 12

To meet net-zero carbon emissions goals by 2050, carbon capture and storage (CCS), a United Nations–endorsed emissions mitigation approach, must increase by at least 9.95 gigatons (Gt)/year (269 Gt in total by 2050). Saline geological structures are known as having the largest storage potential for carbon dioxide (CO_2), which is currently estimated to range between 30 and 300 Gt in Canada. The uncertainty in this estimate highlights a dire need for more sophisticated evaluations of CO_2 storage capacities.

Aligning our theoretical knowledge of CO_2 storage efficiency factors with practical knowledge can provide us with better estimates of geological site capacity and help advance the roll-out of national CCS strategies.

Jim Craven and Victoria Tschirhart from the Geological Survey of Canada and their collaborators, Ian Ferguson from the University of Manitoba and Bernard Giroux from the *Institut National de Recherche Scientifique*, have been studying carbon storage at Aquistore, a CCS site located within the Western Canada Sedimentary Basin in Saskatchewan. They have been assessing the state of CO_2 storage at the deep CCS site as a follow-up study to a 2013 baseline survey and a 2015 CO_2 post-injection survey.

Craven's team performed electromagnetic measurements of the saline geological structure, or reservoir, at the site, to image the absorption of 360 kilotons of dispersed liquid CO_2. They compared these geophysical measurements with other types of measurements derived through a technique known as seismic imaging. These measurements were used to confirm electromagnetic results and deliver a more detailed understanding of the absorption state within the deep saline structure of the reservoir. Electromagnetic results were also used to complement seismic assessments, such as to gain more information on the absorption potential of these structures.

The injection of liquid CO_2 changes the electrical properties of the reservoir, allowing the team to map changes in the structure by performing repeated electromagnetic measurements. The team will use the finite element method – a method used for complex 3D modelling – to improve the quality of the images generated from this study. Through this work, the team will deliver a unique assessment of the state of carbon storage in the Western Canadian Sedimentary Basin. They will also be able to detect signs of reservoir leakage and changes to the immediate surrounding environment. The PCSP supported this work by providing them with the essential equipment, including jack hammers and copper rods, that they needed to install electrodes into the ground and use the electromagnetic technology.

Craven's team plans to continue data collection to track changes brought about by CO_2 injections and construct a complete 3D map of the CO_2 stored within the underground site. Optimizing the use of electromagnetic and seismic methods to track the state of captured and stored CO_2 within geological reservoirs over time promises to advance knowledge of Canada's subsurface CO_2 capacity. This will increase the precision and certainty of Canada's CO_2 storage estimated capacity and inform regulatory and investment decisions that are foundational to scaling up carbon capture and storage and meeting net-zero by 2050.

Programming a recorder to collect data

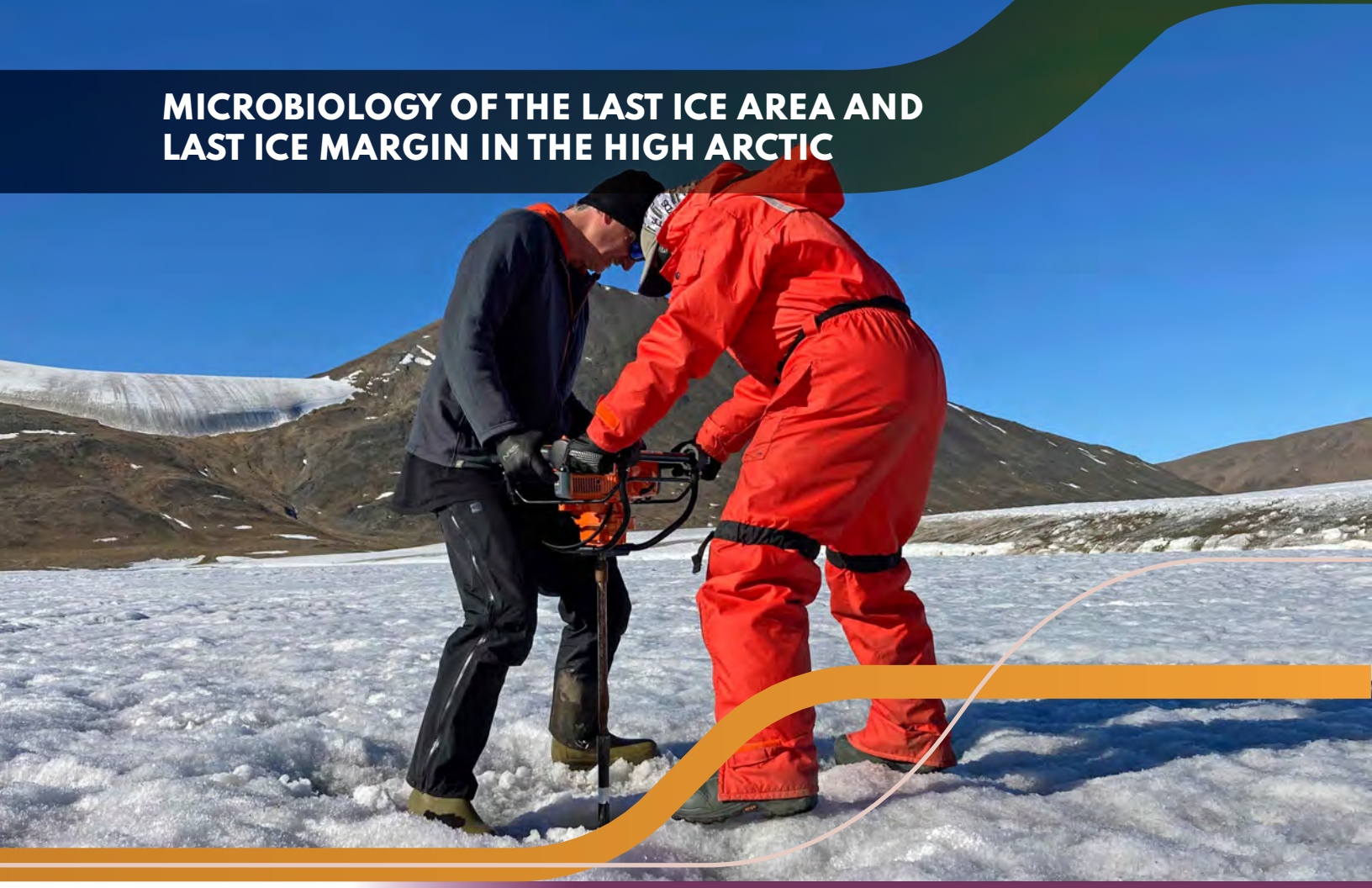
Supporting accessibility, equity, diversity and inclusion in research

The PCSP has implemented measures to help reduce barriers to women, Indigenous Peoples, and diverse groups in research. In 2020, the PCSP made changes to the project selection criteria for university researchers to include equity, diversity and inclusion measures, and put a stronger emphasis on including Indigenous Peoples as partners in research.

Adjustments were also made to reduce unintended barriers to researchers encountering career interruptions that are due to such events as parental leave or illness. Additionally, the PCSP began collecting data on gender at the applicant level to better inform participation rates. The systematic collection of data will facilitate Gender-Based Analysis Plus (GBA Plus) to monitor participation rates and decisions about project selection for unintended bias.

A client diversity survey was conducted in 2021 and was sent to all participants of PCSP-supported projects that year. This survey will be repeated in the future to monitor trends and participants' experience with the PCSP. This information will inform a range of decisions from project selection criteria and allocation of support to procurement and help related to program delivery.

MICROBIOLOGY OF THE LAST ICE AREA AND LAST ICE MARGIN IN THE HIGH ARCTIC



Drilling a sampling hole through the ice on Markham Lake, Northwest Territories

Alexander Culley, Warwick Vincent, Connie Lovejoy, Dermot Antoniades, Denis Boudreau, Raoul-Marie Couture and Jesse Greener (Université Laval)

Featured story location on the map: 13

Due to a phenomenon influenced by climate change known as Arctic amplification, the North is warming nearly four times faster than the rest of the planet. For this reason, the "last ice area" (LIA), found along the northern shore of Ellesmere Island in Canada and predicted to retain year-round ice up to mid-century, is of great value to scientific research. As well, the deterioration of cold climate features such as ice shelves, permafrost, icebergs and glaciers are threatening the health of ice-dependent ecosystems in the region, including microbial ecosystems.

Knowledge of "last ice" microbial communities can provide insights on the impacts of Arctic amplification. Ice-dependent microbes such as viruses, bacteria and archaea travel to and through freshwater environments. They can live in these extreme environments for reasons we hardly understand. The LIA is also viewed as a final refuge for ice-dependent marine species whose health depends on these northern microbial ecosystems. The incentives to study High Arctic "last ice" microbial communities for informing conservation efforts and preparing decision-makers for the impacts of Arctic warming are thus evident.

Alex Culley and the research team from Université Laval work with a transdisciplinary team of collaborators from the Nunavut Research Institute, the Centre for Northern Studies, the Université du Québec à Chicoutimi, Fisheries and Oceans Canada, the Natural History Museum of the United Kingdom, the National Biodiversity Cryobank of Canada, the Canadian Light Source, the National Institute of Polar Research of Japan, the Alfred Wegener Institute for Polar and Marine Research, the University of Lisbon and the Laboratory for Cryospheric Research, among others.

The team has been studying viral, bacterial and archaeal communities along the northern coast of the Ellesmere Island region, including Ward Hunt Island Lake, since 2014. Team members are assessing the impact, diversity and

behaviour of these communities in diverse northern aquatic and ice habitats and how their ecology is being affected by the rapidly evolving changes in the region. Culley's lab, the Viral Discovery and Ecology Laboratory, is focused on creating a complete description of microbial diversity, with emphasis on aquatic viruses and viruses that infect dominant northern microbial hosts.

Culley's team and colleagues have been collecting samples from lakes, fiords and frozen habitats to provide a unified, transdisciplinary analysis of the microbial communities of the LIA and their associated ecosystems. The Viral Discovery and Ecology Lab will use these samples to describe virus interactions with their hosts in the air, ice, soil, and fresh and saltwater using techniques in molecular biology. The team will address key hypotheses about the environmental role of these northern viruses. This will create a physical, chemical and biological portrait of virus ecology in the High Arctic.

Through community partnerships, Culley's team has worked with Northerners in the field and is participating in a locally run research program in Resolute Bay to answer community questions. Beyond generating insights into Arctic research, this program will accelerate training and capacity building in the North and strengthen Inuit partnerships. The PCSP provided equipment, supplies and aircraft services (helicopter and Twin Otter aircraft) that were essential to accessing and establishing sampling sites.

In future field seasons, Culley's team plans to investigate the ecology of viruses at other sites that are similar to the LIA and are most sensitive to climate change. These include numerous lakes that are losing their ice cover and the Ward Hunt Ice Rise, which is known as potentially being the largest and oldest ice feature in the region.

Findings will support implementing conservation policies for fast-changing polar regions and inform preservation planning for priority areas such as Quttinirpaaq ("Top of the World" in Inuktitut) National Park, the Tuvaijuittuq Marine Protected Area in northern Nunavut, and others.

> *We feel privileged to work in this remote, extreme and rapidly transforming region of the world. This program is centered on the Last Ice Area and the land adjacent to it because this region harbours some of the oldest ice and ice-dependent life in the Arctic. It is these ice-based habitats that are disappearing the fastest as global temperatures continue to climb. Our specific interest lies in understanding the diversity, dynamics and function of LIA microbial communities. Not only are microbes the most abundant and diverse organisms in the Arctic, microbes play a critical role in the cycling of nutrients and energy. Therefore, understanding the dynamics and interactions of this group is vital to understanding the ecology of the ecosystem as a whole. In collaboration with our northern, national and international partners, we hope to understand more about this fragile and fascinating community before it has irrevocably changed.*
>
> **Alexander Culley**
> Université Laval

Sampling microbial mats from the remnants of the Ward Hunt Ice Shelf, Nunavut

OCEAN, ICE, AND ATMOSPHERE OBSERVATIONS IN SUPPORT OF INUIT COMMUNITIES AND GREENHOUSE GAS EXCHANGE STUDIES

Transporting field equipment to the sea ice to collect samples

Brent Else (University of Calgary)

Featured story locations on the map: 14

The Earth's oceans are responsible for absorbing about 25% of carbon dioxide (CO_2) emissions from the atmosphere. They thus play a large role in maintaining the air composition that is required to sustain life as we know it. As climate warms and impacts the extent of sea ice over the polar oceans, it is critical to understand their role in CO_2 absorption.

The vast size of ocean ice ecosystems contributes significantly to the global-scale CO_2 cycle. Better knowledge of CO_2 exchange during periods of ice growth, melt and decay can provide us with important insights about the impact of a changing climate on CO_2 absorption by the polar oceans. Improved measurement techniques and increased data collection can help explain polar ocean CO_2 exchange so that global carbon fluxes can be calculated with more precision.

Brent Else is an associate professor at the University of Calgary. With the guidance and support of the Ekaluktutiak Hunters and Trappers Organization, Brent installed specialized weather instruments, performed environmental surveys and collected water samples on Qikirtaarjuk, a small island near Cambridge Bay, to support his research in marine biogeochemistry. Brent and his team travelled by snowmobile in the winter and by boat in the summer and camped on-site in the spring for ice break-up season to collect carbon chemistry measurements from sea ice, melt ponds and underlying seawater. His work specifically targets the study of CO_2 cycling in complex Arctic aquatic environments and the development of sea ice CO_2 exchange models.

Brent's team has been using instruments that measure CO_2 flux between the atmosphere and the ocean at weather observation points on Qikirtaarjuk Island since 2015. In 2016, the team also installed weather stations at more heavily travelled locations to support community needs for weather information.

By 2022, several years of data collected by Brent's team showed that the ocean absorbs CO_2 from the atmosphere when ice melts during the early spring. It is then released into the atmosphere in the summer when the sea water warms up and is absorbed again in the fall when the sea water cools.

The team used a unique technique to accurately measure CO_2 fluxes over various sea surface conditions, including open water, ice break-up, and land-fast ice (sea ice that is attached to land). The results of this technique identified some of the physical and chemical factors that drive CO_2 exchange and will help to improve carbon sink estimates for the Arctic Ocean.

The PCSP has provided aircraft support to Brent's project since 2017, which allows the team to visit the weather stations during periods when travel by boat or snow mobile is not possible. Brent and his team plan to continue this study to build a series of carbon flux measurements over time. The results of this work will inform international global climate models and derive insights about fluxes of other climate-significant gases.

Deploying instruments to measure CO_2 dissolved in seawater

DID YOU KNOW

In 2018, Brent Else and his team worked with the Arctic Research Foundation and the Kitnuna Corporation to install a mobile research lab on Qikirtaarjuk Island that generates its own wind and solar energy. The lab provides electricity for sample processing and acts as a power source for the team's weather stations. The Ekaluktutiak (Cambridge Bay) Hunters and Trappers Organization expressed interest in using these labs to support community activities such as the observation of marine traffic and noise, search and rescue operations, and remote communications. Brent's team aims to promote the use of the lab to power community weather stations and report important environmental information to Inuit communities in the near future.

The mobile research laboratory and flux tower on Qikirtaarjuk Island, Nunavut

The team deploys a conductivity, temperature and depth instrument to measure the salinity, temperature and other characteristics of seawater.

STUDY OF IRON HATS IN THE EXPEDITION FIORD REGION AS AN ANALOGUE OF GEOLOGICAL FORMATIONS ON THE PLANET MARS

The first base camp established near the White Glacier in Nunavut comprises a dome tent that serves as a common area; an office and kitchen; individual tents and a radio antenna for daily reporting to the PCSP.

Myriam Lemelin (University of Sherbrooke)

Featured story locations on the map: 15

The climate of the planet Mars once resembled that of Earth. Mars is dynamic, revealing seasons, polar ice caps, canyons and extinct volcanoes that demonstrate an active past that produced natural systems that could support life.

The Terrestrial Mineral Analysis by Remote Sensing (T-MARS) project was developed to document the geological past and the processes that have shaped the surfaces of the planets in our solar system. The T-MARS project is part of the science priorities for space exploration established by Canada's scientific community and is researching astrobiology and geology, in particular. The information gathered will fuel innovative research in space technologies, planetary exploration and earth systems science.

The primary objective was to study iron hats in the Canadian Arctic, which are geological formations caused by the interaction of water, energy and metal-rich bedrock systems. Iron hats are ideal analogues of geological formations on Mars that could preserve traces of ancient life. The project was designed to practice a methodology similar to those used during the Mars missions.

Myriam Lemelin is a professor at the University of Sherbrooke and, for this project, worked with research partners Marie-Claude Williamson (Geological Survey of Canada) and Richard Léveillé (McGill University). The team also included collaborators Dr. Cassandra Marion (Canada Aviation and Space Museum) and Sean Clark (a student from Sacred Heart High School, Stittsville, Ontario), and students from the University of Sherbrooke and McGill University.

Myriam and the team

- mapped areas of iron hats on Axel Heiberg Island in Expedition Fiord

- took field measurements and samples
- conducted laboratory studies to investigate the processes that formed them
- analyzed the composition and the chemical and biological characteristics of the samples

Iron hats contain abundant minerals that require the presence of water to develop the formation. Because similar minerals have been identified on Mars, this study assessed the potential of these geological formations to preserve traces of life. The T-MARS field team used the same methodology to study samples from both the High Arctic and Mars. The team used handheld instruments to observe the samples in the field and conducted more sophisticated analysis in a laboratory.

To refine their interplanetary search methodology, the team collected data from the Arctic tundra, including lichen-covered rocks, to verify the effect of vegetation on satellite images. The university students reviewed the data to provide guidance on the exploration steps needed in the field. They also gained experience in collecting, preserving and interpreting data.

The data collected in 2022 will be used to validate a predictive mapping method to identify iron hats by using satellite data. In addition, the analysis will measure the organic carbon content and identify lipid chains attributable to the presence of microbes in the iron hats. This information will be used to confirm the astrobiological potential.

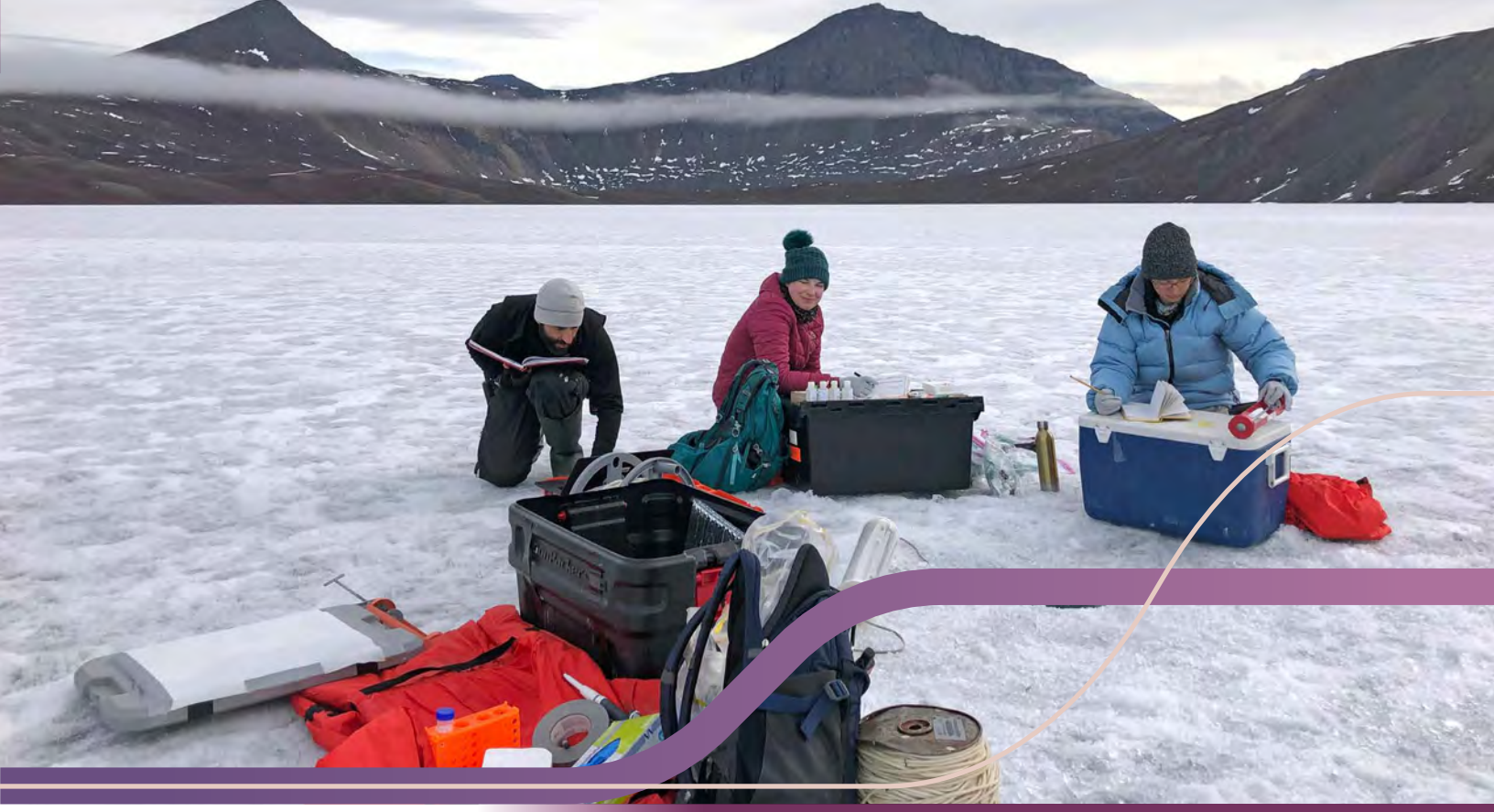
The PCSP provided airlifts, shipping equipment and logistical support for the project's 2022 season. Consequently, the T-MARS team was able to distribute educational modules on planetary science to local northern communities and to develop a publicly accessible website. The educational modules will help young people to carry out simulations of space exploration.

Measuring the spectral signature of the iron hats to improve its reference data for classifying the geology of the region

> *The logistical support and funding received from the PCSP were crucial to the realization of our field campaign in the High Arctic. This would otherwise have been impossible because of the high costs of travelling to such latitudes. The support and funding have made it possible to train a significant number of students in the Arctic context and to maximize the scientific return of our project. The samples collected will help train the next generation and continue scientific discoveries for many years to come.*
>
> **Myriam Lemelin,**
> University of Sherbrooke

LIST OF SUPPORTED PROJECTS IN 2020, 2021 AND 2022

Transporting samples to the Ward Hunt Island field laboratory for analysis in Nunavut



Sampling to study the chemistry of a lake on Ward Hunt Island, Nunavut

The PCSP project list includes all the projects from the 2020, 2021 and 2022 seasons, with the year that the project took place in parentheses after the title. The list is organized alphabetically by province and territory and by the last name of the principal investigator. Each project listing includes the project title, principal investigator, institution and location within the province or territory.

*Projects that have field site locations in multiple territories and/or provinces are listed under each applicable region and marked with an asterisk.

ALBERTA

Characterization of water resource vulnerability in the Whooping Crane Nesting Region using water isotope tracers and pond sediment records (2021, 2022)

*Also in the Northwest Territories
Roland Hall (University of Waterloo)
Wood Buffalo National Park

BRITISH COLUMBIA

Sedimentology of an ancient deep marine turbidite system, Neoproterozoic Windermere Supergroup, western Canada (2021, 2022)

Bill Arnott (University of Ottawa)
Various locations near McBride

Global navigation satellite system (GNSS) station installation (2022)

Stuart Elson (Natural Resources Canada)
Calvert Island

Tatshenshini-Alsek Park – Monitoring of two contaminated sites: Decommissioned Windy Craggy Mine site and Rainy Hollow, an old pump station along decommissioned pipeline (2021)

Darren Fillier (Parks Canada)
Windy Craggy Mine, Rainy Hollow and Tatshenshini-Alsek Park

Fieldwork to assess the geothermal potential of the Garibaldi Volcanic Belt (2021, 2022)

Steve Grasby (Natural Resources Canada)
Mount Cayley

Targeted Geoscience Initiative 6 – Rare earth elements in phosphorites (2022)

Steve Grasby (Natural Resources Canada)
Williston Lake area

Acoustic sediment survey of Seton Lake (2022)

Alain Grenier (Natural Resources Canada)
Seton Lake

Geo-mapping for Energy and Minerals (GEM) GeoNorth –Faults, fluids and landscape evolution (2022)

*Also in Yukon
Dawn Kellett (Natural Resources Canada)
Atlin

Petrology of Ni-Cr-Cu-PGE mineralization in Alaskan-type intrusions (2022)
Dejan Milidragovic
(Natural Resources Canada)
Lunar Creek (Cassiar Land District) **and Wrede Creek**

Tweedsmuir Glacier and the end of Alsek River's migratory sockeye salmon run (2021, 2022)
Dan Shugar (University of Calgary)
Tweedsmuir Glacier

MANITOBA

Collaborative monitoring long-term risks and impacts of climate change on the seasonal ranges of the eastern migratory Cape Churchill caribou population (2021)
Ryan Brook (University of Saskatchewan)
Wapusk National Park

Winter trial (climatic effect) in Shilo (2022)
Carl De Landurantaye (Department of National Defence)
Canadian Forces Base Shilo

On ice ecology of polar bears in Hudson Bay (2022)
Andrew Derocher (University of Alberta)
Various locations near Churchill

The ecology, population dynamics and status of polar bears (Ursus maritimus) in relation to environmental changes (2020)
Nicholas Lunn
(Environment and Climate Change Canada)
Kaska Goose Lodge, Lee Lake and the Churchill Northern Studies Centre

Examining adverse impacts of climate extremes on Arctic-breeding shorebirds (2021)
Erica Nol (Trent University)
Wapusk National Park

Population dynamics of Subarctic-breeding shorebirds at the boreal-tundra ecotone (2022)
Erica Nol (Trent University)
Wapusk National Park

Tundra food web interactions at the Arctic's edge (2021, 2022)
James Roth (University of Manitoba)
Wapusk National Park

Permafrost conditions in the Hudson Bay Lowlands and adjacent Lake Agassiz deposits (2021, 2022)
Pascale Roy-Leveillee (Université Laval)
Various locations near Churchill and Thompson and glacial Lake Agassiz

Caribou trail camera monitoring in Wapusk National Park (2022)
Russell Turner (Parks Canada)
Wapusk National Park

Hydroecological monitoring in Wapusk National Park (2020, 2021, 2022)
Matthew Webb (Parks Canada)
Wapusk National Park

Permafrost monitoring in Wapusk National Park (2021, 2022)
Matthew Webb (Parks Canada)
Wapusk National Park

NEW BRUNSWICK

Howitzer field trials (2020)
Carl De Ladurantaye
(Department of National Defence)
5th Canadian Division Support Base – Gagetown

Targeted Geoscience Initiative – Fieldwork (2022)
*Also in Newfoundland and Labrador
Neil Rogers (Natural Resources Canada)
Mount Pleasant mine

Canada-United States border monument maintenance (2022)
*Also in Ontario and Quebec
International Boundary Commission
(Natural Resources Canada)
Locations along the Canada – United States border

NEWFOUNDLAND AND LABRADOR

Chromite and platinum group metals in ophiolitic complexes using the Bay of Islands Complex (BOIC) as a natural laboratory (2022)
Jean H. Bedard (Natural Resources Canada)
Bay of Islands and Gros Morne National Park

Advanced Microgrid towards Arctic Zero Emissions (AMAZE) (2022)
*Also in Nunavut
Martin Kegel (Natural Resources Canada)
Cartwright

Geological investigation of the Mistastin Lake impact structure (2021)
Gordon Osinski (Western University)
Mistastin Lake

Chromite research and development (2022)
Dogan Paktunc (Natural Resources Canada)
Bay of Islands

Geo-mapping for Energy and Minerals (GEM) – GeoNorth Hopedale project (2022)
Roger Paulen (Natural Resources Canada)
Near Hopedale

Targeted Geoscience Initiative – Fieldwork (2022)
*Also in New Brunswick
Neil Rogers (Natural Resources Canada)
Burgeo

Genetic diversity of native berry species (2022)
Tyler Smith (Agriculture and Agri-Food Canada)
Makkovik

Installing an autonomous LiDAR station to monitor topographical changes in a buried ice area

NORTHWEST TERRITORIES

Following trails of the caribou: Understanding Shúhta Goʔepę́ (northern mountain caribou) historical and contemporary population structure and connectivity in the Mackenzie Mountains region (2021, 2022)

Leon Andrew and Deborah Simmons (Sahtú Renewable Resources Board)
Mackenzie Mountains

Monitoring permafrost in Tuktut Nogait National Park (2021)

Colleen Arnison (Parks Canada)
Uyarsivik Lake in Tuktut Nogait National Park

Assessing impacts of road development on northern mountain caribou in Nahanni and Nááts'įhch'oh National Park Reserves (2021, 2022)

Sarah Arnold (Parks Canada)
Howard's Pass Access Road

Aquatic health of Nahanni National Park Reserve (2021, 2022)

Sarah Arnold (Parks Canada)
Nahanni National Park Reserve

Investigating occupancy rates of collared pika (*Ochotona collaris*) and alpine vegetation communities in Nahanni National Park Reserve (2022)

Sarah Arnold (Parks Canada)
Nahanni National Park Reserve

Divii (Dall's sheep) research project (2020)

Édouard Bélanger (Gwich'in Renewable Resources Board)
Northern Richardson Mountains near Aklavik

Permafrost geochemistry associated with the construction of the Inuvik to Tuktoyaktuk highway (2021)

Melissa Bunn (Natural Resources Canada)
Inuvik to the Tuktoyaktuk highway

Permafrost geochemistry related to infrastructure development (2022)

Melissa Bunn (Natural Resources Canada)
Inuvik

National glaciology project – Queen Elizabeth Islands (2021, 2022)

*Also in Nunavut
David Burgess (Natural Resources Canada)
Melville Ice Cap

Permafrost characteristics and climate change, western Arctic coast (2021, 2022)

Christopher Burn (Carleton University)
Illisarvik (a drained lake)**, Garry Island, Niglintgak Island, Tununuk and Richards Island**

Core rescue – Preble Island East Arm (2020)

Scott Cairns (Northwest Territories Geological Survey)
Preble Island and Great Slave Lake

Lake sediment survey (2020)

Scott Cairns (Northwest Territories Geological Survey)
Mohawk Lake Esker

Tectonostratigraphy of the East Arm basin rocks and the nature of the underlying basement rocks (2022)
Rebecca Canam
(Northwest Territories Geological Survey)
Preble Island and Great Slave Lake

Investigation into the extent of slumping and its impact on landscape morphology within the Thomsen River Watershed in Aulavik National Park (2021)
Hayleigh Conway (Parks Canada)
Aulavik National Park

Methane release and biogeochemistry of thawing permafrost in the Inuvialuit Settlement Region (2022)
Scott Dallimore (Natural Resources Canada)
Mackenzie Delta

Evaluating mineral potential of the Winter Lake greenstone belt, Slave craton (2021)
Michelle DeWolfe (Mount Royal University)
Shallow Lake, Point Lake, Slimer Lake and Silli Lake

Methane flux and biogeochemistry studies, Mackenzie Delta (2021)
Mathieu J. Duchesne
(Natural Resources Canada)
Central Mackenzie Delta

Korea-Canada-USA Beaufort Sea research program (2022)
Mathieu J. Duchesne
(Natural Resources Canada)
Beaufort Sea

Assessing the rheological evolution of the Great Slave Lake shear zone (2021)
Brendan Dyck (Simon Fraser University)
East Arm of Great Slave Lake

Constraining the timing and duration of motion along the Wopmay Fault (2022)
Brendan Dyck (University of British Columbia)
Gamèti

National glaciology project – Mass balance Northern Cordillera (2021, 2022)
Mark Ednie (Natural Resources Canada)
Bologna Glacier

Stratigraphy of the Nonacho Group basin (2022)
Beth Fischer
(Northwest Territories Geological Survey)
Nonacho Lake

Characterization of recent permafrost landslides and ground ice distribution in the central Mackenzie Valley (2021)
Duane Froese (University of Alberta)
Mackenzie Valley

Geological and geophysical characterization of permafrost and thaw landforms in the central Mackenzie Valley and Mackenzie Mountains (2022)
Duane Froese (University of Alberta)
Redstone, Keele and Johnson River basins

Population assessment of Dolly Varden (2021, 2022)
*Also in Yukon
Colin Gallagher
(Fisheries and Oceans Canada)
Big Fish River and Rat River

Dempster Highway permafrost stability and processes (2022)
*Also in Yukon
Paul Gammon (Natural Resources Canada)
Dempster Highway

Microbial biogeochemical processes driving carbon and mercury transformation in Arctic permafrost (2022)
Jacqueline Goordial (University of Guelph)
Swiss Cheese Lake and Niglintgak

A researcher holding a sea ice core

Understanding changes in aquatic ecosystem health and water quality in the Fort Good Hope Ramparts area (2021, 2022)

Kirsty Gurney
(Environment and Climate Change Canada)
Ts'ude Niline Tuyeta and Fort Good Hope

Characterization of water resource vulnerability in the Whooping Crane Nesting Region using water isotope tracers and pond sediment records (2021, 2022)

*Also in Alberta
Roland Hall (University of Waterloo)
Wood Buffalo National Park and Fort Smith

Beaufort Sea coastal restoration project – Using Indigenous plant species to stabilize coastline affected by permafrost thaw slumping (2020)

Erika Hille (Aurora College)
Various locations near Kugmallit Bay

The geochemical response of Arctic freshwater systems to regional variability in permafrost thaw (2020)

Erika Hille (Aurora College)
Trail Valley Creek Research Station and Kugmallit Bay

Western Arctic permafrost monitoring network (2021)

Erika Hille (Aurora College)
Miner River, Crumbling Point, Tuktoyaktuk, North Pingo Point, Richards Island and Sitidgi Lake

Characterizing the effects of climate change on permafrost and freshwater resources in the Beaufort Delta Region (2022)

Erika Hille (Aurora College)
Miner River, Rengleng River, Reindeer Station and Jimmy Lake

Remote camera monitoring of murres in Cape Parry Migratory Bird Sanctuary (2022)

Danica Hogan
(Environment and Climate Change Canada)
Cape Parry Migratory Bird Sanctuary

Snow goose colony surveys at Kendall Island Migratory Bird Sanctuary and Anderson River Delta Migratory Bird Sanctuary (2022)

Danica Hogan
(Environment and Climate Change Canada)
Anderson River Delta Migratory Bird Sanctuary and Kendall Island Migratory Bird Sanctuary

Monitoring for impacts of harvest and climate change on the Great Bear Lake aquatic system (2022)

Kimberly Howland
(Fisheries and Oceans Canada)
Smith Arm

Thermotectonic and metallogenic study of the Arrowhead outlier of the Point Lake greenstone belt, Slave craton (2020, 2021)

Bernadette Knox
(Northwest Territories Geological Survey)
Various lakes

Monitoring and mapping permafrost landscape change and geohazards (2020, 2021, 2022)

Steven Kokelj
(Northwest Territories Geological Survey)
Various locations across the Northwest Territories

Permafrost landscapes in transition: Lakes as sentinels of change (2021)

Jennifer Korosi (York University)
Noell Lake and Parsons Lake

Climate change implications for legacy arsenic ecotoxicity in mining-impacted lakes near Yellowknife (2022)

Jennifer Korosi (York University)
Various lakes near Yellowknife

Preliminary assessment of potential critical minerals and technology metals sources in the Slave Geological Province (2021)

Gideon Lambiv Dzemua
(Northwest Territories Geological Survey)
Leith Lake, Squalus Lake, Labrish Lake and east of Yellowknife

Landscape change in the western Arctic (2021, 2022)

*Also in Yukon
Trevor Lantz (University of Victoria)
Various locations in the northern Northwest Territories

River monitoring in Aulavik and Tuktut Nogait National Parks (2021, 2022)

Paden Lennie (Parks Canada)
Thomsen River in Aulavik National Park and Hornaday River in Tuktut Nogait National Park

Raptor Survey in Tuktut Nogait National Park (2022)

Paden Lennie (Parks Canada)
Uyarsivik Lake in Tuktut Nogait National Park

Assessment of the condition of cultural resources at Mercy Bay, Aulavik National Park (2022)

Kate Leonard (Parks Canada)
Aulavik National Park

Movement of coastal and freshwater fishes in the Ulukhaktok region (2021)

Lisa Loseto (Fisheries and Oceans Canada)
Ulukhaktok on Victoria Island

Beluga habitat and coastal programs (2021)

*Also in Yukon
Lisa Loseto (Fisheries and Oceans Canada)
Mackenzie Estuary

Assessing the spatiotemporal movement and potential contribution of East Arm of Great Slave Lakes lake trout, lake whitefish and inconnu stocks to the local commercial fishery (2022)

Brendan Malley
(Fisheries and Oceans Canada)
Various locations on Great Slave Lake

Hydrology and climate of the western Canadian Arctic (2021, 2022)

Philip Marsh (Wilfrid Laurier University)
Trail Valley Creek Research Station

Tectonostratigraphy of the Nonacho Group basin and nature of basement rocks of the Rae Craton (2020, 2021)

Edith Martel
(Northwest Territories Geological Survey)
Nonacho Lake, Thekulthili Lake, Taltson Lake and MacInnis Lake

Annual maintenance of Environment and Climate Change Canada's automatic weather station array – Arctic Archipelago (2022)

*Also in Nunavut
Michael Maurice
(Environment and Climate Change Canada)
Cape Providence and Mould Bay

Defining the ecological niche of bull trout in the Canadian western Arctic to inform conservation planning (2021, 2022)

Neil Mochnacz (Fisheries and Oceans Canada)
Wrigley Creek and Prairie Creek watershed

Defining the biothermal envelope of Dolly Varden in the Canadian western Arctic to inform conservation planning (2022)

Neil Mochnacz (Fisheries and Oceans Canada)
Fish Creek watershed

Transportation resilience in the Arctic informed by Landscape Systems (TRAILS) – Permafrost and terrain research (2021, 2022)

Peter Morse (Natural Resources Canada)
Tuktoyaktuk, North Head, Involuted Hill and McKinley Bay

Impacts of permafrost thaw slump extent, severity and persistence on stream biotic health (2022)

Jordan Musetta-Lambert
(Environment and Climate Change Canada)
Peel Plateau

Surficial geology, glacial sediment transport history and source bedrock investigation in the Dessert Lake Drumlin Field (2020, 2021)

Philippe Normandeau
(Northwest Territories Geological Survey)
Dessert Lake Drumlin Field and Birch Creek

Critical mineral signatures in the Slave Geological Province surficial material (2022)

Philippe Normandeau
(Northwest Territories Geological Survey)
Yellowknife area

Subarctic lakes in a changing climate (2021, 2022)

Michael Palmer (Aurora College)
Yellowknife area

Climate change fingerprinting of fire and vegetation in Nahanni National Park and Nááts'įhch'oh National Park Reserve (2022)

Marc-André Parisien
(Natural Resources Canada)
Hay River Lowland, Selwyn Mountains, Peel River Plateau, Nahanni Plateau and Hyland Highland

Precambrian tectonics (2021)

Sally Pehrsson (Natural Resources Canada)
South Rae Province

Holocene records of seasonal climate and fire activity in the Mackenzie Delta region, northwest Canada (2022)

Trevor Porter (University of Toronto)
Richardson foothills and Campbell Dolomite Uplands

Functional, structural and biodiversity studies of Arctic freshwater watersheds: Validating protocols for monitoring and cumulative impacts assessment (2021, 2022)

Michael Power (University of Waterloo)
Fort McPherson and Stony Creek

Inuvik Satellite Station Facility (2020)

Jiri Raska (Natural Resources Canada)
Inuvik

Western Arctic snow goose management (2022)

Eric Reed
(Environment and Climate Change Canada)
SikSik Lake on Banks Island

Examining impact melt rocks near the summit of Discovery Hill, near the Mistastin crater in the Labrador region of Newfoundland and Labrador

Reservoir characterization of the Manetoe dolomite facies of the Nahanni Formation, Mackenzie Mountains area (2021)

Jonathan Rocheleau
(Northwest Territories Geological Survey)
Pointed Mountain, First Canyon, Nahanni Butte, Grainger River, Red Rock Pass and Little Doctor Lake

Mapping and modelling permafrost hazards in the Mackenzie Mountains (2022)

Ashley Rudy
(Northwest Territories Geological Survey)
Sahtú and Deh Cho regions

Assessment of large-scale geohazard in the western Arctic: Earthquake risk in a warming climate (2022)

*Also in Yukon
Andrew Schaeffer (Natural Resources Canada)
Banks Island and Victoria Island

Changing carbon sinks in subarctic Canada (2021, 2022)

Sherry Schiff (University of Waterloo)
Daring Lake, Wekweeti and various lakes near Yellowknife

Abrupt change within the discontinuous permafrost zone (2021, 2022)

Wendy Sladen (Natural Resources Canada)
Yellowknife area

Changing permafrost conditions in the Mackenzie Valley (2021, 2022)

Sharon Smith (Natural Resources Canada)
Various locations across the Mackenzie Corridor

Plot-scale measurement of tundra and boreal forest carbon dioxide and methane fluxes from natural and anthropogenic sources using manual and automated chamber techniques (2021)

Oliver Sonnentag (Université de Montréal)
Trail Valley Creek Research Station and Scotty Creek

A multi-level assessment of Arctic tundra carbon and water fluxes (2022)

Oliver Sonnentag (Université de Montréal)
Trail Valley Creek Research Station and Scotty Creek

Land-water linkages and the fate of terrestrial carbon in aquatic ecosystems of the western Canadian Arctic (2021, 2022)

Suzanne Tank (University of Alberta)
Mackenzie Delta, Peel River, Peel Plateau and Stony Creek

Shale basin evolution in the Northwest Territories mainland (2022)

Viktor Terlaky
(Northwest Territories Geological Survey)
Powell Creek, Gayna Gorge, Imperial River, Carcajou River South and Dodo Canyon

Dynamics of ultra-high temperature mountain belts (2022)

Eric Thiessen
(Memorial University of Newfoundland)
Thubun Lakes

Beaufort Sea coastal dynamics – Monitoring and observations for climate change (2021, 2022)

*Also in Yukon
Dustin Whalen (Natural Resources Canada)
Inuvialuit Settlement region

Development of the environmental DNA (eDNA) approach for the detection of fish species distribution in the Northwest Territories (2021)

Lauren Wiens (Fisheries and Oceans Canada)
Great Slave Lake and adjacent river systems

Twin Otter aircraft on the PCSP ramp in Resolute

Surveying the bathymetry of a temporary lake on a rock glacier with an acoustic Doppler current profiler

NOVA SCOTIA

Targeted Geoscience Initiative-6 – Brazil Lake indicator mineral project (2022)

Beth McClenaghan
(Natural Resources Canada)
Brazil Lake area

NUNAVUT

Karrak Lake assessment of continental efforts at population reduction of light geese (2022)

Ray Alisauskas
(Environment and Climate Change Canada)
Karrak Lake

Long term monitoring at FOX-C (Ekalugad Fiord) (2021)

Selma Al-Soweydawi (Crown-Indigenous Relations and Northern Affairs Canada)
Ekalugad Fiord

Advanced Microgrids towards Arctic Zero Emissions (AMAZE) (2022)

*Also in Newfoundland and Labrador
Gisele Amow (Department of National Defence) **and Mark Rossetto** (National Research Council Canada)
Cambridge Bay

The functioning and evolution of the ecosystems of Stuckberry Valley, northern Ellesmere Island (2022)

Dermot Antoniades (Université Laval)
Lake Hazen, Stuckberry Valley, Clements Markham Inlet and Piper Pass

Baffin Island, Southampton Island and Perry River goose banding (2022)

Frank Baldwin
(Environment and Climate Change Canada)
Nikko Island, Coral Harbour, Boas River Main, various other locations on Southampton Island, Perry River and Ahiak (Queen Maud Gulf) **Migratory Bird Sanctuary**

Small wind turbines for Arctic communities (2020, 2021, 2022)

Carsen Banister
(National Research Council Canada)
Cambridge Bay

Preliminary examination of glacial-marine coupling in a seasonally ice-covered High Arctic Fiord (2022)

David Barber and David Babb
(University of Manitoba)
Expedition Fiord on Axel Heiberg Island

Fieldwork to support ecosystem mapping in eastern areas of the Canadian High Arctic Research Station (CHARS) Environmental Research Area (2021)

Garry Beattie (Polar Knowledge Canada)
Various locations in the central Kitikmeot region

Arctic and red fox ecology on Bylot Island (2021, 2022)

Dominique Berteaux
(Université du Québec à Rimouski)
Bylot Island

Ecology of migratory birds in the Canadian Arctic (2021, 2022)
Joël Bêty (Université du Québec à Rimouski)
Bylot Island

Glacier-ocean interactions in the Canadian High Arctic (2021, 2022)
Maya Bhatia (University of Alberta)
Grise Fiord, Sydkap Glacier, Jakeman Glacier, Fram Fiord Glacier, Sverdrup Glacier, True Love Inlet and Starnes Fiord

Iqaluit Clean Energy Forum (2022)
Jeffrey Biggs (Natural Resources Canada)
Iqaluit

Lake ice in the Canadian High Arctic (2021, 2022)
Laura Brown (University of Toronto Mississauga)
Various lakes on Cornwallis Island and Nanuit Itillinga National Wildlife Area (Polar Bear Pass) **on Bathurst Island**

National Glaciology Project – Queen Elizabeth Islands (2021, 2022)
*Also in the Northwest Territories
David Burgess (Natural Resources Canada)
Meighen Ice Cap, Agassiz Ice Cap and Devon Ice Cap

1990s caribou camp and fuel cache clean-up at Ahiak Migratory Bird Sanctuary (2021)
Clément Chevallier
(Environment and Climate Change Canada)
Ahiak (Queen Maud Gulf) **Migratory Bird Sanctuary**

Fulmar colony surveys in Lancaster Sound (2022)
Clément Chevallier
(Environment and Climate Change Canada)
Various locations in Lancaster Sound

Installation of remote monitoring systems at the Siqiniq Migratory Bird Sanctuary (2022)
Clément Chevallier (Environment and Climate Change Canada) **Siqiniq** (Prince Leopold Island) **Migratory Bird Sanctuary**

A new window on the universe: Radio astronomy from northern Canada (2022)
Hsin Chiang (McGill University)
McGill Arctic Research Station on Axel Heiberg Island

Arctic Program for Regional and International Shorebird Monitoring (Arctic PRISM) – Tier 1 surveys (2022)
Nikolas Clyde (Environment and Climate Change Canada)
Ahiak (Queen Maud Gulf) **Migratory Bird Sanctuary**

Glacier monitoring on southern Ellesmere Island (2022)
Luke Copland (University of Ottawa)
Sydkap Glacier and Manson Icefield

Impact of oxygen pulses on redox-sensitive chemicals and microbiome in Canada's northernmost lake (2022)
Raoul-Marie Couture (Université Laval)
Ward Hunt Island

Characterizing the impact of viruses in the Last Ice Area (2022)
Alexander Culley (Université Laval)
Ward Hunt Island

Coastal dynamics and hazards in Grise Fiord and Jones Sound (2022)
David Didier (Université du Québec à Rimouski)
Grise Fiord, Jones Sound, Sydkap Glacier, Starnes Fiord and Jakeman Glacier

Climate change in the High Arctic: Impact on wildlife and on the permafrost thermal regime and carbon stocks (2021)
Florent Domine (Université Laval)
Bylot Island

Snow, vegetation and fauna in the High Arctic (2022)
Florent Domine (Université Laval)
Bylot Island

Geophysical imaging of the Devon subglacial lakes (2022)
Christine Dow (University of Waterloo)
Devon Ice Cap

Re-estimating the abundance of the Lancaster Sound and Norwegian Bay polar bear subpopulations via genetic mark-recapture sampling (2021)
Markus Dyck (Government of Nunavut)
Arctic Bay, Nicolay Lake, Creswell Bay, Cape Grant and Grise Fiord

Climate change effects on Arctic marine predators: Impacts of heat stress and prey changes on thick-billed murres, an Arctic seabird (2022)
Kyle Elliott (McGill University)
Coats Island

Weather, ice, ocean and freshwater measurements to understand greenhouse gas cycles in aquatic ecosystems (2021)
Brent Else (University of Calgary)
Various locations near Cambridge Bay

Ocean, ice, and atmosphere observations in support of Inuit communities and greenhouse gas exchange studies (2022)
Brent Else (University of Calgary)
Cambridge Bay, Melbourne Island, Qikirtaarjuk Island and 30 Mile River

Sirmilik National Park Operations (2021, 2022)
Carey Elverum (Parks Canada)
Sirmilik National Park

Population dynamics of rodents in the Canadian Arctic (2021, 2022)
Dominique Fauteux
(Canadian Museum of Nature)
Cambridge Bay and Bylot Island

Quttinirpaaq National Park Operations (2021, 2022)
Adam Ferguson (Parks Canada)
Quttinirpaaq National Park

Disturbance and transformation of permafrost in Arctic geosystems (2021)
Daniel Fortier (Université de Montréal)
Bylot Island

Ground ice of eastern Canadian High Arctic polar desert (2022)
Daniel Fortier (Université de Montréal)
Locations on Cornwallis Island and Ward Hunt Island

Inuinnait Heritage: A collaborative approach to archaeological research in the Canadian Arctic (2022)
Max Friesen (University of Toronto)
Cambridge Bay, Kent Peninsula and Iqaluktuuq

Recent changes (100 years) in carbon accumulation in Canadian Arctic peatlands (2022)
Michelle Garneau
(Université du Québec à Montréal)
Bylot Island

Population biology of tundra birds and small mammals: Demography, trophic interactions and climate change (2021, 2022)
Gilles Gauthier (Université Laval)
Bylot Island

Community-led coastal surveys of common eider nesting islands in the Belcher and Sleep Islands (2022)
Grant Gilchrist
(Environment and Climate Change Canada)
Belcher Island and Sleep Island

Population studies of eider ducks breeding at East Bay Island and thick-billed murres breeding at Coats Island (2022)
Grant Gilchrist
(Environment and Climate Change Canada)
East Bay Island and Qaqsauqtuuq (East Bay) **Migratory Bird Sanctuary**

Inuit Field Training Program at East Bay mainland and Prince Charles Island (2022)
Grant Gilchrist and Paul Smith
(Environment and Climate Change Canada)
Prince Charles Island and East Bay mainland on Southampton Island

Population studies of thick-billed murres at Cape Graham Moore (2022)
Grant Gilchrist
(Environment and Climate Change Canada)
Cape Graham Moore

Microbes on the go: Release of cryospheric microbes to downstream habitats (2022)
Catherine Girard
(Université du Québec à Chicoutimi)
Ward Hunt Island and Resolute Bay area

Saving Morin Point: Climate change risk assessment and archaeological heritage recovery (2022)
Lynda Gullason
Dundas Harbour

Geo-Mapping for Energy and Minerals (GEM-2) – Baffin Bay project community engagement (2020)
James Haggart (Natural Resources Canada)
Pond Inlet

High Arctic tundra ecosystem responses to 30 years of experimental and observed climate change (2021, 2022)
Greg Henry (University of British Columbia)
Alexandra Fiord, Knud Peninsula and Princess Marie Bay

Canadian Coast Guard and United States Coast Guard VIP visit (2021)
Tanis Hunter (Fisheries and Oceans Canada)
Resolute

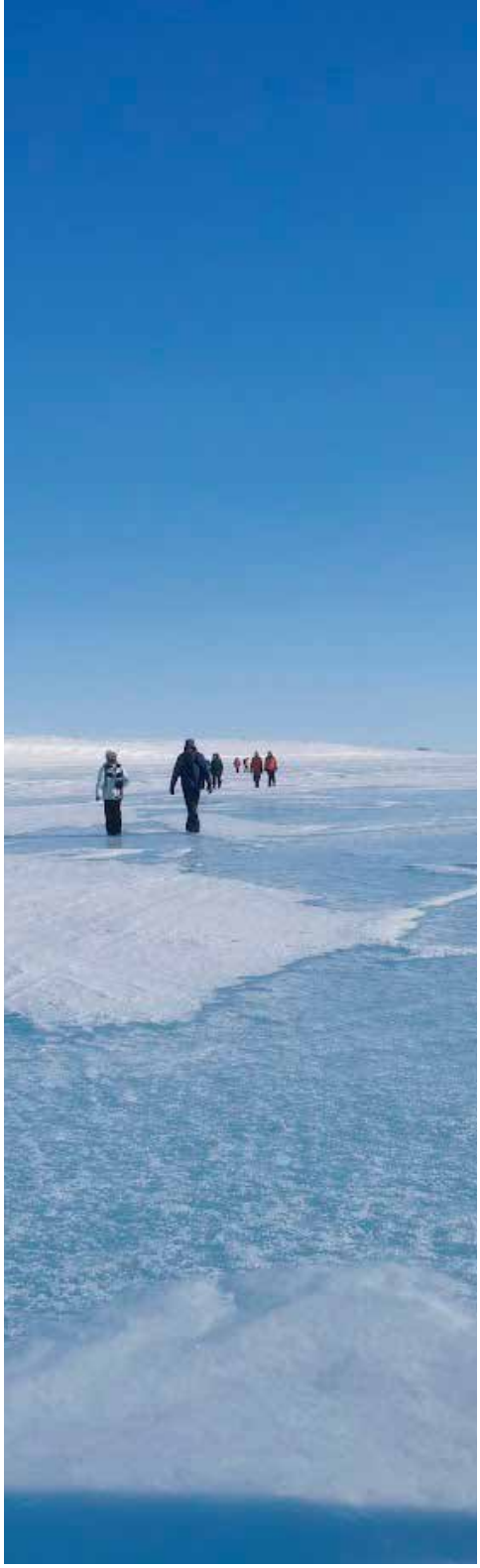
Assessing risks of food and vector-borne diseases in wildlife in the Canadian Arctic (2022)
Emily Jenkins (University of Saskatchewan)
Karrak Lake and Perry River

Study of the spatial heterogeneity of soil-snow-vegetation interactions in a Canadian High Arctic ecosystem (2022)
Christophe Kinnard
(Université du Québec à Trois-Rivières)
Bylot Island

Emerging infectious disease in High Arctic ungulates – Terrestrial investigations (2022)
Susan Kutz (University of Calgary)
Fosheim Peninsula on Ellesmere Island

Effect of degrading ice wedge polygon landscapes on local topography hydrology, and water quality (2022)
Denis Lacelle (University of Ottawa)
Eureka

Migratory bird ecology, migration and health on Victoria Island (2021, 2022)
Jean-François Lamarre
(Polar Knowledge Canada)
Anderson Bay and Victoria Island



Walking on sea ice near Cambridge Bay, Nunavut

Land and water impacts and response to climate and permafrost changes in the High Arctic (2022)

Scott Lamoureux (Queen's University)
Cape Bounty on Melville Island and locations near Resolute Bay on Cornwallis Island

Arctic lakes under the influence of climate: Oxythermia, biogeochemical functioning and greenhouse gas emissions (2022)

Isabelle Laurion
(Institut National de la recherche scientifique)
Qarlikturvik Valley and Sirmilik National Park on Bylot Island

Slave craton volcanogenic massive sulfide mineralization study (2022)

Lorraine Lebeau
(Canada-Nunavut Geoscience Office)
Izok Lake

Permafrost monitoring (2021)

Anne-Marie Leblanc
(Natural Resources Canada)
Rankin Inlet

Population dynamics of greater snow geese in relation to habitats (2022)

Josée Lefebvre
(Environment and Climate Change Canada)
Bylot Island

Geological study and mapping of hydrothermal deposits and gossans on Axel Heiberg Island in Expedition Fiord as analogues for Mars (2022)

Myriam Lemelin (Université de Sherbrooke)
McGill Arctic Research Station on Axel Heiberg Island

Study of the spatial heterogeneity of soil-snow-vegetation interactions in a Canadian High Arctic ecosystem (2021)

Esther Lévesque
(Université du Québec à Trois-Rivières)
Bylot Island

Restoration of anadromous Arctic char (*Salvelinus alpinus*) and Dolly Varden (*Salvelinus malma*) near Kugluktuk (2021, 2022)

Tracey Loewen (Fisheries and Oceans Canada)
Various locations along Coppermine River near Kugluktuk

Stress-mediated mechanisms linking individual state, climate variability and population health in Arctic-breeding birds (2022)

Oliver Love (University of Windsor)
East Bay Island and Qaqsauqtuuq (East Bay) **Migratory Bird Sanctuary**

Defence of North America (2022)

Erin MacNeil (Defence Research and Development Canada)
Gascoyne Inlet on Devon Island

Aerial survey of High Arctic walrus and narwhal stocks (2022)

Cory Matthews (Fisheries and Oceans Canada)
Various coastlines along Ellesmere, Devon, Cornwallis and Bathurst Islands

Improving High Arctic walrus stock assessment using satellite telemetry, genetics and time-lapse photography (2022)

Cory Matthews (Fisheries and Oceans Canada)
Brooman Point, Goose Fiord and Kearney Cove

Annual Maintenance of Environment and Climate Change Canada's automatic weather station array – Arctic Archipelago (2022)

*Also in the Northwest Territories
Michael Maurice
(Environment and Climate Change Canada)
Cape Liverpool, Svartevaeg, Eureka, Fort Ross, Gateshead, Grise Fiord, Isachsen, Rea Point and Steffanson Island

Resolute seismic station upgrade (2022)

Lorne McKee (Natural Resources Canada)
Resolute

Multidisciplinary Arctic Program (MAP) – Last Ice area (2021)

Christine Michel
(Fisheries and Oceans Canada)
Tuvaijuittuq Marine Protected Area

Arctic Conservation, Observation, Research and Engagement (Arctic CORE) (2022)

Christine Michel
(Fisheries and Oceans Canada)
Nansen Fiord and other locations in the Tuvaijuittuq Marine Protected Area

Baffin Island and High Arctic inspections (2022)

Joseph Monteith (Crown-Indigenous Relations and Northern Affairs Canada)
Baffin Island, Ellesmere Island and Axel Heilberg Island

Identifying putative microbial drivers of methane flux on Earth and on Mars (2022)

John Moores (York University)
Expedition Fiord on Axel Heiberg Island

Milne Fiord ice-ocean interactions: Implications for the stability of ice shelves and glaciers in the Polar Regions (2022)

Derek Mueller (Carleton University)
Purple Valley, Milne Ice Shelf and Milne Fiord

Investigating potential effects of climate warming on trends of mercury and persistent organic pollutants in arctic aquatic and terrestrial environments (2021, 2022)

Derek Muir
(Environment and Climate Change Canada)
Amituk, Sophia, Laura and Eleanor Lakes; Cape Bounty; Lake Hazen and Resolute

Auyuittuq National Park Operations (2021, 2022)

Mathew Nauyuq (Parks Canada)
Auyuittuq National Park

Fine-scale distribution and habitat use of shorebirds breeding in degraded tundra habitats (2022)
Erica Nol (Trent University)
East Bay mainland on Southampton Island

Climate Change Research at the McGill Arctic Research Station (2022)
Christopher Omelon (Queens University)
McGill Arctic Research Station on Axel Heiberg Island

Reconstructing the post-impact history of the Haughton impact structure (2022)
Gordon Osinski (Western University)
Haughton River Valley on Devon Island

Evolution of postglacial landscapes and hydrological gateways in the Foxe Basin – Nettilling Lake region (2021)
Reinhard Pienitz (Université Laval)
Nettilling Fiord

Qausuittuq National Park Operations (2021, 2022)
Angela Piercey (Parks Canada)
Qausuittuq National Park

Berms – Whale Cove and Chesterfield Inlet (2022)
Michel Plouffe (Natural Resources Canada)
Whale Cove and Chesterfield Inlet

McGill Arctic Research Station science program (2021)
Wayne Pollard (McGill University)
McGill Arctic Research Station on Axel Heiberg Island

Long-term monitoring of contaminants in thick-billed murres in the Eastern Canadian Arctic (2022)
Jennifer Provencher
(Environment and Climate Change Canada)
Cape Graham Moore near Bylot Island

Powering and metering radar sites and surveillance systems (2022)
Solange Prud'Homme (Natural Resources Canada)
Alert and Cambridge Bay

Biogeochemical and ecological consequences of permafrost thaw on coastal Arctic lakes (2022)
Milla Rautio
(Université du Québec à Chicoutimi)
Various lakes on southern Victoria Island

Aerial surveys of Pacific Common Eiders in the central Canadian Arctic (2022)
Eric Reed
(Environment and Climate Change Canada)
Bathurst Inlet and Queen Maud Gulf

A curious visitor taking a closer look (Nares Strait, Nunavut)

Emerging infectious diseases in High Arctic ungulates – Aerial assessment (2022)
Amelie Roberto-Charron
(Government of Nunavut)
Fosheim Peninsula and surrounding areas on Ellesmere Island

Long-term observations to assess long-term changes in tundra vegetation (2022)
James Schaefer (Trent University)
Wellington Bay

Population plasticity in behavioural responses and their consequences to novel predator-prey interactions under changing biotic and abiotic stressors on Mitivik (East Bay) Island (2022)
Christina Semeniuk (University of Windsor)
East Bay Island and Qaqsauqtuuq (East Bay) **Migratory Bird Sanctuary**

Exploration of saline cryospheric habitats with Europa Relevance (ESCHER): An approach using airborne and submarine semiautonomous systems (2022)
Mark Skidmore (Montana State University)
Devon Ice Cap

Population studies of shorebirds at East Bay mainland and Prince Charles Island (2022)
Paul Smith and Jennie Rausch
(Environment and Climate Change Canada)
Prince Charles Island and East Bay mainland on Southampton Island

Ikkattuaq Migratory Bird Sanctuary shorebird surveys (2022)
Paul Smith and Lisa Pirie
(Environment and Climate Change Canada)
Various locations in East Bay mainland and Ikkattuaq (Harry Gibbons) **Migratory Bird Sanctuary on Southampton Island**

Pond Inlet Arctic char mixed stock fishery analysis (2022)
Ross Tallman (Fisheries and Oceans Canada)
Pond Inlet

Guys Bight site assessment (2021)
Rachel Théorêt-Gosselin (Crown-Indigenous Relations and Northern Affairs Canada)
Guys Bight

Regional climate, glacier dynamics and downstream impacts on Axel Heiberg Island (2021)
Laura Thomson (Queen's University)
Expedition Fiord and Müller Ice Cap on Axel Heiberg Island

Mass balance and energy fluxes of White Glacier, Axel Heiberg Island (2022)
Laura Thomson (Queen's University)
Expedition Fiord and Müller Ice Cap on Axel Heiberg Island

Royal Canadian Geographical Society (RCGS) podcasting workshop at the Canadian High Arctic Research Station (2022)
Jason Tologanak (Polar Knowledge Canada)
Cambridge Bay

Identifying and understanding the effect of temporal and spatial changes towards the biodiversity and carbon sequestration processes in the High Arctic (2022)
Masaki Uchida (National Institute of Polar Research)
Oobloyah Bay

Northern Ellesmere Island in the global environment – Sentinel North (2021, 2022)
Warwick Vincent (Université Laval)
Ward Hunt Island

High Arctic beluga whale stock structure (2022)
Cortney Wheeler
(Fisheries and Oceans Canada)
Creswell Bay and Elwin Bay

Investigations of microbial activity in cryoenvironments in the Canadian High Arctic (2021, 2022)
Lyle Whyte (McGill University)
McGill Arctic Research Station on Axel Heiberg Island

Assessment of bioremediation potential of marine fuels on Northwest Passage Arctic beaches (2021, 2022)
Lyle Whyte (McGill University)
Cornwallis Island

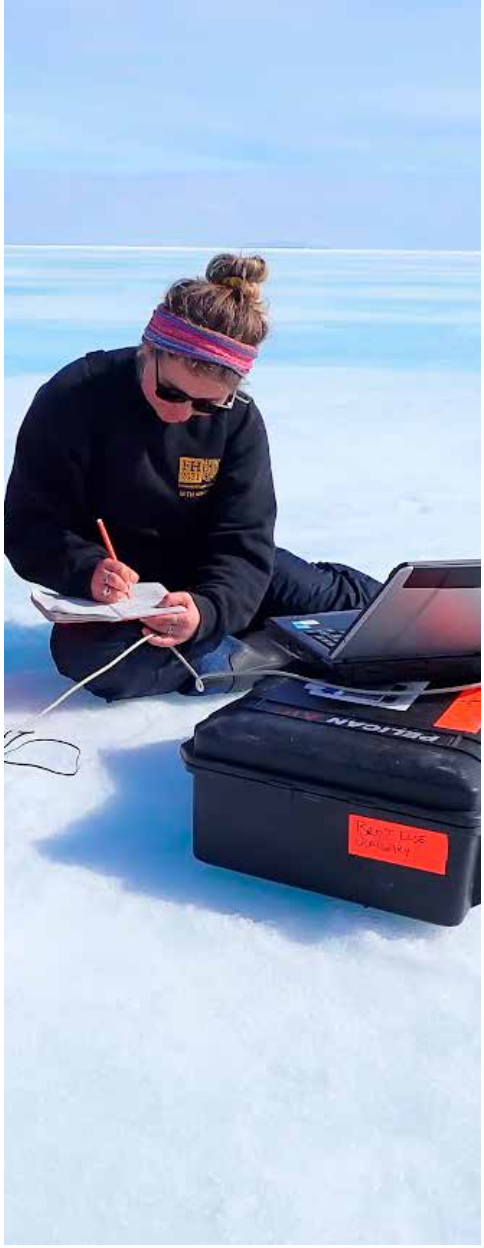
Developing new technologies to access and investigate the hypersaline, subzero Devon Island subglacial lake system, a unique Mars and icy moon analogue (2022)
Lyle Whyte (McGill University)
Devon Ice Cap

Ukkusiksalik National Park Operations (2021)
Monty Yank (Parks Canada)
Ukkusiksalik National Park

Cold Weather Layering System (CWLS) (2022)
Canadian Special Operations Forces Command (CANSOFCOM)
(Departmental of National Defence)
Various locations throughout Nunavut

Canadian Armed Forces Arctic Training Centre (CAFATC) training activities based in Resolute
(Department of National Defence)

- Arctic Operators Course (2021, 2022)
- CAFATC Operations (2020, 2021, 2022)
- Maintenance visit to the CAFATC (2020, 2021, 2022)
- Canadian Forces School of Search and Rescue (2020, 2022)
- Canadian Ranger Patrol Group Training (2021)
- Canadian Forces School of Survival and Aeromedical Training (2020)
- Canadian Army Doctrine and Training Centre (CADTC) Commander Visit (2020)
- Canadian Forces College Joint Command and Staff Program (2020)
- CAFATC Fall Reconnaissance 1 and 2 (2021, 2022)
- Joint Task Force (North) – Operation Nanook-Nunalivut (2020)
- Joint Task Force (North) – Operation Nanook-Nunakput (2021)



Measuring dissolved CO_2 in seawater

A view of the A'ąy Chù' River valley in Yukon from a helicopter

ONTARIO

Advanced knowledge of Mer Bleue Bog (2022)
Jason Ahad (Natural Resources Canada)
Ottawa

Geophysical survey, Lake Timiskaming (2021, 2022)
Kevin Brewer (Natural Resources Canada)
Lake Timiskaming

Canadian Hazards Information Service all-terrain vehicle (ATV) training (2021)
John Buckle (Natural Resources Canada)
Ottawa

Creating and testing a coring kit prototype (2022)
Igor Egorov (National Research Council Canada)
Ottawa

Mafic-ultramafic ore project – Superior (2022)
*Also in Quebec
Michel Houlé (Natural Resources Canada)
Thunder Bay and Esker camp

Fieldwork on Wikwemikong Unceded Reserve, Manitoulin Island (2020)
Cindy S. Kliaman (Natural Resources Canada)
Wikwemikong

Sediment sampling – Whiskey Lake (2022)
Sean Langley (Natural Resources Canada)
Whiskey Lake

Geoenvironmental studies of mining-impacted sediments downstream of the historic Cobalt Mining Camp (2022)
Michael Parsons (Natural Resources Canada)
Lake Timiskaming

Lichen survey to monitor caribou food supply in northern Ontario (2022)
Christian Prevost (Natural Resources Canada)
Various locations north of Timmins

Targeted geoscience initiative – Huronian paleoplacer gold (2022)
Robert Rainbird (Natural Resources Canada)
Southern Cobalt Basin northeast of Sudbury

Instrument monitoring at Mer Bleue Bog (2022)
Carrie Rickwood (Natural Resources Canada)
Ottawa

Development of environmental guidelines for critical minerals to evaluate impact assessments for new mines and environmental monitoring (2022)
Carrie Rickwood (Natural Resources Canada)
Ottawa

Targeted Geoscience Initiative-6 – Fieldwork in the Thunder Bay and Nipigon area associated with the Mid-Continent Rift (2021)
Jennifer Smith (Natural Resources Canada)
Thunder Bay and Nipigon area

Mafic and ultramafic intrusions of the Mid-Continent Rift (2022)
Jennifer Smith (Natural Resources Canada)
Thunder Bay area

International Great Lakes Datum (IGLD) 2020 – Global navigation satellite system (GNSS) campaign (2022)
*Also in Quebec
Rachel Van Herpt (Natural Resources Canada)
Great Lakes and St. Lawrence River systems

Canada-United States border monument maintenance (2020, 2021)
*Also in New Brunswick and Quebec
International Boundary Commission (Natural Resources Canada)
Locations along the Canada–United States border

Lands and Minerals Sector occupational health and safety training (2021)
Natural Resources Canada
Ottawa

QUEBEC

Chromium mobility around old mines (2021)
Nicholas Benoit (Natural Resources Canada)
Saint Joseph de Coleraine

Looking for evidence of ancient earthquakes to better understand modern earthquake hazards (2021)
Greg Brooks (Natural Resources Canada)
Témiscaming

Paleoseismic studies in eastern Canada (2021, 2022)
Greg Brooks (Natural Resources Canada)
Témiscaming and Tee Lake

Coastal oceanography in James Bay (2020)
Virginie Galindo
(Université du Québec à Rimouski)
James Bay

Mafic-ultramafic ore project – Superior (2022)
*Also in Ontario
Michel Houle (Natural Resources Canada)
Lac Arques and Grasset camps

Cumulative effect – Radisson sector (2021)
Josué Jautzy (Natural Resources Canada)
Jamésie

Sampling of waters, sediments and mine wastes for cumulative effects research at abandoned chromite mines (2021)
Michael Parsons (Natural Resources Canada)
Eastern Townships

Intraplate seismicity – Charlevoix and Mauricie – Site effects (2021)
Didier Perret (Natural Resources Canada)
Charlevoix and Mauricie

Targeted Geoscience Initiative – Orogenic ore systems – Urban-Barry (2022)
Jean-Luc Pilote (Natural Resources Canada)
Eeyou Istchee region

Béancour geothermal tests (2020)
Christine Rivard (Natural Resources Canada)
Béancour

International Great Lakes Datum (IGLD) 2020 – Global navigation satellite system (GNSS) campaign (2022)
*Also in Ontario
Rachel Van Herpt (Natural Resources Canada)
Great Lakes and St. Lawrence River systems

Forestry research: Laurentian Forestry Centre (2022)
David Wagner (Natural Resources Canada)
Québec (city)

Canada–United States border monument maintenance (2021, 2022)
*Also in New Brunswick and Ontario
International Boundary Commission (Natural Resources Canada)
Locations along the Canada–United States border

Looking down on the Donjek Glacier in Yukon from a field site

Returning from a day spent studying the coast around Grise Fiord, Nunavut

SASKATCHEWAN

Canadian Nuclear Safety Commission training inspection (2022)
Moe Abdo, Michelle MacCormack and Sophie Yao
(Canadian Nuclear Safety Commission)
McArthur Lake and Key Lake

Benchmarking CO_2 storage capacity with real-world measurements (2022)
Jim Craven (Natural Resources Canada)
Estevan

Targeted Geoscience Initiative-6 – Uranium magnetotelluric survey in the eastern Athabasca Basin (2021, 2022)
Victoria Tschirhart (Natural Resources Canada)
Athabasca Basin

SaskPower Boundary Dam Power Station (2022)
Donald White (Natural Resources Canada)
Estevan

YUKON

Assessment of Dolly Varden stocks in Ivvavik National Park (2020, 2021, 2022)
Colleen Arnison (Parks Canada)
Various locations in Ivvavik National Park

Assessing the effects of climate-induced variability on the behaviour, distribution and demography of the Porcupine caribou herd in Ivvavik National Park (2022)
Colleen Arnison (Parks Canada)
Sheep Creek in Ivvavik National Park

Hydrological changes in glaciered mountainous catchments of Yukon (2021, 2022)
Michel Baraer (École de technologie supérieure)
St. Elias Mountains, Kluane First Nation Territory and Grizzly Creek

Impacts of climate change on Beringian species at Risk (2020)
Bruce Bennett (Government of Yukon)
Carmacks

Fishing Branch River chum salmon instream incubation (2021)
Jeremy Brammer
(Vuntut Gwitchin First Nation Government)
Fishing Branch River

Permafrost vulnerability in Old Crow Flats (2021)
Fabrice Calmels (Yukon University)
Old Crow Flats

Mass balance, dynamics and recent changes of glaciers in Kluane National Park (2021, 2022)
Luke Copland (University of Ottawa)
Various glaciers in Kluane National Park and Reserve

Digitizing ice patch landscapes in southern Yukon (2022)
Peter Dawson (University of Calgary)
Alligator Lake

A comprehensive analysis of surging glacier dynamics and controls in the Yukon Territory (2021, 2022)

Christine Dow (University of Waterloo)
Lowell Glacier and Donjek Glacier in Kluane National Park and Reserve

Observational constraints on the state and dynamics of Canada's high-altitude terrestrial cryosphere, southwest Yukon (2021)

Gwenn Flowers (Simon Fraser University)
Various locations in Kluane National Park and Reserve

Evolving glacier dynamics in the St Elias Mountains of southwest Yukon (2022)

Gwenn Flowers (Simon Fraser University)
Various locations in Kluane National Park and Reserve

Population assessment of Dolly Varden (2021, 2022)

*Also in Northwest Territiries
Colin Gallagher (Fisheries and Oceans Canada)
Babbage River

Dempster Highway permafrost stability and processes (2022)

*Also in Northwest Territiries
Paul Gammon (Natural Resources Canada)
Dempster Highway

Evidence for early complex life in the Tonian and Cryogenian of the Wernecke Mountains (2022)

Galen Halverson (McGill University)
Hematite Creek and Mount Profeit

Northern Yukon archaeological site monitoring (2022)

Ty Heffner (Government of Yukon)
Various locations near Old Crow

Geo-mapping for Energy and Minerals (GEM) GeoNorth –Faults, fluids and landscape evolution (2022)

*Also in British Columbia
Dawn Kellett (Natural Resources Canada)
Whitehorse

Geochemical signatures of the Casino porphyry deposit (2022)

James Kidder (Natural Resources Canada)
South of Selwyn

Landscape change in the western Arctic (2021, 2022)

*Also in the Northwest Territories
Trevor Lantz (University of Victoria)
Various locations in northern Yukon

Beluga habitat and coastal programs (2021)

*Also in Northwest Territiries
Lisa Loseto (Fisheries and Oceans Canada)
Mackenzie Estuary

Hydrological and ecological research in Vuntut National Park (2020, 2021)

Ian McDonald (Parks Canada)
Vuntut National Park

Climate change impacts on caribou summer range in Vuntut National Park (2021, 2022)

Ian McDonald (Parks Canada)
Vuntut National Park

Climate change impacts on shallow lake ecosystems in Vuntut National Park (2022)

Ian McDonald (Parks Canada)
Vuntut National Park

Digitizing ice patch landscapes in southern Yukon Territory (2021)

Kelsey Pennanen (University of Calgary)
Alligator Lake, Montana Mountain and the Sandpiper ice patch

Dual-band airborne radar remote sensing for monitoring Arctic climate change processes (2022)

Bernhard Rabus (Simon Fraser University)
Kluane National Park and Reserve

Working the winch during a study in Jones Sound, Nunavut

A field laboratory for energy and mass exchange at glacier surfaces (2021, 2022)
Valentina Radic (University of British Columbia)
Kaskawulsh Glacier in Kluane National Park and Reserve

Morley River and Nisutlin River chinook salmon research and restoration (2022)
Gillian Rourke (Teslin Tlingit Council)
Morley River watershed and Nisutlin River watershed

Post-disturbance permafrost recovery pathways in a warming climate in Old Crow Flats, a thermokarst lowland in the forest-tundra transition of northern Yukon (2022)
Pascale Roy-Leveillee (Université Laval)
Old Crow Flats

Assessment of large-scale geohazard in the western Arctic: Earthquake risk in a warming climate (2022)
*Also in the Northwest Territories
Andrew Schaeffer (Natural Resources Canada)
Yukon North Slope

Subglacial hydraulics and glacier dynamics in the Donjek Ranges (2021, 2022)
Christian Schoof (University of British Columbia)
Various glaciers in Kluane National Park and Reserve

Field validation and monitoring of climate-change refugia in Yukon Southern Beringia (2022)
Diana Stralberg (Natural Resources Canada)
Various locations near Dawson City

Evaluating impacts of climate-change induced landscape change and disturbance on lakes and rivers in Old Crow Flats (2021, 2022)
Kevin Turner (Brock University)
Old Crow Flats

Beaufort Sea coastal dynamics – Monitoring and observations for climate change (2021, 2022)
*Also in the Northwest Territories
Dustin Whalen (Natural Resources Canada)
Inuvialuit Settlement Region

Kluane National Park and Reserve fire history and stand origin mapping (2021, 2022)
Ellen Whitman (Natural Resources Canada)
Kluane National Park and Reserve and Haines Junction

Impacts of climate change on Beringian species at risk (2022)
Caitlin Willier (Government of Yukon)
Various locations near Carmacks and Dawson City

Monitoring change in the alpine tundra: Dall sheep and shrubs (2021, 2022)
Carmen Wong (Parks Canada)
Kluane National Park and Reserve

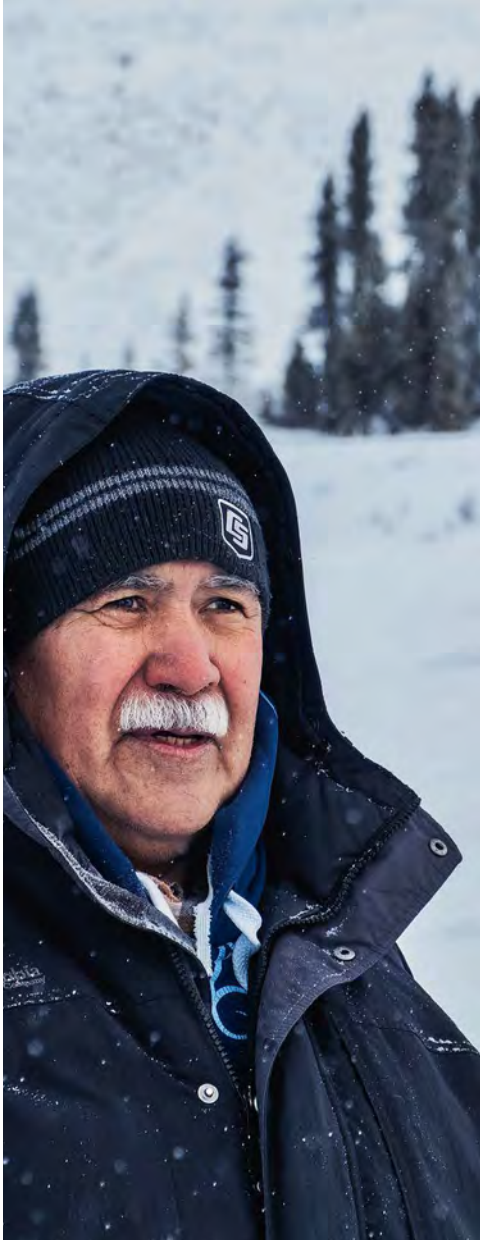
Pleistocene palaeontology and palaeoecology of the Old Crow region, northern Yukon (2022)
Grant Zazula (Government of Yukon)
Old Crow River

CANADA-WIDE

Health Portfolio Operations Center (HPOC) Mobilizations (2021, 2022)
HPOC Mobilizations
(Public Health Agency of Canada)
Canada-wide

INTERNATIONAL

Lake Untersee biogeochemistry (2022)
André Pellerin
(Université du Québec à Rimouski)
Lake Untersee, Antarctica



Dene elder Leon Andrew overseeing the genetic survey of the Redstone caribou herd in the Mackenzie Mountains in the Northwest Territories

ANNEX

Filtering water samples for marine chlorophyll and particulate carbon analyses in the Grise Fiord, Nunavut

PCSP Project Review Committee

The PCSP Project Review Committee (PRC) reviews and evaluates all logistics requests submitted by university-based researchers. The review process is based on the PRC Scoring Guide, which includes the following criteria: feasibility of the requested logistics, quality of the application, scientific recognition and impact, and student and local involvement and engagement. For more information on the review process for university applicants, contact the PCSP.

PCSP Project Review Committee Members 2020–2022

Maya Bhatia (2021, 2022)
Department of Earth and
Atmospheric Sciences
University of Alberta

Jules Blais (2020)
Department of Biology
University of Ottawa

Florent Domine (2021, 2022)
Department of Biology
Université Laval

Lisa Hodgetts (2022)
Department of Anthropology
Western University

Michael Kristjanson (2020, 2021)
Polar Continental Shelf Program
Natural Resources Canada

Trevor Lantz (2020, 2021 – Chair)
Environmental Studies
University of Victoria

Micheline Manseau (2020 – Chair)
Landscape Science and
Technology Division
Environment and Climate Change Canada

Derek Mueller (2022)
Department of Geography and
Environmental Studies
Carleton University

Erica Nol (2020)
Biology Department
Trent University

Glenn Parsons (2022)
Polar Continental Shelf Program
Natural Resources Canada

Jennifer Provencher (2021, 2022)
Ecotoxicology and Wildlife Health Division
Environment and Climate Change Canada

Mary Sanborn-Barrie (2020, 2021, 2022 – Chair)
Geological Survey of Canada
Natural Resources Canada

Walking back to camp after sampling on the sea ice