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Polar Continental Shelf Program
SCIENCE REPORT
2011 | 2012

Logistical support for leading-edge scientific research in the Canadian Arctic

Canada

Polar Continental Shelf Program
Science Report 2011–2012

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Cover Photograph: Fly camp at Alexandra Fiord, Nunavut.
Table of Contents photograph: Hoodoos on Bylot Island are a Ski-Doo and qamutiik ride away from Pond Inlet, Nunavut.

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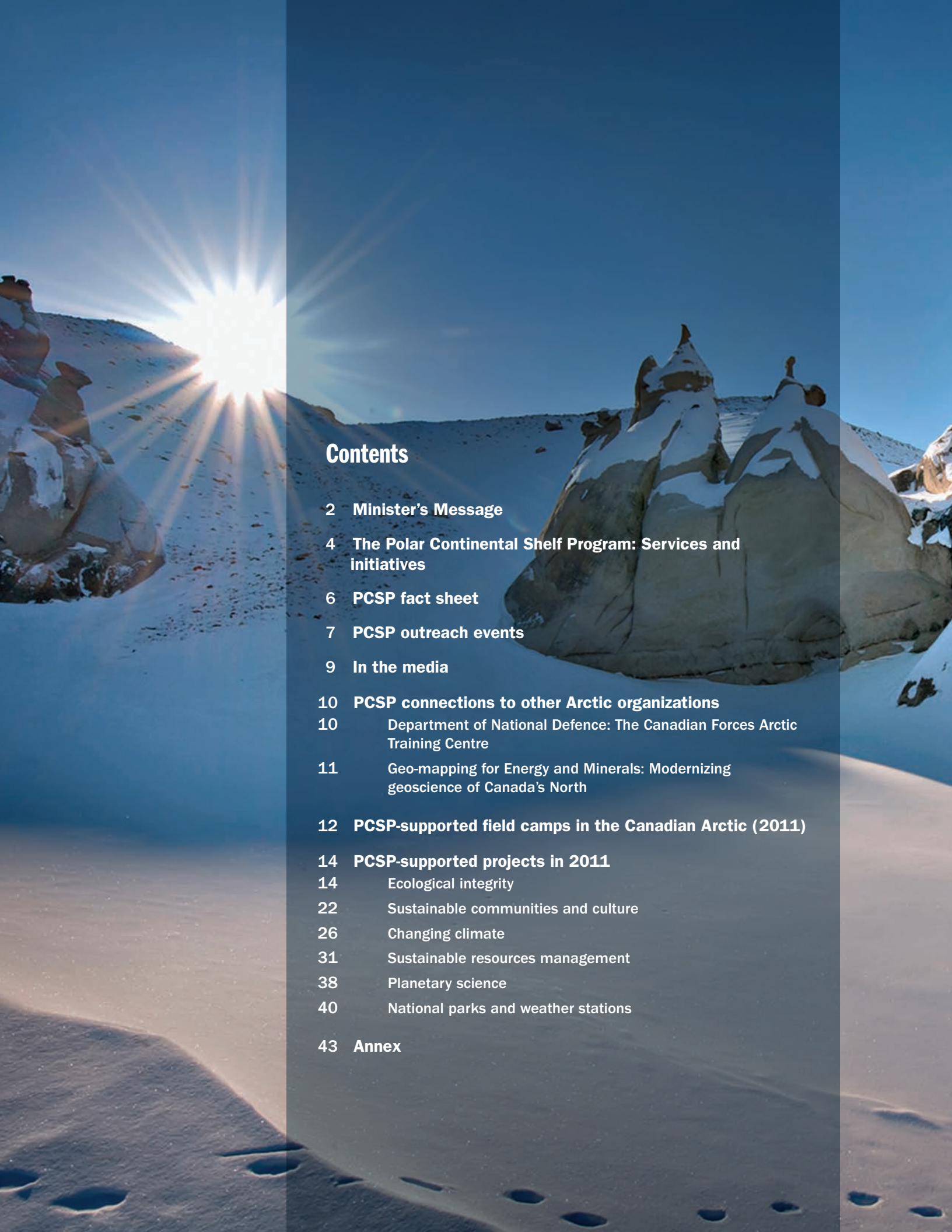

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Shoreline en route to Devon Island, Nunavut

Minister's Message

It is my pleasure to introduce the 2011-2012 Polar Continental Shelf Program (PCSP) Science Report. Since its inception in 1958, the PCSP has served as a catalyst for Arctic science. By providing safe, specialized and cost-effective logistical support, the PCSP is facilitating the collection of scientific knowledge necessary to better understand the geography of our country and make informed policy decisions.

In Budget 2009, our government invested millions through Canada's Economic Action Plan to upgrade key existing Arctic research facilities, including PCSP's operations in Resolute Bay, Nunavut. Northern logistical support services are now based out of a newly renovated and upgraded facility, featuring 5000 square metres of living accommodation, laboratory space, office space and a warehouse/operations centre. The facility has been undergoing further expansion so that it may host the Canadian Forces Arctic Training Centre program beginning this summer. This partnership between my department and the Department of National Defence will greatly benefit the scientific community by allowing the facility to operate during the winter months, expanding the amount of available accommodations, as well as increasing the storage and working space.

The PCSP's expertise is vital to the long-term prosperity of northern communities. For the past five years, the program has provided logistical support to Natural Resources Canada's Geo-mapping for Energy and Minerals program as they mapped the geology of the North to identify areas of highest resource potential. These detailed geological maps will allow northern communities to make informed decisions about their future economy and society, while simultaneously helping the private sector make strategic exploration investment decisions in new energy and mineral resources in Canada's Arctic.

The PCSP will also be providing logistical support to the Canadian High Arctic Research Station whose science program is currently being developed by Aboriginal Affairs and Northern Development Canada. The world-class research station, expected to be operational in 2017, will be on the cutting edge of Arctic science, addressing areas such as environmental science and resource development.

With a strong network that stretches from the Yukon-Alaska border to Greenland and from below the Arctic Circle to the geographic North Pole, the PCSP's presence in the Arctic is ever growing.

To ensure cooperation between federal departments and the maximization of resources, the PCSP has established a strong partnership with ArcticNet, a network of centres of excellence funded by the Government of Canada, which enhances capacity for northern research.

Our Government has made the North one of its top priorities. Through our Northern Strategy, we are working to ensure it achieves its true promise as a healthy, prosperous region within a strong and sovereign Canada.

Sincerely,

The Honourable Joe Oliver, P. C, M.P.
Minister of Natural Resources

ᒥᓂᔅᑕᐅᑉ ᑐᓴᕐᑲᓯᐊᖏᑦ – ᓄᓇᕐᔪᐊᑉ ᐅᐊᖕᓇᐅᓂᖅᐹᖓᓂ ᓄᓇᐃᑦ ᐊᒻᒪᓗ ᐃᖃᖓᓃᑦᑐᑦ ᓄᓇᐃᑦ ᐃᒪᕐᓂ ᖃᐅᔨᓴᖅᑕᐅᓂᖏᓐᓄᑦ ᐅᓂᒃᑳᓕᐊᑦ 2011–2012

ᖁᕙᐊᓱᒃᑐᖓ ᑐᓂᔪᓐᓇᕋᒪ 2011-2012–ᒥᓗ ᓄᓇᕐᔪᐊᑉ ᐅᐊᖕᓇᐅᓂᖅᐹᖓᓂᒃ ᓄᓇᐃᑦ ᐊᒻᒪᓗ ᐃᖃᖓᓃᑦᑐᑦ ᓄᓇᐃᑦ ᐃᒪᕐᓂ ᖃᐅᔨᓴᖅᑕᐅᓂᖏᓐᓂᒃ ᐅᓂᒃᑳᓕᐊᓂᒃ. ᑕᐃᒪᖓᑦ ᐱᖑᖅᑎᑕᐅᓚᐅᖅᓯᒪᖓᒥᒃ 1958–ᖑᑎᓪᓗᒍ, ᑖᒃᑯᐊ ᖃᐅᔨᓴᕝᕕᐅᖃᑦᑕᕐᓂᖏᑦ ᓯᕗᓪᓕᖅᐹᕇᓴᐅᖃᑦᑕᖅᓯᒪᕗᑦ ᐊᓯᔾᔨᓂᕐᒧᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ. ᑕᐃᒪᓕ ᐱᑕᖃᖅᑎᑦᑎᖃᑦᑕᕐᓂᒃᑯᑦ ᐅᓪᓗᓇᐊᓇᖅᑐᖃᖏᑦᑐᒥᒃ, ᖃᐅᔨᒪᔨᑕᓇᔭᐅᔪᓂᒃ ᐊᒻᒪᓗ ᐊᑭᑐᓗᐊᖏᓐᓂᖅᓴᐅᔪᓂᒃ ᐸᕐᓇᐅᑕᐅᓯᒪᖃᑦᑕᓇᐊᓕᖓᓂᒃ ᐃᑲᔪᑎᖃᖅᑎᑦᑎᓂᕐᒥᒃ, ᑖᒃᑯᐊ ᖃᐅᔨᓴᕝᕕᖏᑦ ᐃᓂᓪᓚᖓᐃᑦᑎᐊᖅᐳᑦ ᑲᑎᖅᓱᖅᑕᐅᓯᒪᔪᓂᒃ ᓄᐊᑕᐅᓯᒪᔪᓂᒃ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᓂᒃ ᖃᐅᔨᒪᓕᓂᖅ ᐱᑕᖃᓇᖅᑐᓂᒃ ᑐᑭᓯᐅᒪᑦᑎᐊᒃᑲᓂᕈᒪᓪᓗᒍ ᓄᓇᕐᔪᐊᖅᐳᑦ ᐊᒻᒪ ᐊᑐᐊᓚᓕᐅᕈᓇᕐᓂᕐᒧᑦ ᐃᓱᒪᓕᐅᖅᓯᒪᑦᑎᐊᕐᓗᑎᒃ ᖃᐅᔨᒪᑦᑎᐊᕐᓗᑎᒃ.

ᑮᓇᐅᔭᐃᑦ ᐊᑐᖅᑐᒃᓴᐅᓂᖏᓐᓂᒃ 2009–ᒥ, ᒐᕙᒪᒋᔭᕗᑦ ᐊᑭᓕᖅᑐᐃᖃᑦᑕᓇᐊᓚᓚᐅᖅᐳᑦ ᒥᓕᔭᖕᖏᓃᑐᓂᒃ ᑲᓇᑕᐅᑉ ᑮᓇᐅᔭᓕᐅᕝᕕᒃᓴᖏᓐᓄᑦ ᖃᓄᐃᓕᐅᕆᐊᕈᑎᒃᓴᓄᑦ ᐸᕐᓇᐅᑎᑎᒍᑦ, ᓄᑖᕈᕆᐊᖅᑕᐅᖁᔭᐅᓪᓗᑎᒃ ᒫᓐᓇᐅᔪᖅ ᐱᒻᒪᕆᐅᓂᖏᑦ ᐱᖁᑎᒋᔭᐅᔪᓂᒃ ᐅᑭᐅᖅᑕᖅᑐᒥ ᖃᐅᔨᓴᕝᕖᑦ, ᐊᒻᒪᓗ ᖃᐅᔨᓴᕝᕕᐅᕙᖕᓂᖏᓐᓄᑦ ᐊᐅᓚᑕᐅᕙᒃᑐᑦ ᖃᐅᓯᐃᑐᖅᒥ, ᓄᓇᕗᑦ. ᐅᑭᐅᖅᑕᖅᑐᖅᐸᓯᖕᒥ ᐸᕐᓇᒃᓯᒪᑎᐊᖅᑕᓇᐊᖅᑲᕐᓂᕐᒧᑦ ᐃᑲᔫᑎᑦ ᐱᔾᑎᕋᖅᑕᐅᔪᓇᖅᓯᕗᑦ ᓄᑖᓂᒃ ᐊᒻᒪᓗ ᓄᑖᕈᕆᐊᖅᑕᐅᓯᒪᒃᑲᓂᖅᓯᓂ ᐃᓪᓗᕐᑯᑎᖕᖏᓐᓂᒃ, ᐃᓂᖃᓕᖅᓯᑎᒃ 5,000–ᓂᒃ ᑭᐸᕇᓇᒃᑐᓂᒃ ᑐᔪᕐᒥᕙᓕᖕᓂᒃ, ᖃᐅᔨᓴᕝᕕᓪᓕᓇᐅᔪᓂᒃ, ᑎᑎᕋᕝᕕᖕᓂᒃ ᐊᒻᒪᓗ ᓯᕐᓗᐊᕌᓗᖕᒥᒃ/ᐊᐅᓚᑦᑎᕙᐅᔪᒥᒃ. ᐃᒡᓗᕐᑯᑎᖓᑦᑕᐅᖅ ᐊᖏᓪᓕᑭᐊᖅᑕᐅᓯᒪᓕᓇᕋᖅ ᑕᐃᒫᒃ ᑲᓇᑕᒥ ᐅᓇᑕᖅᑐᒃᓴᐃᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐃᓕᓐᓂᐊᕝᕕᖃᕈᓐᓇᑦᑎᐊᕐᓂᐊᕐᒪᑕ ᐱᑭᐊᕐᓂᐊᓕᖅᑐᒥᒃ ᑕᒪᑐᒪᓂ ᐊᐅᔭᐅᓂᐊᖅᑐᖅ. ᑕᒪᓐᓇ ᐃᓚᕆᑰᑕᐅᓕᖅᑐᖅ ᐃᖃᓇᐃᔭᕝᕙᖁᑎᑎᓐᓄᑦ ᐊᒻᒪᓗ ᐃᖃᓇᐃᔭᕝᕙᖓᓐᓄᑦ ᑲᓇᑕᒥᒃ ᓴᐳᓐᓂᐊᖅᑎᒃᑯᑦ ᐊᖏᔪᒥᒃ ᐃᑲᔪᕐᓂᖃᕐᓂᐊᖅᑐᖅ ᖃᐅᔨᓴᖅᑏᑦ ᐱᓕᕆᕙᖕᓂᖏᓐᓄᑦ, ᐃᓂᒃᓴᖅᑎᑕᐅᔪᓐᓇᕐᓂᐊᓕᕐᒥᒃ ᐅᑭᐅᒃᑯᑦ, ᐊᒻᒪᓗ ᑐᔪᕐᒥᔪᓐᓇᑦᑎᐊᕐᓂᐊᓕᖅᓯᑎᒃ ᐃᓂᒃᓴᖃᑎᐊᕐᓗᑎᒃ ᐊᒻᒪᓗ ᑐᖅᑯᖅᓯᓯᒪᕚᓐ ᐊᖏᓂᖅᓴᐅᓕᕐᓗᑎᒃ ᐊᒻᒪᓗ ᐱᓕᕆᕝᕕᖏᑦ.

ᐅᑭᐅᖅᑕᖅᑐᒥᓐᓂᖅᐹᖑᔪᒥᒃ ᖃᐅᔨᓴᕝᕕᖕᒥ ᖃᐅᔨᒪᔭᑦᑲᓇᐊᖃᒻᒪᓇᖕᒪᑕ ᐊᑯᓂᐅᓂᐊᖅᑐᒧᑦ ᐊᔪᕈᖅᓴᕈᓃᖅᐸᓪᓕᕈᑕᐅᔪᓐᓇᕐᓂᐊᖅᑐᓄᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ ᓄᓇᓕᖕᓄᑦ. ᐊᓂᒍᖅᓯᒪᓕᖅᑐᓂᒃ ᑖᓪᓕᒪᓂᒃ ᐊᕐᕌᒍᓂᒃ, ᐊᑐᖅᑕᐅᔪᑦ ᑖᒃᑯᓄᖓ ᐃᑲᔫᑕᐅᖃᑦᑕᖅᓯᒪᕗᑦ ᐸᕐᓇᒃᓯᒪᖃᑦᑕᓇᐊᖅᑲᕐᓂᕐᒧᑦ ᓄᓇᒥᐅᑕᐅᖃᐃ ᑲᓇᑕᒥ ᓄᓇᖑᓕᐅᖅᑎᖕᖏᓐᓄᑦ, ᐆᒪᕐᑯᑎᒃᓯᓕᐅᕝᕕᐅᔪᓇᖅᑐᓂᒃ ᐊᒻᒪᓗ ᐅᔭᕆᖕᓂᐊᓗᒃᓴᖃᒻᒪᖓᑖ ᐊᑐᖅᑕᐅᕙᖕᓂᖏᓐᓂᒃ, ᓄᓇᓕᐅᖃᑦᑕᕐᓂᖏᓐᓄᑦ ᓄᓇᖏᓐᓂᒃ ᐅᑭᐅᖅᑕᖅᑐᒥ, ᖃᐅᔨᒪᔭᐅᔪᒪᓂᖏᓐᓄᑦ ᐊᖏᓂᖅᐹᖑᔪᒥᒃ ᓄᓇᒥᐅᑕᖃᕐᓂᖏᑦ ᐃᓗᐊᓂ. ᑕᒪᒃᑯᐊ ᐅᓂᒃᑳᖅᓯᒪᓕᑎᐊᖅᑐᑦ ᓄᓇᒥᒃ ᓄᓇᖑᐊᓕᐊᖑᓯᒪᔪᑦ ᐱᔪᓐᓇᐅᑕᐅᖃᑦᑕᕐᓂᐊᖅᐳᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ ᓄᓇᓕᖕᓄᑦ ᖃᐅᔨᒪᑎᐊᕐᓂᖅᓴᐅᖃᑦᑕᓕᕐᓗᑎᒃ ᐃᓱᒪᓕᐅᕈᑎᖃᕈᓐᓇᕐᓂᖏᓐᓄᑦ ᓯᕗᓂᒃᓴᒥ ᑮᓇᐅᔭᓕᐅᕈᑕᐅᔪᓐᓇᖅᑐᓂᒃ ᐊᒻᒪᓗ ᐃᓅᓯᓇᔭᐅᔪᓂᒃ, ᑕᐃᒫᒃᓴᐃᓐᓇᕐᓗ ᐃᑲᔫᑕᐅᓗᑎᒃ ᓇᖕᒥᓂᖅᖢᓂᒃ ᐱᓕᕆᐊᕝᕕᐅᔪᓂᒃ ᕿᓂᕝᕕᐅᔪᓐᓇᕐᓂᖏᓐᓂᒃ ᐊᑭᓕᖅᑐᖅᑕᐅᔪᓐᓇᖅᑐᓂᒃ ᐃᓱᒪᓕᐅᕈᑕᐅᑎᐊᒃᑲᓂᕈᓐᓇᕐᓂᐊᕐᒪᑕ ᓄᑖᓂᒃ ᐆᒪᕐᑯᓯᐅᕝᕕᒃᓯᓕᐅᕈᓐᓇᖅᑐᓂᒃ ᐊᒻᒪᓗ ᐅᔭᕋᖕᓂᐊᓗᒃᓴᐅᔪᓐᓇᕐᓂᖏᓐᓂᒃ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᖓᓂ.

ᐅᑭᐅᖅᑕᖅᑐᒥᓐᓂᖅᐹᒥᒃ ᖃᐅᔨᓴᕝᕕᒃᑕᐅᖅ ᐊᑑᑎᖃᕐᓂᐊᕐᒥᔪᑦ ᐸᕐᓇᒃᓯᒪᑎᐊᖃᑦᑕᓇᐊᖃᕐᓂᖏᓐᓄᑦ ᑲᓇᑕᒥ ᖁᑦᑎᒃᑐᕐᒥᐅᑕᓂᓂᒃ ᖃᐅᔨᓴᕝᕕᐊᓗᐊᓐᓂᒃ, ᑕᐃᑲᓂ ᖃᐅᔨᓴᕝᕕᖓᓐᓂᒃ ᒫᓐᓇᐅᔪᖅ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᑦ ᓴᓇᔭᐅᕙᓪᓕᐊᓕᖅᑎᓪᓗᒋᑦ ᓄᓇᖃᖄᖅᑐᓕᕆᔾᔪᑎᓄᑦ ᐊᒻᒪᓗ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐱᕙᓪᓕᐊᔪᓕᕆᔾᔪᑎᓄᑦ ᑲᓇᑕᒥ. ᓄᓇᕐᔪᐊᕐᒥ ᐱᐅᓂᖅᐹᒥᒃ ᖃᐅᔨᓴᕝᕖᖃᕐᐊᖅᓯᑎᒃ, ᐊᐅᓚᑕᐅᓕᕐᓂᐊᕋᓯᕆᔭᐅᔪᖅ 2017–ᖑᓕᖅᐸᑦ, ᐱᐅᓂᖅᐹᑦᑎᐊᓂᒃ ᐱᕐᑯᑎᖃᕐᓂᐊᖅᑐᖅ ᐊᑐᓕᕐᓴᑎᐊᖅᑐᓂᒃ ᐅᑭᐅᖅᑕᖅᑐᒥ ᖃᐅᔨᓴᕈᑎᓂᒃ, ᒪᑯᓄᖓ ᐊᑐᕈᓇᕐᓂᐊᓂᖅᑐᓂᒃ ᓰᕐᓗ ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ ᐊᒻᒪᓗ ᓄᓇᒥᐅᑕᓕᕆᓂᕐᒥᒃ ᐱᕙᓪᓕᐊᑎᑦᑎᓂᕐᒧᑦ.

ᓴᖏᔫᓪᓗᑎᒃ ᐱᓕᕆᖃᑎᒌᒍᓐᓇᕐᓂᖏᑦ ᔪᑳᒥᐅᓂᒃ–ᐊᓛᔅᑲᒥᐅᓂᒃ ᑭᒡᓕᖅᑲᖅᑐᓂᒃ ᑕᐃᒪᖓᓗ ᐊᑯᑭᑦᑐᕐᒥᐅᓄᑦ/ᑲᓚᓖᑦ ᓄᓈᓐᓄᑦ, ᐊᒻᒪᓗ ᐊᑖᓃᒃ ᐅᑭᐅᖅᑐᖅᐸᓯᐅᓂᕋᖅᑕᐅᔫᑉ ᐊᖕᒪᓗᕐᓂᖓᓂᒃ ᑖᑉᐅᖓᓗ ᓄᓇᕐᔫᑉ ᖃᖓᓂ ᕿᑭᐊᓄᑦ, ᖃᐅᔨᓴᕝᕕᐊᓗᒃ ᑕᒪᓐᓇ ᐅᑭᐅᖅᑕᖅᑐᒦᑦᑐᖅ ᐱᕈᖅᐸᓪᓕᐊᑐᐃᓐᓇᖅᑐᖅ.

ᐱᓕᕆᖃᑎᒌᑦᑎᐊᕐᑯᓪᓗᒋᑦ ᑲᓇᑕᐅᑉ ᒐᕙᒪᒃᑯᖏᓐᓂᒃ ᐃᖃᓇᐃᔭᕝᕖᑦ ᐊᒻᒪᓗ ᐊᑐᖅᑕᐅᑎᐊᕐᓂᖅᐹᖏᓐᓂᒃ ᐊᑐᖅᑕᐅᖁᓪᓗᒋᑦ, ᐅᑭᐅᖅᑐᖅᐸᓯᖕᒦᓐᓂᖅᐹᖑᔪᓄᑦ ᖃᐅᔨᓴᕝᕕᖓᑦ ᓴᖏᔪᒥᒃ ᐃᓚᖃᐃᓐᓇᖅᓯᒪᓕᖅᐳᑦ ᐋᒃᑎᒃᓂᐊᑦᑯᓐᓂᒃ, ᐊᒥᓱᖓᓴᐅᓪᓗᑎᒃ ᐱᓕᕆᕝᕕᐅᔪᑦ ᐱᐅᔫᒪᓇᖓᓂᒃ ᐱᓕᕆᕝᕕᐅᕙᒃᑐᑦ, ᐊᑭᓕᖅᑐᖅᑕᐅᓯᒪᓪᓗᑎᒃ ᑲᓇᑕᐅᑉ ᒐᕙᒪᒃᑯᖏᓐᓄᑦ, ᐊᔪᕈᓐᓃᕈᑕᐅᕙᒃᑲᓂᖅᐹᖓᓕᑕ ᐅᑭᐅᖅᑕᖅᑐᒥ ᖃᐅᔨᓴᕈᓇᕐᓂᕐᒧᑦ .

ᒐᕙᒪᒋᔭᕗᑦ ᐅᑭᐅᖅᑕᖅᑑᓂᕐᒥᒃ ᖁᕝᕙᓯᖕᓂᖅᐹᑦᑎᐊᒥᒃ ᓯᕗᓪᓕᖅᐹᖑᑎᑦᑎᖃᑦᑕᐅᓯᒪᕗᑦ. ᐊᑐᕐᓗᓂᑦ ᐅᑭᐅᖅᑕᖅᑐᒥᒃ ᖃᓄᐃᓕᐅᕈᑎᒃᓴᐃᑦ, ᐱᓕᕆᓕᖅᐳᒍᑦ ᐅᔾᔨᖅᑐᑦᑎᐊᕈᒪᓂᖅ ᐊᖑᒪᔪᓇᕐᓂᖕᖏᓐᓂᒃ ᓱᓕᔪᓂᒃ ᐱᓂᐊᕐᓂᕋᖅᓯᒪᔭᖏᓐᓂᒃ, ᓴᕿᑎᔪᒪᓚᐅᕐᓂᖕᖏᓐᓂᒃ ᖃᓄᐃᖕᖏᑦᑐᓂᒃ, ᐊᔪᖅᓴᖕᖏᑐᓂᒃ ᐊᕙᒃᑐᖅᓯᒪᓂᖃᕐᓂᕐᒥᒃ, ᑲᓇᑕᒥᑐᒥᒃ ᓴᖏᔪᒥᒃ ᑕᐱᑕᑦᑎᐊᖅᑐᓂᒡᓗ.

ᑎᑎᕋᖅᑐᖅ,

ᓂᐳᐊᖅᑕᐅᓯᒪᔪᖅ ᔾᔪ ᐋᓕᕗᑦ, ᑲᓇᑕᒧᑦ ᒪᓕᒐᓕᐅᖅᑎᐅᖃᑕᖅ, ᒥᓂᔅᑕᐃᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ

ᒥᓂᔅᑕᐅᔪᖅ ᓄᓇᒥᐅᑕᓕᕆᓂᕐᒧᑦ

The Honourable
Joe Oliver, P.C., M.P.
Minister of Natural
Resources

ᓂᐳᐊᖅᑕᐅᓯᒪᔪᖅ ᔾᔫ ᐋᓕᕙ,
ᒪᓕᒐᓕᐅᖅᑎ ᒥᓂᔅᑕᐃᑦ
ᑲᑎᒪᔨᖏᓐᓂᒃ, ᑲᓇᑕᐅᑉ
ᒪᓕᒐᓕᐅᕝᕕᖓᓂ
ᒥᓂᔅᑕ ᓄᓇᒥᐅᑕᑐᖃᕐᑲᓕᕆᓂᕐᒧᑦ

The Polar Continental Shelf Program: Services and initiatives

Canada's North is a vast and varied environment with many natural phenomena that are not yet fully understood. With a wealth of scientific knowledge yet to be uncovered, the Arctic is an intriguing and relevant subject of study, yet simultaneously, it is a difficult and daunting place to explore. The Polar Continental Shelf Program (PCSP), a division of Natural Resources Canada (NRCan), aids scientists in planning and executing their field research in Canada's North.

With over 50 years of experience operating in the Arctic, the PCSP has the expertise and infrastructure to efficiently and effectively coordinate flights to and from field camps. The PCSP also maintains a communications network with remote fly-camps to ensure the safety of PCSP-supported scientists. A major element of the PCSP's logistical support network is the operation and maintenance of its facility in Resolute, Nunavut. This facility is the PCSP's hub of Arctic operations. It hosts living accommodations for up to 215, a dining room that can seat up to 100 people at every meal, three recreational lounges, a fitness centre and a state-of-the-art laboratory. In addition, the PCSP supplies fuel for aircraft and camps as well as specialized field equipment, including vehicles, tents, satellite telephones and other items necessary for a safe and successful field science campaign.

Alain Sigouin shelves a snow machine at the TFSS warehouse.

The PCSP's operations are maintained by 36 staff members working in Ottawa, Ontario, and Resolute, Nunavut. The PCSP team is divided into the following four units based on function.

Technical Field Support Services

Technical Field Support Services (TFSS) in Ottawa, Ontario, manage the PCSP $7 million equipment inventory. The TFSS warehouse contains all equipment necessary for a successful field campaign, including vehicles, watercraft, tents, clothing, GPS units and drills, to name just a few items. The staff at TFSS maintain all equipment in working order and track the loan of equipment to field parties.

Arctic Logistics Support Centre

The Arctic Logistics Support Centre in Resolute, Nunavut, is in charge of planning and delivering the day-to-day field logistics of PCSP-supported researchers and partners. Staff procure and schedule charter aircraft to transport scientists to and from their field sites and maintain radio communications with these fly-camps. Staff also maintain fuel caches across the Arctic, monitor weather conditions to ensure

flight safety, and facilitate search and rescue missions when necessary. Finally, ground-level operations are managed at the PCSP facility in Resolute, including food services and building management.

Science and Logistics Coordination Centre

The Science and Logistics Coordination Centre in Ottawa, Ontario, manages client relations, program development, partnerships and outreach for the PCSP. Staff offer advice in terms of licensing and permitting required on a project-by-project basis and act as a liaison with other Arctic organizations and government departments to form efficient partnerships. This group also produces outreach material and coordinates events to communicate the work of the PCSP and its supported scientists to a broader public.

The TFSS warehouse stocks equipment for a successful field season, including boots in every size.

Office Management Unit

The Office Management Unit is responsible for the business end of the PCSP's operations. The staff manage the PCSP's accounting and bookkeeping, and establishes contracts with aircraft companies and other services providers. The group is also responsible for procurement and human resources needs of the PCSP.

Spotlight on a PCSP employee: Karen Thombs

The PCSP facility in Resolute is widely renowned for having the best food available in the North. This is in large part due to the efforts of Karen Thombs, a long-time cook in the PCSP facility's kitchen. Karen worked casually for the PCSP between 1993 and 1996, before joining the team permanently in 2003. Over her years with the organization, her responsibilities have included placing food orders, taking inventory, purchasing equipment, planning meals and cooking. In short, Karen's work includes any duties necessary for smooth operation of the kitchen. Karen takes pride in her work and notes that the key to being successful working in a remote location such as Resolute is a dedicated work ethic.

Karen Thombs in the kitchen at the PCSP facility in Resolute, Nunavut

The longest-standing employee in the kitchen at the PCSP facility in Resolute, Karen enjoys the flexibility and creative control that she has in menu creation and is committed to pleasing the palette and meeting the dietary needs of every person that visits her dining room. A driving force behind Karen's dedication is her desire to ensure that scientists are well-fed before they head off to their field camps and have a hot, delicious meal waiting for them when they come back.

Karen's favourite thing about working in the PCSP facility in Resolute is how closely she gets to interact with clients. She notes that her time at the facility is full of memories of chatting with scientists and having a great time in the dining room. After meeting all of the scientists who have passed through the PCSP dining room over the years, she sees many as friends, and looks forward to meeting with them again year after year. In recognition of her hard work and dedication, Karen was awarded the Queen Elizabeth II Diamond Jubilee Medal in 2012.

PCSP fact sheet

- Projects supported since 2002: 1454
- Average number of projects supported each year (since 2002): 132
- Average number of field researchers supported each year (since 2002): 844
- Average number of flight hours requested each year (since 2007): 8973
- Average number of hours flown each year (since 2007): 6380
- Approximate number of scientific publications resulting from PCSP support per year: 271*
- Approximate number of items of field equipment issued each year: 53 000

*Source: Evaluation of the Polar Continental Shelf Program Final Report (2012)

Figure 1. PCSP-supported projects each year

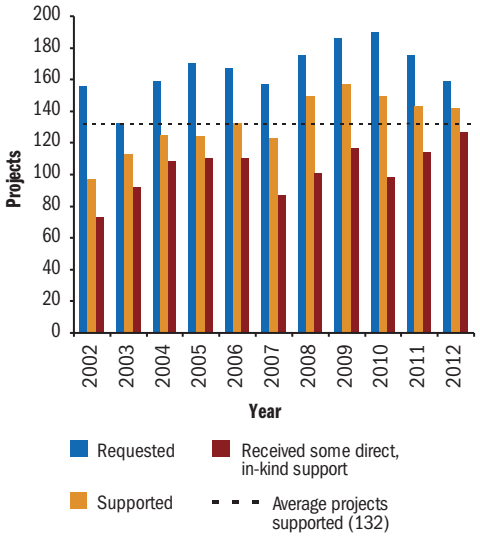
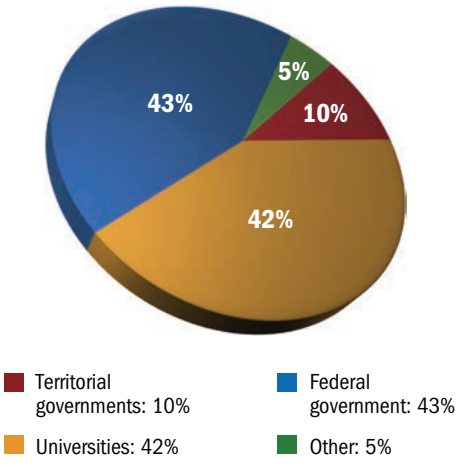


Figure 2. General distribution of PCSP-supported projects by institution



Source: Evaluation of the Polar Continental Shelf Program Final Report (2012)

In 2011

- Projects supported: 142
- Field researchers supported: 932
- Flight hours requested: 6750
- Hours flown: 4807

PCSP outreach events

Cool Science Saturdays and Science Funfest

Winterlude is a city-wide festival held annually in the National Capital Region to celebrate the joys of winter. The PCSP, being a great lover of all things cold and snowy, participated in the festival's *Cool Science Saturdays* in February. The PCSP recreated a northern science field camp right in the heart of Ottawa, drumming up interest in Arctic research among festival revellers, young and old. The PCSP also collaborated with partners from NRCan's Geo-mapping for Energy and Minerals (GEM) program so that visitors learned not only about rocks and minerals, but also got a taste of what it means to perform field research in the Canadian Arctic. The PCSP put together a similar camp during NRCan's Science Funfest in October to celebrate National Science and Technology Week.

International Polar Year Conference 2012: From Knowledge to Action

The fourth International Polar Year (IPY) (2007-2008) marked a period of international scientific collaboration toward a greater understanding of the circumpolar Arctic and the Antarctic. The PCSP was heavily involved in the IPY through the many PCSP-supported scientists who contributed to, and received support from, the IPY. The 2012 IPY conference *From Knowledge to Action* (Montréal, April 22–27) marked the grand finale of this important global initiative. As its name suggests, the goal of this conference was to motivate political action based on the lessons learned from the fourth IPY.

NRCan was a platinum sponsor of the IPY conference, and the PCSP played a central role in the success of the event. The PCSP organized and staffed the NRCan booth, which provided information about NRCan and its role in northern science to government officials, northern researchers, students and the general public. The event proved to be an excellent opportunity for the PCSP to communicate its arctic activities, to learn about other northern organizations and to build upon its already extensive northern network.

Chantal Audet and Chris Evans staff the Natural Resources Canada exhibit at the International Polar Year conference in Montréal.

Louisa Gillespie, a resident of the Hamlet of Resolute, performs a traditional Inuit drumming song during the annual PCSP Open House.

Guests enjoy the festivities during the fifth annual PCSP Open House.

PCSP 2012 Open House

The fifth PCSP Open House was hosted at the PCSP facility in Resolute on July 26, 2012. This annual event brings together the community of Resolute, PCSP staff, scientists and government officials, allowing them to interact and exchange ideas and experiences in an informal setting.

The event was highly successful, as an estimated 150 local guests from the community of Resolute Bay were in attendance. The Open House featured interactive displays by the PCSP as well as by the Royal Canadian Mounted Police, First Air, the GEM program and the Canadian Armed Forces. Guests of the PCSP were treated to a barbecue lunch, a craft table featuring a pet rock station, scientific demonstrations in the Dr. Roy "Fritz" Koerner Laboratory, and a cameo appearance by NRCat. Cultural contributions from the local community included throat singing, drumming, local art displays, bannock sampling and a tour and history of the Hamlet of Resolute.

In the media

Frozen Planet: a world beyond imagination

"Frozen Planet" allows viewers to travel to the Arctic to experience beautiful and harsh polar environments without ever leaving home. *Frozen Planet: a world beyond imagination* [sic] explores the lives of plants, animals and people living in the polar regions. The seven-part series profiles the vanishing habitats and species that inhabit both the Arctic and Antarctic and shows how life survives and thrives through the extreme seasonal changes within these environments. The series was produced by the British Broadcasting Corporation (BBC) over a four-year period, first aired on the Discovery channel in 2011 and is available on DVD.

During the 2008–2009 filming of this series, the PCSP arranged logistics for film crews to travel to Pond Inlet, Karrak Lake and Bay Fiord (Ellesmere Island), Nunavut. While in the Canadian Arctic, the BBC team filmed arctic wolves hunting to sustain their pack of wolf pups, beluga whales congregating in the shallows to exfoliate their skin, and narwhal tracking along their migration route near Pond Inlet. The on-the-ground wildlife footage shot during these field campaigns provides the viewer with a level of access to wilderness and wildlife that is usually granted only to the polar explorer. Sometimes working alongside PCSP-supported scientists, the documentary team has also developed narrative that is highly instructive and tells the story of the Arctic in an accessible and entertaining way.

DID YOU KNOW?

Support for the construction and operation of the Canadian High Arctic Research Station and its Science and Technology Program was announced in 2012 as part of Canada's Northern Strategy. This station will serve as a new hub for science and technology in Canada's North, focusing on the issues of resource development, Northern sovereignty, environmental stewardship and climate change, and strong and healthy northern communities. Year-round operations will begin in Cambridge Bay, Nunavut, in 2017.

Narwhal swim along a lead in the sea ice near Pond Inlet.

PCSP connections to other Arctic organizations

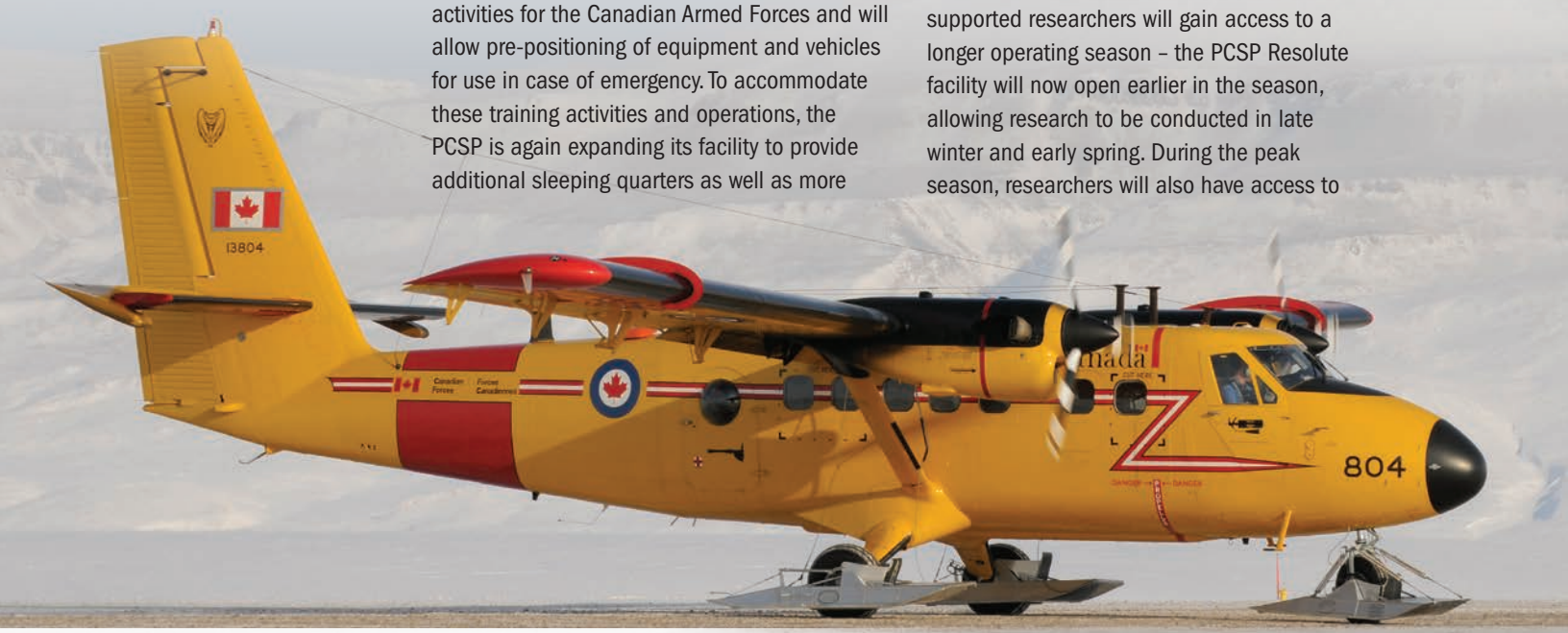
The Arctic is at the forefront of Canadian priorities. The PCSP's long presence in the Canadian North and its experience in operating in the Arctic has made the PCSP a key partner in many government initiatives. The PCSP also has strong links with non-federal partners including northern colleges and territorial governments. This close collaboration across government and non-government sectors ensures a unified approach to dealing with emerging Arctic issues to the benefit of all partners involved.

Department of National Defence: The Canadian Forces Arctic Training Centre

In 2010, the PCSP entered into a new major collaboration with the Department of National Defence (DND) to host the Canadian Forces Arctic Training Centre (CFATC). This long-term collaboration builds on the success of the PCSP-DND partnership to deliver the Arctic Operation Advisor course (run at the PCSP Resolute facility since 2008), Operation Nunalivut (since 2011) and Operation Nanook (2010 and 2011). CFATC will support training activities for the Canadian Armed Forces and will allow pre-positioning of equipment and vehicles for use in case of emergency. To accommodate these training activities and operations, the PCSP is again expanding its facility to provide additional sleeping quarters as well as more warehousing and working space. This facility upgrade, which is currently estimated at $21-million, is funded entirely by DND.

The PCSP facility in Resolute, including the new expansion, will continue to be run by NRCan through the PCSP. However, beginning on April 1, 2013, operation costs for the entire facility will be shared between both government departments. By sharing the facility and its operating costs with DND, the PCSP will realize efficiencies that will improve overall support to scientists.

For instance, through this partnership, PCSP-supported researchers will gain access to a longer operating season – the PCSP Resolute facility will now open earlier in the season, allowing research to be conducted in late winter and early spring. During the peak season, researchers will also have access to



A Canadian Armed Forces Twin Otter aircraft lands at Eureka, Nunavut.

additional accommodations because the facility expansion adds 140 beds, increasing capacity to 215 patrons. Finally, telecommunications improvements in this facility upgrade will benefit all patrons.

Geo-mapping for Energy and Minerals: Modernizing geoscience of Canada's North

In large areas of the North, public knowledge of geoscience is inadequate for attracting and guiding private sector investment. In 2008, the GEM program, a five-year, $100-million program, was developed to improve knowledge and characterize the geological context of the North. The program's two objectives are to inform exploration investment decisions of private industry and to help in land-use planning among northern communities and within the territories. Throughout this program, GEM has relied upon the PCSP to coordinate aircraft and provide field equipment.

Now at the end of its five-year phase, the program has completed five field seasons and 20 large-scale projects in all three territories and the northern parts of six provinces. GEM has identified areas of high potential for gold, nickel, platinum-group elements, rare metals, base metals and diamonds. GEM has also developed new models for hydrocarbon systems that indicate that large oil and gas potential may exist in new areas not currently explored by industry.

Results include 34 high-resolution geophysical surveys and 637 open file releases of new geoscience maps and data. GEM has applied advanced approaches for making its information and knowledge digital, comparable, openly accessible and useable. GEM has also successfully prompted several new private sector activities in the North. The activities include international mining investments for nickel exploration in the Melville Peninsula in Nunavut, extensive staking of diamond prospecting permits on southeast Baffin Island in Nunavut and the discovery by industry of significant copper-gold-silver deposits in Yukon.

GEM accomplished these feats through its extensive series of field research projects, using cutting-edge geochemistry methods, documenting geological structures and evolution, and introducing innovative concepts that improve understanding of the resource potential of the North. The methods included airborne geophysics, on-the-ground field observation and laboratory investigation.

DID YOU KNOW?

ArcticNet researchers applying for PCSP logistical support may receive additional aircraft hours funded through a supplement provided by ArcticNet. ArcticNet is part of the "Network of Centres of Excellence" program and brings scientists together with partners in Inuit organizations, northern communities, governments and the private sector to help Canadians face the impacts and opportunities posed by climate change and modernization in the North. The objectives of ArcticNet are therefore complementary to those of the PCSP. Collaboration between the two to maximize aircraft support to ArcticNet researchers improves the ability of both organizations to support the Arctic science needed to address key policy issues.

Trilobite fossils found on Truro Island, Nunavut

> "With most of the project locations in remote areas and not serviced by infrastructure, it would have been impossible to conduct our research without the services that our partners at the PSCP provided. The PCSP safely delivered our scientists to remote locations and provided them with the supplies to live comfortably and conduct their research in a challenging environment."
>
> — Alain Leclair, GEM Program Coordinator

PCSP-supported field camps in the Canadian Arctic (2011)

Legend

Field Camp Research Themes:

- Ecological Integrity
- Sustainable Communities and Culture
- Climate Change
- Sustainable Resources Management
- Planetary Science
- National Parks and Weather Stations
- Multiple project types

Location Type:

- Communities
- PCSP Resolute Facilities
- Military Outposts
- National Parks

Air Distances In Kilometers

			Iqaluit
		Alert	2091
	Inuvik	2274	2843
Resolute	1503	1090	1573

Air distances and directions follow great circle routes: the shortest distance between places on the globe, and the route most often taken by aircraft.

Community names derived from the Canadian Geographical Names Data Base and Furgal, C., Kalhok, S., Loring, E. and Smith, S. 2003. *Knowledge in action: Northern Contaminants Program structures, processes and products*. Indian and Northern Affairs Canada, Canadian Arctic Contaminants Assessment Report II, 90 pp.

Vertical Near Side Perspective Projection, height adjusted to 3000 km above the Earth

PCSP-supported projects in 2011

The PCSP supported 142 projects from a variety of disciplines in the natural and social sciences in 2011. This annual report features several projects that exemplify the type of world-class science supported by the PCSP throughout the Canadian North. Projects are organized under six major themes: ecological integrity; sustainable communities and culture; changing climate; sustainable resources management; planetary science; and national parks and weather stations. All PCSP-supported projects are listed within the themes, with the understanding that some projects may fit several categories.

ECOLOGICAL INTEGRITY

The term "ecological integrity" refers to an ecosystem's ability to maintain itself in a state of equilibrium through its many natural interactions and processes. Ecological integrity studies therefore examine the composition and abundance of plant and animal species, the interactions between the biotic and abiotic environments, and changes in ecosystems over time.

Studying fish in the Inuvialuit Settlement Region

Eaten as a traditional subsistence food, fish is an important and healthy resource for many northern communities, including those of the Inuvialuit Settlement Region (ISR) of the Northwest Territories. Recently, residents of the northern ISR communities remarked on changes in the size of individual Arctic char being caught and consumed, sparking concern about possible links between fish health and observed climate change, and the long-term viability of this resource.

In response to this issue, a project was initiated in 2008 by researchers from Trent University, in collaboration with federal scientists and the local hunters and trappers committees, aiming

As part of a courtship ritual, an Arctic tern offers fresh fish to a prospective mate in Churchill, Manitoba.

to understand and monitor this issue by using scientific study and traditional knowledge. A highly successful interdisciplinary research program developed, in which local fishermen were trained to help collect samples as well as share their expert knowledge. This program has inspired additional study of contaminant transfer among other fish species. The studies outlined below provide citizens of the ISR with important baseline information on the overall health of fish within the region.

Monitoring environmental effects on Arctic Char growth

Jennie Knopp and Chris Furgal (Trent University), James D. Reist (Freshwater Institute, Fisheries and Oceans Canada) and the Sachs Harbour and Olokhaktomiut Hunters and Trappers Committees

This study uses an interdisciplinary approach to gather and integrate scientific ecological information and Inuvialuit Knowledge of Arctic char to determine which environmental factors (both climatic and within the lake) influence their growth. Working with trained local harvesters on Kuptan, Middle and Capron lakes, Northwest Territories, researchers recorded length, weight and sex of fish caught by local fishermen and examined stomach contents and checked for parasites. The otoliths (ear bones) were examined to determine age and growth history. Researchers also recorded data about water chemistry, bank erosion, lake volume and depth, and determined that each lake habitat is slightly different. Correspondingly, the three populations exhibited differences in growth characteristics, including maximum size and the age at which maximum size was reached.

These scientific observations align with the traditional knowledge gathered through interviews with local experts. Notably, local residents remember a change in the size and numbers of individual Arctic char caught in the late 1980s. They noted late sea ice formation, warmer than average seasonal air temperatures and major shifts in storm events around the same time. This event was also captured through scientific examinations of the growth histories of the Arctic char in two of the study lakes. The mutual agreement of these data sets promotes confidence in the usefulness and value of the interdisciplinary approach to this research and in the community-based monitoring program. These findings imply that Arctic char populations are sensitive to the environment in which they live and are therefore likely to respond to the increasingly dynamic Arctic climate.

Jennie Knopp conducts a Traditional Knowledge interview with local expert Gordon Anaviak in Tuktoyaktuk, N.W.T.

Jennie Knopp and Catherine Kuptana, a local resident of Sachs Harbour, work together to remove otoliths from a lake trout.

Contaminant transfer in the aquatic food web

Nikolaus Gantner, Shannon McFadyen (University of Victoria), Donald Ross and Jolie Gareis (Aurora Research Institute), James D. Reist (Freshwater Institute, Fisheries and Oceans Canada), Benjamin Kissinger, Gary Anderson (University of Manitoba), Jennie Knopp, Chris Furgal and Holger Hintelmann (Trent University)

Mercury is a natural element that can cause health problems to humans when it is consumed in great quantities through eating fish. The amount of mercury in the tissue of animals that occupy higher levels on the food chain is projected to increase through anthropogenic inputs as a result of future environmental changes, such as a warming climate, industrial development or land use change. The baseline mercury levels of fish within the ISR are therefore of great interest to scientists and to the community.

To investigate mercury levels within fish, researchers developed a community-based monitoring approach (similar to the approach used to monitor Arctic char) in which local fisherman collect fish from lakes that have different salinity profiles, including Yaya Lake (riverine), Big Lake (freshwater), Noell Lake (freshwater) and the Husky Lakes (marine influence). Researchers then take tissue samples from the muscle, liver and stomach of lake trout, lake whitefish, blue herring, broad whitefish and fourhorn sculpin to ascertain the total mercury concentration of tissues in different fish species. Because each fish species occupies a different niche within the aquatic environment (for instance, lake trout occupy freshwater environments while blue herring is a marine species) researchers can make associations between habitat use, diet and mercury concentrations. Researchers also sample surface sediments from these lakes to investigate elemental transfers between lake habitat and fish specimens. Another aspect of the study investigates the movement and growth of fish (particularly lake trout) within the Husky Lakes, because this information will enhance the local capacity to manage the fisheries. The understanding of the study lakes obtained through traditional knowledge has provided expert information for the study of environmental conditions, food webs, species presence and fish harvesting.

Though this study is still in its early stages, researchers have determined that different fish species display varying levels of mercury in their tissues. These differences may be related to diet, level on the food chain and/or habitat use. Higher mercury concentrations measured in freshwater lake trout as compared to their marine counterparts seem to reflect the greater food availability for fish in the marine environment as compared to the lake environment. Most importantly from a community perspective, in no cases did mercury levels exceed the recommended guidelines for human consumption.

> “The interdisciplinary approach to research facilitates a process of collaboration between practitioners of the two knowledge bases, enhancing our understanding of our changing northern environment and its effects on subsistence resources.”
>
> — Jennie Knopp

The Yukon North Slope grizzly bear project

Ramona Maraj (Environment Yukon)

As a species that eats both plants and animals, grizzly bears are an essential component of the Yukon North Slope ecosystem. Grizzlies have been hunted by Inuvialuit people for centuries and presently, throughout the North Slope region, Inuvialuit hold preferential rights to hunt grizzly bears. Though nowadays the species carries only minor cultural significance, the sale of a grizzly hide can be a significant boon to a hunter and his/her family. In various parts of North America, grizzly bear populations are on the decline. For this reason, the Yukon North Slope grizzly bear project was initiated in 2004 by Environment Yukon, in partnership with Parks Canada, the Aklavik Hunters and Trappers Committee and the Wildlife Management Advisory Council for the North Slope. The goal of this project is to determine basic information about the health of the local grizzly bear population (including population size, birth and death rates, and habitat range) and to use this information to review hunting quotas.

Traditional knowledge from the community of hunters from Aklavik was used to gather information on bear habitat use and hunt management. Aklavik is a nearby community composed primarily of Gwich'in and Inuvialuit people, most of whom are active hunters. In general, the hunters believe that the bear population has not changed appreciably in the last 20 years. Interviews indicate that grizzlies use the entire North Slope landscape. In the spring and fall, they are most often found in the mountains where ground squirrels are plentiful. Before they hibernate, many bears will move to the coast to find food, including seals. The bears are fattest in August and September and are in their dens by October.

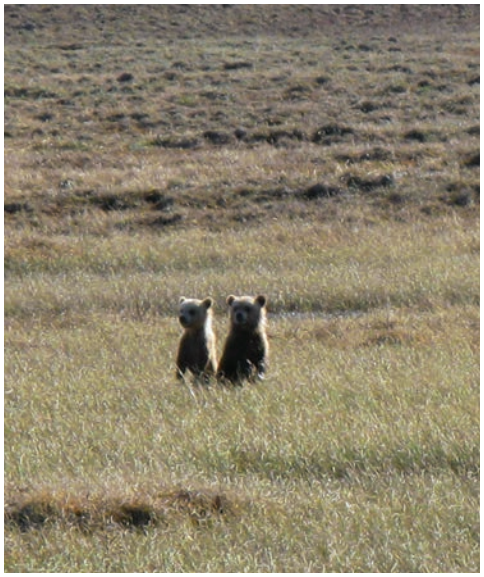
A grizzly bear hair sample collected during the DNA-based mark-recapture study. Researchers use the results of DNA analysis of the hairs to estimate the bear population for the region.

Researchers also employed a variety of scientific techniques to qualify grizzly bear population dynamics. For instance, scientists captured and sedated bears and recorded information on age, sex, weight, length, head size, girth and physical condition – all to determine the health of individual grizzlies. While the bears were sedated, scientists attached collars enabled with GPS or VHF (very high frequency radio signals) to track movement and survival among these bears. Hair traps were also installed at

DID YOU KNOW?

Field researchers from across the federal government may apply to use field equipment from the TFSS inventory, even if they are not performing research based in the Arctic. For instance, the International Boundary Commission uses vehicles and equipment from TFSS in the work they do to maintain the Canada-United States border demarcation.

Cubs looking on as their mother is fitted with a radio collar. This collar allows researchers to track the survival of this family.



strategic locations throughout the North Slope. Using DNA markers within the retrieved hairs, scientists were able to count individual bears that had visited the sites and thereby estimate the population.

Through their analyses, scientists determined that individual bears tend to stay in specific, yet overlapping regions and that males tend to have a larger range than female bears. Surveys in the 1970s estimated the population at 340. Preliminary analyses of the current study indicate that the grizzlies on the Yukon North Slope are healthy, and their numbers have not changed appreciably and may even be increasing. Therefore, the present quota is sustainable for the grizzly bear population.

> “Watching the connection between the bears and the people of the North Slope has been one of the most profound experiences from this project. They are truly brothers and sisters. I hope that connection remains, as it has preserved the balance on this landscape for many decades.”
>
> — Ramona Maraj

Researchers gather health information and fit a radio collar on a female grizzly bear to help understand survival rates, reproduction rates, habitat use and the home range size of bears in this region.

Projects focused on ecological integrity

Karrak Lake assessment of continental efforts at population reduction of light geese

Principal investigator: Ray Alisauskas (Science and Technology/Wildlife Research, Environment Canada)
Locations: Karrak Lake and Perry River, NU

Survival in arctic geese

Principal investigator: Ray Alisauskas (Science and Technology/Wildlife Research, Environment Canada)
Locations: Atkinson Point and Perry River, NU

Ecosystem response to environmental change in subarctic lakes and ponds

Principal investigator: Shelley Arnott (Department of Biology, Queen's University)
Location: Wapusk National Park, Man.

Baffin Bay and Kane Basin polar bear subpopulation assessments

Principal investigator: Stephen Atkinson (Department of Environment, Government of Nunavut)
Locations: Pond Inlet, Clyde River and Qikiqtarjuaq (Baffin Island), Grise Fiord and Alexandra Fiord (Ellesmere Island), NU

Arctic marine Ice-associated ecosystem in a Changing Environment (Arctic-ICE)

Principal investigator: David Barber (Clayton H. Riddell Faculty of Environment, University of Manitoba)
Location: Resolute Passage, NU

2011 Arctic field operations

Principal investigator: Luc Béland (Canadian Coast Guard, Fisheries and Oceans Canada)
Location: Eureka (Ellesmere Island), NU

Ecology of arctic and red fox on Bylot Island

Principal investigator: Dominique Berteaux (Centre for Northern Studies, Université du Québec à Rimouski)
Location: Bylot Island, NU

Seabird studies at Coats Island, Nunavut

Principal investigator: Birget Braune (Science and Technology/Wildlife Research, Environment Canada)
Location: Coats Island, NU

Ecological structure of northern arthropods: Adaptations to a changing environment

Principal investigator: Christopher Buddle (Department of Natural Resource Sciences, McGill University)
Location: Green Cabin, Aulavik National Park (Banks Island), N.W.T.

Production and loss of methylmercury and its uptake in lake food webs of the High Arctic

Principal investigator: John Chételat (Science and Technology/Ecotoxicology and Wildlife Health, Environment Canada)
Location: Resolute (Cornwallis Island), NU

Movement patterns and habitat use of polar bears in the Beaufort Sea

Principal investigator: Andrew Derocher (Biological Sciences, University of Alberta)
Location: Tuktoyaktuk, N.W.T.

Linking scientific and traditional knowledge to develop effective environmental indicators of change for Arctic char community-based monitoring

Principal investigator: Chris Furgal (Indigenous Environmental Studies Program, Trent University)
Locations: Capron Lake, Raddi Lake, Middle Lake, Fish Lake, Kuptan Lake and Ikahavik Lake (Banks Island), N.W.T.

Evaluation of hydro-climatic drivers of contaminant transfer in aquatic food webs in the Husky Lakes Watershed (Inuvialuit Settlement Region, Northwest Territories)

Principal investigator: Nikolaus Gantner (Department of Geography, University of Victoria)
Locations: Husky Lakes, Big Lake, Yaya Lake, Noell Lake, Inuvik and Tuktoyaktuk, N.W.T.

Biology of tundra birds: demographics, trophic interactions and climate change

Principal investigator: Gilles Gauthier (Centre for Northern Studies, Université Laval)
Location: Bylot Island, NU

Population studies of Common and King Eider ducks breeding in East Bay, Southampton Island

Principal investigator: Grant Gilchrist (Science and Technology/Wildlife Research, Environment Canada)
Location: East Bay (Southampton Island), NU

East Bay shorebirds (Arctic PRISM Tier 2 Site)

Principal investigators:
Grant Gilchrist and Jennie Rausch (Environmental Stewardship/Northern Conservation, Environment Canada)
Location: Bernard River (Banks Island), N.W.T.

Dolly Varden population assessment

Principal investigator: Kimberly Howland (Arctic Aquatic Research Division, Fisheries and Oceans Canada)
Locations: Firth River, Rat River, Babbage River, Big Fish River, Joe Creek and Fish Creek, Y.T.

The biology and ecology of sympatric polymorphic lake trout, Salvelinus namaycush, in Great Bear Lake, N.W.T.

Principal Investigator: Kimberly Howland (Arctic Aquatic Research Division, Fisheries and Oceans Canada)
Location: Great Bear Lake, N.W.T.

The ecological determinants of muskrat abundance and health at the northern edge of their range

Principal investigator: Murray Humphries (Department of Natural Resources Sciences, McGill University)
Location: Old Crow Flats, Y.T.

Succession in microbial communities in glaciers and glacial forelands of the Icefield Ranges, southern Yukon

Principal investigator: Brian Lanoil (Department of Biological Sciences, University of Alberta)
Locations: Duke Glacier and Trapridge Glacier, Y.T.

The production of greenhouse gases and methylmercury in ponds formed by melting permafrost

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

Baffin Island goose banding

Principal investigator: Jim Leafloor (Environmental Stewardship Branch/Canadian Wildlife Service, Environment Canada)
Locations: Nikko Island, Taverner Bay, Bowman Bay, Koukdjouak River (Baffin Island), NU

Southampton Island goose banding

Principal investigator: Jim Leafloor (Environmental Stewardship/Canadian Wildlife Service, Environment Canada)
Location: Coral Harbour (Southampton Island), NU

Population dynamics of Snow Geese in relation to habitat

Principal investigator: Josée Lefebvre (Environmental Stewardship Branch/Canadian Wildlife Service, Environment Canada)
Location: Bylot Island, NU

Ecology of Ross's Gulls and Ivory Gulls in Penny Strait, NU

Principal investigator: Mark Mallory (Environmental Stewardship Branch/Canadian Wildlife Service, Environment Canada)
Location: Tern Island, NU

Seabird and contaminant monitoring, Prince Leopold Island, NU

Principal investigator: Mark Mallory (Environmental Stewardship Branch/Canadian Wildlife Service, Environment Canada)
Location: Prince Leopold Island, NU

South Beaufort Sea polar bear habitat and population assessment

Principal investigator: Ramona Maraj (Fish and Wildlife Branch, Yukon Government)
Location: Herschel Island, Y.T.

The Yukon North Slope grizzly bear project

Principal investigator: Ramona Maraj (Fish and Wildlife Branch, Yukon Government)
Location: Shingle Point, Y.T.

Sea Ice BIOTA (Biological Impacts Of Trends in the Arctic)

Principal investigator: Christine Michel (Arctic Aquatic Research Division, Fisheries and Oceans Canada)
Location: Lancaster Sound, NU

Assessment of Bull Trout habitat use in the lower South Nahanni watershed, Northwest Territories

Principal Investigator: Neil Mochnacz (Arctic Aquatic Research Division, Fisheries and Oceans Canada)
Location: Prairie Creek, N.W.T.

In-stream flow needs for northern form Dolly Varden in the Canadian Western Arctic

Principal investigator: Neil Mochnacz (Arctic Aquatic Research Division, Fisheries and Oceans Canada)
Locations: Big Fish River, Rat River and Babbage River, Y.T.

Dynamics and habitat use of lemmings under climate change

Principal investigator: Douglas Morris (Department of Biology, Lakehead University)
Locations: Walker Bay, Kent Peninsula, NU

Investigating potential regional effects of climate warming on mercury and other contaminants in landlocked Arctic char

Principal investigator: Derek Muir (Aquatic Ecosystems Protection Research, Environment Canada)
Locations: Cape Bounty (Melville Island), Lake Hazen (Ellesmere Island) and Resolute (Cornwallis Island) NU

The geochemical ecology of Cryptoendolithic microorganisms: Relationships between cyanobacteria and sandstone weathering in the Canadian High Arctic

Principal investigator: Christopher Omelon (Department of Earth Sciences, University of Western Ontario)
Location: Eureka (Ellesmere Island), NU

Eclipse Sound narwhal research

Principal investigator: Jack Orr (Arctic Aquatic Research Division, Fisheries and Oceans Canada)
Location: Tremblay Sound (Baffin Island), NU

Viscount Melville Sound polar bear sub-population survey

Principal investigator: Jodie Pongracz (Wildlife Division – Environment and Natural Resources, Government of Northwest Territories)
Locations: Polar Bear Cabin (Banks Island), Cape Providence (Melville Island), Wynniatt Bay (Victoria Island) and Mould Bay (Prince Patrick Island), N.W.T.

Arctic shorebird monitoring program (Arctic PRISM)

Principal investigator: Jennie Rausch (Environmental Stewardship/ Northern Conservation, Environment Canada)
Locations: Bernard River (Banks Island), Kagloryuak River (Victoria Island) and Forsyth Lake (Prince of Wales Island), NU

Ecology and management of waterfowl populations from the western Canadian Arctic

Principal investigator: Myra Robertson (Environmental Stewardship Branch/ Northern Conservation Division, Environment Canada)
Location: Inuvik, N.W.T.

Large-scale integrated Cretaceous biostratigraphic correlations and paleogeographic and paleoenvironmental reconstructions across the Boreal realm

Principal investigator: Claudia Schroder-Adams (Earth Sciences, Carleton University)
Location: Mount Bridgeman and Fosheim Peninsula (Ellesmere Island) and Glacier Fiord (Axel Heiberg Island), NU

Walrus study – Foxe Basin

Principal investigator: Rob Stewart (Arctic Aquatic Research Division, Fisheries and Oceans Canada)
Location: Hall Beach, NU

Ecological monitoring in Vuntut National Park

Principal investigator: Leila Sumi (Yukon Field Unit – Vuntut National Park, Parks Canada)
Location: Vuntut National Park, Y.T.

Buffalo River inconnu radio telemetry study

Principal investigator: Melanie Toyne (Arctic Stock Assessment, Fisheries and Oceans Canada)
Location: Buffalo River, N.W.T.

The Canadian arctic buoy program

Principal investigator: Bruno Tremblay (Atmospheric and Oceanic Sciences, McGill University)
Location: South of Byam Channel, NU

Phylogeny and phylogeography of predaceous diving beetles in the Nearctic (Coleoptera: Dytiscidae) with an emphasis on arctic ecosystems

Principal investigator: Steven Vamosi (Department of Biological Sciences, University of Calgary)
Locations: Resolute (Cornwallis Island) and Bylot Island, NU

Non-invasive polar bear monitoring In M'Clintock Channel

Principal investigator: Peter van Coeverden de Groot (Department of Biology, Queen's University)
Locations: Cape Alexander, Cape Sydney (King William Island), Gateshead Island and Prince of Wales Island, NU

Microbial investigations of permafrost and cold saline springs in the High Arctic

Principal investigator: Lyle Whyte (Department of Natural Resources Sciences, McGill University)
Location: Expedition Fiord (Axel Heiberg Island), NU

Hydro-ecological responses of arctic tundra lakes to climate change and landscape perturbation

Principal investigator: Frederick Wrona (Water and Climate Impacts Research Centre, Environment Canada)
Locations: Noell Lake and Upland Lakes, N.W.T.

Hydrology and resilience of High Arctic wetlands: Submerging vs. emerging ecosystems

Principal investigator: Kathy Young (Department of Geography, York University)
Locations: Polar Bear Pass (Bathurst Island) and Sherard Bay (Melville Island), NU

UNCLOS-CHS equipment inventory check YRB

Principal investigator: Scott Youngblut (Canadian Hydrographic Service, Fisheries and Oceans Canada)
Location: Resolute (Cornwallis Island), NU

SUSTAINABLE COMMUNITIES AND CULTURE

The Canadian Arctic, though sparsely populated, is home to rich and diverse cultures, formed and preserved by the groups that have historically occupied this territory. Projects focusing on sustainable communities and culture include studies of archaeology and of the history of northern peoples, as well as studies that focus on the current northern way of life.

Inughuit Arctic explorers at Cape Sheridan

Genevieve LeMoine and Susan Kaplan (The Peary-MacMillan Arctic Museum and Arctic Studies Center, Bowdoin College)

Robert E. Peary was an American explorer, generally credited with being the first person to lead a successful expedition to the North Pole in the early 20th century. Peary's team consisted of men from the United States and Newfoundland and about 50 Inughuit (Polar Inuit) people from Northwest Greenland. Recognizing the northerners' aptitude for hunting land and marine wildlife, dog-sledding and sewing, Peary brought along entire Inughuit families to leverage these essential skills. The crew sailed as far north as possible during the warm months, making it to Cape Sheridan on the northern tip of Ellesmere Island, Nunavut. Here, they spent the winter caching supplies in preparation for their push to the North Pole, which would occur when the sun rose above the horizon in spring. While crew members from Newfoundland and the United States spent most of their time on the S.S. Roosevelt, the Inughuit chose to overwinter on the land living in tents and snow houses. Two winters were spent in this manner in 1905–1906 and 1908–1909 before Peary achieved his goal in April 1909.

The lives of the Newfoundlanders and Americans during this time are well-documented through writings and photographs. However, little is known about the lives of the Inughuit during this voyage. Using first-hand written accounts from George Wardwell, the chief engineer from the Peary expedition, as well as archaeological examination, a team of researchers from the Peary-MacMillan Arctic Museum and Arctic Studies Center has provided a window into the lives of these Inughuit people.

During a 2011 archaeological excavation at Cape Sheridan, researchers collected artefacts from the former camp, including animal bones, scraps of wood, glass, plastics, strips of hide and metal, including many tin cans. Though these are all items one would expect to discover at a camp site, researchers were particularly intrigued by the cans they had documented, as well as those collected by Parks Canada researchers who worked at the site in the early

At the first sign of fall ice, children in Hall Beach, Nunavut, eagerly lace up their skates for a game of hockey.

Susan Kaplan excavates a test pit at Floeberg Beach, Nunavut.

1980s. The cans had not simply been discarded, rather they had been converted into a variety of containers and tools, including funnels, bowls, pots and gas lamps for the purpose of lighting and heating homes.

Traditionally, Inughuit women tended soapstone lamps, skilfully controlling the burn of seal blubber to ensure little or no smoke was released into their homes. However seal blubber was in short supply at Cape Sheridan where marine wildlife is minimal – the soapstone lamps were of little use. Abandoning their traditional lamps, the Inughuit used lamps fashioned from discarded tins for burning kerosene. The researchers hypothesize that these lamps were smokier and sootier than their traditional counterparts and made heating and lighting their homes more difficult.

Peary relied heavily on the labour of the Inughuit women. They were required to sew clothing and footwear for the explorers as well as their own families, and were also tacitly expected to provide "feminine companionship" to the expedition men, and were therefore frequently subject to sexual harassment. Also working under unfamiliar circumstances with periods of food shortage, records show frequent episodes of "arctic hysteria" among Inughuit women. The lamps, indicative of the ingenuity and resiliency of these Inughuit people, are also symbolic of the difficulties encountered by these people, and particularly by these women, as contact with Euro-Americans intensified. This subtle but significant evidence of Inughuit families at Cape Sheridan provides insight into this important cultural interface in the history of the Inughuit people.

> "The laughter of children, the howling of the dogs and the creaking of the SS Roosevelt frozen into the ice are long gone, but evidence of their presence there persists."
>
> – Genevieve LeMoine

Reconstructing an historic event reporting toxic berries on Bylot Island

José Gérin-Lajoie and Esther Lévesque (Département de chimie-biologie, Université du Québec à Trois-Rivières and Centre d'études nordiques, Université Laval)

In 2008, Esther Lévesque and José Gérin-Lajoie travelled to Pond Inlet to present an annual summary of the diverse scientific studies (including studies on geese, foxes, birds and vegetation) taking place on Bylot Island to local and regional authorities and the community. This was also the occasion of the start of a new project under the International Polar Year that would study climate change impacts on Canadian arctic tundra with a focus on berry species. Aimed at integrating Inuit perception of climate change with scientific studies, the purpose of this project was to collect local knowledge of plants and environmental factors that affect their growth. While presenting this new project, Lévesque was asked by the community to investigate an historic incident during which the majority of an outpost camp died from a mysterious illness. Survivors of this event have long suspected that toxic berries were responsible for the deaths. Lévesque,

Sharing stories between Elders and youth

whose work regularly involves communities, jumped at the chance to conduct research relevant to and desired by the community.

Subsequently, co-investigator José Gérin-Lajoie returned to the community to conduct a series of interviews with survivors of this event and relatives of survivors. Researchers also consulted historical documents to reconstruct the course of events surrounding that fateful fall. Records of the incident from archives including those of the Oblats de Marie Immaculée mission, the Anglican Church, the Hudson Bay Company, the RCMP and the Pond Inlet Archives were analysed for their accounts of the deaths. The reconstructed story follows.

In 1943, five families lived in Qarmaarjuit (Borden Peninsula). In the fall, all of the men from Qarmaarjuit went hunting. It was a successful expedition – they caught three walrus, one of which looked underweight and was possibly sick or wounded. The hunters stopped to gather berries in Qinniqtut (Bylot Island) before returning home. The families ate the berries, and the walrus meat was consumed raw as well as cooked, as was the usual custom. Shortly after consuming the food from this expedition, people experienced stomach pains and diarrhea. Over the course of the fall, one by one, people fell ill and died – the eventual death toll for the small community was 27. Those who did not fall ill were left to bury the dead and care for the sick. Both the local Catholic priest and the Anglican minister went to the camp to help with the sick people, burn the meat caches, sod houses, clothes and sleeping skins and also to move survivors to igloos across Navy Board Inlet. For a time, the community was quarantined, and the camp was eventually abandoned.

Researchers accompanied by Elders and youth from the community visited the area from which the allegedly poisonous berries had originated. The field trip promoted intergenerational exchanges about their local history.

DID YOU KNOW?

Museum researchers who conduct field work may apply for PCSP support. For instance, in 2012 PCSP supported mineralogists from the Royal Ontario Museum (Toronto) who were researching mineral deposits in the Richardson Mountains in northeastern Yukon.

Old sod houses at Qarmaarjuit, Borden Peninsula, Baffin Island, Nunavut

As expected, no poisonous species were found nor were any toxic elements present within the soil. Only two types of berries were observed – black crowberry and bilberry, both of which are commonly consumed. Having eliminated the berries as possible culprits for the epidemic, researchers presented the reported symptoms to northern health officials for their diagnoses. While trichinosis and botulism were common because of the Inuit diet of uncooked flesh, the heavy rates of death, the absence of fever and the long period over which people died are inconsistent with these afflictions. Given the symptoms, it is most likely that these people died of E. coli poisoning, either from the walrus meat or from narwhal meat that was stored in the caches. However, the true cause of the epidemic will never be known with certainty because no autopsies were conducted at the time.

The project findings have been related to northern stakeholders in a variety of ways. The researchers appeared on local radio shows, and a report on the project was presented to Parks Canada who later translated it into Inuktitut. An hour-long film that documents the story, the research and the findings of this work is currently in production. This documentary, which also depicts today's way of life for the key characters, will serve as a legacy to the community of Mittimatalik.

> "The 1943 Qarmaarjuit epidemic in Mittimatalik has most certainly not been caused by the presumed "toxic berries" collected on Bylot Island. The most probable cause would be enterocolitis due to contaminated meat either from the walrus the hunters brought back or from the meat caches nearby."
>
> – José Gérin-Lajoie

Projects focused on sustainable communities and culture

NWT ice patch monitoring program

Principal investigator: Tom Andrews (Prince of Wales Northern Heritage Centre, Government of the Northwest Territories)
Location: Mackenzie Mountains, N.W.T.

Local knowledge and botanical validation related to an historic event reporting toxic berries near Mittimatalik, Nunavut

Principal investigator: Esther Lévesque (Department of Biology and Chemistry, Université du Québec à Trois-Rivières)
Locations: Nalluat and Qarmaarjuit, (Baffin Island), Qirngniqtut and Titiralik (Bylot Island), NU

Inughuit and explorers at Cape Sheridan

Principal investigator: Genevieve LeMoine (The Peary-MacMillan Arctic Museum, Bowdoin College)
Location: Cape Sheridan, NU

Van Tat Gwich'in navigation systems project

Principal investigator: Shirleen Smith (Heritage Branch, Vuntut Gwichin Government)
Location: Porcupine Lake, Y.T.

Helluland archaeology project

Principal investigator: Pat Sutherland (Research/Archaeology and History, Canadian Museum of Civilization)
Location: Cape Tanfield, NU

CHANGING CLIMATE

Ongoing climate change within the Arctic is an issue that has garnered much attention in recent years among scientists, policy makers and northern communities alike. Increasingly, there is an urgency to improve understanding of the nature of changes being experienced by these highly sensitive northern ecosystems. PCSP-supported projects examine many aspects of climate change including studies of past, current and projected future climate; studies of sea ice, land ice (including water bodies and glaciers) and permafrost; and studies of plant and animal adaptations to changing environmental conditions.

Arctic-ICE: Examining marine primary productivity and climate change interactions

CJ Mundy, Dave Barber, Tim Papakyriakou and Søren Rysgaard (Centre for Earth Observation Science, University of Manitoba), Michel Gosselin (Université du Québec à Rimouski), Maurice Levasseur and Jean-Éric Tremblay (Université Laval), Yves Gratton (Université du Québec), Lisa Miller (Institute of Ocean Sciences, Fisheries and Oceans Canada), Gary Stern (Freshwater Institute, Fisheries and Oceans Canada), Simon Belt and Tom Brown (University of Plymouth), Michael Scarratt (Maurice Lamontagne Institute, Fisheries and Oceans Canada), Philippe Tortell and Roger Francois (University of British Columbia) and Gerhard Dieckmann (Alfred Wegener Institute)

Recent decreases in the extent of summer sea ice have induced changes to northern marine biota. Primary producers (plants at the base of the marine food chain, including algae and phytoplankton) grow under sea ice as phytoplankton blooms, within ponded melt water atop sea ice and within sea ice. Arctic-ICE is a multi-year program dedicated to investigating the physical and biological processes that control the timing of marine primary productivity, and to determining the role of ice and sea ice biota in controlling gas exchange with the atmosphere. Working in camps located on sea ice that extends from the shore off Resolute, Nunavut, Arctic-ICE scientists have been collecting melt-season data since 2010. The data are collected through biological sampling and sensors that measure everything from the salinity of the water column to the carbon dioxide (CO_2) released into the atmosphere. This work has led to several important discoveries to date.

For instance, scientists have observed immense under-ice phytoplankton blooms. These grow in non-turbulent waters and contribute strongly to marine primary productivity in the Arctic. High under-ice productivity occurs where nutrients exist near the ocean surface and where there is sufficient light transmission for photosynthesis

The icebreaker and research vessel CCGS *Amundsen* takes scientists and students past the Smoking Hills, on the east coast of Cape Bathurst in the Canadian Arctic.

to occur. Arctic-ICE researchers have linked the onset of these blooms to the onset of snow melt in the High Arctic, which is occurring earlier with our warming climate. The implications of an earlier phytoplankton bloom to the local ecosystem have yet to be determined.

Analysis of the physical processes leading to marine primary productivity has also yielded interesting results. Snowdrifts and ice deformation control the initial location of melt ponds, whereas any cracks or holes in the ice (including seal breathing holes) control the evolution of melt ponds throughout the season. During the spring melt, algae grow within and below these melt ponds when solar radiation is at its peak. These melt water flora are therefore adapted to withstand high UV radiation and contain UV-screening compounds known as mycosporine-like amino acids. These have also been found in the water column, which is surprising because scientists did not anticipate that UV radiation could penetrate so deeply through the ice cover and into the water column.

Finally, algae and phytoplankton in ice were found to contribute to particulate dimethylsulfoniopropionate (DMSP) concentrations. Bacteria break DMSP into dimethylsulfide, which is an important climatically active gas that can influence cloud production. DMSP concentrations were high at the base of the ice, but very low in the water column beneath, suggesting that a significant amount of this compound can be expelled into the atmosphere upon ice melt. Another climatically active gas that researchers are examining is CO_2 and how exchanges of this gas are occurring between the atmosphere and these marine ecosystems. Preliminary results indicate that gas bubbles within sea ice may play a more important role than previously thought and that this should be integrated into future studies of polar carbon cycling.

Arctic-ICE's integrated, process-based approach to studying sea ice has therefore contributed to a more complete appreciation of the ice-covered marine ecosystem and the important role of sea ice in maintaining the marine food web and atmospheric equilibrium. The findings to date also improve understanding of oceanography in general.

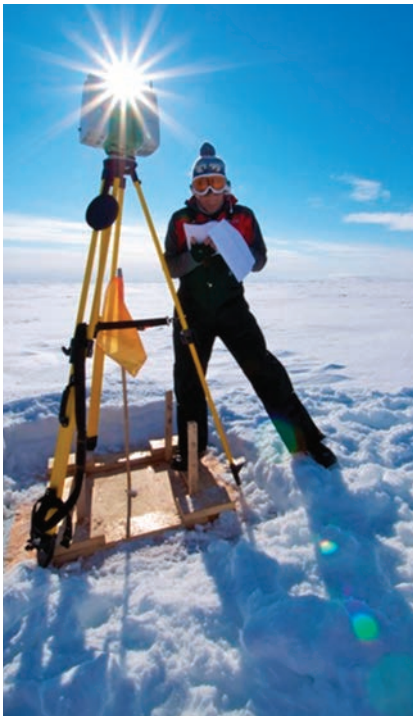
> "We are rapidly discovering that sea ice is not simply a barrier to gas exchange between the atmosphere and ocean, but drives its own set of processes that greatly affect this exchange."
>
> — Arctic-ICE researchers

Using radar to study ice cover on rivers and lakes

Joost van der Sanden (Canada Centre for Remote Sensing, Natural Resources Canada)

River and lake ice have various important effects on natural processes and human activities. For example, roads running over ice-covered rivers and lakes represent important transportation routes in Canada's North; ice jam-related flooding helps sustain riparian ecosystems but also creates a major hazard to homes, businesses and infrastructure; and changes in ice cover duration may be used as a powerful indicator of climate change.

Unfortunately, using ground measurements to monitor freshwater ice is difficult and expensive because Canada's land area is vast. Joost van der Sanden and a team of researchers from the Canada Centre for Remote Sensing (CCRS) have therefore initiated research to assess and develop the usefulness of images from Canadian radar satellites for observing river and lake ice cover characteristics (including ice type, ice texture and ice thickness) as well as processes (such as freeze-up and breakup of ice). Unlike ground-based monitoring techniques, radar satellite imaging has the potential to collect information over large areas without requiring



Ph.D. student Jack Landy installs 3D mapping LIDAR used to observe the melt evolution of the snow-sea ice surface.

DID YOU KNOW?

Scott Lamoureux and his team collaborated with elementary teacher Linda Lamoureux to produce a children's book, published in English and Inuktitut, that explains the work that scientists are conducting on Melville Island. **The Cape Bounty Project** encourages children to think about the natural environment surrounding their own communities and describes how scientists examine plants, animals, soil, water and air to study climate change. Printed copies of this innovative outreach material will be distributed to schools in Nunavut to promote interest in science among local people at an early age, and online versions will be available for free download as well.

any travel. Additionally, radar remote sensing has advantages for monitoring ice: data can be collected night and day, regardless of weather conditions; radar is highly sensitive to ice and water; and radar waves can penetrate dry snow to take images of ice characteristics that are not otherwise visible to the human eye.

Using radar images acquired over the Mackenzie Delta and other locations, CCRS scientists have investigated optimal radar sensor settings and developed innovative river and lake ice mapping and monitoring approaches. The development of radar remote sensing for monitoring freshwater ice relies heavily on ground reference data collected in situ for the validation of information derived from radar image products. Consequently, fieldwork that collects data that characterize the ice and snow cover at selected sample sites has been an integral part of the research. CCRS scientists collected snow and ice cover profiles in the field and recorded information on the presence of ice types, cracks, bubbles, liquid water pockets and impurities (such as sediments), comparing these characteristics to the signals recorded in the radar imagery.

Results have shown that radar remote sensing offers good potential for mapping ice cover types as well as the presence of wet surfaces (which can be indicative of imminent ice breakup).

These results indicate that remote sensing may facilitate monitoring ice cover and flood conditions of arctic river systems during spring breakup. This type of information supports a variety of science, engineering and management activities including break-up and flood forecasting, hydrological modelling, and decision making related to ice road routing, wildlife management, water intake and discharge, and ice jam flood emergency preparedness.

> "The principal research challenge is to build a better understanding of the interaction of radar waves with ice cover and the effects of variability in ice cover characteristics on the radar signal."
>
> — Joost van der Sanden

Collection of in situ data on ice and snow cover in the Mackenzie Delta, N.W.T.

Projects focused on changing climate

Ecology of insectivorous birds on Bylot Island

Principal investigator: Joël Bêty (Département de biologie, chimie et géographie, Université du Québec à Rimouski)
Location: Bylot Island, NU

Freshwater and tundra baseline monitoring near Uyarsivik Lake in Tuktut Nogait National Park

Principal investigator: Jean-François Bisaillon (Western Arctic Field Unit/ Resource Conservation, Parks Canada)
Location: Uyarsivik Lake, Tuktut Nogait National Park, N.W.T.

Enhanced contaminant transport to lake ecosystems by thawing permafrost

Principal investigator: Jules Blais (Department of Biology, University of Ottawa)
Location: Inuvik, N.W.T.

Glacier mass balance and snow pollution studies across the Queen Elizabeth Islands, Canada

Principal investigator: David Burgess (Geological Survey of Canada/Northern Canada, Natural Resources Canada)
Locations: Melville Ice Cap (Melville Island), N.W.T., Meighen Ice Cap (Meighen Island), Devon Ice Cap (Devon Island) and Agassiz Ice Field and Grise Fiord (Ellesmere Island), NU

Permafrost and climate change, western Arctic Canada

Principal investigator: Chris Burn (Department of Geography and Environmental Studies, Carleton University)
Locations: Garry Island and Illisarvik, N.W.T.

Archipelago oceanography in winter: Ecologically and biologically significant areas in the Canadian Arctic

Principal investigator: Eddy Carmack (Institute of Ocean Sciences/ Ocean Science Division, Fisheries and Oceans Canada)
Location: Resolute (Cornwallis Island), NU

Mass balance, ice dynamics and recent changes of the Kaskawulsh Glacier, Yukon

Principal investigator: Luke Copland (Department of Geography, University of Ottawa)
Location: Kaskawulsh Glacier, Kluane National Park and Reserve, Y.T.

Northern Ellesmere ice shelves, epishelf lakes & climate impacts

Principal investigator: Luke Copland (Department of Geography, University of Ottawa)
Location: Purple Valley, Milne Ice Shelf (Ellesmere Island), NU

Characterization of freshwater diatom indicators and zooplankton and other paleolimnological analyses from Cape Herschel and area, Ellesmere Island, NU

Principal investigator: Marianne Douglas (Earth and Atmospheric Sciences, University of Alberta)
Locations: Resolute (Cornwallis Island), Alexandra Fiord and Cape Herschel (Ellesmere Island), NU

Mass balance measurement of White and Baby Glaciers, Axel Heiberg Island, Nunavut

Principal investigator: Miles Ecclestone (Department of Geography, Trent University)
Location: Expedition Fiord (Axel Heiberg Island), NU

Glacier mass balance variability in a small subarctic mountain range, southwest Yukon Territory

Principal investigator: Gwenn Flowers (Department of Earth Sciences, Simon Fraser University)
Location: Kluane National Park and Reserve, Y.T.

High Arctic periglacial ecosystem responses to climate change

Principal investigator: Daniel Fortier (Department of Geography, University of Montréal)
Location: Bylot Island, NU

Canadian Arctic Sea Ice Mass Balance Observatory (CASIMBO)

Principal investigator: Christian Haas (Earth and Atmospheric Sciences and Geophysics, University of Alberta)
Locations: Resolute (Cornwallis Island), Alert and Grise Fiord (Ellesmere Island), NU and Qaanaaq (Greenland)

Adaptation to warming in High Arctic tundra plants

Principal investigator: Gregory Henry (University of British Columbia)
Location: Alexandra Fiord, Sverdrup Pass, Eastwind Lake and Princess Marie Bay Fiord (Ellesmere Island), NU

Evaluating the impacts of mega-scale permafrost disturbances on the hydrological and aquatic systems in Stoney Creek watershed, N.W.T.

Principal investigator: Denis Lacelle (Department of Earth Sciences, University of Ottawa)
Location: Fort McPherson and Peel Plateau, N.W.T.

High Arctic permafrost landscape stability and water quality, Sabine Peninsula and Cape Bounty, Melville Island, Nunavut

Principal investigator: Scott Lamoureux (Department of Geography, Queen's University)
Location: Cape Collingwood and Cape Bounty (Melville Island), NU

Mechanistic links between individual quality and life-history strategies in Arctic-breeding birds

Principal investigator: Oliver Love (Biological Sciences, University of Windsor)
Location: East Bay (Southampton Island), NU

Hazardous sea ice in the Canadian archipelago

Principal investigator: Humfrey Melling (Ocean Science Division/Pacific, Fisheries and Oceans Canada)
Location: Resolute (Cornwallis Island), NU

A comprehensive ice motion characterisation of the terminus region of Fountain Glacier

Principal investigator: Brian Moorman (Department of Geography, University of Calgary)
Location: Fountain Glacier (Bylot Island), NU

Soil and permafrost monitoring along the Firth River in Ivvavik National Park

Principal investigator: Linh Nguyen (Western Arctic Field Unit/Resource Conservation, Parks Canada)
Location: Sheep Creek, Ivvavik National Park, Y.T.

Impacts of warming climatic conditions on freshwater ecosystems via thawing permafrost, Inuvik, Northwest Territories

Principal investigator: Michael Pisaric (Department of Geography and Environmental Studies, Carleton University)
Location: Inuvik, N.W.T.

An integrated study of permafrost conditions on Herschel Island

Principal investigator: Wayne Pollard (Department of Geography, McGill University)
Location: Herschel Island, Y.T.

The biophysical significance of groundwater and ground ice in cold polar environments

Principal investigator: Wayne Pollard (Department of Geography, McGill University)
Locations: Expedition Fiord (Axel Heiberg Island), Eureka (Ellesmere Island), NU

Climate change effects of a changing cryosphere on northern lakes

Principal investigator: Terry Prowse (Science and Technology Branch/ Aquatic Ecosystem Impacts, Environment Canada)
Location: Cambridge Bay (Victoria Island), NU

Satellite remote sensing of temperature and changes in Arctic snow cover

Principal investigator: Alain Royer (Centre d'applications et de recherches en télédétection (CARTEL), Université de Sherbrooke)
Location: Barnes Ice Cap (Baffin Island), NU

Dynamics and change of the Devon Island ice cap

Principal investigator: Martin Sharp (Earth and Atmospheric Sciences, University of Alberta)
Location: Devon Island ice cap (Devon Island), NU

Permafrost in the Mackenzie Valley

Principal investigator: Sharon Smith (Geological Survey of Canada/ Northern Canada, Natural Resources Canada)
Locations: Inuvik and Norman Wells, N.W.T.

Net ecosystem exchange of the greenhouse gases CO_2 and CH_4 in the High Arctic

Principal investigator: Vincent St. Louis (Department of Biological Sciences, University of Alberta)
Location: Lake Hazen, Quttinirpaaq National Park (Ellesmere Island), NU

Pan-Arctic Measurements and Arctic Regional Climate Model Simulations (PAM-ARCMIP) 2011

Principal investigator: Walter Strapp (Science and Technology Branch/ Meteorological Research Division, Environment Canada)
Locations: Resolute (Cornwallis Island), Hot Weather Creek, Eureka, Fosheim Peninsula and Alert (Ellesmere Island), NU

RADARSAT-2 polarimetric observations of winter ice cover in the Mackenzie Delta

Principal investigator: Joost van der Sanden (Canada Centre for Remote Sensing, Natural Resources Canada)
Location: Inuvik, N.W.T.

Thermokarst landscape hydroecology

Principal investigator: Brent Wolfe (Geography and Environmental Studies, Wilfrid Laurier University)
Locations: Old Crow Flats, Y.T. and Wapusk National Park, Man.

Glacier mass balance and snow pollution monitoring, Auyuittuq National Park

Principal investigator: Christian Zdanowicz (Geological Survey of Canada/ Glaciology Division, Natural Resources Canada)
Location: Penny Ice Cap (Baffin Island), NU

SUSTAINABLE RESOURCES MANAGEMENT

The Canadian North is home to a veritable wealth of natural resources including energy reserves, minerals and water. Studies focussing on sustainable resources management explore the distribution, types and formation processes of these reserves. Sustainable resources management also relies upon effective infrastructure in support of resource exploration, and these projects are also explored within this section.

Mapping bedrock and surficial geology in Hall Peninsula

David Mate, Gabriel Machado, Tommy Tremblay, Celine Gilbert, Serge Basso, Carl Bilodeau and Roxanne Takpanie-Briere (Canada-Nunavut Geosciences Office), Mike Young (Dalhousie University), Diane Skipton (University of Ottawa), Rich From (University of Manitoba), Cameron MacKay (University of Saskatchewan), Julie Leblanc-Dumas (Université Laval) and Patricia Peyton (Arctic College)

The geology of the Hall Peninsula, Baffin Island, is presently poorly understood. Current surficial geology maps of this area exist only at the national scale (1:5 000 000), and therefore do not include sufficient geoscientific information to allow for early stage mineral exploration. Bedrock in the area was last surveyed in the 1960s and also lacks important detail. Recently, kimberlites (diamond-bearing rock deposits) have been discovered in the region. Because of this and the peninsula's proximity to Iqaluit (Nunavut's most commercially developed settlement), there is a growing interest in developing resources that may exist in this area. To do so effectively, the Hall Peninsula Integrated Geoscience Program (HPIGP) is mapping the bedrock and surficial geology of the area at a much finer scale (1:100 000 for surficial geology and 1:250 000 for bedrock geology).

The HPIGP is led by the Canada-Nunavut Geosciences Office, consists of partners from academic institutions and the federal and territorial governments, and is supported by several local, Inuit-owned businesses. Working out of a temporary field camp of 20 to 25 researchers, scientists are collecting information from the bedrock to help understand how the peninsula was formed (its tectonic history). Striations, glacial erosion marks and landforms are being measured to help reconstruct ice flow dynamics and map glacial erosion history while till is being sampled to explore for mineral deposits. Samples of bedrock and surficial materials are also being collected to help characterize the composition of these rocks and to determine whether metal deposits, including gold, copper or other rare earth elements, may be present. Finally, scientists are surveying

The abandoned Polaris Mine on Little Cornwallis Island, Nunavut

the state of permafrost and terrain stability within the region. This information will help to address risks to any land-based or coastal infrastructure that may be erected as a result of resource development.

This work relies upon close collaboration with the local Inuit communities. Through various agreements and contracts, several local companies and people have been employed within the camps as coordinators, students and technicians. Presentations on the work being conducted have been made in the communities of Pangnirtung and Iqaluit, and delegates from these communities have made site visits to the camp.

Though mapping of this region is not expected to be complete until 2014, interesting discoveries have already been made. Much to the delight of the local communities, the 2012 field campaign uncovered 11 new soapstone deposits, which could supply local carvers with carving stone. The information ultimately gained from this study will help developers to make decisions about potential resource exploration and development, and will help to inform policy-makers and planners in matters of land-use planning.

Canada-Nunavut geoscience field camp, Hall Peninsula

> "This carving stone find is a good example of how geoscience information could benefit Inuit."
>
> – Okalik Eegeesiak, President of the Qikiqtani Inuit Association [Nunatsiaq News (QIA President's report puts positive spin on Olympic Junket), October 1, 2012]

Examining the long-term viability of an NWT ice road

Tim Patterson (Carleton University), Jennifer Galloway (Geological Survey of Canada – Calgary), Hendrik Falck (Northwest Territories Geoscience Office), Helen Roe (Queen's University Belfast), Graeme Swindles (Leeds University), Ian Clark (University of Ottawa), Michael Pisaric (Brock University), Paul Gammon (Geological Survey of Canada – Ottawa), Andreas Prokoph (Carleton University) and the North Slave Métis Alliance

The Tibbitt to Contwoyto Winter Road (TCWR) is the world's longest heavy-haul ice road, spanning a distance of 586 kilometres (km) and built mainly atop seasonally frozen lakes. Open for approximately three months per year, this route connects at least three major mining developments to Yellowknife and is travelled by approximately 11 000 trucks per year transporting in excess of $500-million worth of goods. By this winter (2013), traffic along this road is projected to grow to 14 000 truckloads. As transport overland is by far the most cost-effective method of shipping, there is significant interest in the long-term viability of this road – how vulnerable are the underlying lake ecosystems to climate change? The answer to this question may impact the course of industrial development within the Northwest Territories. The work of Tim Patterson's team has therefore recently garnered a significant amount of attention.

Dr. Graeme Swindles and Ph.D. student Lisa Neville, Leeds University, collect water property data from a lake on the TCWR.

Scientists are using lake sediment cores to determine the long-term variability in local climates. Since 2010, the team has been collecting cores from 189 small, non-turbulent lakes along the TCWR. While temperature records are only available in this region since 1950, examination of lake sediments allows researchers to evaluate climate fluctuations (including temperature and precipitation trends) and their associated effects on lake ecosystems over the last 8500 years. Patterson's team have also designed a custom microtome (a tool able to cut 0.2-millimetre thick slices of a material) that allows examination of the lake history at a subdecadal scale.

To gain confidence in the results of their analyses, scientists have cross-referenced findings from recent history with data records from tree rings, temperature records and journal entries regarding seasonal ice cover from the North Slave Métis Alliance. Through analysis of microfossils, sediments, stratigraphic layering, isotopes and grain size, the team has been able to identify historical El Niño events within the sediment cores. These events occur on a two to seven year cycle, and have caused significant interruptions to highway service in recent years. In 2006, El Niño caused a warmer than average winter locally, which shortened the usual operating season by a month. Fewer than 7000 truckloads were shipped North that winter, and much of the needed materials had to be airlifted in, leading to economic losses for the mines. One mine was even forced to shut down temporarily owing to insufficient fuel for its operations.

Other important climate regimes impacting the region are also identifiable within these cores. Sunspot cycles, as well as the Pacific Decadal Oscillation (PDO), each of which can have a cooling or warming effect in a given winter, can be examined over the 8500-year lake sediment

history. Given a recent return to the negative phase of the PDO, and the fact that the next few solar cycles are predicted to be very weak, preliminary results suggest that this ice road will be viable through the next several decades.

However, while the effect of long-term natural climate cycles can be determined, the effect of recent CO_2 increases, which seem to be without precedent in the sediment cores recovered, are more difficult to constrain. Future research by Patterson's team will involve integrating the sediment core records with global climate models to gain a more accurate picture of how climate change might impact this region, and thus this important transport corridor.

> "It is critical that policy-makers, planners and mine developers have reasonable data upon which to base economic forecasts, as alternate transportation costs are prohibitively high."
>
> — Tim Patterson

DID YOU KNOW?

In emergency situations, the PCSP is often the first to be aware of the situation, and chartered aircraft can be dispatched by Resolute logistics coordinators to help manage the emergency. The PCSP keeps an inventory of vehicles and field equipment available in Resolute that may be used for emergencies and can track the location of chartered aircraft every seven minutes. In an emergency, the PCSP coordinates with the Nunavut Rescue Coordination Centre, Parks Canada and Rescue Coordination Centre Trenton to facilitate medical evacuations and search and rescue operations.

Identifying permafrost conditions for northern highway transportation

Stephen Wolfe, Dan Kerr, Greg Oldenborger, Dan Riseborough, Caroline Duchesne, Mark Ednie and Wendy Sladen (Geological Survey of Canada, Natural Resources Canada), Naomi Short, Robert Fraser, Ian Olthof, Joost van der Sanden and Yu Zhang (Canada Centre for Remote Sensing, Natural Resources Canada)

Seasonal and all-weather roads are vital links for communities and resource development in the Northwest Territories. Highway 3, for example, is the only road access to Yellowknife from the south and to major projects in the mineral-rich North Slave Geological Province. Temperature cables, installed along the highway by a team of scientists led by NRCan's Climate Change Geoscience Program, indicate the presence of warm permafrost. At approximately -2°C, the ground is frozen, but it is near its thawing point. Electrical resistivity tests, which help identify where permafrost exists, indicate that the permafrost beneath Highway 3 is discontinuous, and that transitions between frozen and unfrozen ground occur over short distances. Where permafrost is ice-rich, melting of this ground ice can lead to settlement along sections of the highway. Identifying regions that are likely to be affected by the melting of ice is important for managing risks to infrastructure.

Changes in the surface topography along Highway 3 can occur through freezing and thawing of the active layer (the seasonally frozen upper layer of permafrost) or by thawing of the underlying ice-rich permafrost. In areas where water pools (such as bogs, fens or flooded terrain), the ground thaws preferentially. The highway itself can also cause local pooling where it blocks the natural drainage. Therefore the ability to identify wet terrain and ice-rich permafrost helps scientists to locate risks to infrastructure.

Using data from different remote sensing techniques, NRCan scientists have developed methods to identify where ground settlement due to permafrost thaw could cause infrastructure damage. InSAR (a satellite-mounted radar sensor) can be used to measure elevation changes of the ground surface over time on the order of centimetres. As well, intensity measurements from LiDAR (an aircraft-mounted sensor using light to measure the elevation and properties of a surface) can distinguish wet terrain from dry terrain, and road surfaces from natural surfaces (including bedrock and vegetation). Lastly, aerial photographs and satellite imagery can be used to determine the land cover and terrain types. Through combining these datasets, scientists are able to map where pooling and ground settlement due to permafrost thaw is occurring. This ability to remotely monitor thaw-susceptible areas helps planners and engineers to identify highway sections that may require remediation and ensure the safety and serviceability of this important corridor. These methods may also be applied in other regions across the North to help maintain transportation infrastructure.

Permafrost can contain thick layers of ice that make the ground unstable when thawed, creating hazards for infrastructure.

> “Climate warming in the North poses risks to existing and proposed infrastructure and geoscience information at a range of scales is required to assess adaptation alternatives and solutions.”
>
> — Stephen Wolfe

An abandoned section of Highway 4, east of Yellowknife. The road surface has continued to settle because of permafrost thaw.

Projects focused on sustainable resources management

Tectonics and sedimentation in the High Arctic

Principal investigator: Benoit Beauchamp (Department of Geoscience, University of Calgary)
Locations: Borup Fiord Pass, Hare Fiord, Mount Leith, Mount Burrill and Ooblayah Bay (Ellesmere Island), NU

GEM northern base and precious metal potential, Victoria Island

Principal investigator: Jean Bédard (Geological Survey of Canada, Natural Resources Canada)
Location: Victoria Island, NU and N.W.T.

GEM diamonds project: Wager Bay surficial geology activity

Principal investigator: Janet Campbell (Geological Survey of Canada, Natural Resources Canada)
Locations: Repulse Bay, NU and Victoria Island, NU and N.W.T.

GEM multiple metals - Melville Peninsula

Principal investigator: David Corrigan (Geological Survey of Canada, Natural Resources Canada)
Location: MacKar Inlet and Melville Peninsula, NU

Investigations of methane release from deep permafrost and gas hydrates in the Mackenzie Delta area

Principal investigator: Scott Dallimore (Geological Survey of Canada, Natural Resources Canada)
Location: Inuvik, N.W.T.

GEM geology of northwestern Victoria Island, NWT

Principal investigator: Keith Dewing Geological Survey of Canada, Natural Resources Canada)
Locations: Minto North Camp and Collinson Crater (Victoria Island), N.W.T.

GEM hydrocarbon potential of Ellef Ringnes Island

Principal investigator: Keith Dewing (Geological Survey of Canada, Natural Resources Canada)
Location: Malloch Dome (Ellef Ringnes Island), Eureka and Alexandra Fiord (Ellesmere Island) and Glacier Fiord (Axel Heiberg Island), NU

Regional lake sediment and water geochemistry survey, Tibbet to Contwoyto Winter Road, Northwest Territories

Principal investigator: Hendrick Falck (Northwest Territories Geoscience Office, Government of the Northwest Territories)
Locations: Lockhart Rest Camp and Lac de Gras Rest Camp, N.W.T.

Regional stream sediment and water geochemistry survey, Mackenzie Mountains, Northwest Territories

Principal investigator: Hendrick Falck (Northwest Territories Geoscience Office, Government of the Northwest Territories)
Location: Coates Lake, N.W.T.

GEM bedrock mapping and structural analysis of Mackenzie Plain and Franklin Mountains

Principal investigator: Karen Fallas (Geological Survey of Canada, Natural Resources Canada)
Locations: Norman Wells and Tulita, N.W.T.

Subsidence, flooding, and erosion hazards in the Mackenzie Delta

Principal investigator: Donald Forbes (Geological Survey of Canada – Atlantic, Natural Resources Canada)
Location: Inuvik, N.W.T.

GEM Ellesmere Island teleseismic experiment

Principal investigator: James Haggart (Geological Survey of Canada, Natural Resources Canada)
Location: Eureka (Ellesmere Island), NU

South Wopmay bedrock mapping project phase II

Principal investigator: Valerie Jackson (Northwest Territories Geoscience Office, Government of the Northwest Territories)
Locations: Rebesca Lake and Little Crapeau Lake, N.W.T.

GEM northern uranium for Canada: Northeast Thelon compilation

Principal investigator: Charles Jefferson (Geological Survey of Canada/ Central and Northern Branch, Natural Resources Canada)
Location: Baker Lake, NU

Regional geoscience studies and petroleum potential of Mackenzie Plain area, central Northwest Territories

Principal investigator: Adrienne Jones (GNWT Industry, Tourism and Investment, Northwest Territories Geoscience Office)
Location: Norman Wells, N.W.T.

GEM minerals diamonds

Principal investigator: Bruce Kjarsgaard (Geological Survey of Canada, Natural Resources Canada)
Locations: Baffinland Iron Mine and Mingo Lake (Baffin Island), Tahoe Lake area (Victoria Island), Charles Island and Wager Bay area, NU

Geomagnetic work

Principal investigator: Mark Lamothe (Geomagnetic Laboratory, Natural Resources Canada)
Location: Resolute (Cornwallis Island), NU

Hydrological studies, Mackenzie Delta region

Principal investigator: Philip Marsh (National Water Research Institute/Hydrological Processes, Environment Canada)
Location: Richards Island and Trail Valley Creek, N.W.T.

Hall Peninsula, Nunavut, regional geoscience study

Principal investigator: David Mate (Canada-Nunavut Geoscience Office/ Natural Resources Canada, Aboriginal Affairs and Northern Development Canada and Government of Nunavut)
Location: Iqaluit (Baffin Island), NU

Annual Resolute Bay water survey

Principal investigator: Colin McCann (Water Survey of Canada, Environment Canada)
Location: Resolute (Cornwallis Island), NU

Volcanogenic massive sulphide potential of the Archean Banting Group, Slave Province, NWT, Canada

Principal investigator: Luke Ootes (Northwest Territories Geoscience Office, Government of the Northwest Territories)
Location: Yellowknife, N.W.T.

Paleoclimatological assessment of the central Northwest Territories: Implications for the long-term viability of the Tibbett to Contwoyto winter ice road

Principal investigator: R. Tim Patterson (Department of Earth Sciences, Carleton University)
Locations: Lac de Gras Rest Camp and Lockhart Rest Camp, N.W.T.

Metamorphism and tectonics of Cumberland Peninsula, Baffin Island, Nunavut

Principal investigator: David Pattison (Department of Geoscience, University of Calgary)
Locations: Touak Fiord, Clephane Bay and Mischief Glacier (Baffin Island), NU

CASE 12-Vendom Fiord

Principal investigator: Karsten Piepjohn (Federal Institute for Geosciences and Natural Resources/Polar Geology, Germany)
Location: Humphreys River (Ellesmere Island), NU

GEM Cumberland Peninsula multiple metals project

Principal investigator: Mary Sanborn-Barrie (Central and Northern Canada Branch/ Geological Survey of Canada, Natural Resources Canada)
Location: Pangnirtung (Baffin Island), NU

Observational constraints on glacier sliding laws

Principal investigator: Christian Schoof (Department of Earth and Ocean Sciences, University of British Columbia)
Location: Unnamed valley glacier, Kluane National Park and Reserve, Y.T.

Paleozoic vertebrates of Devon Island

Principal investigator: Neil Shubin (University of Chicago)
Location: Tucker River (Devon Island), NU

Limnology and paleoecology of lakes

Principal investigator: John Smol (Faculty of Arts and Sciences, Queen's University)
Locations: Cape Herschel and Alexandra Fiord (Ellesmere Island) and Resolute (Cornwallis Island), NU

Mesoproterozoic Bylot Basins, Nunavut

Principal investigator: Elizabeth Turner (Department of Earth Sciences, Laurentian University)
Locations: Red Rock Valley and Bellevue Mountain (Baffin Island), NU

UNCLOS

Principal investigator: Jacob Verhoef (UNCLOS, Natural Resources Canada)
Location: Kugluktuk, NU

Climate change geoscience for infrastructure adaptation in the North Slave permafrost region

Principal investigator: Stephen Wolfe (Central and Northern Canada/ Geological Survey of Canada – Northern, Natural Resources Canada)
Location: Yellowknife, N.W.T.

Lower paleozoic stratigraphy and petroleum potential on southern Baffin Island (GEM energy project)

Principal investigator: Shunxin Zhang (Canada-Nunavut Geoscience Office/ Natural Resources Canada, Aboriginal Affairs and Northern Development Canada and Government of Nunavut)
Location: Iqaluit (Baffin Island) NU

PLANETARY SCIENCE

The Canadian Arctic is one of the harshest environments on earth. With its characteristically cold winters, few other locations offer conditions so analogous to those that may exist on other planets. PCSP-supported planetary science projects therefore include equipment-testing for space missions, as well as studies of organisms that are able to survive this harsh climate (and may therefore exist on other planets as well). The frigid, long polar night also makes it an excellent location from which to view the stars and planets for several months per year.

Ukpik: testing a High Arctic astronomical observatory

Eric Steinbring (National Research Council) and Ray Carlberg (University of Toronto)

Ideally, astronomy is done where it is cold, dark and where there is little air above you (or none at all). Putting telescopes in space therefore seems ideal for astronomical observation. However, apart from being a very expensive endeavour, this is not always necessary. In fact, there are advantages to operating viewing facilities from strategic locations on the ground, including the ability to build big facilities – much larger than would be practical in orbit.

Only a handful of places on Earth offer the reasonably accessible, near-space conditions required by astronomers. Not surprisingly, the best viewing locations are some of the most extreme locations on Earth. Observatories exist on the summit of Mauna Kea, Hawaii, (the tallest mountain on Earth when measured from its base on the seafloor), the Atacama Desert, Chile, (one of the driest places on earth) and the high glacial plateau of Antarctica (the coldest place on earth). With this in mind, Eric Steinbring and Ray Carlberg set out to test whether the extreme environment of the Canadian North could suitably host such an observatory.

The long, dark night of the polar winter seemed an ideal fit for astronomy. Researchers were also seeking an environment with cold, dry air and a stable thermal inversion (air that is colder near the earth's surface and gets warmer with altitude, a condition associated with atmospheric stability). The observatory also required exposed rock on which to mount instruments. These requirements pointed to a site located at high elevation and the highest possible latitude, near the coast and on an isolated peak. Finally the site had to be accessible, near an airstrip and a major research base.

The ideal location was concluded to be the northern coast of Ellesmere Island, and "Ukpik" (the Inuktitut word for snowy owl) was built by the National Research Council and installed in 2007. The test observatory was so-named because of the distinct owl-like shape of the camera's body. Based on the data collected over four years, sky and weather conditions

A researcher crosses an expanse of arctic desert on Devon Island, Nunavut. This landscape is similar to landscapes found on Mars.

at this location are ideal for a permanent observatory. Preliminary data also indicate that "seeing" from this location is excellent and that sharp images of stars can be captured. These first tests with Ukpik showed that the conditions on the high coastal mountains of Ellesmere Island compare favourably with the best observatory sites worldwide. This project has evolved, with researchers now building much more precise instruments for astronomy through the long northern night.

> "High coastal mountains on Ellesmere Island offer some of the best conditions on Earth for astronomy. Perhaps even more remarkable is that it took development of the most extreme locations in Antarctica to spur interest in Canada's own Far North."
>
> — Eric Steinbring

An Inuksuit station is deployed on a remote mountaintop.

DID YOU KNOW?

The PCSP loans field equipment to Inuit Tapiriit Kanatami (ITK) in support of their operations. ITK is Canada's national Inuit organization, representing four Inuit regions: Nunatsiavut (Labrador), Nunavik (northern Quebec), Nunavut and the Inuvialuit Settlement Region (Northwest Territories). ITK is an advocacy program that represents and promotes the interest of Inuit people on a wide variety of issues and challenges at a national level. During ITK's Inuit Executive Arctic Training in 2012, the PCSP provided arctic gear to participants.

Projects focused on planetary science

Canadian High Arctic analog sites prospection and evaluation with a focus on analog medicine projects

Principal investigator: Alexandre Monarque (Space Science and Technology/ Science and Academic Development, Canadian Space Agency)
Locations: Eureka (Ellesmere Island) and Axel Heiberg Island, NU

Astronomical site testing on Ellesmere Island

Principal investigator: Eric Steinbring (Herzberg Institute of Astrophysics/ Canadian Gemini Office, National Research Council)
Locations: Yelverton Bay and Eureka (Ellesmere Island), NU

NATIONAL PARKS AND WEATHER STATIONS

There are 11 national parks located across the Canadian Arctic, each of which represents an important northern ecosystem to be protected and preserved for future generations. The PCSP supports projects aimed at understanding the environmental dynamics within Canadian national parks, as well as the routine operations required for park and weather station maintenance.

Monitoring shrubs in Kluane National Park and Reserve

Carmen Wong (Kluane National Park and Reserve, Parks Canada)

In recent years, scientists have noticed changes in vegetation composition across the North that coincide well with observed climate changes. Other research performed across the Canadian North, including remote sensing studies and field-based studies, has noted shrub expansion and a loss of overall plant diversity despite increases in plant productivity. Shifts in vegetation can have a profound impact on local wildlife, causing habitat loss for certain species and creating habitat for other species. Although a broad climate warming has been noted across Yukon, little current information exists as to how vegetation in Yukon's alpine tundra is changing.

To better understand changes in this environment, Carmen Wong's team from Parks Canada has established a permanent set of sample vegetation plots at six subdrainage basins throughout Kluane National Park and Reserve that are representative of the alpine ecosystem. These plots will be monitored over time for changes in plant species composition to determine the rate, extent and nature of changes in shrub cover within the park. This ground-level data at fine spatial resolution will be used in unison with low altitude aerial photography at coarser resolution to infer changes in shrub cover across the park.

Examination of physical and climatic parameters such as topography, efficiency of drainage (poor versus well-drained terrain), and the presence and duration of snow cover will also help determine how these changes may relate to micro-climates within the park. Although long-term monitoring will be required to gain definitive insight into the vegetation changes occurring, preliminary results show variation in shrub cover between subdrainage basins.

A Twin Otter aircraft sits at the Parks Canada Tanquary Fiord warden station, Quttinirpaaq National Park, Ellesmere Island.

These variations seem to relate to the presence of snow, and future research will focus on the relationship between the presence of shrubs and the date of snowmelt. This information is essential for reporting on ecological integrity within Canada's national parks.

Being strongly committed to local community engagement, Kluane National Park and Reserve also began the "Chef in the Park" initiative while establishing this monitoring program. Chef in the Park brings local chefs into the backcountry of the St. Elias Mountains to work as camp cooks. As essential members of the field party, these chefs play a valuable role in the field camp, while simultaneously engaging with and learning about the Canadian landmass.

> "In this vast landscape we studied the minute landscape of plants on our hands and knees and saw worlds within worlds."
>
> — Miche Genest, volunteer chef

Recording plant diversity along the Logan Glacier, Kluane National Park and Reserve

Projects focused on national parks and weather stations

Hornaday River water monitoring program 2011

Principal investigator: Jean-François Bisaillon (Western Arctic Field Unit, Parks Canada)
Location: Hornaday River, N.W.T.

The HMS *Investigator* rediscovery project year II

Principal investigator: Henry Cary (Western Arctic Field Unit/Cultural Resource Management, Parks Canada)
Locations: Polar Bear Cabin and Mercy Bay (Banks Island), N.W.T.

Yearly servicing of automatic weather stations at Isachsen, Mould Bay, Stefansson Island, Rae Point, Grise Fiord and Eureka (Ellesmere Island), NU

Principal investigator: Rich DeVall (Met Services of Canada, Environment Canada)
Locations: Resolute (Cornwallis Island), Isachsen (Ellef Ringnes Island), Mould Bay (Prince Patrick Island), Rae Point (Baffin Island), Grise Fiord and Eureka (Ellesmere Island) and Stefansson Island, NU

The Polar Environment Atmospheric Research Laboratory (PEARL)

Principal investigator: James Drummond (Department of Physics, University of Toronto)
Location: Eureka (Ellesmere Island), NU

Sirmilik National Park operations

Principal investigator: Carey Elverum (Nunavut Field Unit/Sirmilik National Park, Parks Canada)
Locations: Sirmilik National Park (Baffin Island and Bylot Island), NU

Ukkusiksalik National Park operations

Principal investigator: Paula Hughson (Ukkusiksalik National Park, Parks Canada)
Locations: Radio Repeater and Sila Lodge, NU

Upper Crow River salmon reconnaissance

Principal investigator: Richard Mahoney (Vuntut Gwitch'in First Nation)
Location: Crow River, Y.T.

Northern Watch

Principal investigator: Jim Milne (Defence Research and Development Canada, Department of National Defence)
Location: Gascoyne Inlet (Devon Island), NU

Baseline monitoring of biodiversity and ecological processes in Aulavik National Park

Principal investigator: Linh Nguyen (Western Arctic Field Unit/ Resource Conservation, Parks Canada)
Locations: Green Cabin and Muskox River (Banks Island) and Inuvik, N.W.T.

Auyuittuq National Park operations

Principal investigator: Delia Siivola (Nunavut Field Unit/Auyuittuq National Park, Parks Canada)
Location: Auyuittuq National Park (Baffin Island), NU

METAREAs site selection

Principal investigator: Trevor Smith (Met Services of Canada, Environment Canada)
Locations: Axel Heiberg Island, Bylot Island and Melville Island, NU

Quttinirpaaq National Park operations

Principal investigator: Alex Stubbing (Nunavut Field Unit/Quttinirpaaq National Park, Parks Canada)
Locations: Tanquary Fiord, Lake Hazen and Fort Conger (Ellesmere Island) and Ward Hunt Island, NU

Ecological monitoring in Vuntut National Park

Principal investigator: Leila Sumi (Yukon Field Unit/Vuntut National Park, Parks Canada)
Location: Vuntut National Park, Y.T.

Northern Ellesmere Island in the Global Environment (NEIGE)

Principal investigator: Warwick Vincent (Biology Department, Université Laval)
Locations: Resolute (Cornwallis Island) and Ward Hunt Island, NU

Change in the alpine: researching methods to monitor shrubs in Kluane National Park and Reserve

Principal investigator: Carmen Wong (Yukon Field Unit/Kluane National Park and Reserve, Parks Canada)
Locations: Kluane National Park and Reserve, Y.T.

Annex

PCSP Advisory Board

The PCSP Advisory Board provides the Director General of the Strategic Policy and Operations Branch within NRCan and the PCSP with recommendations and advice on the following:

- logistical services provided by the PCSP
- screening processes for logistics requests
- membership of the PCSP Project Review Committee, which reviews university-based logistics requests
- consideration of Traditional Knowledge and Arctic communities' interests

PCSP Advisory Board Members – 2012

Martin Fortier (Chairperson)
Executive Director, ArcticNet
Université Laval

Marianne Douglas
Professor, Department of Earth and Atmospheric Sciences
Director, Canadian Circumpolar Institute
University of Alberta

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Aurora College

Scot Nickels
Senior Science Advisor Director,
Inuit Qaujisarvingat:
The Inuit Knowledge Centre Inuit
Tapiriit Kanatami

PCSP Project Review Committee

The PCSP Project Review Committee annually reviews logistics requests from university-based researchers to set priorities for PCSP direct, in-kind support. This committee bases its evaluation on the following criteria:

- feasibility
- assurance of scientific excellence
- performance of previous projects and publications record
- quality of application
- involvement of highly qualified personnel (including students and local involvement)

PCSP Project Review Committee Members – 2012

Vincent St. Louis (Co-chairperson)
Professor, Department of
Biological Sciences
University of Alberta

Alrick Huebener (Co-chairperson)
Policy Executive, Earth Sciences Sector
Natural Resources Canada

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