CANADA'S ARCTIC JOURNAL
JANUARY/FEBRUARY 2014 • $ 5.95

# above&beyond

# ON THIN ICE

## THE STATE OF ARCTIC SEA ICE

## Canadian Polar Commission

### A Gateway for Northern Research

## A Whale-sized History Book

### The Oldest Living Mammal on Earth

## The First Talentshow Salluit

PM40050872
www.arcticjournal.ca

above&beyond
CANADA'S ARCTIC JOURNAL

**Publisher & Editor**
Tom Koelbel

**Contributing Editor**
Teevi Mackay

**Inuktitut Translation**
Kevin Kablutsiak

**Advertising**
Doris Ohlmann
(Ottawa)
613-257-4999

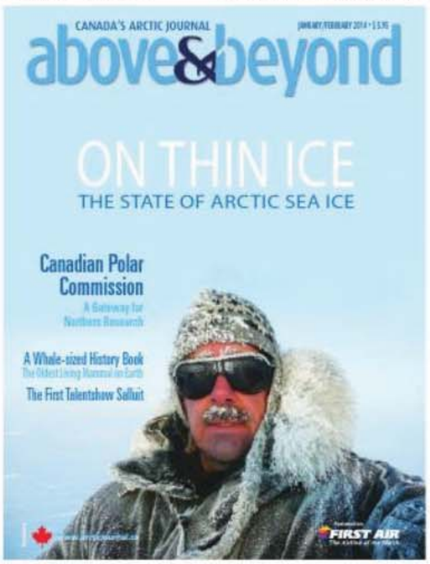
**Circulation**
Patt Hunter

**Design**
Robert Hoselton, Beat Studios

email: editor@arcticjournal.ca

**Toll Free: 1 • 877 • 2ARCTIC**

Volume 26, No. 1 January/February 2014




A GORGEOUS DAY OUT ON THE ICE.
© DR.CHRISTIAN HAAS

Cover Price $5.95
ANNUAL SUBSCRIPTION RATES

| Canada | US/Foreign |
|---|---|
| 6 issues $30.00 | 6 issues $45.00 |

(Includes applicable taxes)

Read online:
**arcticjournal.ca**

Celebrating our 26th year as the popular In-flight magazine for First Air, *The Airline of the North*.

Société Makivik
Makivik Corporation

# 28 On Thin Ice

We have camped among polar bears and seals, and enjoyed good company with our Inuit guides. In our tow are *qamutiit* equipped with electromagnetic ice thickness sensors and snow radars, which can map ice and snow conditions continuously as we move along on our snowmobiles. The data are required to evaluate the state of the sea ice in the sounds, straits and channels of the Canadian Arctic Archipelago, where little is known about sea ice and oceanic change and consequential impacts on the eco-system and local residents. — Text and photos by Dr. Christian Haas

# 14 A Whale-sized History Book

## The Oldest Living Mammal on Earth

The most interesting and intriguing fact about the Bowhead whale is that it is believed to be one of the oldest living animals to exist on this planet. With unique collaboration between the Inupiat Inuit whale hunters of Northern Alaska and biologists, it is now estimated that adult Bowheads can, and some likely do, live more than 200 years. — Text by David Reid / Photos by Doc White

# 34 Canadian Polar Commission

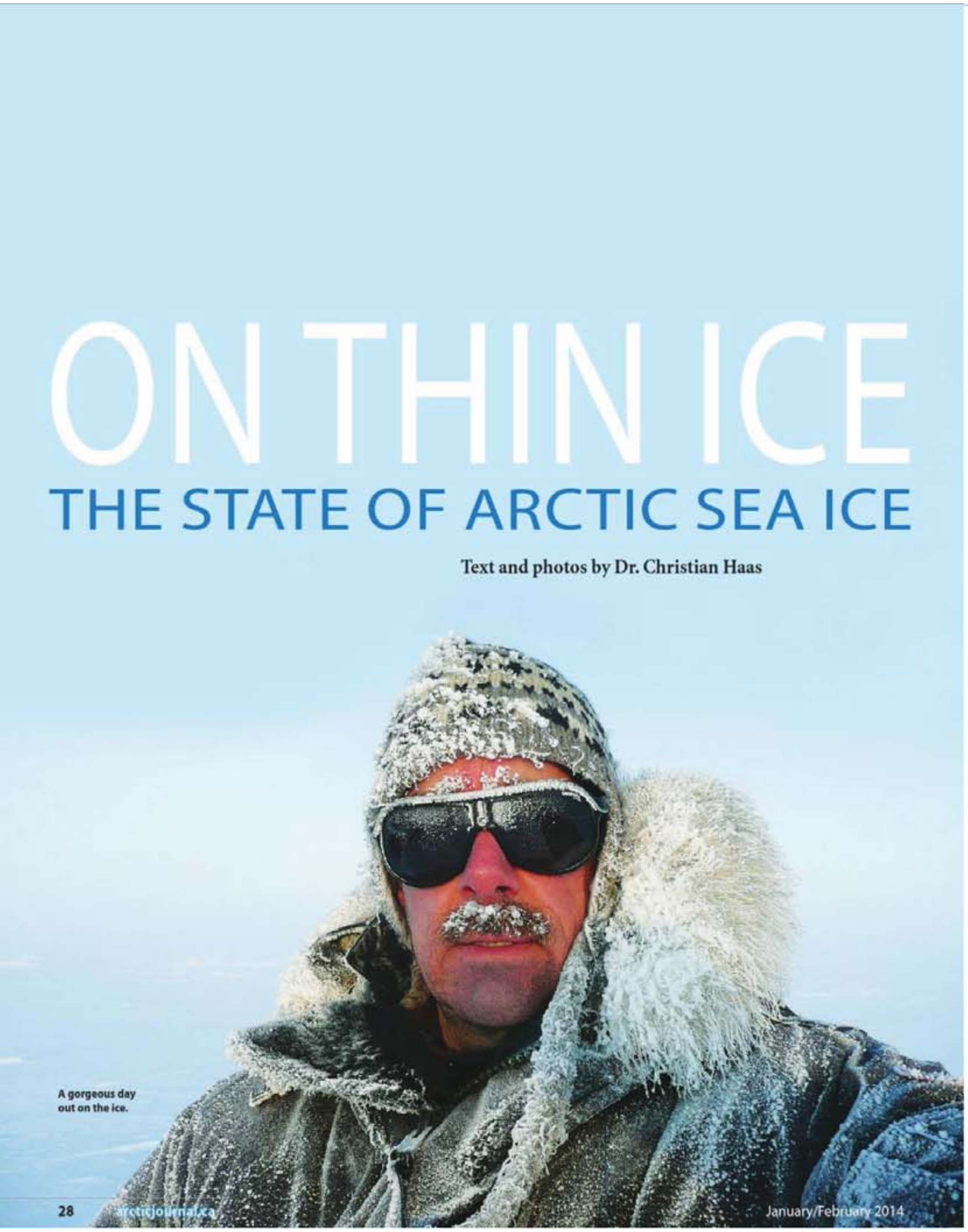
The last five decades have witnessed a range of significant changes in the Arctic environment, with warming temperatures and declining sea ice that could open up the region to commercial shipping within the next five decades. The Canadian Polar Commission manages the growing body of news and knowledge about our polar regions. The nature of Canada's activities in the Arctic encompass different roles: "a pristine wilderness, teasing our imaginations; a frontier, packed with economic opportunity; a laboratory for scientific investigation; and a homeland to part of the country's population".
— Tim Lougheed



PUBLICATIONS MAIL
AGREEMENT NO. 40050872
RETURN UNDELIVERABLE CANADIAN
ADDRESSES TO:
CIRCULATION/ABOVE&BEYOND
P.O. BOX 683
MAHONE BAY, NS B0J 2E0
Email: info@arcticjournal.ca

# ON THIN ICE
## THE STATE OF ARCTIC SEA ICE

Text and photos by Dr. Christian Haas



A gorgeous day out on the ice.

My arms and back are sore and eyes and face are burning as we tackle the last 50 kilometres of our 400 km, five-day snowmobile survey from Resolute Bay to Grise Fjord, the two northern most communities in Canada's Arctic. But a bright sun shines through the crispy air as we cross Jones Sound and approach the grand views of the mountains and fjords along the southern coast of Ellesmere Island. It is mid May, and behind us lie long days of negotiating rough snow drifts and ridged sea ice. We have camped among polar bears and seals, and enjoyed good company with our Inuit guides. Nothing seems to be able to ever change this pristine landscape.

However, in our tow are *qamutiit* equipped with electromagnetic ice thickness sensors and snow radars, which can map ice and snow conditions continuously as we move along on our snowmobiles. The data are required to evaluate the state of the sea ice in the sounds, straits and channels of the Canadian Arctic Archipelago, where little is known about sea ice and oceanic change and consequential impacts on the ecosystem and local residents.

Most sea ice information comes from satellite sensors, which show the areal coverage, but not the ice's thickness or snow cover characteristics. In winter and spring, Canada's Arctic is completely covered with landfast ice, and changes are invisible from space. Over the Arctic Ocean, data have been obtained systematically for over 30 years, and reveal a sobering picture: During September, the month with the minimum annual ice coverage, the Arctic-wide areal extent of sea ice has declined by 13.7 per cent per decade. In 2012, a record minimum was reached with only 3.63 million square kilometres ice extent, only 55 per cent compared to long-term mean conditions between 1981 and 2010. In winter, Arctic sea ice extent has declined less dramatically, but still significantly with a trend of -2.5 per cent per decade in March. It was 15.13 million square kilometres in March 2013. Although these trends are superimposed by strong year-to-year variability of plus or minus one million square kilometres and more, nothing seems to be able to stop these trends, and ice free summers seem inevitable in the coming decades. This will have consequences for the global and Arctic climate and ecosystem, as well as for Northerners and shipping and resource exploration in the Arctic.

Satellite data also show two other important changes of the Arctic's sea ice: the ice has become younger overall, as thick, multiyear ice has been replaced by thinner, first-year ice, and the ice cover's drift and deformation have accelerated. Novel satellite laser and radar altimetry observations also show that the ice has become much thinner. In summer, mean thicknesses in the central Arctic have decreased from around 2 m before 2000 to just over one metre in 2009.

With funding from the European Union, the European Space Agency, and the Federal and Provincial Governments, we have performed independent airborne ice thickness measurements north of Ellesmere Island since 2004. This region possesses the thickest and oldest ice in the Arctic, as it is located downstream of the major ice drift streams,

Hauling a sled-based electromagnetic ice thickness sensor across a giant, multi-year sea ice pressure ridge north of Ellesmere Island.

Drill-hole measurements are performed during helicopter landings on sea ice to calibrate the airborne measurements.

the Beaufort Gyre and Transpolar Drift. Pushed by prevailing northerly winds, sea ice is continuously moved from the region of the North Pole towards Canada, where it thickens by deformation and compression, thrusting up against the northern coasts of the Queen Elizabeth Islands. The ice thickness in this area is therefore sensitive to changes in the intensity and direction of this ice drift, and integrates over climate conditions in much of the Arctic Ocean.

Based out of the Canadian Forces Station Alert, and using helicopters and airplanes provided through the Polar Continental Shelf Project in Resolute Bay, we have performed ice thickness surveys up to a latitude of 86°N with a so-called EM bird, a tethered electromagnetic induction sounder. This method is sensitive to the electrical conductivity distribution in the underground, and takes advantage of the strong conductivity contrast between the resistive ice and conductive sea water underneath. Our results show that mean ice thicknesses in the region have decreased from more than 5 m in 2004 to less than 4 m in 2012. This is still thick enough to support assertions of the regions surrounding Ellesmere Island as the last refuges of sea ice in the coming decades, or the Last Ice Area as promoted by the World Wildlife Fund in Canada.

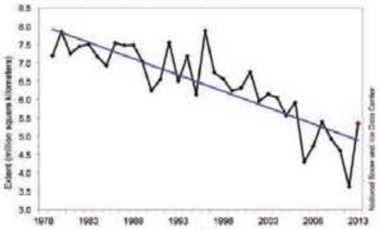
The scale of the changes reported above have come as a surprise to many and exceeded the worst expectations of climate change experts and sea ice forecasters. Although coinciding with observations of increased air temperatures in the Arctic, most climate models have underestimated the rapidity of the Arctic's sea ice demise. This demonstrates the complexities of the sea ice climate system and the involved feedback processes, including the impact of short and long wave radiation, clouds, precipitation, winds, and ocean currents and heat flux, which make understanding and predicting the sea ice system very difficult.

The situation is even more complicated in Canada's Arctic and along the Northwest Passage. Lying downstream of the ice drift systems described above, Canada's Arctic's ice cover is a mixture of thick multi-year ice incurring from the north, and locally formed first-year ice. Within the islands of the Canadian Arctic Archipelago the ice is landfast and immobile from October or November until June or July. In summer, multi-year ice can be imported to or exported from the region depending on prevailing winds and currents, thus strongly modifying late-summer ice extent. The redistribution of ice from one region to another complicates interpretation of sea ice changes caused by changes in air temperatures or radiation. According to statistics provided by Environment Canada's Canadian Ice Service, ice coverage in Canada's Arctic has strongly decreased as well, albeit at smaller rates than observed Arctic-wide. However, the region is subject to much larger interannual variability and years with minimum ice coverage in Canada rarely coincide with minimum years in the Arctic Ocean. 2012 was an exception in this regard when both Arctic-wide and Canadian ice coverage reached record minima, with Canadian sea ice covering only about 30 per cent of its long-term average extent.

The large interannual variability hampers predictions of the opening of the Northwest Passage and its suitability as a routine shipping route during summer. More ice thickness information is needed at the end of winter to predict the break-up of the landfast ice and opening of shipping channels, to estimate the following decay of the ice, and to evaluate the hazard potential of the remaining ice. Unfortunately, airborne surveys are expensive and Canada's Arctic is vast. Therefore, comprehensive ice thickness mapping has not been feasible so far.

However, local residents and Canadian rangers travel frequently over the ice between and beyond communities. It is our goal to equip communities with sledge-based EM sensors like the ones described above, such that valuable ice thickness data can be

**Satellite observations of Arctic summer (September) ice extent between 1979 and 2013.**




*(Source: National Snow and Ice Data Center, Boulder, Colorado).*

Homing in to CFS Alert after an ice thickness survey over the Arctic Ocean.

*Qamutiq* equipped with electromagnetic ice thickness sensor to provide continuous ice thickness readings along snowmobile tracks.

Last preparations before take-off with the "EM Bird," a tethered ice thickness sensor slung below the helicopter.

Camping on the land (sea ice) during ice thickness surveys in the waters of the Canadian Archipelago.

continuously obtained during those journeys. The gathered data will complement more dedicated but time- and range-limited airborne surveys to comprise a network of Canada's Arctic sea ice mass balance observatories. In turn, local communities will be able to observe first-hand the changes happening to their region and affecting their usage of the sea ice environment. First successful collaborations have been established with the Canadian Rangers.

So far we haven't performed our snowmobile surveys long enough to observe any significant change within the Canadian Archipelago. In addition, the large spatial variability of ice conditions due to varying freeze-up conditions in different years and at different locations requires good spatial coverage of measurements to be representative for a larger region. However, we have collected several thousand kilometres of ice thickness data, which form the basis of and reference for a more extensive data set to be gathered in the future.

And there are still "discoveries" to be made. By surveying the fjords along the south coast of Ellesmere Island, we have mapped regions of very thin ice. According to climatological records, the ice in Canada's Arctic grows between 1.6 and 1.9 m every winter. However, the ice in some of these fjords was only less than half as thick. Although known and avoided by some hunters as regions of early ice break-up, the extent and thickness of these areas was not well known. Salinity and temperature measurements in the water under the ice have revealed that there is increased oceanic heat flux in these regions, due to tidal upwelling of deeper, warmer water above shallow sills within or in front of the fjords.

Snowmobile ice thickness survey in South Cape Fjord. The EM ice thickness sensor is mounted on the second *qamutiq* towed by the first snowmobile.

Such observations are important for evaluations of future ice conditions in a warming climate. The regions of thin ice are most likely to open up first and to form year-round polynyas of open water, as occur already today in some narrow channels between islands, for example the Hell Gate and Cardigan Strait polynya between Ellesmere and Devon Island. Occurrence of more polynyas would have important consequences for the microclimate and ecosystem in these fjords. Intermittently, thinner ice is more prone to seawater flooding under a snow cover, which depresses the ice surface below the water level. Flooded snow significantly hampers over ice travel by snowmobiles and *qamutiit*, and may be a first immediate, negative consequence of continuing melting sea ice for northern residents. Similar conditions are frequently encountered further south on Baffin Island where the ice is thinner and the snow is thick.

*Dr. Christian Haas is Canada Research Chair in Arctic Sea Ice Geophysics at York University in Toronto, Ontario.*