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Polar Continental Shelf Program

SCIENCE REPORT 2017

Logistical support for leading-edge scientific research in
Canada and its Arctic



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Polar Continental Shelf Program Science Report 2017 – Logistical support for leading-edge scientific research in Canada and its Arctic

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Cover photograph: Servicing a time-lapse camera system at the terminus of Iceberg Glacier, Axel Heiberg Island, Nunavut

Section header image: Dried up tundra landscape in the Nettilling Lake region, Baffin Island, Nunavut

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CONTENTS

2	Minister's Message
4	The Polar Continental Shelf Program
6	Celebrating 60 years of science in support of sovereignty across the Arctic
12	Field equipment support for science and operations across Canada
16	International collaboration
18	Arctic-Antarctic Exchange Program
20	Field sites supported by the Polar Continental Shelf Program (2017)
22	Science and operation highlights from 2017
37	List of supported projects in 2017
56	Annex



A stop on northern Ellesmere Island to examine rocks deposited at the time of the worst mass extinction in Earth's history. The rocks forming the canyon and convenient landing pad are comprised of abundant fossil shells of sea animals that lived 252 million years ago.



Minister's Message

To many Canadians, the Arctic is a distant and mysterious place. Others call it home. But to all of us, it is an important part of our national identity.

As the Far North captivates our imaginations, it remains one of the least understood places on the planet today.

For 60 years, the Polar Continental Shelf Program (PCSP) has played a critical role in helping to increase our understanding of Canada's North, providing support for scientific investigations in areas such as ecological integrity, sustainable communities, technology innovations, climate change, planetary science, mineral and energy potential, and natural resource development.

In 2017 alone, the PCSP supported more than 150 Arctic research projects, involving more than 900 participants from federal and territorial government departments and agencies; universities; and international, northern and independent organizations.

The Arctic environment is undergoing significant changes, requiring more work to deepen our understanding of the region. The Government of Canada is working with northerners to define a long-term vision for the region through the Northern and Arctic Policy Framework.

The science supported by the PCSP will underpin this framework and help produce the knowledge we need to make more informed decisions on the issues facing the Arctic today, helping to protect the Northern environment and provide economic and social benefits to northern and Indigenous communities.

The work of the PCSP will bring the Arctic closer, shining a light on its scientific mysteries for the benefit of all Canadians.

The Honourable Amarjeet Sohi
Canada's Minister of Natural Resources

Thermokarst thaw lakes
and Sheldrake River
near Umiujaq, Nunavik



The Polar Continental Shelf Program

Natural Resources Canada's Polar Continental Shelf Program (PCSP) provides safe, efficient and cost-effective logistics in support of Government of Canada priorities and economic prosperity. The PCSP is a whole-of-government service that coordinates field logistics across multiple disciplines to safely conduct fieldwork in the Canadian Arctic.

This service is available to federal, provincial and territorial government departments and agencies; universities; northern organizations; and international and independent research groups. Through this work, the PCSP directly contributes to the exercise of Canada's Arctic sovereignty.

The PCSP also offers the use of equipment to federal government science and operational programs conducting fieldwork across the Canadian landmass.

The PCSP provides the following services:

- planning and coordination of air transportation to and from field camps throughout the Canadian Arctic
- accommodation and meals at the Arctic Logistics Hub in Resolute, Nunavut
- laboratory, meeting and office space at the Arctic Logistics Hub in Resolute, Nunavut
- a communications network (radio and satellite telephones) and twice daily check-ins with camps in the field
- field equipment for use across Canada and in the Arctic
- supplying, transporting and positioning fuel for aircraft, equipment and field camps
- advice on logistics and field equipment needs for fieldwork across the Canadian landmass

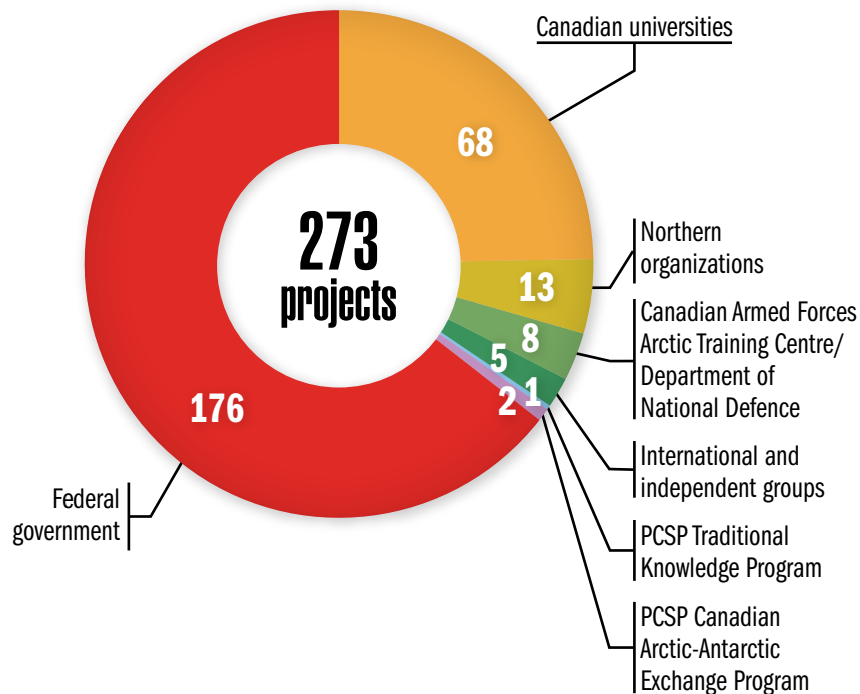


PCSP staff load field equipment onto a Twin Otter aircraft for transport to a PCSP-supported field site

Highlights of the 2017 field season



Breakdown of PCSP-supported projects in 2017





Celebrating 60 years of science in support of sovereignty across the Arctic

Over the past 60 years, the PCSP has become recognized internationally as Canada's centre of excellence for field logistics. The initiative was developed from a need to provide more scientific and technical information about the Arctic when interest and activity was increasing dramatically in the region.

The PCSP began as a small, science-based organization that coordinated logistics and conducted research over a few disciplines (geology, geophysics and oceanography). During the formative years, the PCSP determined and developed the logistical requirements to conduct fieldwork in remote regions of the Canadian Arctic.

The PCSP evolved into the large-scale logistics provider that it is today, providing support to Canadian and international researchers studying a wide range of disciplines from northern traditional knowledge and archaeology, biology and ecology, geology and planetary science to climate change.

Strong demand for Arctic science continues to increase because Canada's North is one of the fastest changing environments on Earth, is an area of high natural resource potential, and faces important social and health challenges for communities. There is as much a need now as there was 60 years ago for continued scientific investigation and increased knowledge and evidence about the Arctic to inform decision making.



Erecting the transmission mast for the navigation system at the Isachsen weather station on Ellef Ringnes Island in 1959

Early years

During the early years in operation, the PCSP focused mainly on scientific study. In addition, the PCSP also determined the types of logistics support required to conduct Arctic fieldwork, tested research methods and scientific equipment, conducted baseline surveys, collected data and addressed navigation issues. At that time, the PCSP had its own team of scientists to conduct research in the Arctic. Two separate field parties conducted research in the Arctic during the first field season in 1959.

One of these parties travelled to the joint Canada-United States weather station, Isachsen, on Ellef Ringnes Island in Nunavut. This exploratory season was devoted to learning how and when to conduct science in an Arctic environment. This field party established a low-frequency navigation system that enabled more science to be conducted in the region and vastly improved the safety of the excursions.

Over the next two decades, many major scientific projects took place that established Canada's fundamental understanding of the Arctic and the continental shelf. Glacier mass balance monitoring since the early 1960s and ice core measurements have become standard reference for climate change in the Canadian Arctic.

Expeditions to the North Pole and the development of ice island camps during the early years contributed to understanding the interaction between the ice and the ocean as well as to the systematic mapping of major seafloor features.

During the 1970s, the international collaboration Arctic Ice Dynamics Joint Experiment (AIDJEX) studied how sea ice moved and changed in response to ocean and atmospheric conditions. AIDJEX was conducted from camps on ice floes in the Beaufort Sea. Information obtained from AIDJEX led to the design of offshore drilling rigs, drilling ships and artificial islands capable of operating in the Arctic.

Following this study, two major continental crust investigations to study the origins of the Arctic Ocean were conducted from ice island camps. The Lomonosov Ridge Experiment (LOREX 79) was in 1979, and the Canadian Expedition to Study the Alpha Ridge (CESAR) took place in 1983.



The McGill Arctic Research Station (MARS) in Expedition Fiord, Axel Heiberg Island, Nunavut, was established by McGill University in 1960 and is one of the longest operating field research facilities in the high Arctic. The PCSP has supported science programs from MARS for decades.

The Lomonosov and Alpha ridges are underwater mountain ranges that extend north from Canada's Arctic continental shelf. Core samples from the CESAR investigations contributed to understanding 3 million years of the Arctic Ocean's history. LOREX 79 used a multi-disciplinary approach to study the nature and origins of the Lomonosov Ridge. These programs helped to identify natural extended regions of Canadian territory and indicated areas with resource potential, including oil and mineral potential.

Building on these earlier projects, the PCSP established a field camp on an ice island, known as Hobson's Choice (named in honour of the PCSP director at the time – George Hobson). The camp was an effective scientific platform between 1984 and 1989. This project enabled the first large-scale survey of Canada's eastern Arctic continental shelf and the successful collection of information from a broad spectrum of disciplines. The research conducted on the ice island helped characterize Canada's extended Arctic continental shelf. These early projects helped to develop Canadian expertise for conducting research from free floating ice platforms and continue to provide a foundation for present-day Arctic field campaigns.

Changing focus

Each season, the PCSP developed and tested methods to accomplish Arctic fieldwork and transformed challenges into learning opportunities. During these early years, the PCSP developed extensive expertise in coordinating logistics for Arctic field campaigns.

In the mid-1980s, the PCSP shifted from a science-based project to a logistics-based program. With that change, the PCSP began supporting scientific research projects from a wider range of agencies, including federal and territorial governments, universities, and international, northern and independent organizations. This shift led the PCSP to enable scientific research over a greater diversity of natural and social sciences, including disciplines ranging from anthropology to zoology and with a broadened geographic scope. These changes led to an increase in the number of projects requesting support from the PCSP and has expanded Canada's wealth of knowledge about the Arctic.

The PCSP recognized the importance of knowledge held by Arctic peoples to understanding the region. It developed the Traditional Knowledge Program in the 1990s to support projects that focus entirely on the preservation of the rich repository of traditional knowledge of Arctic peoples.

Some notable projects supported by the PCSP's Traditional Knowledge Program have been run by the Vuntut Gwitchin Government Heritage Branch. These projects partner elders with youth in culturally or historically significant locations in the Van Tat Gwich'in traditional territory and enable the knowledge transfer and preservation of Van Tat Gwich'in history, environmental knowledge and culture.

Also during the 1990s, to encourage more international collaboration, the PCSP developed the Canadian Arctic-Antarctic Exchange Program. This program encourages collaboration among Canadian Arctic and non-Canadian Antarctic scientists to undertake joint studies. This program has enabled Canadian Arctic scientists to expand their research to the southern pole and conduct complimentary research in Antarctica.

The PCSP has partnered with many major scientific programs over the years, including:

- International Polar Year
- ArcticNet (a network of Centres of Excellence of Canada)
- Polar Knowledge Canada's Science and Technology Program
- Canadian High Arctic Research Station
- Geo-mapping for Energy and Minerals program (Natural Resources Canada [NRCan])



A 1960 PCSP team prepares to evacuate their camp on the Arctic Ocean because of the formation of a pressure ridge on the sea ice.



Filming an interview between a mentor and a learner as part of the Van Tat Gwich'in Historic Lifeways Project. This project was supported through the PCSP's Traditional Knowledge Program.

These partnerships have helped improve field research in Canada's Arctic and continue to inform decision making across a range of issues including climate change, resource development, land use and environmental integrity.

"The PCSP doesn't decide what science gets done, that is decided by the agencies. The PCSP helps scientists get to the field, get themselves established and get themselves home safely."

– George Hobson (PCSP Director, 1972–1989)

Evolution of the Resolute facility

Over the past six decades, the infrastructure of the program evolved to respond to the changing needs of science. During this time, increasing interest in Canada's Arctic led to more requests for support from the PCSP. At times, the PCSP Resolute facility operated beyond capacity, housing scientists in tents beside the facility or in local hotels.

To cope with this growing demand, the PCSP's Resolute facility has gone through some significant improvements; from its early days of a small wooden shack to the modern multi-use facility that it is today. The improvements include housing accommodations for 237 people, a kitchen and dining room for 100 people, a stand-alone laboratory, offices and boardrooms, a lounge, and a fitness room.

Today, the PCSP operates a significant piece of Arctic infrastructure that can house more scientists comfortably and support a broader range of activities, including laboratory analysis straight out of the field. Improvements continue through the Accelerated Infrastructure Program 2 and will include greening the buildings in Resolute and installing an incinerator to reduce the facility's environmental footprint.



Aerial view of the PCSP facility in Resolute, Nunavut, in 2014



Logging an ice core taken on White Glacier, Axel Heiberg Island, Nunavut. White Glacier has the longest, near-continuous mass balance record for any high Arctic glacier, stretching back to 1960.

In 2010, a 25-year partnership was developed between the PCSP and the Department of National Defence (DND) in support of the Canadian Armed Forces Arctic Training Centre (CAFATC). This partnership enables the Canadian Armed Forces to train military personnel to conduct operations in the Arctic and to enhance the military's ability to respond to emergency situations and help other government agencies respond to any issues that may arise.

DND contributed to the expansion of the facility in Resolute, which has enabled more scientists to be accommodated annually and allows the accommodation of DND personnel during the science "off-season." This expansion included a high frequency radio farm that has increased communications capabilities across the Arctic, resulting in safer conditions for everyone conducting fieldwork in remote regions of the Arctic. Efficiencies are created through this beneficial partnership for both the PCSP and DND, reducing the need for duplication of the facility and services and resulting in cost savings while delivering on multiple Government of Canada priorities.

Enabling science

Arctic scientists rely on support from the PCSP to conduct their research in order to contribute to a better understanding of current issues, future risks and opportunities in Canada's north. The PCSP enables the collection of scientific data and information across Canada's landmass through the provision of safe and efficient logistics support and field equipment. This service allows the scientists to focus on their research, and leave the logistics coordination and field equipment expertise to the PCSP.

Sixty years of PCSP support has contributed to the advancement of scientific knowledge in Canada's Arctic. Scientists have observed climate change and its effects across a range of disciplines. The effects include changes in sea ice coverage and characteristics; permafrost warming and degradation; retreating glaciers and ice caps; accelerated coastal erosion; and changes in wildlife populations, migration and behaviour. Across many regions in the Arctic, Inuit cultural histories have been documented

and preserved through the transfer of traditional knowledge and archaeological investigations, and geological investigations have led to the discovery of regions with mineral and resource potential.

The vast amounts and wide variety of scientific data that have been collected, analyzed and reported on by PCSP-supported scientists contributes to the knowledge base of Canada's land, people and environment. This wealth of information that has come from 60 years of PCSP support enables informed decision making for communities, industry and government and is of great importance to scientists and all Canadians. It has informed local decision making on wildlife harvesting practices; government decisions on resource management and development; and international agreements on climate change and governance of use of the oceans and their resources.

By supporting annual scientific projects and field camps across the North, the PCSP helps Canada to assert a continuous, visible and purposeful presence in the Arctic and directly contributes to Canada's sovereignty in its territory and adjacent waters.

"The PCSP represents a very important and the only key organization that is absolutely necessary for such remote and difficult areas like the huge Canadian Arctic. Therefore, we would like to thank the PCSP for the great support, the perfect organization and the possibility to carry out such complex challenging expeditions. We are always impressed by the goal-oriented manner of the PCSP's staff, who always find solutions even in the most complicated circumstances. Without the PCSP, research in the Canadian Arctic would not be possible this way."

– Dr. Hans-Joachim Kumpel, former president of Federal Institute for Geosciences and Natural Resources Germany (BGR)



Examining metalliferous black shale exposure on the bank of Peel River, Yukon



Field equipment support for science and operations across Canada

The PCSP's Field Equipment Unit (FEU) provides clients access to a large inventory of field equipment to help ensure safe and successful field campaigns. The PCSP is committed to providing clients with the right equipment to safely conduct fieldwork across the Canadian landmass. Field equipment is available to PCSP-supported scientists and operations conducting fieldwork in the Arctic and is also available to Government of Canada employees conducting fieldwork across Canada.

Full life cycle management of equipment

The PCSP's FEU manages a multi-million dollar inventory of field equipment in two warehouses at the PCSP facilities in Ottawa, Ontario, and Resolute, Nunavut. The FEU is responsible for managing the entire life cycle of the equipment, including planning, equipment selection, procurement, delivery, maintenance, repair and disposal. Client feedback plays an important role in equipment selection and procurement, including reporting results from testing new equipment in the field.

The field equipment includes:

- communications equipment (satellite telephones)
- camping gear (tents, stoves, dishes, sleeping bags and air mattresses)
- winter clothing (parkas, insulated pants, boots and mitts)
- field vehicles (snowmobiles, boats, ATVs and fat bikes)
- safety supplies (bear repellent, first aid kits and flares)

All equipment has a life cycle based on safety and the useful life of the item. The FEU monitors the equipment life cycle to ensure safety and reliability while in the field.

Some pieces of equipment have stood the test of time and have been included in the inventory for over 60 years, such as the Logan tent because of its durability, versatility, and ability to withstand strong winds. Other items, such as satellite telephones and fat bikes with trailers have been added to the inventory to reflect changing technology and requirements for fieldwork of today.

Importance of annual planning

The movement of equipment across the country to remote locations requires sufficient lead time and planning. Advanced planning ensures that all clients have the equipment they need on time. The annual request for PCSP support occurs in October for all projects taking place in the Arctic during the following field season. The majority of these projects occur between March and September. The PCSP requires time to plan for the large number of projects with overlapping timeframes and to coordinate shipping equipment over great distances across the Arctic.



Field equipment in the Ottawa warehouse ready for inspection by the field party members



A field camp viewed from a drone at Strand Fiord on Axel Heiberg Island, Nunavut

Did you know?

Currently the FEU inventory includes 82 all terrain vehicles, 103 snowmobiles, 39 boats and 19 fat bikes with trailers.

Other requests that occur outside of the October application period are for field equipment to be used all across Canada. They are identified well before the scheduled fieldwork (at least eight weeks) to ensure the FEU has enough time to plan, procure and deliver to clients. The FEU is responsible for shipping the field equipment in the most efficient manner (by land, air or sea) to arrive where and when it is needed.

The annual sealift is one method that the FEU uses to transport equipment and goods to and from the Arctic and requires planning to begin almost a year in advance. Sealift is used to re-supply the Resolute warehouse with field equipment, move fuel to remote field camps, and deliver building materials for the PCSP facility in Resolute.

Benefits to clients and Canada

The PCSP provides field equipment to clients working across the Canadian landmass from the federal and territorial governments, universities, and international, northern and independent organizations. Clients can borrow high quality and well maintained gear from the PCSP, reducing costs

for each project and increasing the feasibility and safety of the fieldwork. The PCSP offers this unique centralized service, which results in cost savings and efficiencies across government and all organizations that use it, and reduces the need for duplication within these agencies. The FEU employees offer expert advice to clients to ensure that they have the best equipment to meet their individual requirements.

Government of Canada science and operation projects make use of the field equipment service to conduct fieldwork across Canada to assist in the delivery of departmental mandates and government priorities. During 2017, NRCan's Surveyor General Branch, through the International Boundary Commission, used PCSP equipment in Yukon and along the Quebec border with Vermont, New York and Maine that delivered on the mandate to maintain the Canada-United States boundary. NRCan's Geological Survey of Canada (GSC) also used the PCSP equipment inventory to deliver on the mandate to maintain an up-to-date knowledge base of Canada's landmass. Fieldwork was also conducted at numerous locations across the country, including Fort McMurray, Alberta, and Atlin, British Columbia.

Field equipment is provided upon request to employees from other government departments to ensure health and safety measures are followed. In 2017, various government departments, including the Canadian Space Agency and the Canadian Nuclear Safety Commission, borrowed parkas, trousers, Arctic mitts and boots for travel to the Arctic.



A field camp on Igloolik Island, Nunavut

The Public Health Agency of Canada (PHAC) has used equipment for emergency dispatch of personnel to remote areas in the Arctic where they contribute to the health and well-being of Northerners. PHAC has a large employee base and being able to borrow clothing from the PCSP eliminates the need for them to purchase gear for each individual, resulting in significant cost savings that can be allocated elsewhere.

Did you know?

Fat bikes are an efficient way to travel while in the field and can be used with a trailer to transport equipment and supplies to and from field sites. The oversized tires absorb bumps on uneven terrain and provide traction on rough terrain, snow and sand. They are quiet, cause minimal environmental disturbance and do not require fuel. Additionally, they are much easier to transport into the field as they are small and lightweight compared to an ATV or snowmobile.

Gordon Osinski, a PCSP-supported scientist, used a fat bike to travel from camp to study sites while studying how ground ice and freeze-thaw processes modify the ground surface in permafrost areas on Axel Heiberg Island, Nunavut. Using the fat bike instead of travelling on foot allowed him to reach sites faster and accomplish more in the same amount of time.



Avoiding wet feet on a fat bike at Strand Fiord on Axel Heiberg Island, Nunavut

The shared use of the high quality equipment that the PCSP provides creates cost savings across government, resulting in more efficient use of public funds, and improves the safety conditions for employees travelling to remote regions and extreme environments.

The FEU is an important component of the PCSP's service offering. Clients can rely on the PCSP for their field equipment needs and on the expertise of the FEU to select the correct items for their particular field season needs. PCSP's centralized inventory of field equipment enables the delivery of Government of Canada science and operation priorities, creating cost savings and efficiencies while also ensuring safety during fieldwork across the diverse Canadian landmass.

Did you know?

Field equipment was issued to numerous Government of Canada departments and agencies during 2017, including Natural Resources Canada, Shared Services Canada, Indigenous and Northern Affairs Canada, Public Safety Canada, Fisheries and Oceans Canada, the Public Health Agency of Canada, Parks Canada, the Canadian Nuclear Safety Commission, and the Canadian Space Agency.



Unloading field equipment from the twin otter upon arrival at Prince Patrick Island, Northwest Territories



International collaboration

In addition to Canadian research projects, the PCSP provides logistics coordination assistance to international scientific research collaborations in the Arctic. International collaborations increase the efficiency and effectiveness of the research and enhance the advancement of scientific knowledge about the Arctic.

These arrangements bring together specialists from around the world and allow scientists to share knowledge, expertise and best practices. Examples from PCSP's 60 year history have ranged from geological investigations into the origin of the Arctic Ocean, programs to study sea ice dynamics, to large-scale studies of wildlife migrations that cross international boundaries. A major international collaboration from the 2017 field season is highlighted here.

International collaboration to study the origin of the Arctic Ocean

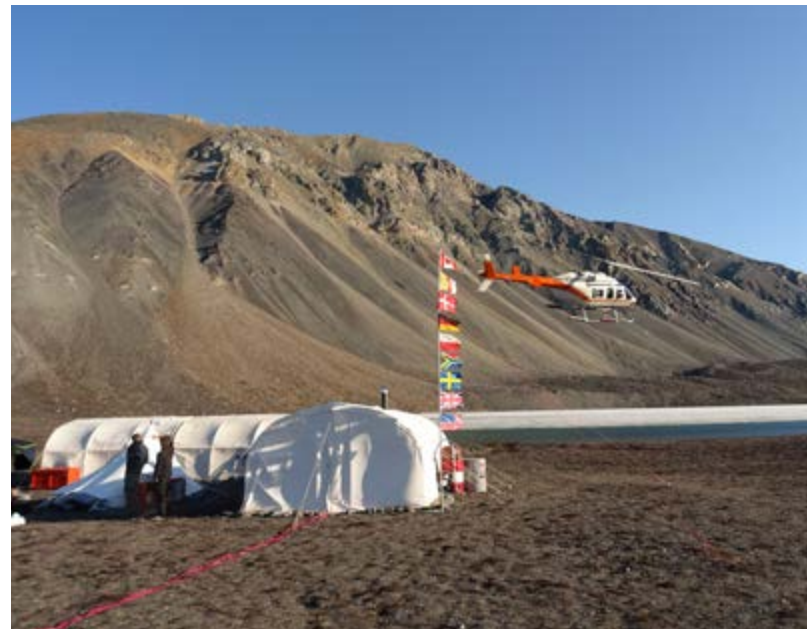
Karsten Piepjohn (Federal Institute for Geosciences and Natural Resources Germany – BGR) and **Steve Grasby** (Geological Survey of Canada, Natural Resources Canada)

Featured story locations on the map: 1

The northern margin of Canada has a complex geologic history, including the formation of sedimentary basins, the collision of land masses that formed large mountain belts, the emplacement of a large igneous province that influenced global climate, and the formation of the Arctic Ocean. This long and complex history is written in the geologic record of northern Ellesmere and Axel Heiberg islands and requires a multidisciplinary approach to unravel. Research conducted in this region helps explain the geologic history of the broader circum-Arctic and consequently brings the attention of international researchers.

The Federal Institute for Geosciences and Natural Resources Germany (BGR) initiated the ongoing Circum-Arctic Structural Events program (CASE) in 1992 to study terrestrial geophysics and geology in the Arctic. The main goal is to understand the deformation of rocks across the high Arctic as they relate to the formation of the Arctic Ocean and the final break-up of the ancient northern continent Laurasia. CASE is a collaborative endeavor, using relationships among national geological institutions, universities and museums of the countries where fieldwork

is conducted. CASE geoscientific expeditions have taken place in Svalbard, Siberia, the Yukon North Slope and the Canadian Arctic Archipelago.



A helicopter and the flag mast of the international geoscientific expedition CASE 19-Pearya at the base camp on northern Ellesmere Island between Kulutingwak Fiord and Yelverton Inlet

BGR and the Geological Survey of Canada (GSC) have collaborated on CASE since 1998. The project CASE 19-Pearya took place in 2017 on northern Ellesmere Island, Nunavut. It was a major collaboration between the GSC and BGR involving 50 participants. Thirty scientists from a broad range of geoscientific disciplines participated in the expedition. They came from 19 institutions in 8 countries to increase the feasibility of the project by sharing funding and logistics, but also to share the scientific knowledge and expertise of the participants. The participants were from Canada, Germany, Poland, the United States, the United Kingdom, Sweden, South Africa and Denmark.

The Pearya Terrane is a rock unit on the northern coast of Ellesmere Island. The 2017 fieldwork focused on the role, evolution and plate tectonic relationship of the Pearya Terrane to other areas in the Arctic adjacent to the Arctic Ocean. The fieldwork involved visiting study sites by helicopter to conduct detailed field analyses of rock packages and collect representative hand samples. Detailed geochemical analyses of these samples was performed in the laboratory to determine the age and origin of the rocks that make up the Pearya Terrane.

The field season was highly successful and answered many outstanding research questions about the origin of the Arctic Ocean. At the same time, new discoveries have generated a completely new suite of scientific questions that will drive future research.

Results from this field research will help to resolve one of the last outstanding plate tectonic questions on Earth: how and when the Arctic Ocean formed. It will also aid in the correlation of rocks from the offshore Canada Basin to onshore geology of northern Ellesmere Island, which contributes to Canada's claim to the extended continental shelf under the United Nations Convention on the Law of the Sea (UNCLOS).

BGR and GSC, along with their international partners, have plans to work in the Canadian Arctic until 2023. Future work will take place on central Ellesmere Island, in the Barrow Strait area, on Parry Islands, and again on the Pearya Terrane. It will focus on the young, Tertiary period structural evolution during the final break-up of Laurasia and the formation of the Arctic Ocean.

Geologists from Poland, Sweden, the United States, Canada and Germany on a ridge that forms the boundary between the Pearya Terrane and the ancient North American continent of Laurentia

Results from this work will correlate rocks from the offshore Canada Basin to the onshore geology of northern Ellesmere Island. This information will inform the delineation of Canada's extended continental shelf and support claims under the international framework for ocean activities.

"The ongoing support of the PCSP makes working in some of the most remote and challenging environments on Earth possible. Their tireless work makes our research efforts possible."

- Steve Grasby

"Although the summer was cold, foggy and cloudy, the organization of the transports between Resolute Bay and Yelverton Inlet went extremely well because of the excellent logistic support and flexibility of the PCSP staff in Resolute Bay."

- Karsten Piepjohn





Arctic-Antarctic Exchange Program

The PCSP's Arctic-Antarctic Exchange program encourages international collaboration among Canadian Arctic and non-Canadian Antarctic scientists who want to undertake joint studies in both polar regions.

To date, 27 projects have been supported under the Arctic-Antarctic Exchange Program. They have looked at a range of issues, including ground ice stability in response to climate warming, permafrost as an analogue for Mars, and changes in ice shelf stability. One project that is part of the Arctic-Antarctic Exchange Program is highlighted here.

Investigating basal channels as pathways for epishelf lake drainage and mechanisms of ice shelf breakup

Derek Mueller and Andrew Hamilton (Carleton University)

Featured story location on the map: 2

Until recently, nearly the entire northern coast of Ellesmere Island was fringed with ancient ice shelves. These floating platforms of ice connected to a landmass form by the combination of ice flowing into the ocean from glaciers or ice sheets, snow accumulation and sea ice formation. An epishelf lake is a body of fresh water that has accumulated above the saltwater (freshwater is less dense and therefore floats above saltwater) and is dammed by an ice shelf.

Epishelf lakes form when an ice shelf blocks the mouth of a fiord, creating a floating dam and trapping the freshwater runoff from the adjacent land. When an epishelf lake deepens beyond the thickness of the ice shelf, the freshwater drains and forms basal channels beneath the ice shelf. The Milne Ice Shelf, along northern Ellesmere Island, contains what is likely the last remaining epishelf lake in the Canadian Arctic.



Scientists from Canada and Korea conduct radar surveys on the Nansen Ice Shelf, Antarctica.

Derek Mueller and his team have been studying the Milne Ice Shelf since 2008 and the Milne Epishelf Lake since 2011. Mueller's team is investigating a freshwater channel they have identified beneath the Milne Ice Shelf. This channel represents a significant structural weakness in the ice shelf. Studying the channel provides insights into the process that may lead to the collapse of other ice shelves in the Arctic, and can help explain the accelerated collapse of ice shelves in Antarctica where similar freshwater channels have been observed.

During early 2016, Mueller and Christine Dow (University of Waterloo) partnered with international scientists from the United States, South Korea and New Zealand. The group conducted joint research in both the Canadian Arctic on the Milne Ice Shelf and in Antarctica on the Nansen Ice Shelf.



Preparing to profile through a natural crack in the ice on the Milne Ice Shelf, Ellesmere Island, Nunavut

This international collaboration is part of the Land-Ice/Ocean Network Exploration with Semiautonomous Systems (LIONESS), a project led by the Korea Polar Research Institute (KOPRI). In November of 2016, Mueller and Dow visited Antarctica's Nansen Ice Shelf to take part in LIONESS research.

Mueller and Dow collected ice-penetrating data on Nansen Ice Shelf for ice thickness mapping and to look for evidence of sub-ice shelf melting and refreezing. Their investigations in Antarctica will be used to plan future targeted under-ice missions and to look for evidence of sub-ice shelf melt and refreezing, and will enable them to compare processes with those observed in the Canadian Arctic.

Andrew Hamilton led a research team on the Arctic portion of the exchange on the Milne Ice Shelf and Epishelf Lake and was accompanied by a research engineer from KOPRI. The team was able to melt a hole through 9 metres (m) of ice above the basal channel and obtain live measurements as it flowed beneath the ice shelf and over the seawater, including water temperature, salinity, turbidity and current speed. The team installed seismometers and a continuous GPS to measure ice quakes and glacier motion and an instrument that will continue to record water properties and flow speeds over the entire year.

Preliminary analysis of the 2017 data suggests that properties of the epishelf lake outflow may be driving the thinning of the ice shelf along the channel. The analysis also shows that the dominant mechanism leading to ice shelf break-up may be the formation of these freshwater channels under the ice. Future work will involve returning to the Milne Ice Shelf in 2018 and returning to Antarctica with LIONESS in 2019.

This international collaboration creates the unique opportunity for direct comparisons of the analogous ice-ocean processes between Arctic and Antarctic ice shelves.

“The formation of basal channels could be a critical factor in ice shelf breakup, and this collaborative study will improve our understanding of this process in both the Arctic and Antarctic.”

– Andrew Hamilton

Want to learn more?

Visit the Water and Ice Research Laboratory (WIRL) website at <https://wirl.carleton.ca/>.



Science and operation highlights from 2017

The PCSP provided support to 153 science and operation projects across the Canadian Arctic and 112 federal science and operation projects using field equipment across Canada during 2017.

The PCSP provides logistics support and coordination, including the use of field equipment, to projects across Canada's Arctic from a wide range of agencies. It also provides the use of field equipment to federal government science and operations across Canada. PCSP-supported projects cover a variety of disciplines, including climate change, ecological integrity, environmental conservation, cultural heritage and sustainable resource management.

The following stories feature some of the research and operations that the PCSP supported during the 2017 field season. The first two stories highlight fieldwork that was conducted outside the Arctic using PCSP field equipment. The other stories highlight science and operational projects that took place across the Canadian Arctic. Refer to the featured story location number to view the project's field location(s) on the report's field sites map.

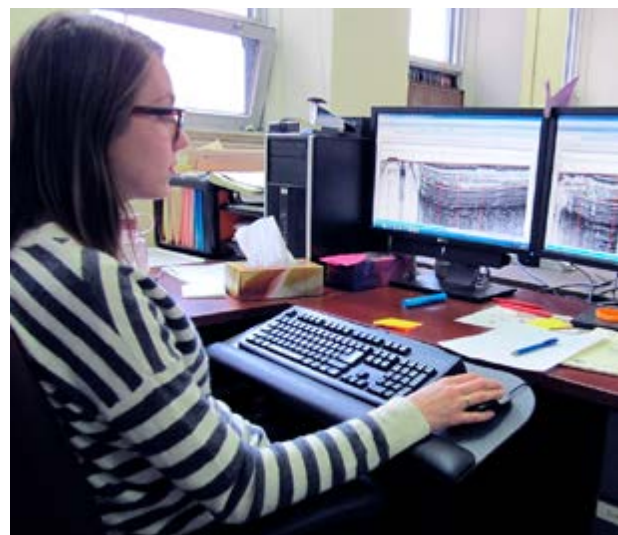
Investigating evidence of ancient earthquakes in lake sediments

Greg Brooks (Geological Survey of Canada – Northern Canada)

Featured story locations on the map: 3

The record of measured and historical earthquakes in Canada is relatively short. At best, the record extends back to the 17th century and only for parts of what was New France in eastern Canada. Paleoseismology investigates geological evidence of prehistoric earthquakes to understand the location, frequency and magnitude of strong earthquakes that occur infrequently. A better understanding of the long-term seismic history is important to inform building codes and the design and regulation of critical infrastructure, such as hydroelectric dams and nuclear power plants.

Lake bed sediments can contain evidence of landslides, including prehistoric landslides that were caused by moderate to strong earthquakes. Examining landslide deposits from a common stratigraphic level in a lake bed can be indicative of an ancient earthquake. Greg Brooks from the Geological Survey of Canada (GSC) is studying lakes in northwestern Quebec and northeastern Ontario for such evidence.



A Geological Survey of Canada co-op student uses geophysical interpretative software to “pick” the top and bottom of submarine landslide deposits on subbottom acoustic profile records.



Geological Survey of Canada scientists coring on Lac Duparquet, Quebec

Over the past three years, Brooks has investigated landslide deposits buried in three lakes in the Rouyn-Noranda region of western Quebec. The Nuclear Waste Management Organization is an important partner in this research. Understanding the hazards in this region is important to ensure safety and long-term stability when planning the location of key nuclear infrastructure.

A subbottom acoustic profile of the lake bottom revealed that the lakes contain multiple layers of landslide deposits. A series of landslide maps were compiled using the data for each lake. Each map depicts the landslides that are found at distinct stratigraphic levels in the lake bottom.

Using this geophysical data, Brooks selected locations for further investigation of the lake bed. At these locations, he collected sample cores of the lake bottom sediment while the lakes were frozen. The cores contain distinct layers of sediment that are deposited annually in the lake bottom, known as varves. The landslide deposits are then dated by analysing their position in relation to these annual varves.

Through this research, Brooks has discovered evidence of up to 11 paleoearthquakes over 450 years between about 8,950 and 9,400 years ago. One event showed that widespread landslides occurred in each of the three lakes during the same year. This discovery provides strong evidence that a significant paleoearthquake occurred in the region about 9,000 years ago.

Brooks will conduct further lake bottom profiling and core sampling over the next few years to map the extent of this landslide signature to estimate the magnitude of this paleoearthquake. This research helps to determine the regional seismic activity and understanding what happened in the past will help determine what might happen in the future. Understanding the earthquake risks in the region is important to guide infrastructure development to ensure safety for people and the environment.

Understanding the environmental risks associated with future critical metal mining in Canada

Michael Parsons (Geological Survey of Canada, Atlantic)

Featured story location on the map: 4

In recent years, the global demand for critical metals used in green energy and high-tech applications has been on the rise. The critical metals in demand include antimony (Sb), cobalt (Co), indium (In), lithium (Li), niobium (Nb), and rare earth elements. They are used in such devices as rechargeable batteries, hybrid vehicles, mobile telephones and medical imaging equipment.

Canada has an abundance of these critical metals, and new mines are being planned across the country. However, significant knowledge gaps exist about the environmental impacts of mining these metals, and more research is required to help regulators develop environmental guidelines for these activities.



Collecting water samples at depth from a flooded pit lake.

As part of the Lands and Minerals Sector's Environmental Geoscience Program, Michael Parsons is conducting research near the abandoned St. Lawrence Columbiac Mine in Oka, Quebec. This mine operated from 1961 to 1976 and was one of the world's largest producers of niobium at the time.

The niobium and rare earth element deposits at this site are similar to many others across Canada that are under consideration for mine development. The mine contains piles of waste rock, tailings, slag (smelter waste), two flooded open pits, and water-filled underground mine workings. Parsons, along with colleagues from GSC-Ottawa, Queen's University, and the University of Ottawa, has been studying this site since 2015 to better understand the key environmental risks associated with mining niobium and rare earth elements. The overall goal of this research is to help position Canada as an environmentally responsible supplier of critical metals.

Parsons and his colleagues visited the site in each of the four seasons and collected mine waste, surface water, and groundwater to characterize the distribution, transport, and fate of metals and radioactive elements. Data loggers were installed in the flooded open pits and in groundwater wells to measure seasonal variations in water quality. The research team is also using field leaching experiments to study long-term changes in the composition of waters draining from the mine wastes.

Key findings indicate that the tailings at the mine are low in potentially hazardous elements, including uranium and thorium. However, the smelter slag contains concentrations of radioactive elements that exceed current Canadian guidelines for the disposal of radioactive waste. Additionally, results show that potentially hazardous elements in the local bedrock and mine waste are not very mobile in well-oxygenated surface water, but may be more mobile in deeper, low-oxygen groundwater. These results will be shared with the Province of Quebec and the Municipality of Oka to assist with the long-term management of this mine site.



Monitoring vertical changes in water chemistry in a flooded pit lake using a multi-parameter water quality sonde



Setting off for a day of water sampling at the St. Lawrence Columbian Mine in Oka, Quebec

Fieldwork for this project will wrap up in 2018 following the final collection of seasonal surface water and groundwater samples. A conceptual model is being produced to help predict water quality at future critical metal mines across Canada. This study will inform environmental decision making and will help industry improve environmental predictions for future mining projects, which will reduce risks to ecosystems and human health.

“The support we’ve received from PCSP staff on Sheffield Road has been essential to the success of this project. High quality, reliable clothing and field equipment from the PCSP have kept us safe in the field and allowed us to operate in extreme heat, freezing cold, lots of rain, and occasionally, sunny and pleasant conditions.”

- Michael Parsons

Testing user-friendly protocols to monitor pond water dynamics for conservation and outreach in Wapusk National Park

Chantal Ouimet (Parks Canada)

Featured story location on the map: 5

Wapusk National Park, located on the southwestern shore of Hudson Bay, is a remote and protected area that is home to an abundance of wildlife. The park encompasses a range of landscapes and ecosystems of the Hudson Bay Lowlands from coastal beach ridges to permafrost thaw lakes and tundra to boreal forest. Thousands of shallow lakes provide key habitat to large populations of waterfowl and other wildlife.

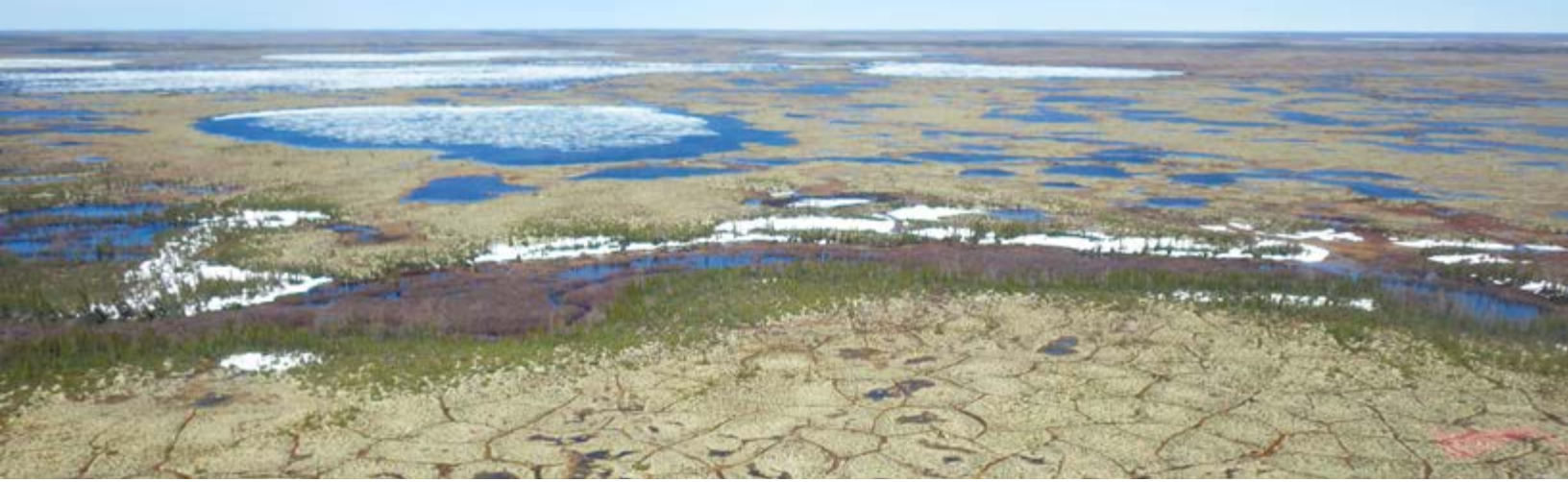
Parks Canada runs monitoring programs in national parks to maintain and restore ecological integrity. These programs monitor for change and assess whether the changes are due to natural processes or human impacts. Chantal Ouimet, an Ecologist from Parks Canada, works in collaboration with university scientists to assess how the hydrology and ecology of the lakes across different habitats in Wapusk National Park are changing over time. The lakes are susceptible to alteration by climate change and the exponential increase in Lesser Snow Goose populations.

The increased abundance of geese can lead to vegetation degradation, resulting in changes in pond dynamics and water quality.

A main objective of this project is to develop and test detailed monitoring protocols to enable consistent and reliable sampling methods. These protocols need to be user-friendly for anyone to carry out, thereby ensuring consistent, reliable and high quality data collection to monitor the state of the park, regardless of staff turnover. Over the 2017 field season, 10 non-scientific Parks Canada staff and students accompanied Ouimet into the park on several field trips over spring, summer and fall, to experience and learn about the park. Three of these individuals tested and applied different protocols for selected aspects of the monitoring program, including field and laboratory preparations. These individuals provided feedback to improve the methods and instructions within the protocols.



Parks Canada non-scientific staff work with resource conservation staff to collect hydroecology samples in the remote Wapusk National Park, Manitoba.



Wapusk National Park coastal ecosystems: an expansive intermingling of water and land

The 2017 field season provided field notes and water samples from 46 ponds over spring, summer and fall and will be analyzed to assess pond dynamics and the spatial extent of Lesser Snow Goose impact. This project is ongoing, and Parks Canada will continue to monitor pond water dynamics and the impacts of goose populations on pond and vegetation health in the park. In future years, Ouimet will guide more individuals into the park to test the accuracy and transferability of the monitoring protocols.

This project created a unique opportunity for Parks Canada staff who work in non-scientific roles to visit Wapusk National Park and gain a better understanding of the methods for monitoring park health. This field experience allowed the participants to become familiar with the park and helped them to understand the monitoring goals and the potential impacts of stressors on park ecosystems. The staff can apply what they learned to their work and will share the experience with their community, enhancing the public appreciation for Wapusk National Park.

“Long-term monitoring is essential to understand changing northern ecosystems. Training and bringing people other than scientists to participate in long-term monitoring and experience Wapusk National Park landscapes is a great way to impress deeply on them how humans are impacting far away ecosystems and to engage them to share with others, in their own words and photos, what they have seen, sampled, learned and, hopefully, integrated enduringly”

– Chantal Ouimet



The park ecologist points out terrestrial impacts of snow geese (grubbing and shoot pulling) in Wapusk National Park, Manitoba. This pond was sampled to assess aquatic impacts of geese under the ecological integrity monitoring program.

Want to learn more?

Learn more about research and monitoring at Wapusk National Park at <http://www.pc.gc.ca/en/pn-np/mb/wapusk/info/gestion-management/gestion-management3>.

Prince Patrick Island Pliocene paleoclimatology, paleoecology, and paleo-landscapes

John Gosse, Sydney Stashin (Dalhousie University) and Adam Csank (University of Nevada)

Featured story location on the map: 6

During the Pliocene Epoch (5.3 to 2.6 million years ago), the global temperature was an average of 2°C warmer than present day. Evidence indicates that the Arctic was up to 16°C warmer during this time, resulting in very different landscapes and ecosystems that supported forests as far north as Ellesmere Island, Nunavut.

Climate models predict that during this century the average global temperature will increase by an average of 2°C. Determining the conditions that were present during the Pliocene Epoch may provide insight into what might be expected were the global climate to warm an average of 2°C. Analyzing the records that are preserved in stream bed deposits and wood fragments that accumulated during the Pliocene Epoch can provide details of how global climate warming might affect Arctic landscapes and ecosystems.

Pliocene Landscape and Arctic Remains—Frozen in Time (PoLAR-FIT) is an international, multidisciplinary team of scientists that has collaborated for more than a decade to quantify the Arctic's response to climate change based on paleoclimate (past climate) data in relation to present day climate warming scenarios. Over the past decade, PoLAR-FIT has provided paleoclimate data over a wide range of time (4.0 to 2.7 million years ago), including temperature, precipitation, atmospheric CO₂, rate of sedimentation, and differences in flora and fauna.

During the 2017 field season, John Gosse, Sydney Stashin and Adam Csank (members of PoLAR-FIT) conducted field research on Prince Patrick Island, Northwest Territories. Prince Patrick Island is a critical location to analyze the Beaufort Formation, which is a layered pebbly sand unit that was deposited during the Pliocene Epoch. The team focused their research on two 30-m sections of the Beaufort Formation where the ancient stream sands and gravels were exposed along freshly cut riverbanks.

The team investigated paleoflow (direction of flowing water from the past) of the Pliocene streams and collected sand and cobble samples to date the stream layers. The age of the sediment layers and erosion rates of the areas that sourced the ancient stream sediments will be determined from these samples. This will help to determine how fast erosion occurred in the Arctic under a 2°C warmer planet scenario. Their research indicates that the ancient stream paleoflow measurements were generally westward. This finding is consistent with results from their 2013 fieldwork on Banks Island and supports the theory that northwest passages were not open during the Pliocene Epoch.

The team also collected 40 wood fragment samples. Analysis of the tree-ring widths will potentially provide a continuous record of several hundred years of Pliocene climate with annual resolution. Further analysis of the wood will allow the researchers to reconstruct the growing season temperatures during the Pliocene Epoch on Prince Patrick Island.



A Dalhousie University student exhumes a 3.5 million-year-old tree for sampling.



Collecting sediment samples and analyzing sedimentary structures on Prince Patrick Island, Northwest Territories

This research contributes to a long-term project to study Pliocene Arctic paleoenvironment (past environment) and landscape evolution. The results of this study will give insight into the changes that might accompany a present day climate-warming scenario with similar conditions to those that occurred during the Pliocene Epoch. The PoLAR-FIT project will help prepare northern community planners and residents for changes that may be expected with future climate warming in the Arctic.



Annual variation in tree rings are used to reconstruct past climate and provide insight into present and future climate warming.

Want to learn more?

A review of PoLAR-FIT contributions to Arctic paleoclimate and landscape change is available at www.researchgate.net/publication/316460164_PoLAR-FIT_Pliocene_landscapes_and_arctic_remains_frozen_in_time.

“We feel privileged and very fortunate to have accessed Prince Patrick Island. After attempts in previous years were thwarted by weeks of bad weather, this successful July 2017 field season resulted from the 12 months of field logistical support from the PCSP, artful flying by the pilots, and support from the Aurora Research Institute and the communities of Sachs Harbour and Ulukhaktok.”

– John Gosse

Ecosystem approach in Tremblay Sound

Marianne Marcoux (Fisheries and Oceans Canada)

Featured story location on the map: 7

The narwhal is an important cultural, economic and subsistence species for many Inuit communities in the Arctic. The narwhal, sometimes referred to as a sea unicorn, is a medium-sized whale that resides in Arctic waters and has a long distinctive tusk spiraling straight out from one of two teeth. Fisheries and Oceans Canada (DFO) is responsible for maintaining sustainable aquatic ecosystems through habitat protection, oceans management and ecosystem research. DFO monitors and sustainably manages narwhal populations, which are vulnerable to various threats, including hunting, contaminants, industrial activities and climate change. The narwhal was identified in 2004 as Special Concern by the Committee on the Status of Endangered Wildlife in Canada because of increased hunting during the 1990s for the commercially valuable tusk.

Tremblay Sound is a large channel located near Pond Inlet on northern Baffin Island, Nunavut, and is designated as a Canadian National Marine Conservation Area. Tremblay Sound supports one of the largest densities of narwhals during the summer, is a region of rich biodiversity with poorly understood food web dynamics, and is currently undergoing increases in shipping activity. Marianne Marcoux is part of the Ecosystem Approach in Tremblay Sound (EAT) project, which aims to understand the interactions and key relationships within the ecosystem, including predator-prey food web interactions and population dynamics.

The narwhal is the focus species, however, Marcoux's research investigates various marine mammals, sharks, fish and zooplankton (tiny invertebrates near the bottom of the food chain) in Tremblay Sound. This research project



Two narwhals swimming in Eclipse Sound



A field team pulls the net during narwhal tagging in Tremblay Sound, Nunavut.

is collaborative and involves universities, industry, non-profit organizations, and government, as well as the local Pond Inlet Hunter and Trapper Organization. Traditional knowledge and anecdotal evidence has indicated that narwhal populations associated with Pond Inlet and Arctic Bay may share a summer stock, where previously the regions were considered two separate stocks. A better understanding of narwhal movement between management areas and the confirmation of separate or combined populations will help to ensure the proper management of the species.

Using various methods of tagging, the team will assess the movement and behaviour of different species. During the 2017 field season, more than 40 participants took part in the EAT fieldwork and successfully captured and tagged 20 narwhals, 31 sharks, 2 ringed seals and more than 170 fish, including Arctic char, Arctic cod, fourhorn sculpin and slimy sculpin.

Did you know?

The narwhal is an important subsistence species for northern Indigenous cultures and provides food and materials for traditional lifestyles. The skin, fat and meat is consumed, and the tusks are used for carving and are an important source of income for some Inuit artists and hunters.

Tagging narwhals is a sophisticated procedure, and to ensure safety and efficiency, at least 12 people are required. While installing tags on the narwhals, the team collected tissue samples and took physiologic, stress and physical measurements (body and tusk lengths). The tissue samples were used to establish the whales' DNA profiles and to assess diet and health-related indicators.

This research is ongoing. Marcoux and the EAT team will return to Tremblay Sound to tag more animals in 2018. Tagging the whales is the most direct method to observe inter-annual variability of the animal movements and to determine if the animals are moving between management areas. This work will lead to a greater understanding of the unique ecosystem at Tremblay Sound and will help to determine if the narwhal stocks are distinct, enabling the proper management of this unique species.

Want to learn more?

Have a look at Fisheries and Oceans Canada Facebook page to learn more about their ongoing work, and search "Tremblay" to see updates about this project: www.facebook.com/FisheriesOceansCanada/.

Ecosystem monitoring on Igloodik Island, Nunavut

Marie-Andrée Giroux and Nicolas Lecomte (Université de Moncton)

Featured story location on the map: 8

Climate change and anthropogenic activities are having an impact on Arctic ecosystems and the health and abundance of various wildlife populations. Igloodik Island, off the coast of Melville Peninsula in Nunavut, is a hub of ecological activity and home to a great diversity of wildlife. In particular, there is a large population of migratory birds that reside on the island during the summer and migrate south to overwinter in warmer regions. Some small shorebirds migrate as far as South America to overwinter. The large-scale migration of birds is one of the major links between the Arctic and southern regions of the world.

Marie-Andrée Giroux and Nicolas Lecomte have collaborated on a long-term ecosystem-monitoring program on Igloodik Island since 2013. They monitor the abundance and distribution of arthropods (insects and spiders), small mammals, plants, nesting birds and predators to improve the understanding of the tundra food web. Giroux's main research focus is on the impacts of human activities on Arctic ecosystems and the resulting effects on predator-prey interactions. Lecomte's research goal is to determine the mechanisms through which climate change and food availability affect the predation and reproductive success of Arctic nesting species.

As part of the long-term monitoring program on Igloodik Island, during 2017 Giroux and Lecomte monitored predation rates, nesting success, food abundance, migratory patterns, and climate variables affecting shorebirds. Shorebird populations are in decline and of concern internationally and are an important component of the tundra ecosystem because they are prey to most tundra predators. Giroux and Lecomte also monitored the abundance of lemmings, another key prey in the tundra food web, and insects on which the shorebirds feed.

The migratory nature of shorebirds produce challenges for research and management, so Giroux and Lecomte are part of numerous international research networks that follow standardized protocols to produce comparative results at sites spread across the Arctic. Through pooling data from eight Arctic sites across Canada and Alaska, the Arctic Shorebirds Demographic Network determined migration routes and connectivity between breeding and wintering sites of semipalmated sandpipers, the shorebird species with the strongest decline in North America. Understanding the migration routes will help determine key areas for declining populations, which will guide future research to identify the driving factors for the decline.



Predation on Igloodik Island: an Arctic fox steals a goose egg.



A long-tailed jaeger on Igloolik Island whose migration path will be tracked with a geolocator

This ecosystem research project is conducted in close consultation with the Government of Nunavut and the Igloolik community. Igloolik residents have shared their valuable knowledge of the region and elders and families occasionally visit the research camp. Part of the success of this project can be attributed to the quality of the relationship between the researchers and the Igloolik community since its inception in 2013.

“Changes in the Arctic ecosystems are happening at increasing rates. Ecosystem-based research strongly rooted in collaboration and partnership with Inuit communities is the key to manage such a timely challenge.”

- Nicolas Lecomte

Indigenous and Northern Affairs Canada High Arctic land and water regulatory inspections

Jonathan Mesher and Justin Hack (Indigenous and Northern Affairs Canada)

Featured story locations on the map: 9

Water is of utmost importance to northern communities, especially to those who pursue traditional lifestyles and rely on the preservation of healthy aquatic ecosystems for subsistence. A major priority for the Government of Canada is managing water resources in the Arctic. Indigenous and Northern Affairs Canada (INAC) is responsible for governing all Crown land and water in Nunavut.

INAC enforces the regulations set forth by the Nunavut Water Board to control water use and waste disposal into or near water. The Nunavut Water Board ensures the conservation of waters in Nunavut for the benefit of northern residents in particular and to all Canadians. Any project that uses water or deposits waste within Nunavut must hold either a licence or authorization from the Nunavut Water Board. The licences include regulations on how to extract water, how much water a camp can use, where and how to deposit waste, criteria for waste being deposited and sampling protocols.

Field inspections are part of INAC's core mandate and help to ensure the proper management and protection of water resources in Nunavut. In 2017, Jonathan Mesher and Justin Hack inspected more than 70 sites across the Canadian Arctic Archipelago on Somerset, Cornwallis, Bathurst, Devon, Axel Heiberg and Ellesmere Islands. They inspected sites that ranged from municipalities, mines and exploration camps to weather stations and research and military camps, as well as any other activities that use water, deposit waste or have an impact on the ecosystem.

The field inspections took 11 days and covered about 7,300 km. Non-compliance issues include the overuse of water, storing waste inappropriately, conducting work outside of the approved area, withdrawing water from unapproved sources, and using water without a permit. If a case of non-compliance is identified, inspectors will issue written warnings and provide instructions for the proponent to come into compliance with the terms and conditions of the licences and permits.

These inspections help to protect water in Nunavut and ensure that no unauthorized waste is deposited into Arctic waters or on land that may enter the Arctic waterways. INAC inspectors are responsible to enforce legislation if a project is not following the terms or conditions in their licence. These inspections directly contribute to Government of Canada priorities through the environmental stewardship and effective management of natural resources in Nunavut.

Did you know?

The Nunavut Water Board and Indigenous and Northern Affairs Canada are authorized to license and enforce the use of Crown land and water in Nunavut under several acts and regulations, including the *Arctic Waters Pollution Prevention Act*, the *Nunavut Planning and Project Assessment Act*, the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, and the *Nunavut Waters Regulations*.



Icebergs at the head of Strand Fiord surrounded by ancient deformed rocks, Axel Heiberg Island, Nunavut

Landslides in the Caribou Hills after extreme rainfall

Christopher Burn (Carleton University) and **Steve Kokelj** (Northwest Territories Geological Survey)

Featured story location on the map: 10

Permafrost shapes much of the Arctic landscape and underlies more than a third of Canada. It is a sensitive indicator of climate change and a critical factor to consider for northern infrastructure planning. Most research into the effects of climate change on permafrost involves assessing the temperature response within the permafrost to the steady warming that has been observed throughout the Arctic. However, recent changes in precipitation have led to some significant effects on permafrost, though these factors are not yet well understood. A layer of ice is often present at the base of the active layer, which is the surface layer above the permafrost that freezes and thaws each year. Under warming conditions or periods of excess precipitation, saturation at the base of the active layer can cause a reduction in soil strength and landsliding on hillslopes.

Christopher Burn and Steve Kokelj investigate and monitor changes in permafrost conditions in relation to climate change in the western Canadian Arctic. The East Channel of Mackenzie River is a route that travellers from Inuvik use to reach the northern coast. The route passes Reindeer Station, a historic post comprised of several cabins that lies at the foot of a 10-km long escarpment rising from the river up to the Caribou Hills. Two sets of landslides have occurred along the slopes of this escarpment after periods of heavy rain in 2009 and 2017. Twenty-five landslides occurred along these hills in 2009. Burn and Kokelj are studying the conditions that lead to such extensive mass movements and the instability that climate change brings to permafrost landscapes.

During the 2017 field season, prior to the new landslides, the largest 2009 landslide track at Caribou Hills was surveyed. Following this routine visit, numerous new landslides were reported near Reindeer Station in late September 2017. Douglas Esagok, who has collaborated with Burn and Kokelj for over 20 years, visited the site and reported more than 80 new landslides visible from the East Channel. These new landslides had obliterated the track surveyed earlier in the season. In both cases, the landslides



Landslide scars from the autumn 2017 event on the East Channel of the Mackenzie River near Reindeer Station, 40 km north of Inuvik

occurred over a period of one or two days, and the events followed two of the wettest late summer seasons on record. Recent rainfall records indicate that of the wettest 16 summers since 1958, 9 have occurred since 2002. This suggests that the precipitation regime in the western Canadian Arctic may be changing and may lead to increases in the frequency of mass movement events.

Burn and Kokelj will continue to monitor the landscape of the Caribou Hills and will conduct fieldwork in the region in 2018 to investigate how climate, terrain variables and internal feedbacks have intensified landslide and thaw slump activity. As part of this investigation, they are studying the stability of the Dempster Highway and assessing its resilience to climate change. The overall goal of this research is to monitor the impacts of permafrost thaw, identify thaw-sensitive terrain, and assess risk to infrastructure built on permafrost including buildings, roads, cultural heritage sites, and oil and gas infrastructure.

“We have been aware for some time of the long-term implications of permafrost thaw for infrastructure built on permafrost, but only recently have we seen the new, recurring effects of high rainfall on the northern landscape. These pose the most immediate challenges for the sustainable maintenance of the northern highway system.”

– Christopher Burn





List of supported projects in 2017

Arctic Visit

Project lead: Sheriff Abdou
(Public Health Agency of Canada)

Location: Iqaluit (Baffin Island), Nunavut

Subproject 2: U-rich Metasomatic Processes (Targeted Geoscience Initiative 5)

Principal investigator:
Pedro Acosta-Gongora
(Natural Resources Canada)

Location: Happy Valley-Goose Bay,
Newfoundland and Labrador

Impacts of Ship-Source Air Pollutant Emissions on Lake Ecosystem Health in the Arctic

Principal investigator: Julian Aherne
(Trent University)

Location: Pond Inlet (Baffin Island),
Nunavut

Karrak Lake Assessment of Continental Efforts at Population Reduction of Light Geese

Principal investigator: Ray Alisauskas
(Environment and Climate Change Canada)

Locations: Karrak Lake and Perry River,
Nunavut

Seismic Network Renewal

Principal investigator: Calvin Andrews
(Natural Resources Canada)

Locations: Locations in New Brunswick,
Nova Scotia, Ontario, British Columbia
and Nunavut

NWT Ice Patch Monitoring Program

Principal investigator: Tom Andrews
(Prince of Wales Northern Heritage Centre)

Location: Mile 222, Northwest Territories

Environmental change in aquatic ecosystems of northern Ellesmere Island

Principal investigator: Dermot Antoniades
(Université Laval)

Location: Stuckberry Point, Nunavut

Arctic Support to British Antarctic Survey

Principal investigator: Rod Arnold
(British Antarctic Survey)

Location: Resolute (Cornwallis Island),
Nunavut

East-Central British Columbia Field Program

Principal investigator: Bill Arnott
(University of Ottawa)

Location: Headwaters of Castle Creek near
McBride, British Columbia



A curious Arctic wolf on Prince Patrick Island, Northwest Territories

Teleseismic structure of the crust and mantle beneath Banks Island, NWT

Principal investigator: Pascal Audet (University of Ottawa)

Locations: Inuvik and Ulukhaktok, Northwest Territories

Tree line dynamics and the greening of the tundra: understanding the mechanisms of these changes

Principal investigator: Jennifer Baltzer (Wilfrid Laurier University)

Location: Trail Valley Creek, Northwest Territories

Nunavut Transportation and Transmission

Principal investigator: Olivier Bellehumeur-Genier (Natural Resources Canada)

Location: Rankin Inlet, Nunavut

Passive and active microwave remote sensing for active layer soil moisture measurement

Principal investigator: Aaron Berg (University of Guelph)

Location: Trail Valley Creek, Northwest Territories

Ecology of arctic and red fox on Bylot Island

Principal investigator: Dominique Berteaux (Université du Québec à Rimouski)

Locations: Locations on Bylot Island, Nunavut

NRCan – Office of the Chief Scientist Visit Nunavut

Project lead: Rachelle Besner (Natural Resources Canada)

Locations: Cambridge Bay (Victoria Island) and Baker Lake, Nunavut

Public Hearings – Tlicho

Project lead: Rachelle Besner (Natural Resources Canada)

Location: Whati, Northwest Territories

Ecology of migratory birds in the Canadian Arctic

Principal investigator: Joël Bêty (Université du Québec à Rimouski)

Locations: Locations on Bylot Island and East Bay Island, Nunavut

Using lake sediments to track human impacts on Arctic freshwater ecosystems

Principal investigator: Jules Blais (University of Ottawa)

Locations: Bathurst Island, Little Cornwallis Island and Somerset Island, Nunavut

Landslides and Marine Geohazards

Principal investigator: Andrée Blais-Stevens (Natural Resources Canada)

Location: Lakelse Lake, British Columbia

Testing traditional and non-traditional methods to assess walrus abundance

Principal investigator: Paul Blanchfield (Fisheries and Oceans Canada)

Locations: Ivjuvik, Quebec, and Sanikiluaq, Nunavut

Nunavik Project – Development of citizens services in Nunavik Inuit communities

Principal investigator: Lorraine Boyce (Service Canada)

Location: Nunavik, Quebec

Instrument calibration at Eureka weather station as part of the Canadian Brewer Spectrophotometer Network

Principal investigator: Michael Brohart (Environment and Climate Change Canada)

Location: Eureka (Ellesmere Island), Nunavut

Paleoseismic research in Northeastern Ontario and Western Quebec

Principal investigator: Greg Brooks (Natural Resources Canada)

Locations: Kirkland Lake, Ontario, and Malartic, Quebec

Lake Ice in the Canadian High Arctic

Principal investigator: Laura Brown (University of Toronto Mississauga)

Locations: Resolute (Cornwallis Island) and Polar Bear Pass (Bathurst Island), Nunavut

State and evolution of Canada's glaciers/Essential Climate Variables – mass balance – Queen Elizabeth Islands, Nunavut and Northwest Territories

Principal investigator: David Burgess (Natural Resources Canada)

Locations: Agassiz Ice Cap and Grise Fiord (Ellesmere Island), Devon Ice Cap (Devon Island), Meighen Ice Cap (Meighen Island), Nunavut, and Melville Ice Cap (Melville Island), Northwest Territories

Permafrost and climate change, western Arctic Canada

Principal investigator: Christopher Burn (Carleton University)

Locations: Garry Island and Illisarvik, Northwest Territories



Setting up a GPS receiver on a boundary marker that marks the Yukon-Alaska border while surveying along the 141st meridian

Metallogenic investigation of the East Arm of Great Slave Lake

Principal investigator: Scott Cairns (Northwest Territories Geoscience Office)
Locations: Union Island and West Camp, Northwest Territories

Targeted Geoscience Initiative-5 Porphyry Project: Arc-related porphyry mineralization subproject activities P-1.1 and P-1.2

Principal investigator: John Chapman (Natural Resources Canada)
Locations: Horsefly, Kamloops, Likely and Prince George, British Columbia

National Public Service Week

Project lead: Stefani Chevrier (Natural Resources Canada)
Location: Ottawa, Ontario

Mass balance, dynamics and recent changes of glaciers in Kluane National Park, Yukon

Principal investigator: Luke Copland (University of Ottawa)
Locations: Kaskawulsh glacier and Quintino Sella (Mount Logan), Kluane National Park and Reserve, Yukon

Glacier monitoring on Axel Heiberg Island

Principal investigator: Luke Copland (University of Ottawa)
Location: Expedition Fiord (Axel Heiberg Island), Nunavut

GEM-2 Reconnaissance Fieldwork – Nain Labrador

Principal investigator: David Corrigan (Natural Resources Canada)
Location: Nain, Newfoundland and Labrador

Pond Inlet engagement

Principal investigator: Nicole Couture (Natural Resources Canada)
Location: Pond Inlet, Nunavut

Fieldwork in Haida Gwaii – seismic network

Principal investigator: Katherine Coyle (Natural Resources Canada)
Locations: Locations on Haida Gwaii Islands, British Columbia

FunFest and Open Doors Ottawa

Project lead: Kathryn Coyle (Natural Resources Canada)
Location: Ottawa, Ontario

Upgrading Canadian National Seismograph Network

Principal investigator: Kathryn Coyle (Natural Resources Canada)
Locations: Hope, Penticton and Vedder, British Columbia

GEM-2 Kaskattama Highlands Manitoba

Principal investigator: Jim Craven (Natural Resources Canada)
Location: Kaskattama highland region, Manitoba



The fuel cache brought in to support summer field operations on northern Ellesmere Island with a DC-3 in the background. Although old, these reliable aircraft are among the few that can operate in the harsh northern environment.

Virus-host interactions in the High Arctic

Principal investigator: Alexander Culley (Université Laval)

Locations: Ward Hunt Island and Resolute (Cornwallis Island), Nunavut

Glacial retreat and meltwater geochemistry effects on the regeneration of bryophytes resurfacing from a polar glacier, Ellesmere Island, NU

Principal investigator: Geordie Dalglish (The W. Garfield Weston Foundation)

Locations: Sverdrup Pass and Tanquary Fiord (Ellesmere Island), Nunavut

Canada-Korea-USA Marine and Coastal Geohazard Studies – 2017 Terrestrial and Marine Field Activities

Principal investigator: Scott Dallimore (Natural Resources Canada)

Location: Herschel Island, Yukon

Southern Mackenzie Surficial Mapping

Principal investigator: Stephen Day (Natural Resources Canada)

Location: west of the former Pine Point Mine, Northwest Territories

Guinea emergency management training

Project lead: Danielle Demers (Public Health Agency of Canada)

Location: Ottawa, Ontario

Investigation into the extent of slumping and its impact on landscape morphology within the Thomsen River Watershed in Aulavik National Park (NWT)

Principal investigator: Peter deMontigny (Parks Canada)

Locations: Aulavik National Park and Polar Bear Cabin (Banks Island), Northwest Territories

On ice ecology of polar bears in Hudson Bay

Principal investigator: Andrew Derocher (University of Alberta)

Location: Churchill, Manitoba

Annual Inspection and Maintenance of ECCC's network of automatic weather stations across the Arctic Archipelago

Principal investigator: Rich DeVall (Environment and Climate Change Canada)

Locations: Cape Providence (Melville Island) and Mould Bay (Prince Patrick Island), Northwest Territories, Cape Liverpool (Bylot Island), Fort Ross (Somerset Island), Isachsen (Ellef Ringnes Island), Rea Point (Melville Island), Stefansson Island, Svartevaeg (Axel Heiberg Island), Gateshead Island, Grise Fiord and Eureka (Ellesmere Island), and Pond Inlet (Baffin Island), Nunavut

Canadian Hazards Information Service Network Refurbishment

Principal investigator: Scott Dodd (Natural Resources Canada)
Locations: Locations on Haida Gwaii (Queen Charlotte Islands), British Columbia

Study of the acceleration of permafrost thawing by climate-induced changes in snow physical properties

Principal investigator: Florent Domine (Université Laval)
Location: Bylot Island, Nunavut

A comprehensive analysis of surging glacier dynamics and controls in the Yukon Territory, Canada

Principal investigator: Christine Dow (University of Waterloo)
Location: Lowell Glacier, Kluane National Park and Reserve, Yukon

Glacial Limits Western Northwest Territories

Principal investigator: Alejandra Duk-Rodkin (Natural Resources Canada)
Locations: Fort Simpson and Norman Wells, Northwest Territories

Estimating the abundance of the Gulf of Boothia polar bear subpopulation via genetic mark-recapture studies

Principal investigator: Markus Dyck (Government of Nunavut, Department of Environment)
Locations: Fort Ross and Kugaaruk, Nunavut

Estimating the abundance of polar bears in Davis Strait

Principal investigator: Markus Dyck (Government of Nunavut, Department of Environment)
Locations: Allen Island, Jackman Sound, Touak Fiord, Kimmirut, York Sound (Baffin Island), Port Burwell (Killiniq Island), Nunavut, and St. John's Harbour, Newfoundland and Labrador

Fuel cache recovery of Baffin Bay fuel caches

Principal investigator: Markus Dyck (Government of Nunavut, Department of Environment)
Locations: Cape Hunter and Illuttalik Island, Nunavut

Fuel cache clean up M'Clintock Channel

Principal investigator: Markus Dyck (Government of Nunavut, Department of Environment)
Locations: Locations along M'Clintock Channel, Nunavut

State and Evolution of Canada's Glaciers Mass Balance Northern Cordillera, Northwest Territories

Principal investigator: Mark Ednie (Natural Resources Canada)
Location: Bologna Glacier, Northwest Territories

Establishing key marine hotspots for seabirds throughout the year

Principal investigator: Kyle Elliott (McGill University)
Location: Coats Island, Nunavut

A Weather Station Network Near Cambridge Bay to Support Safe Travel and Fundamental Boundary Layer Meteorology Research

Principal investigator: Brent Else (University of Calgary)
Locations: Cambridge Bay (Victoria Island) and Qikiqtarjuaq Island, Nunavut

Active Control Station – Baker Lake 2017 Upgrades

Principal investigator: Stuart Elson (Natural Resources Canada)
Location: Baker Lake, Nunavut

Active Control Station Upgrades – Safety Equipment

Principal investigator: Stuart Elson (Natural Resources Canada)
Locations: Algonquin Provincial Park, Ontario, and Baie-Comeau, Quebec

Sirmilik National Park Operations 2017

Principal investigator: Carey Elverum
Locations: Pond Inlet (Baffin Island) and locations in Sirmilik National Park (Bylot Island and Baffin Island)

Glacial retreat and meltwater geochemistry effects on the regeneration of bryophytes resurfacing from a polar glacier, Ellesmere Island, NU

Principal investigator: John England (University of Alberta)
Locations: Sverdrup Pass and Tanquary Fiord (Ellesmere Island), Nunavut

Evaluating the Ecotoxicology of Streams Impacted by Black Shale Layers in the Mackenzie Mountains, NWT

Principal investigator: Hendrik Falck (Northwest Territories Geological Survey)
Location: Misfortune Lake, Northwest Territories

Ringed seal abundance and density in a developing Arctic

Principal investigator: Steve Ferguson (Fisheries and Oceans Canada)
Locations: Churchill, Manitoba, and Pond Inlet (Baffin Island), Nunavut

Observational constraints on glacier form and flow, southwest Yukon, Canada

Principal investigator: Gwenn Flowers (Simon Fraser University)
Location: Kaskawulsh glacier, Kluane National Park and Reserve, Yukon

Response of Arctic periglacial ecosystems to climate change

Principal investigator: Daniel Fortier (Université de Montréal)

Location: Bylot Island, Nunavut

GEO-NEIGE: Geomorphology of Northern Ellesmere Island in the Global Environment

Principal investigator: Daniel Fortier (Université de Montréal)

Locations: Ward Hunt Island and Resolute (Cornwallis Island), Nunavut

Distribution and abundance of Peary caribou and muskoxen on central Ellesmere Island

Principal investigator: Matt Fredlund (Government of Nunavut, Department of Environment)

Locations: Grise Fiord and Eureka (Ellesmere Island), Nunavut

Arctic Cultural Heritage at Risk: Climate Change Impacts on the Archaeological Record in the Western Canadian Arctic

Principal investigator: Max Friesen (University of Toronto)

Location: Kuukpak (Richards Island), Northwest Territories

Postglacial Climates of the Canadian Arctic

Principal investigator: Konrad Gajewski (University of Ottawa)

Locations: Locations on Prince of Wales Island, Nunavut

Population assessment of Dolly Varden 2017

Principal investigator: Colin Gallagher (Fisheries and Oceans Canada)

Locations: Babbage River, Yukon, Big Fish River and Rat River, Northwest Territories

Geoscience tools for supporting environmental risk assessment of metal mining

Principal investigator: Jennifer Galloway (Natural Resources Canada)

Location: North of Queen Maud Gulf Bird Sanctuary, Nunavut

Inuvik-Tuk highway groundwater activity

Principal investigator: Paul Gammon (Natural Resources Canada)

Locations: Locations along the Inuvik-Tuktoyaktuk Highway, Northwest Territories

Public Hearing in Iqaluit on the Nunavut Land Use Plan

Project lead: Amandeep Garcha (Natural Resources Canada)

Location: Iqaluit, Nunavut

Biology of bird and small tundra mammal populations: demographics, trophic interactions and climate change

Principal investigator: Gilles Gauthier (Université Laval)

Locations: Locations on Bylot Island, Nunavut

Population studies of eider ducks breeding at East Bay Island and thick-billed murre breeding at Coats Island, Nunavut

Principal investigator: Grant Gilchrist (Environment and Climate Change Canada)

Locations: Coats Island and East Bay Island, Nunavut

Connections between the Arctic and distant ecosystems through animal migrations: consequences on trophic interactions in the Arctic

Principal investigator: Marie-Andrée Giroux (Université de Moncton)

Location: Igloodik, Nunavut

Periglacial and paleoglacial investigation of the Houghton impact structure and surrounding terrains, Devon Island, Nunavut

Principal investigator: Etienne Godin (University of Western Ontario)

Location: Houghton River Valley (Devon Island), Nunavut

Stikinia Bedrock

Principal investigator: Martyn Golding (Natural Resources Canada)

Location: Favret Canyon, Nevada

PoLAR-FIT Project: Prince Patrick Island paleoclimatology, paleoenvironment, and chronostratigraphy

Principal investigator: John Gosse (Dalhousie University)

Location: Prince Patrick Island, Northwest Territories

Tectonics of the Pearya Terrane, north Ellesmere Island

Principal investigator: Stephen Grasby (Natural Resources Canada)

Locations: Borup Fiord Strip, Otto Fiord and Yelverton Inlet (Ellesmere Island), Nunavut

Rock collection relocation project – Tunney's Pasture

Principal investigator: Alain Grenier (Natural Resources Canada)

Location: Ottawa, Ontario

CryoSat Validation Experiment (CryoVEx)

Principal investigator: Christian Haas (York University)

Locations: Alert and Eureka (Ellesmere Island), Nunavut



Parks Canada staff collect bees for a species at risk inventory supported by the PCSP in Kluane National Park and Reserve, Yukon.

Field Inspections – summer 2017

Principal investigators: Justin Hack and Jonathan Mesher (Indigenous and Northern Affairs Canada)
Locations: Locations across the Arctic Archipelago, Nunavut

Western Arctic Fieldwork

Principal investigator: Thomas Hadlari (Natural Resources Canada)
Location: Yelverton Inlet (Ellesmere Island), Nunavut

Onshore stratigraphic studies, northwest Baffin Bay

Principal investigator: Jim Haggart (Natural Resources Canada)
Locations: Bylot Island and Pond Inlet (Baffin Island), Nunavut

Assessment of changes in hydroecological conditions and metal concentrations in lakes of the Peace-Athabasca Delta using novel periphyton samplers

Principal investigator: Roland Hall (University of Waterloo)
Location: Fort Chipewyan, Alberta

Old rocks in a new light: Integrating the ca. 1.1 Ga Bylot Supergroup's tectonic history and records of environmental change in the context of new age constraints

Principal investigator: Galen Halverson (McGill University)
Locations: Bylot Island, Fabricius Fiord, Nunatsiaq Point and White Bay (Baffin Island), Nunavut

WestLine Maintenance 2017 – International Boundary Commission

Principal investigator: Joe Harrietha (Natural Resources Canada)
Locations: Dawson, Yukon, and the Quebec border with Maine, Vermont and New York

Species and ecosystem constraints on increasing vegetation cover in the High Arctic in a warming climate

Principal investigator: Greg Henry (University of British Columbia)
Locations: Alexandra Fiord and Sverdrup Pass (Ellesmere Island) and Princess Marie Bay (Axel Heiberg Island), Nunavut

Amauti acquisition and film production – Canada Science and Technology Museum

Project lead: Carolyn Holland (Canada Science and Technology Museum)
Location: Inukjuak, Quebec



Sampling a relict ice wedge exposed on the north coast of Pelly Island, Northwest Territories

Development of community-based monitoring for aquatic invasive species (AIS) in the Canadian Arctic – preparing for increased shipping related to resource development and climate change

Principal investigator: Kimberly Howland (Fisheries and Oceans Canada)

Location: Milne Inlet (Baffin Island), Nunavut

Ecology and Behaviour of High Arctic Wolves

Principal investigators: Jonnie Hughes (Perfect Planet Productions) and Dan MacNulty (Utah State University)

Locations: Locations near Eureka (Ellesmere Island), Nunavut

Atmospheric Deposition

Principal investigator: Philippa Huntsman-Mapila (Natural Resources Canada)

Location: Goldenville, Nova Scotia

Suspended sediments and climate change project

Principal investigator: Philippa Huntsman-Mapila (Natural Resources Canada)

Locations: Goldenville Mine and Stirling Mine, Nova Scotia

Exhibitions in Montreal, Forillon and Quebec for GSC @ 175

Principal investigator: Nathalie Jacob (Natural Resources Canada)

Locations: Montréal, Quebec, and Forillon National Park, Quebec

Repeater Tower Sites to Support SAR in Arctic Bay

Principal investigator: Deborah Johnson (Hamlet of Arctic Bay)

Location: Arctic Bay, Nunavut

Fishing Branch River Chum Salmon Habitat Assessments

Principal investigator: William Josie (Vuntut Gwitchin Government)

Location: Eagle Plains, Yukon

Inuvik satellite station energy audit

Principal investigator: Martin Kegel (Natural Resources Canada)

Location: Inuvik, Northwest Territories

Cape Breton Island fieldwork 2017

Principal investigator: Dawn Kellett (Natural Resources Canada)

Location: Cape Breton Island, Nova Scotia

Evaluating the role of snow microstructure on radar backscatter and phase response at multiple frequencies in an arctic environment

Principal investigator: Richard Kelly (University of Waterloo)

Location: Trail Valley Creek, Northwest Territories

Collaborative Central Slave Province Volcanogenic Massive Sulphide (VMS) Project

Principal investigator: Bernadette Knox (Northwest Territories Geological Survey)

Locations: Beaulieu River and Sunset Lake, Northwest Territories

Structural study on the evolution of the Beaulieu River fault system, Slave Province with emphasis on local mineral endowment

Principal investigator: Bernadette Knox (Northwest Territories Geological Survey)
Locations: Itchen Lake and Point Lake, Northwest Territories

Integrated methods to monitor permafrost geohazards, northwestern NWT

Principal investigator: Steve Kokelj (Northwest Territories Geological Survey)
Locations: Fort McPherson and Inuvik, Northwest Territories

Long-term perspectives on aquatic ecosystem change with thawing permafrost

Principal investigator: Jennifer Korosi (York University)
Location: Inuvik, Northwest Territories

Winter survival training support

Project lead: Raffi Kuyumjian (Canadian Space Agency)
Location: Star City area, Russia

Climate and permafrost change impacts on land and water in the High Arctic: integrated research at the Cape Bounty Arctic Watershed Observatory (CBAWO)

Principal investigator: Scott Lamoureux (Queen's University)
Location: Cape Bounty (Melville Island), Nunavut

Vegetation Change in the Western Arctic

Principal investigator: Trevor Lantz (University of Victoria)
Locations: Sachs Harbour (Banks Island) and Inuvik, Northwest Territories

Greenhouse gas emissions from Arctic lakes: process accelerating the mineralization of organic matter released by melting permafrost

Principal investigator: Isabelle Laurion (Institut national de la recherche scientifique, Centre Eau Terre Environnement)
Locations: Locations on Bylot Island, Nunavut

Geological Survey of Canada – South African Abitibi Fieldtrip

Project lead: Christopher Lawley (Natural Resources Canada)
Locations: Chicoutimi, Quebec, and Timmins, Ontario

Targeted Geoscience Initiative-5 Mantle Metal Mobility

Principal investigator: Christopher Lawley (Natural Resources Canada)
Location: Atlin, British Columbia

Targeted Geoscience Initiative-5 Proterozoic Gold

Principal investigator: Christopher Lawley (Natural Resources Canada)
Location: Lynn Lake, Manitoba

Survival in Arctic Geese (Perry River, Queen Maud Gulf Bird Sanctuary)

Principal investigator: Jim Leafloor (Environment and Climate Change Canada)
Location: Perry River, Nunavut

Baffin Island Goose Banding and Habitat Monitoring

Principal investigator: Jim Leafloor (Environment and Climate Change Canada)
Location: Nikko Island, Nunavut

Southampton Island Goose Banding and Habitat Monitoring

Principal investigator: Jim Leafloor (Environment and Climate Change Canada)
Location: Coral Harbour (Southampton Island), Nunavut

ARCTIC IMPACT: Arctic Integrative Monitoring of Predators in the Arctic Tundra

Principal investigator: Nicolas Lecomte (Université de Moncton)
Locations: Bylot Island and Igloodik area (Igloodik Island), Nunavut

Population dynamics of Greater Snow Geese in relation to habitat

Principal investigator: Josée Lefebvre (Environment and Climate Change Canada)
Location: Bylot Island, Nunavut

Climate Change Impacts on Mercury and Methylmercury Sources to Arctic Ecosystems

Principal investigator: Igor Lehnher (University of Toronto-Mississauga)
Location: Lake Hazen (Ellesmere Island), Nunavut

Gascoyne Inlet Underwater Acoustic Array Power and Energy System

Principal investigator: Michael Leonard (Natural Resources Canada)
Location: Gascoyne Inlet, Nunavut

Limnology and Biogeochemistry of Arctic Delta Lakes

Principal investigator: Lance Lesack (Simon Fraser University)
Location: Inuvik, Northwest Territories

Climate dynamics and sensitivity of a High Arctic ecosystem: energy, water and carbon fluxes within the soil-vegetation-snow-atmosphere continuum.

Principal investigator: Esther Lévesque (Université du Québec à Trois-Rivières)
Location: Bylot Island, Nunavut

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

Principal investigator: Oliver Love (University of Windsor)

Location: East Bay Island, Nunavut

Mackenzie-Selwyn Geo-transect

Principal investigator: Robert MacNaughton (Natural Resources Canada)

Locations: Goober Lake and Misfortune Lake, Northwest Territories

Canadian Arctic Underwater Sentinel Experimentation (CAUSE) Project

Principal investigator: Erin MacNeil (Defence Research and Development Canada)

Location: Gascoyne Inlet (Devon Island), Nunavut

Contaminant and population research on high Arctic marine birds

Principal investigator: Mark Mallory (Acadia University)

Location: Prince Leopold Island, Nunavut

Tracking Arctic terns and Sabine's Gulls

Principal investigator: Mark Mallory (Acadia University)

Location: Tern Island, Nunavut

Preservation of organic matter in early diagenetic chert

Principal investigator: Ashley Manning-Berg (University of Tennessee)

Location: White Bay (Baffin Island), Nunavut

Cumberland Sound narwhal population aerial survey

Principal investigator: Marianne Marcoux (Fisheries and Oceans Canada)

Locations: Pangnirtung (Baffin Island) and Cumberland Sound, Nunavut

Tremblay Sound Narwhal Tagging

Principal investigator: Marianne Marcoux (Fisheries and Oceans Canada)

Location: Tremblay Sound (Baffin Island), Nunavut

Hydrological Studies of the Mackenzie Delta Region

Principal investigator: Philip Marsh (Wilfrid Laurier University)

Location: Trail Valley Creek, Northwest Territories

Casino Cu-Au-Mo-Ag Deposit Indicator Mineral Study (TGI5)

Principal investigator: Martin McCurdy (Natural Resources Canada)

Location: Western Yukon

Hydrological and Ecological Research in Vuntut National Park, Yukon

Principal investigator: Ian McDonald (Parks Canada)

Location: Old Crow, Yukon

Synthesis of Glacial History and Dynamics in the Rae Geological Province

Principal investigator: Isabelle McMartin (Natural Resources Canada)

Locations: Arviat and Baker Lake, Nunavut

Lichens of the High Arctic

Principal investigator: Troy McMullin (Canadian Museum of Nature)

Locations: Resolute (Cornwallis Island), Fosheim Peninsula and Lake Hazen (Ellesmere Island), and Axel Heiberg Island, Nunavut

Darnley Bay Nearshore Survey – coastal fishes and habitat associations

Principal investigator: Darcy McNicholl (Fisheries and Oceans Canada)

Location: Darnley Bay, Northwest Territories

Hazardous Sea Ice in the Canadian Archipelago 2009–2017

Principal investigator: Humfrey Melling (Fisheries and Oceans Canada)

Location: Resolute (Cornwallis Island), Nunavut

Under-ice Monitoring of the Northwest Passage

Principal investigator: Christine Michel (Fisheries and Oceans Canada)

Location: Resolute (Cornwallis Island), Nunavut

Enumeration of Chum Salmon on the Fishing Branch River (2017)

Principal investigator: Nathan Millar (Fisheries and Oceans Canada)

Location: Dawson, Yukon

Rapid Landscape Evolution at the Permafrost-Glacier Interface

Principal investigator: Brian Moorman (University of Calgary)

Location: Bylot Island, Nunavut

Dynamics and habitat use by lemmings under climate change

Principal investigator: Douglas Morris (Lakehead University)

Locations: Cambridge Bay (Victoria Island) and Walker Bay, Nunavut

GSC 175th Celebration

Project lead: Peter Morse (Natural Resources Canada)

Location: Ottawa, Ontario

Permafrost and Terrain Research for the Inuvik to Tuktoyaktuk Highway Infrastructure Corridor

Principal investigator: Peter Morse (Natural Resources Canada)

Locations: Inuvik and Tuktoyaktuk, Northwest Territories



Preparing an ice core drill to retrieve another metre of core on the Mount Oxford plateau, northern Ellesmere Island, Nunavut



GEM-2 Sanagak Lake geoscience camp on Boothia Peninsula, Nunavut

Mine site visit

Principal investigator: Saviz Mortazavi
(Natural Resources Canada)

Location: Musselwhite Mine, Ontario

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

Principal investigator: Derek Mueller
(Carleton University)

Locations: Milne Ice Shelf and Purple
Valley (Ellesmere Island), Nunavut

Investigating potential effects of climate warming on trends of mercury and persistent organic pollutants in Arctic aquatic and terrestrial environments

Principal investigator: Derek Muir
(Environment and Climate Change Canada)

Locations: Cape Bounty (Melville Island)
and Resolute (Cornwallis Island), Nunavut

Aircraft support for Auyuittuq National Park Operations and Research

Principal investigator: Mathew Nauyuq
(Parks Canada)

Locations: Penny Ice Cap and locations
near Pangnirtung (Baffin Island), Nunavut

Effects of overabundant arctic geese on other tundra nesting birds

Principal investigator: Erica Nol
(Trent University)

Location: East Bay Mainland
(Southampton Island), Nunavut

Permafrost research and thermistor borehole installation, Western Hudson Bay

Principal investigator: Greg Oldenborger
(Natural Resources Canada)

Locations: Rankin Inlet, Nunavut

A Multidisciplinary Investigation of Salt Diapirs on Axel Heiberg Island, Nunavut

Principal investigator: Gordon Osinski
(University of Western Ontario)

Locations: Lost Hammer Spring and South
Fiord Dome (Axel Heiberg Island), Nunavut

Sustaining hydroecological monitoring to assess state of the park in Wapusk National Park, Manitoba – 2017

Principal investigator: Chantal Quimet
(Parks Canada)

Locations: Locations in Wapusk National
Park, Manitoba

NATO Parliamentary Association – Sub-Committee on Transatlantic Economic Relations and Science and Technology Committee

Project lead: Jean-François Pagé
(House of Commons)

Location: Resolute (Cornwallis Island),
Nunavut

Summer 2017 – Provision of Ice Specialist to CCGS Des Groseilliers

Principal investigator: Denis Paquette (Environment and Climate Change Canada)
Location: Resolute (Cornwallis Island), Nunavut

Sedimentary exhalative and Mississippi Valley-type deposits of the Canadian Cordillera

Principal investigator: Suzanne Paradis (Natural Resources Canada)
Location: Northern British Columbia

Geoenvironmental characteristics of Canadian critical metal deposits

Principal investigator: Michael Parsons (Natural Resources Canada)
Location: Oka, Quebec

South Mackenzie Surficial

Principal investigator: Roger Paulen (Natural Resources Canada)
Location: South Mackenzie River, Northwest Territories

Geo-environmental study of St. Lawrence Columbian Mine

Principal investigator: Jeanne Percival (Natural Resources Canada)
Location: Oka, Quebec

Assessment of Dolly Varden from Firth River and Joe Creek in Ivvavik National Park of Canada

Principal investigator: Nelson Perry (Parks Canada)
Locations: Firth River, Fish Creek, Joe Creek and Sheep Creek, Yukon

Origin of hyper enriched black shale Ni-PGE deposits, Yukon Territory

Principal investigator: Jan Peter (Natural Resources Canada)
Location: Eagle Plains, Yukon

Surveying and maintenance of the international border

Principal investigator: Joël Petit (Natural Resources Canada)
Location: Beauce, Quebec

Evolution of postglacial landscapes and hydrological gateways in the Foxe Basin – Nettilling Lake region, Nunavut

Principal investigator: Reinhard Pienitz (Université Laval)
Location: Igloodik, Nunavut

CASE 19 Pearya

Principal investigator: Karsten Piepjohn (Federal Institute for Geosciences and Natural Resources (BGR), Germany)
Locations: Stenkul Fiord, Wootton Peninsula, and Yelverton Inlet (Ellesmere Island), Nunavut

Gold prospect study in the Rackla Belt

Principal investigator: Nicolas Pinet (Natural Resources Canada)
Locations: Locations in north-central Yukon

A paleoecological perspective of fire and drought in the Northwest Territories from lakes and trees

Principal investigator: Michael Pisaric (Brock University)
Location: Yellowknife, Northwest Territories

Indicator minerals of porphyry deposits

Principal investigator: Alain Plouffe (Natural Resources Canada)
Locations: Locations near Kamloops, British Columbia

Grand-Remous, Boischatel and St-Jean-des-Piles Seismic Station Civil Work

Principal investigator: Daniel Poirier (Natural Resources Canada)
Locations: Grand-Remous, Boischatel and St-Jean-Des-Piles, Quebec

McGill Arctic Research Station (MARS) Science Program

Principal investigator: Wayne Pollard (McGill University)
Locations: Expedition Fiord (Axel Heiberg Island) and Resolute Bay (Cornwallis Island), Nunavut

The Vulnerability of High Arctic Permafrost to Climate Change

Principal investigator: Wayne Pollard (McGill University)
Location: Eureka (Ellesmere Island), Nunavut

The last ~11,700 years of winter temperatures and atmospheric mercury recorded in ice wedges in the Mackenzie Delta region

Principal investigator: Trevor Porter (University Of Toronto Mississauga)
Locations: Anderson Plain, Tuktoyaktuk, Inuvik, Husky Lakes, Garry Island, and Richards Island, Northwest Territories

Targeted Geoscience Initiative – metasomatic ore systems

Principal investigator: Eric Potter (Natural Resources Canada)
Location: Happy Valley-Goose Bay, Newfoundland and Labrador

Geological Survey of Canada: 175th Anniversary – Open House Exhibit, GSC/Atlantic

Project lead: Patrick Potter (Natural Resources Canada)
Location: Dartmouth, Nova Scotia

The influence of landscape condition on biotic production in a warming environment

Principal investigator: Roberto Quinlan (York University)

Location: Inuvik, Northwest Territories

A field laboratory for energy and mass exchange at glacier surfaces

Principal investigator: Valentina Radic (University of British Columbia)

Location: Kaskawulsh glacier, Kluane National Park and Reserve, Yukon

Dismal Lakes-Coppermine River Transect

Principal investigator: Robert Rainbird (Natural Resources Canada)

Locations: Dismal Lakes, Coppermine River, Bloody Fall, and Kendall River, Nunavut, and Dease Lake, Northwest Territories

Arctic Shorebird Monitoring Program (Arctic PRISM) – Tier 1 surveys

Principal investigator: Jennie Rausch (Environment and Climate Change Canada)

Locations: Paulatuk and Yellowknife, Northwest Territories, and Back Hermann, Igloodik and Tree River, Nunavut

Population studies of shorebirds at Nanuit Itillinga Polar Bear Pass National Wildlife Area, Nunavut (Arctic PRISM Tier 2 Site)

Principal investigator: Jennie Rausch (Environment and Climate Change Canada)

Location: Polar Bear Pass (Bathurst Island), Nunavut

Fuel cache clean-up for Aerial Surveys of Pacific Common Eiders in the central Canadian Arctic

Principal investigator: Eric Reed (Environment and Climate Change Canada)

Location: Cambridge Bay (Victoria Island), Nunavut

Integrating Fixed-Wing and Helicopter Surveys to Improve Detection and Species Identification of Breeding Scoters

Principal investigator: Eric Reed (Environment and Climate Change Canada)

Locations: Lynx Lake and Yellowknife, Northwest Territories, and Churchill, Manitoba

Western Arctic Snow Goose Management

Principal investigator: Eric Reed (Environment and Climate Change Canada)

Locations: Sachs Harbour and Siksik Lake (Banks Island), and Inuvik, Northwest Territories

International Boundary Commission Fieldwork in the Highlands of Quebec

Principal investigator: Rodger Reid (Natural Resources Canada)

Location: St. George, Quebec

Coronation Gulf Chars: essential elements of diversity, habitats and conservation in northern sea-run fishes

Principal investigator: Jim Reist (Fisheries and Oceans Canada)

Locations: Locations near Kugluktuk, Nunavut

Atmospheric deposition of fugitive dust in aquatic lakes

Principal investigator: Carrie Rickwood (Natural Resources Canada)

Location: Malartic, Quebec

Suspended particulates

Principal investigator: Carrie Rickwood (Natural Resources Canada)

Location: Malartic and Rouyn-Noranda area, Quebec

Assessing groundwater vulnerability to shale gas activities in the Sussex area, southern New Brunswick

Principal investigator: Christine Rivard (Natural Resources Canada)

Location: Sussex, New Brunswick

GEM-2 Cordilleran Project – Crustal Structure Southeast Yukon

Principal investigator: Jim Ryan (Natural Resources Canada)

Location: Whitehorse and Francis Lake, Yukon

GEM-2 Boothia-Somerset: Integrated Geoscience along the Northwest Passage

Principal investigator:

Mary Sanborn-Barrie (Natural Resources Canada)

Location: Sanagak Lake, Nunavut

GEM-2 North Baffin Bedrock Mapping

Principal investigator: Benoit Saumur (Natural Resources Canada)

Location: Pond Inlet (Baffin Island), Nunavut

Watershed biogeochemical changes in Arctic environments under a changing climate

Principal investigator: Sherry Schiff (University of Waterloo)

Locations: Lake Hazen and Eureka (Ellesmere Island) and Axel Heiberg Island, Nunavut

Observational constraints on glacier sliding and subglacial hydrology

Principal investigator: Christian Schoof (University of British Columbia)

Location: Kaskawulsh glacier, Kluane National Park and Reserve, Yukon

National Aerial Surveillance Program (NASP)

Principal investigator: David Scott (Transport Canada)

Location: Resolute (Cornwallis Island), Nunavut

The Global Microbiome Library: Preserving and Understanding the Inuit Microbial Heritage

Principal investigator: Jesse Shapiro (Université de Montréal)

Location: Resolute (Cornwallis Island), Nunavut

Dynamics and Change of Canadian Arctic Ice Caps

Principal investigator: Martin Sharp (University of Alberta)

Locations: Devon Ice Cap (Devon Island) and Lake Hazen (Ellesmere Island), Nunavut

Canadian Geodetic Survey gravity and GPS fieldwork

Principal investigator: Jason Silliker (Natural Resources Canada)

Locations: Locations in every province and territory in Canada

Qausuittuq National Park – Operations 2017

Principal investigator: Jovan Simic (Parks Canada)

Locations: Locations on Bathurst Island, Nunavut

Remote Sensing Program – Rocky landslide monitoring

Principal investigators: Vern Singhroy and François Charbonneau (Natural Resources Canada)

Location: Gaspésie, Quebec



Sampling Dolly Varden char in the Firth River, Yukon

Population studies of shorebirds at East Bay Mainland and Prince Charles Island, Nunavut

Principal investigators: Paul Smith and Jennie Rausch (Environment and Climate Change Canada)
Locations: East Bay Mainland (Southampton Island) and Prince Charles Island, Nunavut

GEM Western Arctic Margins

Principal investigator: Rod Smith (Natural Resources Canada)
Location: Sachs Harbour (Banks Island), Northwest Territories

Changing permafrost conditions in the Mackenzie Valley

Principal investigator: Sharon Smith (Natural Resources Canada)
Locations: Fort Simpson, Norman Wells and Inuvik, Northwest Territories

Van Tat Gwich'in Historic Lifeways Project

Principal investigator: Shirleen Smith (Vuntut Gwitchin Government)
Locations: Northeast Van Tat Timber Creek and near Mount Sittichinli, Yukon

Eddy covariance measurements of carbon, water and energy fluxes along a latitudinal permafrost gradient across the Taiga Plains, Northwest Territories

Principal investigator: Oliver Sonntag (Université de Montréal)
Locations: Scotty Creek, Smith Creek and Trail Valley Creek, Northwest Territories

Geomagnetic Observatory Alert

Principal investigator: Benoît St-Louis (Natural Resources Canada)
Location: Alert, Nunavut



Sampling bedrock for surface exposure dating to determine the age of the post-glacial marine limit, Kivalliq Region, mainland Nunavut



A muskox on Herschel Island, Yukon

The Lake Hazen watershed as a sentinel of Arctic environmental change

Principal investigator: Vincent St. Louis (University of Alberta)

Location: Lake Hazen (Ellesmere Island), Nunavut

Targeted bedrock mapping in the Tehery Lake-Wager Bay region, northwestern Hudson Bay, Nunavut

Principal investigator: Holly Steenkamp (Canada-Nunavut Geoscience Office)

Locations: Locations near Northwestern Hudson Bay, Nunavut

Land-water linkages and the fate of terrestrial carbon in aquatic ecosystems of the western Canadian Arctic

Principal investigator: Suzanne Tank (University of Alberta)

Locations: Inuvik and Fort McPherson, Northwest Territories

Producing an accurate forage quality map for barren-ground caribou using drone and satellite images

Principal investigator: David Tavares (Parks Canada)

Location: Uyarsivik Lake, Northwest Territories

Green Mines Green Energy

Principal investigator: Bryan Tisch (Natural Resources Canada)

Location: Sudbury, Ontario

Winter survival training for C3 in Star City, Russia

Project lead: Leena Tomi (Canadian Space Agency)

Location: Star City area, Russia

Fury and Hecla Geoscience Project

Principal investigator: Tommy Tremblay (Canada-Nunavut Geoscience Office)

Location: Igloodik, Nunavut

Fingerprinting fertile fluid corridors in the formation of unconformity-related uranium deposits

Principal investigator: Victoria Tschirhart (Natural Resources Canada)

Locations: Locations in Saskatchewan

Evaluating impacts of climate-induced land cover change and permafrost slumping on water and carbon balance in Old Crow Flats, Yukon

Principal investigator: Kevin Turner (Brock University)

Location: Old Crow, Yukon

Energy East Pipeline

Principal investigator: Erika Uchmanowicz (Natural Resources Canada)

Locations: Sault Ste. Marie and Kapuskasing, Ontario



Installing an inverted funnel in a polygonal pond of the Qarlikturvik Valley in Sirmilik Park, Bylot Island, to measure the methane that is released from the pond sediments and contributes to the greenhouse effect

**Quttinirpaaq National Park
Operating Season 2017 &
Federal Infrastructure Initiative**

Principal investigator: Emma Upton
(Parks Canada)

Locations: Lake Hazen, Fort Conger,
Mount Barbeau and Tanquary Fiord
(Ellesmere Island), and Ward Hunt Island,
Nunavut

**Northern Ellesmere Island in
the Global Environment –
Northern Frontier**

Principal investigator: Warwick Vincent
(Université Laval)

Locations: Ward Hunt Island and Resolute
(Cornwallis Island), Nunavut

Intraplate Earthquake Geohazards

Principal investigator: Baolin Wang
(Natural Resources Canada)

Locations: Breckenridge and Low, Quebec

**Coastal Dynamics under the
Climate Change Geoscience
Program**

Principal investigator: Dustin Whalen
(Natural Resources Canada)

Locations: Tuktoyaktuk, Toker Point,
Pullen Island, Pelly Island, East Whitefish,
McKinley Bay and Crumbling Point,
Northwest Territories

**The acceleration of coastal change
and its effect on nearshore
sediment dynamics and ecosystems**

Principal investigator: Dustin Whalen
(Natural Resources Canada)

Locations: Inuvik and Tuktoyaktuk,
Northwest Territories

**Satellite Monitoring for Assessing
Resource Development’s Impact on
Bathurst Caribou (SMART)**

Principal investigator: H. Peter White
(Natural Resources Canada)

Location: Ekati Mine, Northwest Territories

**Microbial investigations of
permafrost and cold saline springs
in the high Arctic**

Principal investigator: Lyle Whyte
(McGill University)

Location: Expedition Fiord (Axel Heiberg
Island), Nunavut

**Lakes of the Peace-Athabasca
Delta: hydrology, paleohydrology and
contaminant depositional history**

Principal investigator: Brent Wolfe
(Wilfrid Laurier University)

Location: Fort Chipewyan, Alberta

Abrupt Permafrost Changes Within the Discontinuous Permafrost Zone

Principal investigator: Stephen Wolfe (Natural Resources Canada)

Location: Yellowknife and Great Slave region, Northwest Territories

Searching for Species at Risk in Kluane National Park and Reserve

Principal investigator: Carmen Wong (Parks Canada)

Locations: Fisher Glacier, Hoodoo Mountain and Kaskawulsh Glacier Area, Yukon

2017 Ukkusiksalik National Park Operations

Principal investigator: Monty Yank (Parks Canada)

Locations: Douglas Harbour, Repulse Bay, Sila Lodge, Snowbank and Wager Bay, Nunavut

Detection of contaminants in High Arctic ice cores

Principal investigator: Cora Young (Memorial University)

Location: Grant Ice Cap (Ellesmere Island), Nunavut

Stikinia Bedrock

Principal investigator: Alex Zagorevski (Natural Resources Canada)

Locations: Atlin, British Columbia, and Whitehorse, Yukon

Sources-Environmental Geosciences Program

Principal investigator: James Zheng (Natural Resources Canada)

Location: Location near Fort McMurray, Alberta

Canadian Armed Forces Arctic Training Centre (CAFATC) training activities based in Resolute (Cornwallis Island), Nunavut, in 2017:

- Canadian Forces School of Survival and Aeromedical Training
- Canadian Forces School of Search and Rescue Course
- Joint Task Force North – Nunavut 17
- CAFATC Winter and Summer Reconnaissance
- NOREX 17
- Joint Task Force North – Operation NEVUS
- Canadian Armed Forces Arctic Training Centre Support Group



Releasing a group of Snow Geese on Bylot Island with the Canadian Wildlife Service biologist



Annex

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 four criteria: feasibility of the requested logistics; quality of the application; scientific recognition of the applicant; 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 2017

Maribeth Murray (Chair)

Department of Anthropology
and Archaeology
University of Calgary

Michael Kristjanson

Polar Continental Shelf Program
Natural Resources Canada

Johann Wagner

Polar Knowledge Canada

Christopher Burn

Department of Geography and
Environmental Studies
Carleton University

Roger Paulen

Geological Survey of Canada
Natural Resources Canada



Installing a weather station in Qausuittuq
National Park, Bathurst Island, Nunavut