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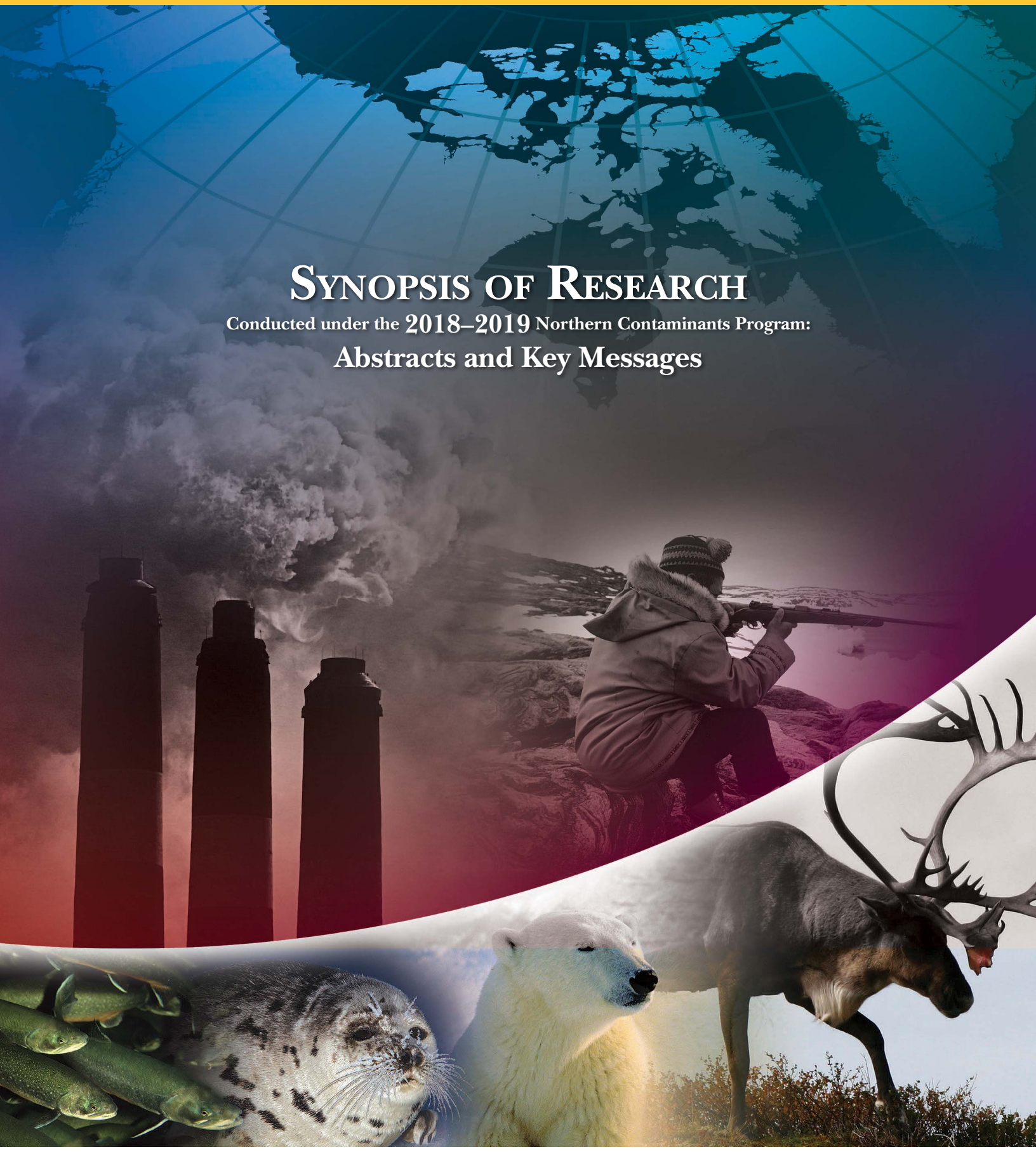

Synopsis of Research

Conducted under the 2018–2019 Northern Contaminants Program:

Abstracts and Key Messages

Canada

Synopsis of Research Conducted under the 2018-2019 Northern Contaminants Program: Abstracts and Key Messages

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Catalogue: R71-64/1E-PDF
ISSN 2561-8164

This publication is also available in French under the title: Résumé de la recherche effectuée en 2018-2019 dans le cadre du Programme de lutte contre les contaminants dans le Nord : résumés et messages clés.

The full version of the *Synopsis of research* is available upon request from the NCP Secretariat (plcn-ncp@rcaanc-cirnac.gc.ca)

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Foreword

The Northern Contaminants Program (NCP) works to reduce and, wherever possible, eliminate contaminants in traditionally harvested foods, while providing information that assists informed decision making by individuals and communities in their food use. The *Synopsis of Research Conducted under the 2018-2019 Northern Contaminants Program: Abstracts and Key Messages* provides a detailed report of the activities and preliminary results of each project funded under the NCP between April 1, 2018 and March 31, 2019.

The projects described in this report cover the broad range of topics that contribute to understanding and addressing northern contaminants issues. They are arranged according to the five NCP subprograms: Human Health; Environmental Monitoring and Research; Communications, Capacity and Outreach; Community Based Monitoring and Research; and Program Coordination and Indigenous Partnerships. Specific research priorities, as outlined in the program's strategic documents (i.e. the NCP Blueprints and NCP Call for Proposals 2018-2019), included dietary contaminant exposure, food choice, and risk perception; effects of contaminants on the health of people and ecosystems; contaminant levels and trends in the Arctic environment/wildlife and the influence of climate change; the benefits/risk evaluation of country food consumption; and environmental microplastics monitoring. Projects were carried out using a variety of methodologies including fieldwork, laboratory analysis, community-based monitoring, and workshops.

All projects supported by the NCP are subject to a comprehensive technical, peer and northern social/cultural review process, involving external peer reviewers, technical review teams, regional contaminants committees and the NCP Management Committee. This review process ensures that each project supports the priorities and objectives of the NCP and its partners. Engagement and partnership with Indigenous organizations, northern territorial and/or community authorities is required for all projects involving activities within northern communities, fieldwork in the North and/or analyses of samples, as a condition of approval for funding.

This report is part of the program's usual activities, ensuring the transparency of the NCP and the timely sharing of results. More detailed project reports, describing project objectives, activities, results, and conclusions are compiled in the *Synopsis of Research Conducted under the 2018-2019 Northern Contaminants Program: Full Report*, which is available through the NCP Publications Database at www.aina.ucalgary.ca/ncp. All individual project reports were lightly edited for clarity and consistency.

In addition to the *Synopsis of Research* publications, publications related to NCP funded projects (including peer reviewed journal articles) can be searched and accessed through the NCP Publications Database at www.aina.ucalgary.ca/ncp. Also, data and metadata associated with individual projects can be found on the Polar Data Catalogue website at www.polardata.ca.

Further information about the Northern Contaminants Program is available on the NCP website at www.science.gc.ca/ncp.

Introduction

The Northern Contaminants Program (NCP) engages Northerners and scientists in researching and monitoring of long-range contaminants that are transported to the Canadian Arctic through atmospheric and oceanic processes from other parts of the world and which remain in the Arctic environment and build up in the food chain. The data generated by the NCP is used to assess ecosystem and human health, and the findings of these assessments are used to address the safety and security of traditional country foods that are important to the health and traditional lifestyles of Northerners and northern communities. The findings also inform policy, resulting in action to eliminate contaminants from long-range sources. The NCP contributes scientific data and expertise to contaminants-related international initiatives such as the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP), and to international agreements such as the United Nations Environment Programme's Minamata Convention on Mercury and Stockholm Convention on Persistent Organic Pollutants, that work on a global scale to improve the health of Arctic people and wildlife over the long term.

The NCP is directed by a management committee that is chaired by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC), and consists of representatives from five federal departments (Environment and Climate Change Canada, Fisheries and Oceans, Health, Polar Knowledge Canada and CIRNAC), five territorial, provincial and regional governments (Yukon, Northwest Territories, Nunavut, Nunavik and Nunatsiavut), four northern Indigenous organizations (Council of Yukon First Nations, Dene Nation, Inuit Tapiriit Kanatami and Inuit Circumpolar Council Canada), five regional contaminants committees, and Canada's Arctic-focused Network of Centres of Excellence, ArcticNet. The NCP Management Committee is responsible for establishing NCP policy and science priorities and for making final decisions on the allocation of funds. The Regional Contaminants Committees in Yukon, Northwest Territories, Nunavut, Nunavik and Nunatsiavut support this national committee with region-specific expertise and advice. Funding for the NCP's budget comes from CIRNAC and Health Canada. Details about the management structures and review processes used to effectively implement the NCP, and the protocol used to publicly disseminate health and harvest information generated by the NCP can be found in the NCP Operational Management Guide (available upon request from the NCP Secretariat).

Background

The NCP was established in 1991 in response to concerns about human exposure to elevated levels of contaminants in fish and wildlife species that are important to the traditional diets of northern Indigenous peoples. Early studies indicated that there was a wide spectrum of substances - persistent organic pollutants, heavy metals, and radionuclides - many of which had no Arctic or Canadian sources, but which were, nevertheless, reaching unexpectedly high levels in the Arctic ecosystem.

The Program's key objective is to reduce and, where possible, eliminate contaminants in northern traditional/country foods while providing information that assists informed decision making by individuals and communities in their food use.

Under the first phase of the NCP, research was focused on gathering the data required to determine the levels, geographic extent, and source of contaminants in the northern atmosphere, environment

and its people, and the probable duration of the problem. The data enabled us to understand the spatial patterns and temporal trends of contaminants in the North, and confirmed our suspicions that the major sources of contaminants were other countries. The data, which included information on the benefits from continued consumption of traditional/ country foods, was also used to carry out assessments of human health risks resulting from contaminants in those foods. Results were synthesized in the first Canadian Arctic Contaminants Assessment Report (1997).

Extensive consultations were conducted in 1997-1998 to find the common elements between the concerns and priorities of northern communities and the scientific needs identified as critical for addressing the issue of contamination in Canada's North. As a result, research priorities were developed based on an understanding of the species that are most relevant for human exposure to contaminants in the North, and geographic locations and populations that are most at risk.

In 1998, initiatives got under way to redesign the NCP, and implement new program features which continue to this day: 1) the NCP blueprints that represent the long-term vision and strategic direction for the NCP; and 2) an open and transparent proposal review process. These features ensure that the NCP remains scientifically defensible and socio-culturally aware, while at the same time, achieving real progress in terms of the Program's broad policy objectives.

In 1998-1999, the NCP began its second phase, which continued until 2002-2003. Results of this phase were synthesized in the 5-part (1, 2, 3, 4, 5) Canadian Arctic Contaminants Assessment Report II (CACAR II 2003). During that time, the NCP supported research designed to answer questions about the impacts and risks to human health that may result from current levels of contamination in key Arctic food species. To ensure a balanced assessment of the risks of consuming traditional food, an emphasis was placed on characterizing and quantifying the benefits associated with traditional diets. Communications activities were also emphasized and supported. Under the leadership of the northern Indigenous organizations, the dialogue between Northerners and the scientific community, which had been initiated during the early days of the NCP, continued to build awareness and an understanding of contaminants issues, and helped to support communities in dealing with specific contaminant issues at the local level.

Since 2003, the NCP has continued to lead and contribute to assessments that synthesize data funded through the NCP program. In 2009, the NCP released the Canadian Arctic Contaminants and Health Report. This report compiled research funded under the Human Health subprogram since the CACAR II release in 2003. It covered topics including health status of the Canadian Arctic population, human exposure to contaminants, toxicology, epidemiology, and risk-benefit evaluation.

Efforts on a third series of Canadian Arctic Contaminants Assessment Reports got under way in 2010, leading to the release of the *CACAR III: Mercury in Canada's North*, in December 2012; the *CACAR III: Persistent Organic Pollutants in Canada's North*, in December 2013; and the *CACAR III Contaminants In Canada's North: Summary for Policy Makers*, in April 2015.

The *CACAR III: Mercury in Canada's North* publication reported on the scientific progress made under the projects supported by ArcticNet, NCP and International Polar Year. The report also evaluated the current understanding of the environmental fate of mercury in the Canadian Arctic. Its key scientific recommendations were: 1) Continue research and monitoring of atmospheric mercury, with an enhanced focus on deposition measurements to facilitate quantification of atmospheric contributions of mercury to Arctic ecosystems. 2) Continue temporal trend monitoring of mercury in Arctic biota, and identify the processes that are changing mercury concentrations in some species. 3) Further characterize the key processes acting on mercury after atmospheric deposition and their effects on the fate of mercury in the Arctic environment. 4) Better characterize the processes that link climate

change with mercury transport, cycling and bioaccumulation. 5) Increase efforts to determine the biological effects of methylmercury exposure on Arctic fish and wildlife.

The *CACAR III: Persistent Organic Pollutants in Canada's North* publication reported research on POPs in the Canadian Arctic over the period of 2003 to 2011. It drew on results from the NCP (2003-2011) as well as on any other published or unpublished studies up to early 2013. This reporting period saw much new knowledge developed on temporal trends of POPs in air and biota, new POPs in many environmental compartments, and on ocean transport to the Arctic. The possible influence of climate warming on trends of POPs has was also investigated. The report made recommendations in relation to the transition from science to policy action, how the expansion of information on the chemical of interest impacts future research directions, how the improved knowledge of time trends of POPs impacts future research directions, the importance of local sources of new POPs, knowledge of factors influencing levels and trends or POPs, and the on-going challenge of assessing the biological effect of POPs.

The *CACAR III Contaminants in Canada's North: Summary for Policy Makers* publication gives an overview of where contaminants originate, how they are transported, and how they interact with the Arctic and Northern environment and ecosystems. The report explores NCP's current knowledge to action initiatives, including a look at the key scientific studies taking place across the Arctic. Finally, the report details the 10 key findings of NCP research to date (Box 1) and the future directions of research in the Arctic (Box 2).

The most recent reports in the CACAR series, *Contaminants in Canada's North: State of Knowledge and Regional Highlights*, and *Human Health 2017* were released in 2018.

As part of the 25th anniversary of NCP, the report on *Contaminants in Canada's North: State of Knowledge and Regional Highlights* synthesizes the detailed scientific results presented in a series of technical reports produced from 2011 to 2017 by the Northern Contaminants Program on the issue of long-range contaminants in the Canadian Arctic. This report elaborates further on the 10 key findings reported in the *CACAR III Contaminants in Canada's North: Summary for Policy Makers* publication and provides details of NCP's activities and a summary of contaminants related issues in the 5 regions of its geographic scope.

In Nunatsiavut, the Nunatsiavut Government Research Advisory Committee (NGRAC) and the Nain Research Centre coordinate the implementation of NCP activities and are the main points of contact for information about long-range contaminants in Nunatsiavut. In Nunavik, NCP activities are coordinated through the Nunavik Nutrition and Health Committee (NNHC). In Nunavut, NCP activities are coordinated by the Nunavut Environmental Contaminants Committee (NECC). In the Northwest Territories (NWT), the NWT Regional Contaminants Committee (NWTRCC) coordinates NCP-related activities. In Yukon, the Yukon Contaminant Committee (YCC) coordinates all NCP-related activities in the territory. Each regional highlight describes information on country foods, health and contaminants; mercury and country food; and POPs and food. The regional highlights also include information on relevant health advisories and scientific studies in the respective regions.

The *CACAR on Human Health 2017* is a Canadian-specific summary of an Arctic Council report from the Arctic Monitoring and Assessment Programme (AMAP) on human health in the Arctic published in 2015. The Northern Contaminants program (NCP) undertook this assessment to address concerns about potential human health risks associated with exposure to environmental contaminants from a diet that includes traditionally prepared and harvested foods from local northern ecosystems. Traditional food, also known as country food, is central to the social, cultural, economic, and spiritual well-being of Inuit, Dene, and Métis in the North and, for many, is essential for their overall

food security. The key finding of the report were that: levels of many contaminants have decreased over time, however, there is still a strong need for additional data to ascertain contaminants trends among pregnant women and women of childbearing age in many regions of the Canadian Arctic; contaminants such as PBDEs and PFAS are also found in people and wildlife and further data is needed to understand human exposure to these contaminants and potential health outcomes; dietary advice should be regionally specific; there is a strong need for co-location of biomonitoring and wildlife monitoring studies, along with dietary assessment work to create stronger data linkage between exposure sources and contaminant levels measured in humans.

Human Health

Yukon contaminant biomonitoring: Old Crow

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Project location

Old Crow, YK

Abstract

Wild foods are critical to the health and well-being of Indigenous communities of the Yukon and elsewhere. Therefore, Gwich'in people of the Yukon have contributed to several long-running environmental monitoring studies that track the safety and sustainability of these foods. Occasionally, these studies have shown particular traditional foods to have high levels of some types of contaminants (e.g., mercury), raising concerns for residents of Old Crow, YT about the safety of the wild foods in their territory. In this second year, we implemented a biomonitoring research project in Old Crow (February 2019). Building upon prior consultations, our research team traveled to the first participating community for data and sample collection. With the assistance of a local research coordinator and nurse, we recruited 77 participants and collected blood, urine, and/or hair samples. Participants also completed two surveys (Health Messages Survey, Food Frequency Questionnaire). Data analysis (metals in blood/urine; persistent organic pollutants (POPs) in plasma; mercury in hair; perfluorinated compounds in serum (PFCs); dietary surveys) is currently underway. During the same visit, we also returned the results from the previous year's data collection on the refinement of the Health Message Survey and the Food Frequency Questionnaire. In collaboration with regional, territorial, and federal partners, new results of 2018-2019 will be returned to participating communities within 12 months post sampling (fall 2019/winter 2020).

Key messages

- A total of 77 residents from Old Crow participated in the biomonitoring project in 2019.
- Samples are currently being analyzed for mercury (hair), metals and metalloids (hair, blood, urine), POPs (plasma), and perfluorinated compounds (PFCs) in serum.
- Results will be returned to participating communities in January 2020.
- Findings from the dietary survey completed in 2017-2018 indicate that the most commonly consumed foods reported by participants from Old Crow were: caribou, moose, Chinook salmon, whitefish and low (grey) blueberries.
- Findings from the health message survey completed in 2017-2018 indicate that almost all participants (97%) from Old Crow had heard that eating traditional foods provides a significant variety and amount of nutrients.

Exposure to food chain contaminants in Nunavik: biomonitoring in adult and youth cohorts of the *Qanuilirpitaa* survey (Year 2)

Project leaders

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Project location

Nunavik, QC

Abstract

Inuit are exposed to a wide range of environmental contaminants through their diet which comprises significant amounts of fish and sea mammals. During the past 25 years our team has monitored the exposure of Nunavimmiut to persistent organic pollutants (POPs) and metals, starting with the Santé Québec Inuit Health Survey in 1992, and followed by the *Qanuippitaa?* 2004 Health Survey and more recently by the *Qanuilirpitaa?* 2017 Health Survey. From 1992 to 2004, for most legacy POPs, a significant decreasing trend was confirmed in environmental components, and wildlife and circumpolar Inuit exposure data. However, mercury and lead exposures remain topical issues, particularly among childbearing and pregnant women in Nunavik. Moreover, new chemicals are introduced each year in the market. These "New POPs and Contaminants of Emerging Concern (CECs)" now reach the Arctic food chain and very little is known about their concentrations and

temporal and regional trends in Inuit. This three-year project aims at updating data on exposure to food-chain contaminants and key nutrients in a representative sample of the Inuit population of Nunavik within the framework of the *Qanuilirpitaa?* Survey, in which 1326 Nunavimmiut participated in 2017. Activities conducted in 2018-2019 included analysing a series of legacy POPs, including polychlorinated biphenyls, chlorinated pesticides and brominated diphenylethers, in plasma samples from 500 Nunavimmiut randomly selected among all *Qanuilirpitaa?* participants. In addition, key nutritional biomarkers were measured: 1) omega-3 polyunsaturated fatty acids in red blood cell membranes; and 2) selenoneine and ergothioneine (and their methylated metabolites) in whole blood samples. This project will allow Canada to maintain its role at the forefront of international biomonitoring efforts on long-range environmental contaminants exposure among circumpolar populations and it contributes to understanding the risks and benefits of country foods consumption in the Arctic.

Key messages

- Concentrations of PCBs, chlorinated pesticides and PBDEs were determined in plasma samples from 500 *Qanuilirpitaa?* Participants.
- N-3 polyunsaturated fatty acids (PUFAs) levels were measured in red blood cell membranes of all 1326 participants.
- Whole blood samples from all participants were analysed for selenoneine and ergothioneine - two key nutrients found in beluga mattaaq.
- Non-targeted screening of pooled plasma extracts is ongoing and may reveal the presence of contaminants of emerging concern.

Exposure to food chain contaminants in Nunavik: evaluating spatial and time trends among pregnant women & implementing effective health communication for healthy pregnancies and children (Year 3 of 4)

Project leaders

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Project locations

- All 14 communities of Nunavik
- Quebec City, Quebec

Abstract

Inuit are exposed to a wide range of environmental contaminants through their country food diet. During the past 20 years, our team has monitored the exposure of Nunavik's Inuit population to persistent organic pollutants (POPs) and metals. In this same period, a decreasing trend was confirmed in environmental concentrations and circumpolar Inuit exposure levels for most legacy POPs. Despite a decreasing trend due to reduced country food consumption, mercury (Hg) exposure remains a critical issue, particularly among pregnant women in Nunavik. As well, new chemicals are introduced on the market each year. These "New POPs and Contaminants of Emerging Concern (CECs)" reach the Arctic food chain and very little is known about their concentrations, temporal and regional trends, and Inuit exposure to them.

Since 2011, we have worked on multiple related projects to assess local country food sources of Hg and nutrients in Nunavik, and to understand the effects of Hg exposure, dietary nutrients, and food security during pregnancy on child development. Together with the Nunavik Regional Board of Health and Social Services (NRBHSS), and based on data provided by the Nunavik Research Center

(NRC), we developed dietary recommendations aimed at mitigating Hg exposure while enhancing nutritional and food security status for women of childbearing-age. Recent data from medical follow-up of pregnant women continue to show high Hg concentrations and reveal that health and dietary recommendations that were provided to assist healthcare providers were not very efficient in reducing Hg exposure in these women.

This four-year project aims to contribute to on-going international biomonitoring efforts on long-range environmental contaminant exposure among pregnant women in Nunavik, and evaluate the comprehension and effectiveness of health and dietary recommendations/advice given to pregnant women, other women of childbearing age, caregivers, and members of the general population.

During year 1, a total of 97 pregnant women from 13 communities in Nunavik were recruited for biomonitoring activities. Results of year 2 show that blood Hg and lead (Pb) levels in 2016-2017 have decreased by 16-18% since the last time they were measured in 2013. Data analyses in year 2 and 3 show that exposure levels of Legacy and New POPs included in the Stockholm Convention have decreased markedly since they were first measured in 1992 or 2004, and continued to decrease in the recent years. However, more recent perfluorinated compounds, (PFNA, PFDA and PFuDA) used to replace older ones, have increased since they were first measured in 2012. PFNA exposure levels are now more than three times higher for women in northern Canada compared to women of the same age in southern Canadian cities. Based on food questionnaire data and methylmercury (MeHg) intake estimations, beluga meat and *nikku* were the main source of MeHg exposure for pregnant women across seasons in 2016-2017, but primarily in the summer when most beluga products are available. Study results were shared and discussed on several occasions with Inuit colleagues and communities and Nunavik and Nunavut health professionals in 2018-2019, and are currently in preparation for publication.

Key messages

- Measurements in 2016-2017 indicate that blood Hg and Pb levels have decreased by 16-18% since the last time they were measured in 2013.
- Exposure levels of Legacy and New POPs included in the Stockholm Convention continued to decrease since they were first measured in 1992 or 2004.
- More recent perfluorinated compounds (PFNA, PFDA and PFuDA) exposure levels have increased since they were first measured in 2012.
- PFNA exposure levels are more than three times higher for women in northern Canada compared to women of the same age in southern Canadian cities.
- Beluga meat and nikku are the main source of MeHg exposure for pregnant women across seasons. The highest exposure occurs in the summer when most beluga products are available.

Contaminant biomonitoring in the Northwest Territories: investigating the links between contaminant exposure, nutritional status, and country food use

Project leader

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Project locations

- Tulit'a, Sahtú Region, NT
- Déline, Sahtú Region, NT
- K'asho Got'ine, Sahtú Region, NT
- Jean Marie River First Nation, Dehcho Region, NT
- K'atl'odeeche, Dehcho Region, NT
- West Point First Nation, Dehcho Region, NT
- Ka'a'gee Tu, Dehcho Region, NT
- Sambaa K'e, Dehcho Region, NT

Abstract

Throughout the fourth and final year of the study, we returned results from previous sample collections in three additional communities. Our research team discussed results and potential future collaborations in person with local leadership as well as return results to participants through public meetings and one-to-one sessions (Tulit'a, K'asho Got'ine, Sambaa K'e, Northwest Territories). With the assistance of local research coordinators and the local health centers, we completed the re-testing and follow up for participants who had elevated levels of a contaminant. In addition to the community report, the leadership partners of each community received the regional report (Dehcho, Sahtú) which won't be shared with the public, and were invited to review and comment the final report on the Mackenzie Valley biomonitoring results. This report is now available online on our website. Over the four-year project (2015-2019), 537 participants (between ages of 6 and >80 years) from nine Dehcho and Sahtú communities took part in this research. We collected 443 hair, 198 urine and 276 blood samples. Participants also completed a health messages survey and two dietary questionnaires (24-hr Recall, Food Frequency Questionnaire). Descriptive results are available for

the majority of collected data (metals in blood/urine; persistent organic pollutants (POPs) in blood; mercury in hair; dietary surveys), but biobanked samples were analysed more recently for segmental hair mercury (results returned to participants) and perfluorinated compounds (currently being analysed). Over all the biomarkers analysed (over 100), lead and polycyclic aromatic hydrocarbons (PAHs) were identified as top priorities, due to their levels above the national levels (from the Canadian Health Measure Survey). Data analysis to identify exposure determinants will be ongoing for the next few years. This multi-year collaborative project led to new research projects with local partners to answer to environmental health concerns (nutrition assessment, CIHR; food security, CIHR; water knowledge exchange, GWF). In parallel, a similar contaminant biomonitoring project in on going in the Yukon (Laird et al.).

Key messages

- Year 3 results were returned to participating individuals and communities in between November 2018 and March 2019. All the results of the 4-year project were returned to the communities.
- For the vast majority of participants, metal exposures fell below available health-based guidance values. In total, 3.6% of the participants were offered a re-testing due to one elevated contaminant (mercury, cadmium, or lead).
- Metals, POPs, phthalates, and arsenic species were generally in the normal ranges of exposure observed in Canada.
- Lead and polycyclic aromatic hydrocarbons (PAHs) levels were more elevated than the national levels but below guidelines associated with adverse health effects.

Community Based Monitoring and Research

Understanding fish mercury concentrations in Dehcho lakes

Project leaders

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Project locations

12 lakes in the NWT (McGill Lake, Tathlina Lake, Kakisa Lake, Trout Lake, Ekali Lake, Gargan Lake, Sanguez Lake, Fish Lake, Greasy Lake, Mustard Lake, Big Island Lake, Willow Lake)

Abstract

Food fishes are a central part of the traditional diet and culture of the First Nations of the Dehcho region of the NWT. Some lakes in this region have food fishes with mercury levels that are above human consumption guidelines, while others that are relatively close by have levels that are well below guidelines. Results from our previous research indicate that drivers of among-lake variation in fish mercury levels are different for each species and the these variables are subject to future climate change (e.g., landscape type in the catchment, lake water chemistry, food web structure and community composition). More study is required, however, to expand into the northern region of the Dehcho (Pehdzeh Ki FN), to complete the dataset that we have been building, and then to refine models such that we can predict how climate and land-use change may affect fish mercury levels in our traditional fishing lakes. In an intensive study of 6 lakes from 2018-2021, we will clarify the importance of in-lake versus catchment controls on fish Hg levels. This synopsis presents interim results from year 1 of 3; in 2018, McGill Lake and Tathlina Lake were intensively sampled.

Key messages

- Mean wet mercury concentrations in both walleye and northern pike from McGill Lake were above Health Canada's commercial sale guideline of 0.5 ppm wet weight.
- Mean wet mercury concentrations in walleye and northern pike from Tathlina Lake were slightly below Health Canada's commercial sale guideline (0.49 and 0.46 ppm wet weight, respectively).
- All Lake whitefish captured in McGill and Tathlina lakes had mercury concentrations that were below Health Canada's commercial sale guideline.
- Watershed land cover has been quantified for several lakes; watersheds differ substantially in catchment: lake area ratios and % of wetland in catchments.
- Partitioning of mercury to suspended sediment in Kakisa Lake may explain lower mercury levels in fish in this lake.
- Most recent results continue to indicate that fish mercury levels are generally lower in lakes that are more productive – intensive data analysis on this is ongoing.

Contaminants in traditional foods of the First Nation Na-Cho Nyäk Dun

Project leader

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Project team

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Project locations

- First Nation of Na-Cho Nyäk Dun Traditional Territory
- Stewart River Watershed
- Mayo, YK
- Keno, YK
- 4 waterways (Ethel Lake, Mayo Lake, Stewart River, McQuesten Lake)

Abstract

The First Nation of Na-Cho Nyäk Dun (FNNND) is concerned about the levels of contaminants in their traditional foods. This project measures the contaminant levels in moose and fish from the FNNND Traditional Territory to assess changes in contaminant concentrations from moose that were tested a decade ago and from previously tested locally harvested fish. This project will be conducted over three years beginning in 2018. Eight moose samples were collected in 2018. Harvesting and analyzing fish samples will occur 2019 and 2020. The project builds capacity within the FNNND by employing locals to aid in harvesting, preparation, and shipment of moose and fish tissue, and organ samples. The samples are analyzed for known and emerging contaminants. NND Lands Officers and Fish and Wildlife Officers will be trained by a qualified research scientist in the preparation of samples and will be taught traditional and cultural practices by local Elders. This project will help the First Nation community and Northerners because test results will provide current data for comparison against historical data. The results will inform the community on northern contaminants and, thus, enable the First Nation to make informed decisions related to the harvest and consumption of traditional foods. Data has yet to be fully analyzed for this project.

Key messages

- Levels of most elements measured in moose tissues are not of concern, although, kidney cadmium concentrations may cause some concern for human health depending on the quantity of organs consumed. Moose meat (muscle) does not accumulate high levels of contaminants and is a healthy food choice.
- This project is facilitating capacity building among FNNND staff and citizens and helping the community gain a deeper, shared understanding of local food sources and the factors which ultimately influence not only the health of moose and fish, but community health as well.
- Continued monitoring of contaminants in northern food systems ensures sustainable traditional aboriginal diets and consumption patterns.

Tłı̨chǫ Aquatic Ecosystem Monitoring Program, Whatì 2018

Project leader

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Project location

Lac La Martre, Whatì, NWT

Abstract

The Tłı̨chǫ Aquatic Ecosystem Monitoring Program (TAEMP) continues to provide a means of addressing community concerns related to changes in aquatic environments and builds on work carried out since 2010. A successful community-driven program, it meaningfully involves community members in conducting contaminants-related research, including the science-based collection of samples, and observations using both Tłı̨chǫ and scientific knowledge to address the question: «Are the fish safe to eat and the water safe to drink?»

In September 2018, a 5-day on-the-land monitoring camp returned to Lac la Martre, near the community of Whatì, with the camp situated at the same site as the 2014 TAEMP camp location. The 2018 participants returned to locations on Lac la Martre, where sediment and water sampling occurred in 2014, to allow for comparative sampling. Elders and community members spoke about fish and aquatic ecosystem health, passed on their knowledge to participants, and ensured safe camp operations and transport to and from sampling locations. Science-based methods for processing fish and collecting water and sediment samples for lab analyses were demonstrated on shore, and field sampling provided youth with hands-on experience in scientific sampling methods. As well, youth participated in cultural activities, including processing fish and visiting grave sites, which were led by Whatì Elders. A results workshop open to the public was held in Whatì in April 2019 to present the results to camp participants and to interested community members.

Fish tissue analysis indicated that mercury levels were low in *Łıh* (lake whitefish); while in *Łıwezǫǫ̀* (lake trout), one out of twenty fish had mercury levels that exceeded the Canadian Food Inspection Agency guidelines. Both łıh and łıwezǫǫ̀ did not show levels of mercury that were considered

abnormal for northern lakes. Comparison of 2018 results to 2014 results showed slightly lower mercury concentration in tissue in 2018. Analysis of water samples indicated no notable difference between 2018 and 2014 with regards to nutrient and physical parameters measured at all sample sites. Except for one site, where the Canadian Environmental Quality Guidelines (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life (CCME 2014) was exceeded for copper, no other parameters exceeded guidelines in the sediments analyzed in 2018. Water and sediment results supported the expectation that water and sediment quality is "good" (i.e. not abnormal) in Lac la Martre.

Key messages

- The fish tissue analyses of fish species typically consumed by residents of Whatì showed that mercury levels were low in ɬh while ɬwezǫ̀ were close to or slightly exceeded the guidelines. No contaminant levels measured in any of the species' fish tissue samples were considered to be abnormal.
- Water and sediment quality results support the expectation that water quality and sediment quality are good in Lac la Martre. No water or sediment contaminant levels were considered to be abnormal.
- Whatì community members were pleased with the implementation of the program, citing the importance of continued monitoring near their community.
- Non-statistical comparison of the 2018 to 2014 results suggests that there are no major changes in the quality of fish, water or sediment.

Contaminants concentrations in traditional country food from the Eclipse Sound and dietary exposure in Pond Inlet, Nunavut: science and local knowledge assessing a local baseline of the risks to human health

Project leader

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Project team

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Project locations

- Emerson Island, NU
- Pond Inlet, NU
- Bylot Island, NU

Abstract

Traditional country food is vital to Inuit culture and it has provided a high-quality diet for millennia. With industrial development, organic contaminant concentrations (e.g. mercury) have, at times, increased in the atmosphere and oceans and has accumulated in ecosystems and living organisms to reach the most remote Arctic regions. These contaminants are known to have adverse effects on animal and human health. Balancing the benefits that country food brings to Arctic residents (body health, mental health, and culture) with the risks associated with the eating country food that contains contaminants is challenging.

In this 2018-2019 Northern Contaminants Program (NCP) funded project, we:

- monitored contaminants (mercury and trace metals) and stable isotopes in different tissues collected from ringed seals in the spring (n=14) and fall (n=13) of 2018;
- ran statistical analyses on the 2017-2018 contaminants data (mercury and trace metals) collected from ringed seals; and
- determined the nutritional content of ringed seals based on the 2017-2018 data. Results for trace metals and stable isotopes analysis of 2018-2019 samples are not yet available and pending at the laboratory. Arctic char could not be sampled this year. POPs analysis will be performed on the last year of the project (2020-2021).

In addition to the NCP objectives, in partnership with Dr. Pierre-Yves Daoust from the University of Prince Edward Island (UPEI), we determined the occurrence of infectious pathogens in ringed seals from the 2017-2018 data (see Appendix).

The ringed seal monitoring program was completed in 2018-2019. Based on the success of this baseline study and local capacity developed, we intend to pursue narwhal monitoring in 2019-2020.

This community-based project was led by James Simonee, with the support from ARCTIConnexion, the Mittimatalik Hunters and Trappers Organization (HTO), and team members. Synopsis report was prepared by ARCTIConnexion, with the contribution of James Simonee.

Key messages

- The current project, monitoring ringed seals, has continued to advance with the involvement of local researchers, mentors, and NCP researchers.
- Ringed seal monitoring has found higher Hg concentration in liver than in muscle.
- Ringed seal liver concentrations of Hg, Ar, and Cd are above recommended thresholds. There was a positive correlation between Hg concentration and age in liver. There were also higher Hg concentrations in sampled tissues in the spring than in the fall.
- The total mercury concentration was, on average, made up of 35% methylmercury (toxic).
- There was a temporal and spatial variation in food use.

Mobilizing Inuit Knowledge and land use observations to assess ecosystem trends and processes affecting contaminants

Project leaders

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Project location

Sanikiluaq, NU

Abstract

Traditional wildlife sampling by communities has involved completing basic sampling information sheets with limited possibilities for utilizing Inuit observations that could provide important context for interpreting contaminants data. The community of Sanikiluaq has been working to develop novel ways to systematically document Inuit knowledge and observations of ecosystem trends and processes. This project formed a key proof-of-concept for using the new SIKU.org platform and mobile app to document Inuit hunting stories of seals and polar bears, in order to provide context on animal ecology, diet, body condition and associated environmental conditions that could benefit contaminants research. The current phase of the project involved a review and evaluation of the results and approach from the proof-of-concept study conducted in 2017-2018, towards future implementation of a three year pilot study that will engage Inuit in systematically documenting their knowledge and observations around harvesting and sampling (e.g. diet, body condition, habitat), and incorporating these results into contaminants analysis.

Based on the feedback obtained in 2017-2018, the tools and features on the SIKU mobile app were updated and improved to better incorporate different kinds of Inuit knowledge and improve ease of use and reliability. A workshop held in September 2018 provided more detailed feedback on how privacy, intellectual property and data stewardship features of the SIKU app and platform could

be designed to provide Inuit users with flexibility to accommodate informed choices as desired for different situations. These features and approaches have since been incorporated into a version 2.0 of the mobile app and online platform which has been positively received. Further approaches to synthesizing data and workflows for incorporating results into contaminants analysis as part of a three-year pilot study were designed with project team members collaborating via core NCP programs for ringed seal and polar bear. Community and project partner reviews and evaluations have indicated that the proof-of-concept phase was successful and is worthwhile developing into a three year pilot study, with specific outcomes to improve analysis and interpretation of ringed seal and polar bear contaminants analyses (i.e., NCP core monitoring projects *Temporal and Spatial Trends of Legacy and Emerging Organic and Metal/Elemental Contaminants in Canadian Polar Bears* - M-05 (R. Letcher, polar bears) and *Temporal trends of persistent organic pollutants and metals in ringed seals from the Canadian Arctic* - M-04 (M. Houde and D. Muir, ringed seals), and more generally establish a better role and approach for meaningfully incorporating Inuit knowledge and observations into contaminants research programs.

Key messages

- The community review and evaluation workshop in Sanikiluaq indicated strong ongoing support for the project and provided guidance on updates to the mobile app and features and next steps for the project moving forward.
- Mobile app and online platform features were developed on SIKU to support community priorities for flexibility in data stewardship, privacy, and intellectual property as well as improvements for usability on the land based on 2017-2018 testing.
- Project team members and collaborating projects have refined the approach for implementing community observations into analysis and interpretation for ringed seal and polar bear core monitoring programs over the next three years.
- The next phase of the project involves a 3 year pilot program that will provide observations from Inuit hunters in a large enough sample size to be a useful for incorporation into contaminants analysis by other partnering projects in year 1, as well as to evaluate seasonal and inter-annual environmental trends in years 2 and 3.

Contaminants in traditional food in the White River First Nation (WRFN) territory

Project leader

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Project team

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Project locations

- Wellesley Lake, WRFN, YK
- Fish Hole Lake, WRFN, YK
- Unnamed Lake, WRFN, YK

Abstract

Wild food is an important part of the diet for many Yukon residents, particularly First Nations, who traditionally harvest caribou, moose, fish, waterfowl, small game, and many plants. Although there has been extensive research on contaminants in those wild foods (Gamberg, 2000) and fish, relatively few samples, including no fish, have been taken from the White River traditional territory. Concern about contaminants in fish in their traditional territory prompted the White River First Nation to initiate this project to sample fish from three local lakes to determine if contaminants are a concern for fish populations or those that are using those populations as food. Fish sampling was planned for the spring of 2019 from Wellesley, Fish Hole and Unnamed Lake in the White River traditional territory. There is no road access to these lakes, so transportation to the sites must be by snow machine in the winter. Unfortunately, there was a sudden and unseasonably warm spell immediately preceding the sampling trip, so, although the attempt was made to reach the lakes, it was unsuccessful due to overflow of the river. The field team was forced to turn back due to the unsafe travel conditions. Fish sampling has been rescheduled for early in 2020, and the analyses will be completed in one year rather than the anticipated two years.

Taku River Tlinget First Nation Traditional Foods Contaminant Monitoring Program

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- **Project team**
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  Environment & Climate Change Canada (ECCC)
- **Project location**
  Taku River Tlinget First Nation Territory, Canada

Abstract

Traditional foods are an important source of nutrition and have spiritual, social, and cultural significance for the Taku River Tlingit First Nation (TRTFN). This project was planned to determine contaminant levels in moose, and two commonly harvested fish species within TRTFN Traditional Territory. The data collected will be used to determine whether these species remain safe food choices and to provide baseline data to see if contaminant levels are changing over time. TRTFN Land Guardians worked with hunters to collect samples from 10 moose in the fall of 2018 and will collect samples from grayling and lake trout from the TRTFN Traditional Territory during the summer of 2019. Moose samples are currently being analyzed for a suite of 38 elements, including cadmium and mercury, and a suite of emerging contaminants. Two workshops with the TRTFN Land Guardians started the process of building capacity with respect to contaminants knowledge and skills for processing samples for contaminant analysis. We anticipate a continuation of this capacity building process with a fish processing workshop in early summer of 2019. After the workshop we will proceed with fish collections and processing. We look forward to communicating the results of the moose tissue analyses (and eventually the fish analyses) with community members and using those results for planning efficient and relevant environmental monitoring in our traditional territory.

Key messages

- Samples were collected from 10 moose from the Atlin area in the fall of 2018.
- Moose tissue samples are currently being analyzed for a range of contaminants.
- Two contaminant workshops were held in Atlin in the fall of 2018, one on contaminants in the environment and one focusing on moose sample preparation.

Community monitoring of plastic pollution in wild food and environments in Nunatsiavut

Project leaders

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Project team

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Project location

Nain, Nunatsiavut

Abstract

Marine plastics act as sponges for contaminants such as methylmercury, polychlorinated biphenyls (PCBs), and other persistent organic pollutants. When marine plastic is ingested, these chemicals collect in an animal's tissues (bioaccumulation) and build up in the food chain; contaminant levels are much higher in animals that eat other animals (biomagnification). As a result, contaminant levels can be high in some wild food species which can be concerning for the people of Nunatsiavut who depend on wild food for its nutritional and cultural significance. To date, we have found plastics in water; on shorelines; and ingested by Arctic char in Nain, Nunatsiavut; though precise amounts are still to be determined. Early sampling has indicated where future sampling should take place and the type of sample sizes required to acquire robust baselines. This program is continuing to grow and sample more locations and areas of concern.

Key messages

- Arctic char has been found to ingest plastics in the Nain region. We are working to obtain a sound sample size to determine a valid baseline, and have decided to sample char at multiple points in the season.
- Plastics have been found in the surface waters around Nain. These are almost exclusively concentrated around the wharf, an inhabited area. These findings have resulted in a new sampling design to divide wharf-adjacent, nearshore, and offshore environments in sampling.
- Plastics have been found on shorelines around Nain. Approximately 80% of anthropogenic debris was plastic, in line with global averages. Despite Nain's plastic bag ban in 2009, a significant amount (higher than provincial average) of film plastic was recorded, mainly from sources other than carrier bags.
- Training workshops have been successful with a range of age groups and show a high interest and knowledge in the community.

Contaminant monitoring and community interests in the Lower Northwest Passage

Project leaders

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Project team

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Project locations

- King William Island, NU
- Rasmussen Basin, NU
- Chantrey Inlet, NU

Abstract

Inuit households in Nunavut face moderate to severe food insecurity at a time when accelerated warming of the Arctic sea ice appears to have increased access to several fish species. In a project supported by Genome Canada, we are currently investigating stocks of char and whitefish populations with the goal to integrate traditional knowledge (TK) with leading-edge genomic science. However, community members, particularly in Gjoa Haven, have asked that these fish be monitored for metal, legacy organic pollutants and other contaminants to ensure that they are safe to eat. Thus, we are monitoring these contaminants, and evaluating beneficial vitamin D levels that are important for the building of strong bones. Fish are caught by Elders, active harvesters, and youth from the waters near the Lower Northwest Passage with sample preparation performed by trained community members. Whitefish from this area are among the most northerly populations studied and their contaminant levels are unknown. Char from the Lower Northwest Passage have also not been monitored for many years. This push from the community to evaluate the relative contamination levels in different types of fish will facilitate the community's wellbeing, food security, and offer the prospect of increased prosperity should they chose to build a sustainable fishery in this region of the Lower Northwest Passage.

Approximately 500 Arctic char, lake whitefish, cisco (*C. autumnalis* and *C. sardinella*), and lake trout were sampled from Inuit subsistence fishing sites on and near King William Island by Elders and youth. All study species except for lake trout generally showed average levels of mercury below subsistence guidelines (0.2 ppm). Of concern for routine consumption, however, was that almost 7 out of 10 lake trout had mercury levels that exceeded Canadian subsistence guidelines. Legacy organic pollutants appear to be at low levels that raise no unease, and collected microplastics have yet to be characterized. Workshops on dietary choices shared TK and discussions about climate change and contaminants. Community youth have been trained, fishers have been hired, and community engagement on this integrated and truly collaborative project has been integral to its success.

Key messages

- Assay of more than 500 salmonids at traditional fishing sites on or near King William Island show that lake whitefish, cisco, and Arctic char have low levels of mercury concentrations (ranging from 0.07-0.12 ppm, n ~300) with lake trout showing higher average levels and exceeding 0.3 ppm, n~ 200.
- Variation in mercury levels were explained by factors such as age (determined by otolith analysis) in all fish species, as well as selenium levels and carbon isotope signatures, the latter indicating their position in the food chain, in both Arctic char and cisco. Results suggest the bioaccumulation of mercury.
- Traditional ecological knowledge, support from the Gjoa Haven Hunters and Trappers Association, and community youth training as well as workshops have been crucial to ensuring the completion of this project. The interest shown by community Elders to analyze fish from subsistence fishing sites has also been an asset to this project.

Sources of methylmercury, perfluoroalkyl substances, and polychlorinated biphenyls to ringed seal food webs of Lake Melville, Northern Labrador

Project leaders

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Project locations

- Lake Melville, NL
- Rigolet, NL
- Northwest River, NL

Abstract

People living on Lake Melville are concerned about contaminant levels in country foods they harvest. Of particular concern is methylmercury (MeHg), the toxic form of mercury that biomagnifies through food webs. Increases in methylmercury concentrations are projected from hydroelectric power development on the Churchill River. Lake Melville is a unique Arctic site to study because it is affected by both river and ocean water and it has a history of polychlorinated biphenyl (PCB) contamination from local sources such as the Goose Bay air base. This study uses combined analyses of mercury (Hg), MeHg, carbon (C), and nitrogen (N) stable isotopes with perfluorinated alkyl substance (PFAS) and PCB congener analyses. This will identify the relative importance of local versus regional and terrestrial versus marine contaminant sources to Lake Melville ringed seal food webs prior to hydroelectric development and as a result of further climate-induced alterations. This will provide a baseline MeHg concentrations, sources and food web dynamics, which is important for understanding how climate changes and flooding for the hydroelectric power production will alter MeHg levels in Lake Melville.

Ninety-eight seal samples were collected during harvests by local hunters between 2013-2018 and are being analyzed for mercury and methylmercury. A subset of these samples are being analyzed for mercury stable isotopes, PFASs, and PCBs. Average concentrations of total mercury (THg) in seal tissues collected in 2017 and 2018 were comparable, with average concentrations of 945 ng/g ± 334 (2017) and 942 ng/g ± 314 (2018) from muscle samples, and 44,556 ng/g ± 43,706 (2017) and 44,784 ng/g ± 43,665 (2018) from liver samples (Figure 4). Average MeHg concentrations in the liver and muscle of Lake Melville seals collected between 2016-2018 were 1,041 ± 1,032 and 558 ± 501 ng/g wet weight (ww), respectively, with 20 of 24 liver samples and 15 of 24 muscle samples surpassing the Canadian frequent consumer guideline of 200 ng/g ww. Average MeHg concentrations in Lake Melville ringed seals are within the range of those recently reported for 14 communities across the Canadian high and sub-Arctic (average muscle mercury concentrations between 2007-2011 were 107-1,070 ng/g) (Brown et al. 2016). Results from mercury stable isotope analyses demonstrate that Lake Melville seals obtain food from both inland and marine sources. PFAS analyses on seal tissues is almost complete for the 2018 samples. Analyses of seals collected in 2017 for PFASs show that adult ringed seals in Lake Melville have 67 ± 12 ng/g wet weight total PFAS, which is comparable to ringed seals in other areas in Labrador, Hudson Bay, and the Beaufort Sea but generally higher than ringed seals from the more northern areas such as Resolute, Sachs Harbour, and Pangnirtung. Higher PFAS concentrations were observed in pups than in adults and were associated with higher trophic level and terrestrial feeding. We are continuing this project in 2019-2020 so that adult seals can be analyzed for the full suite of contaminants, as well as seal health markers, which will strengthen the baseline dataset. Results will be used to assess the impacts of the hydroelectric power developments on wildlife used for food by people of the region and for predicting the impacts of the 22 hydro-electric power developments planned across Canada.

Key messages

- People living on Lake Melville are concerned about contaminant levels in country foods such as ringed seals, that they harvest. Of particular concern is methylmercury (MeHg), the concentration of which is predicted to increase as a result of hydroelectric power development on the Churchill River.
- This project analyzes mercury (Hg), methylmercury (MeHg), carbon (C) and nitrogen (N) stable isotopes, perfluorinated alkyl substances (PFASs), and polychlorinated biphenyls (PCBs) in the Lake Melville food web, which includes ringed seals.
- Information from the project allows for the determination of the relative importance of local versus regional and terrestrial versus marine contaminant sources to Lake Melville ringed seal food webs prior to hydroelectric development and further climate-induced alterations to be determined.
- Average MeHg concentrations in the liver and muscle of Lake Melville seals collected between 2016-2018 were 1,409 ± 1,740 and 830 ± 1,100 ng/g wet weight (ww), respectively, and are comparable to those recently reported at other Labrador locations.
- 2017 data show that adult ringed seals in Lake Melville have 67 ± 12 ng/g wet weight total PFAS, which is comparable to ringed seals in other areas in Labrador (Nain: 45±6 ng/g), Hudson Bay (Arviat: 71±8 ng/g) and the Beaufort Sea (Ulukhaktok 51±6 ng/g), but generally higher than ringed seals from the more northern areas such as Resolute, Sachs Harbour, and Pangnirtung.

- Some types of PFASs, PFOS, and long chain perfluorocarboxylates were higher in Lake Melville ringed seals than other locations but correlation analysis suggests this is driven by the juvenile status of the seals.
- Higher PFAS were associated with higher trophic level and terrestrial feeding.
- Results from this project will be used to assess the impacts of the hydroelectric power developments on wildlife used for food by people of the region.

Mercury in Yukon fish

Project leaders

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Project locations

8 lakes in Yukon Territory (Dezadeash Lake, Kathleen Lake, Kluane Lake, Laberge Lake, Morley Lake, Simpson Lake, Wolf lakes Lake, Gazetted Snafu Lake)

Abstract

In this study, we capitalized on existing fish sampling and harvest initiatives to opportunistically analyze mercury in fish from Dezadeash, Kathleen, Kluane, Laberge, Morley, Simpson, and Wolf Lakes in Yukon Territory. Past sampling on mercury in fish has largely been limited to Laberge, Kusawa, and Kluane Lakes, so this was a significant opportunity to increase the number of lakes for which fish mercury data exist. Samples were made available through Yukon Government's SPIN program (Summer Profundal Index Netting; fish assessment program), Parks Canada's SPIN program, the Yukon Government burbot population assessment, the Kluane Lake Fish Derby, and a harvest camp at Simpson Lake. Indigenous fishers were invited to participate in SPIN programs, led the harvest camp at Simpson Lake, and helped process fish that were collected from Dezadeash Lake. All samples have been analyzed for total mercury. Of 253 samples analyzed, only 8 exceeded Health Canada's guideline for commercial sale (0.5 ppm wet weight). Of these 8 fish, 7 were lake trout, and 1 was a northern pike. All lake whitefish, burbot, round whitefish, and inconnu analyzed had mercury levels that were below Health Canada's commercial sale guideline.

Key messages

- Of 253 fish analyzed (including 6 species from 8 lakes), only 3% exceeded the Health Canada guideline for commercial sale of fish (0.5 ppm wet weight).
- All round whitefish, lake whitefish, and inconnu analyzed were below the Health Canada guideline.
- All burbot from Dezdeash Lake and lake trout from Kluane Lake were below the Health Canada guideline.

Environmental Monitoring and Research

Northern contaminants air monitoring: organic pollutant measurements

Project leader

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Project locations

- Alert, NU (82°30′ N, 62°20′ W)
- Little Fox Lake, YK (61°21′ N, 135°38′ W)

Abstract

The atmosphere is the most rapid pathway for persistent organic pollutants (POPs) to reach the remote Arctic. Since 1992, this continuous monitoring program has measured how much organic pollutants are present in Arctic air. Knowing how levels of organic pollutants change over time helps researchers identify if air concentrations of these pollutants are decreasing, increasing or not changing over time; where these pollutants have come from; how much from which region and what climate conditions influence their movement to the Arctic. Results from this project are used to negotiate and evaluate international control agreements on organic pollutants and to test atmospheric models that explain how contaminants move from sources in the South to the Arctic. Starting in 1992, we have monitored POPs at Alert, Nunavut. In 2006, the program was extended to screen for emerging chemicals, such as current-use pesticides (CUPs), flame retardants and stain-repellent-related per and polyfluoroalkyl substances (PFASs) in Arctic air at Alert. Additionally, a passive flow-through sampler (FTS) specifically designed for use in cold environments has been deployed at Little Fox Lake, Yukon, since August 2011. Here, we updated the time trends of selected halogenated flame retardants (HFRs) from data collected at Alert during 2008 to 2016.

Key messages

- Air monitoring for organic pollutants at Alert, Nunavut, and Little Fox Lake, Yukon, and measurements are ongoing.
- Air concentrations of some halogenated flame retardants (HFRs) started to decline or level off at Alert from 2008 to 2016.

Mercury measurements at Alert and Little Fox Lake

Project leader

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Project locations

- Little Fox Lake, YK
- Alert, NU

Abstract

Mercury (Hg) is a priority pollutant of concern in Canada, especially in Arctic regions. The Arctic primarily receives Hg via long range transport from regions that are mainly from outside of Canada. Through this project we have collected 24 and 11 years of atmospheric Hg concentration measurements at Alert, NU and Little Fox Lake, YK, respectively. These are some of the world's longest records of Hg in the atmosphere and provide significant information on the long-term trends of this toxic chemical in Canadian air. Our results from atmospheric Hg concentration measurements at Alert, Nunavut show a median decreasing trend of 1.37 ± 0.21% per year from 1995 to 2018. In contrast, Hg concentrations at Little Fox Lake, Yukon show an increasing median trend of 0.96 ± 0.31% per year from 2007 to 2018. These measured trends reflect both the increases in Hg emissions that come into Canada in the western Arctic and the global leveling off of Hg emissions as seen in the high Arctic. The project team worked with the Regional Contaminants Committees in both Nunavut and the Yukon to discuss project plans and ideas for this work. Also, the project team travelled to Whitehorse and Iqaluit to work with students on improving their understanding of the transport and fate of contaminants in the Arctic air.

Key messages

- Atmospheric mercury concentration measurements have been collected at Alert, Nunavut since 1995 and at Little Fox Lake, Yukon since 2007. Alert is the longest record of mercury in the atmosphere in the Arctic.
- Gaseous elemental mercury levels at Alert have decreased annually from 1995 to present and at Little Fox Lake have increased annually from 2007 to present.
- The trends assessed using the data collected in the program can be used to reflect changes in regional and global Hg emissions.
- The data collected as part of this program is used as scientific contribution to national policies and strategies. As well, it will be used in the assessment of effectiveness of national and international emission reduction strategies.

Passive air sampling network for organic pollutants and mercury

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Project locations

- Inuvik/Mackenzie Delta, NT (68° 21.417′ N, 133° 42.832′W)
- Fort Resolution, NT (61°10′ N, 113°45′W)
- Cambridge Bay, NU (69°7.844′N, 105°3.395′W)
- Kuujjuaq, QC (58° 14.6′ N, 68°21′W)
- Iqaluit, NU (63°44′ 27.5″N, 68°27′56.7″W)
- Nain, NL (56° 31′ 30.9»N, 61°43′ 29.3» W)
- Northwest River, NL (53°31.5′ N, 60°8.5′W)

Abstract

This project measures contaminants, namely persistent organic pollutants (POPs) and mercury, in the air at seven locations across Canada's North. Before the start of the project in 2014, these contaminants in the air in Canada were only measured at Alert and Little Fox Lake under the Northern Contaminants Program (NCP); and Alert, Little Fox Lake and Coral Harbour as part of the Global Atmospheric Sampling (GAPS) Network. The current project adds seven sites, including Inuvik/Mackenzie Delta, Fort Resolution, Cambridge Bay, Kuujjuaq, Iqaluit, Nain, and Northwest River. These additional sampling locations provide data to create a more comprehensive picture of how contaminants are carried through the air from more southerly regions and arrive in the Arctic and how contaminant levels are changing over time.

Under this project, POP measurements continued at seven passive air sampling stations across the Arctic from April 2017 to March 2018. While passive sampling takes much longer than traditional sampling methods, the passive samplers are a low-cost, low-maintenance way to monitor contaminants in air because they do not require power for pumps or a shed to house the instruments that are usually used for contaminant sampling. Passive sampling is straightforward and can easily involve students or other interested persons in the sample collection. This enhances communication between the project team and local communities as well as creates training opportunities for Northern students. Field tests for developing a passive mercury air sampler have been completed and were sent to the sites for deployment starting July 2018. A northern student, Jamie Thomas, was engaged to research on Indigenous Knowledge (IK) in the Yukon region which may be used in the air monitoring projects for POPs and mercury. Jamie interviewed four Elders for this research. The team worked with Jamie in summarizing her findings from the interviews in a final report. The report has been finished and, through Ta'än Kwach'än Council (TKC), we will seek approval from the Elders for release of this report. We are hoping to be able to share the report with all Regional Contaminants Committees (RCCs) and the NCP Secretariat in 2019.

Key messages

- Mercury passive air samplers have been sent to seven Arctic sites and sampling started in July 2018. POPs air sampling continues at all seven sites.
- Project leaders visited Iqaluit (Nunavut), Whitehorse (Yukon) and Nain (Nunatsiavut) to discuss with the respective Regional Contaminants Committees and community leaders about the science activities and communication/outreach plans under this project. Project leaders also engaged communities through a variety of communication/capacity building activities, including giving lectures at the Nunavut Arctic College and the Yukon College.
- Organophosphate esters (OPEs) flame retardants were found in passive air samples collected at five Arctic sites. Tris(1-chloro-2-propyl) phosphate (TCIPP) was the most abundant OPEs detected at all sites.

Temporal trends of persistent organic pollutants and metals in ringed seals from the Canadian Arctic

Project leaders

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Project locations

- Sachs Harbour, NT
- Resolute Bay, NU
- Arviat, NU
- Nain, Nunatsiavut

Abstract

The major questions that this project is addressing are: 1) how are concentrations of legacy contaminants and other persistent organic pollutants (POPs), as well as mercury, changing over time in ringed seals? and 2) are trends similar across Inuit Nunangat? The presence and trends of new and emerging contaminants are also investigated. The project currently involves annual sampling at Sachs Harbour, Resolute Bay, Arviat, and Nain. All sampling is done by local hunters and coordinated by Hunters and Trappers Associations/Committees in each community.

Results of this core monitoring project indicated that concentrations of legacy compounds such as polychlorinated biphenyls (PCBs), Dichlorodiphenyltrichloroethane (DDT), Chlordane, and Hexachlorocyclohexane (HCH) continued to decline slowly in ringed seals. Trends for flame retardants and results indicated very slow decreases of both Polybrominated diphenyl ethers (PBDEs) and Hexabromocyclododecane (HBCD) in blubber of seals for Sachs Harbour, Arviat, and Resolute. Additional collection in Nain is needed in order to establish temporal trends. Trends for polyfluoroalkyl substances (PFAS) indicated that concentrations of perfluorooctane sulfonate

(PFOS) and perfluoroalkyl carboxylic acids (PFCAs) in liver of ringed seals from Resolute Bay, Arviat and Sachs Harbour have declined between the mid-2000s to 2011, but have increased in recent years at some locations. Mercury concentrations in liver and muscle varied from year to year but overall were not increasing. Moreover, the mean methylmercury (MeHg) concentrations found in the liver of seals ranged between 1.4 and 2.5 µg/g. The annual measurements of contaminants in Arctic ringed seals have demonstrated that these pinnipeds (flipper-footed marine animals) are very good indicators of changing uses and production of chemicals widely incorporated in consumer and industrial products.

Since 2016, outreach activities to the communities have been added to this long-term monitoring project. This year a one-day educational workshop on ringed seal health was successfully organized at the elementary and middle schools in Arviat, Nunavut. Scientists also attended a one-day Inuit Qaujimajatuqangit Workshop presented by the Aqqiumavvik Society. This complementary project (Northern Contaminants Program [NCP] project CB-12 - *Contaminant monitoring and community interests in the lower Northwest Passage*) allowed NCP research scientists working on contaminants in ringed seals to share information about their work, and provided opportunities for Elders to share their knowledge of seal ecology and traditional methods of captures and skinning with students and researchers. This event employed a combination of short interactive presentations, laboratory activities, group discussions, storytelling, games, and art activities to teach participants core concepts on contaminants and health of ringed seal from both scientific and Inuit perspectives. Synergies between the two NCP projects from Environmental Monitoring and Communications, Capacity and Outreach programs provide great opportunities to enhance local capacity building, communications and the integration of Inuit Knowledge in contaminants research on ringed seals.

Key messages

- Legacy compounds such as PCBs, DDT, Chlordane, and HCH continue to decline in blubber of ringed seals.
- Mercury concentrations in liver and muscle vary from year to year but overall are not increasing in ringed seals.
- Increases of perfluoroalkyl substances have been observed in liver of seals in recent years at some locations.
- Synergies between NCP Environmental Monitoring and Communications, Capacity and Outreach programs provide opportunities to enhance local capacity building, communications and the use of traditional ecological knowledge in contaminants research on ringed seals.

Temporal and spatial trends of legacy and emerging organic and metal/elemental contaminants in Canadian polar bears

Project leader

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Project locations

Sample collections from harvested bears for this project were done by hunters via HTO partners from several Nunavut communities in Hudson Bay (Rankin Inlet, Whale Cove, Arviat and Sanikiluaq) and norther Baffin Bay (Clyde River and Pond Inlet).

Abstract

The polar bear (*Ursus maritimus*) is the top predator of the Arctic marine ecosystem and food web. Starting in 2007, and ongoing into the 2018-2019 fiscal year, on a biennial or annual basis, this project continues to examine trends and changes over time and between communities of NCP priority persistent (legacy and emerging) organic and elemental pollutants (POPs) in polar bears. More specifically, this project focuses on the southern (SHB) and western Hudson Bay (WHB; Nunavut) polar bear subpopulations. Priority contaminant data sets for this project now span over 10 years (2006-2018), which is revealing interesting trends. For example, legacy POPs (industrial chemicals and pesticides e.g., PCB, CHL, HCH, CBz and DDT) levels, and especially PCBs and CHLs, remain consistently high in polar bear fat. For WHB bears, SPBDE flame retardant levels in fat rapidly increased up until 2000-2003, and in more recent years continued to increase, but more slowly, with levels that were generally greater in the SHB compared to the WHB bears. Some fluorinated surfactant chemicals called per-/poly-fluoroalkyl substances (PFASs), like the highly accumulating PFOS, continue to be at high levels in bear liver, and at levels comparable to CHLs. Over the period of 2007 to 2018 for both subpopulations, there were significant changes in PFAS levels; the direction and magnitude of changes in PFAS depends on the PFAS. Total mercury (THg) levels in liver samples collected from 2006 to 2018 were generally higher in the WHB compared to the SHB bears. There were no significant trends of THg concentration change over this period for bears from either SHB or WHB. To more clearly reveal and understand the reasons for changes over time in POP levels in Hudson Bay polar bears, the collected data included age, sex, body condition, time of collection, lipid content, diet and food web structure indicators, and indicators of climate

change (sea ice conditions, temperature, etc.). An example of the climate-related results showed higher THg and POP levels in polar bears were most often associated with changes in the sea ice such as earlier freeze ups, shorter ice-free periods, and greater seasonal sea ice coverages.

In 2018 the principle investigator (PI) of this project travelled to the Rankin Inlet and Arviat communities to discuss contaminants and other important polar bears issues with hunters, and also participated in information exchanges with students and other community members in Arviat. The results of this project are being used locally (communities), regionally (Hudson Bay), nationally, and internationally, as polar bears are top predator consumers in the marine food web. Because of their status as top predators, polar bears inform scientists about contaminants in the Arctic and if the contaminants are affecting the health of polar bears. The 2018-2019 results demonstrate that POP and mercury monitoring needs to continue to assess for any unpredictable changes in the levels of exposure and possible health implications for these bears. Indigenous peoples from participating communities are integral partners in this project at all levels, including polar bear harvesting and sample collection, provision of field and Indigenous Knowledge (IK) and ongoing communication exchange. Their provision of knowledge is required to best understand and interpret POP/Hg data in polar bears as there are many factors that influence changes over time and between subpopulations.

Key messages

- Over the last 10 years, regardless of the year sampled (including 2018) or the subpopulation, SPCB concentrations in polar bear fat were by far the highest relative to other legacy POPs (SPCBs, SCHLs, SHCHs, SCBzs and SDDTs) or other POPs that were measured.
- For WHB bears from 1991 to 2018, SPBDE flame retardant concentrations in the fat rapidly increased up until 2000-2003. From 2003 to 2018 the rate of increase slowed by 5 to 10 times; SPBDE concentrations were generally greater in the SHB compared to the WHB bears.
- Among all the PFASs analyzed in liver collected from 2006 to 2018, the concentrations were consistently the greatest for PFOS and C9, C10 and C11 PFCAs; and greater in SHB compared to WHB bears.
- Over the period of 2007 to 2018 for both subpopulations, more PFCAs and PFSAs showed significant linear relationships for the SHB bears than for the WHB bears, e.g. PFOS exhibited no obvious trend in the WHB bears whereas for SHB bears PFOS decreased significantly.
- THg concentrations in liver samples collected from 2006 to 2018 were generally higher in the WHB compared to the SHB bears, and with no significant trends of change over this period.
- Climate variables and factors were influential in the temporal trends of some contaminants, for example, changes in the concentrations of THg and legacy POPs in polar bears were most often associated with increasing sea ice presence (earlier freeze ups, shorter ice free periods, and greater seasonal sea ice coverages).

Temporal trends of mercury and halogenated organic compounds (legacy and emerging) in three beluga populations landed at Hendrickson Island NT, Sanikiluaq NU and Pangnirtung NU

Project Leader(s)

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Project Locations

- Hendrickson Island (HI), NT (near Tuktoyaktuk)
- Sanikiluaq (SQ), NU
- Pangnirtung (PG), NU

Abstract

The program has undergone the first year of a transition with new leadership and team members. The new members worked together to develop a cohesive plan to support project objectives that closely align with Northern Contaminants Program (NCP) and community partner priorities. The overarching objectives of this project remain the same, that is, to continue to monitor contaminant levels in three beluga populations to assess spatial and temporal trends in mercury, organic halogenated compounds (including legacy and new compounds) along with supporting biological and dietary metrics (e.g. stable isotopes, size, age). In addition, a secondary objective was to emphasize communication and outreach by strengthening partnerships with the three beluga harvesting communities. As a first step, we focused our efforts on strengthening partnerships with the community of Pangnirtung, Nunavut. Dr. Cortney Watt visited the community and has begun to develop a relationship with the Pangnirtung Hunters and Trappers Association (HTA) on all related beluga research. Positive outcomes have included obtaining samples since the 2010 collections. Ongoing work to strengthen partnerships, communications and sampling continues. The Beluga Working Group (NCP/DFO chaired) was developed in recognition of the challenges in communication as it relates to human health combined with the variability of health messaging across the Inuit Nunangut. This team brings together regional health authorities, community co-management boards, human and beluga health experts and the M-07 (Temporal trends of

mercury and halogenated organic compounds (legacy and emerging) in three beluga populations landed at Hendrickson Island NT, Sanikiluaq NU and Pangnirtung NU) team to address the communication challenge of risk-benefits of beluga consumption. The development of the risk communication team helped build and align the new M-07 team by considering broader linkages across the regions, across disciplines and with community partners. Early work by the team includes the creation of a metadata table on state of knowledge and results on fluorinated compounds, with remaining analysis underway at this time. We continue to strive towards a solid long term contaminant dataset that can bridge into broader beluga health questions and integrate Traditional Knowledge on the observed climate change impacts on belugas.

Key Messages

- Year one of the M-07 new research team has been a great success with samples collected from all three locations, subsampled to be shipped across expert labs for processing for contaminants, age and dietary biotracers.
- The start of strengthened relations and partnerships with the community and HTA of Pangnirtung NU, enabling sample collection and effective communication.
- Perfluoroalkyl Substances (PFAS) were analysed and results for PFOSA revealed a continued decline over time, and interestingly variability in concentrations across the three beluga populations, with highest levels in Sanikiluaq whales that dominated the PFASs at 78% of the total.
- Analyses for other contaminants are pending at this time, however, in the absence the team has developed a summary table of contaminants and other measurements for these three beluga populations.
- Creation of Beluga Working Group address challenges of communications specific to human health implications by developing a communications plans on presenting project related information and results, including health messages from the regional health authorities.

Temporal trends of contaminants in Arctic seabird eggs

Project leader

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Project locations

- Prince Leopold Island Migratory Bird Sanctuary (PLI), NU
- Coats Island, NU

Abstract

Contaminants are monitored in Arctic seabird eggs as an index of contamination of Arctic marine ecosystems. Eggs of thick-billed murres and northern fulmars have been collected from Prince Leopold Island in the Canadian high Arctic since 1975 making it the longest-running contaminants monitoring program for seabird eggs in the circumpolar Arctic. Eggs of thick-billed murres are also sampled from Coats Island in northern Hudson Bay as a comparative low Arctic monitoring location. Every five years (i.e. 2018), eggs of five seabird species are collected at Prince Leopold Island to corroborate temporal trends of contaminants. Concentrations of PCBs and DDT generally declined from 1993 to 2013 in eggs of five species of seabirds breeding on Prince Leopold Island. PFOS and PFCAs continued to decrease in the fulmar eggs but, although PFOS also continued to decrease in the murre eggs, PFCAs appear to be levelling off. Concentrations of $\sum_{67}$PCN also continued to decrease. Climate change is affecting concentrations of both organochlorines and total mercury in seabird eggs from Prince Leopold Island.

Key messages

- Concentrations of PCBs and DDT generally declined from 1993 to 2013 in eggs of five species of seabirds from Prince Leopold Island.
- Concentrations of PFOS and PFCAs continued to decrease in the fulmar eggs but, although PFOS also continued to decrease in the murre eggs, PFCAs appear to be levelling off.
- Concentrations of polychlorinated naphthalenes continue to decline in eggs of thick-billed murres from Prince Leopold Island.
- Increased concentrations of total mercury in murre eggs from Prince Leopold Island are correlated with increasingly positive North Atlantic Oscillation conditions, heavier snowfall, and cooler summer temperatures.
- In fulmar eggs, increased concentrations of total mercury also correlated with positive North Atlantic Oscillation conditions and cooler summer temperatures but with the added influence of reduced summer sea ice concentration.

Temporal trends and spatial variations of mercury in sea-run Arctic char from Cambridge Bay, Nunavut

Project leaders

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Project locations

Cambridge Bay, Nunavut. The focus is on the sea-run char fishery at Cambridge Bay with additional char samples provided from the commercial fisheries harvests at other locations (Lauchlan, Halovik, Palikyak, Ekalluk, and Jayco Rivers in 2018). We are collaborating in a companion study at Greiner Lake, the primary lake at Cambridge Bay and where the sea-run char caught in the local domestic fishery are believed to reside when not in the sea. This study includes smaller lakes.

Abstract

This core biomonitoring study investigates trends in mercury concentrations in sea-run Arctic char from the domestic fishery at *Ekaluktutiak* (Cambridge Bay). Of particular interest, is how mercury concentrations are changing from year to year because of changes in climate, mercury released into the air from urban and industrial areas, and possible changes in the char diet. We also have been investigating mercury in char from various commercial fisheries' harvest areas to provide information on these fish and better investigate change.

We have found that mercury concentrations are low in sea-run char and tend to be higher in larger fish. They also tend to be higher in thinner, rather than heavier fish. We believe that fish may put on less weight in colder years when they have less food to eat while in the sea. We also have been working with university researchers on studies related to fish in Greiner Lake with our focus being mercury in these fish. We have found higher concentrations of mercury in lake whitefish and lake trout than in char. Their higher concentrations are believed to be related to where the fish are feeding and slower growth rates. We met with the Ekaluktutiak Hunters and Trappers Organization (HTO) in March 2019 and copies of posters that more easily show our study findings with respect to mercury in fish to the HTO.

Key messages

- Mercury concentrations remain very low in sea-run char from the Cambridge Bay domestic fishery.
- Mercury concentrations were low in fish obtained from the commercial fisheries at other locations in the Victoria Island area.
- Mercury concentrations are slightly higher in char living in Greiner Lake than char feeding in the sea.
- Mercury concentrations are higher in lake whitefish and lake trout than in char from Greiner Lake. These two species of fish are near the northern extent of their geographic range and may be experiencing some stress. We think higher mercury concentrations are related to slow growth rates although feeding behavior is also important.

Temporal trends of persistent organic pollutants and mercury in landlocked char in High Arctic lakes

Project leaders

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Project locations

- Cornwallis Island near Resolute, NU
- Ellesmere Island, Lake Hazen, Quttinirpaaq National Park

Abstract

This long-term study examines trends over time of mercury and other trace elements, as well as legacy and new persistent organic pollutants (POPs) in landlocked Arctic char. In 2018, we completed our annual sampling and collected char from lakes near the community of Resolute Bay on Cornwallis Island (Amituk, Char, North, Resolute, and Small) and in Lake Hazen in Quttinirpaaq National Park on Ellesmere Island. Overall, results show that over the period of 2005-2018 concentrations of mercury in char declined in Hazen, Resolute and Hazen Lakes but concentrations have levelled off or increased slightly in Char, North and Small lakes. Concentrations of fluorinated substances have increased in Char, North, Amituk and Hazen lakes since 2015 mainly due to greater amounts of perfluorinated carboxylates which are atmospheric degradation products of volatile fluorinated compounds. Perfluorooctane sulfonate (PFOS) which has been banned or phased out since the mid-2000s, has not increased. During 2018-2019 we published two scientific papers which investigated factors influencing mercury and POPs in landlocked char. Longer ice duration was associated with higher levels of mercury in char muscle while differences in concentrations of POPs and mercury among lakes were related do dissolved organic carbon.

Key messages

- Concentrations of mercury in landlocked Arctic char still show overall declining trends, in some cases since the 1990s. However, levels have recently levelled off or increased slightly.
- Concentrations of perfluorinated substances have increased in all lakes since 2015.
- The year to year variation in concentrations of mercury in landlocked Arctic char appears to be influenced by ice duration.

Spatial and long-term trends in persistent organic contaminants and metals in lake trout and burbot from the Northwest Territories

Project leaders

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Project locations

- Domestic fishery at Lutsel K'e (East Arm Region of Great Slave Lake);
- Commercial fishery operating out of Hay River (West Basin Region of Great Slave Lake); and
- Domestic fishery at Fort Resolution (West Basin Region of Great Slave Lake), located on the Slave River delta.

Abstract

Our study is measuring trends in mercury, other metals, and persistent organic contaminants (POCs) in lake trout and burbot from three locations in two regions of Great Slave Lake. In fall 2018, lake trout were obtained from the domestic fishery at Lutsel K'e (East Arm) and the commercial fishery operating out of Hay River (West Basin). Burbot also were obtained from the domestic fishery at Fort Resolution (West Basin). Moreover, with other funding, we continued to investigate mercury concentrations in burbot at Lutsel K'e and northern pike at Fort Resolution. Average mercury concentrations continue to remain below 0.5 µg/g. Mercury concentrations in fish are continuing to show a gradual trend of increase although the causal factors are not fully understood. In March 2019, we met with several community organizations to discuss our study results, share posters of our findings and to discuss potentially new studies and community partnerships. We continued to work with Fort Resolution on their water intake and Resolution Bay studies.

Key messages

- Mercury concentrations remain relatively low (average <0.5 µg/g) in lake trout, burbot, and northern pike from Great Slave Lake.
- Mercury continues to show a trend of increase in lake trout and burbot; a trend of increase has also been detected in northern pike.
- Several factors affect mercury concentrations in fish including their length, age, weight, and feeding and the most important factor varies by species and location. These differences probably are related to where the fish is feeding in the lake, its genetic features (e.g. fast or slow-growing fish), fishing pressures, and the features of its environment.
- Warming trends continue, although recent years have not been exceptionally warm.
- Persistent organic pollutant concentrations are declining, particularly in West Basin fish, based on our last collections made in 2017. Fish will be analyzed for persistent organic pollutants in 2019.

Temporal trend studies of trace metals and halogenated organic contaminants (HOCs), including new and emerging persistent compounds, in Mackenzie River burbot, Fort Good Hope, NWT.

Project leaders

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Project team

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Project locations

- Rampart Rapids near Fort Good Hope, NT
- Mackenzie River by the Fort Good Hope Renewable Resources Council (FGH RRC), NT

Abstract

Partnering with the Fort Good Hope Renewable Resources Council, we acquired 40 burbot from the Mackenzie River (Rampart Rapids) in early 2018. Our goals were to analyze the concentrations of mercury and other contaminants from this country food (e.g. persistent organic pollutants), analyze the data with historical time-series concentrations (spanning 32 years in total) and other attributes of the fish, and report information to relevant end users in the Sahtú region and the Northwest Territories. The project's contaminants knowledge is shared to promote safe consumption guidelines and sustainable renewable resource management regimes by relevant administrations. Preliminary results indicate that average mercury concentrations in these fish (both liver and muscle tissue) remain below the recommended guideline for consumption. Length and age do not appear to influence mercury concentrations, although in some years, females had higher concentrations in liver. Burbot with dark livers had higher concentrations of mercury in both liver and muscle compared to those with white livers. Dark livers are a sign of starvation (low lipid stores) and thus mercury is likely more concentrated in these dark livers (Lockhart et al. 1989). This seems to support local Indigenous Knowledge that dark livers are "unhealthy". Average annual mercury concentrations have increased over the last decades (Carrie et al. 2010), and thus there is a definite need to continue this environmental monitoring.

Key messages

- Mean concentrations of mercury in muscle and liver over the entire data sets were 0.366 ± 0.145 ($n = 762$) and 0.101 ± 0.088 ($n = 757$) mg/g wet weight, respectively.
- Burbot with dark livers had statistically higher total mercury concentrations in liver ($t=3.819$, $p<0.001$) and muscle ($t=2.596$, $p=0.013$) compared to burbot with white livers. Dark livers are a sign of starvation and contaminants are likely bio-concentrating in these tissues.
- Length and age did not influence mercury concentrations.
- Average annual mercury concentrations have increased over the last three decades, and thus there is a definite need to continue this environmental monitoring.

Temporal trends of contaminants in Yukon lake trout

Project leader

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Project locations

- Lake Laberge, YK
- Kusawa Lake, YK

Abstract

This project has been monitoring contaminants in lake trout from Lake Laberge and Kusawa Lake in the Yukon, since 1993, and annually since 2001. In the fall of 2018 and early winter of 2019, 15 lake trout were collected from Kusawa Lake and 21 from Lake Laberge. Otoliths were aged and liver and muscle samples from these fish are currently being analyzed for a suite of elements, new contaminants (fluorinated and brominated compounds) and older organochlorine pesticides. Previous data from this project are being gathered and curated prior to being analyzed and reported. Mercury levels in muscle from lake trout from Lake Laberge and Kusawa Lake averaged 0.25 and 0.24 $mg \cdot g^{-1}$ respectively, about half the recommended guideline level of 0.50 $mg \cdot g^{-1}$ for commercial sale. Mercury is declining over time in lake trout from both lakes, although there is considerable annual variation. Arsenic concentrations in lake trout muscle decreased over time in Lake Laberge but not in Kusawa Lake, while selenium increased over time in Kusawa Lake but not in Lake Laberge. Both changes were small and likely of little biological significance. Outreach programs were conducted with the Yukon Fisheries Field Assistant Program and the Yukon Fisheries Management Program at Yukon College in Whitehorse, YT. The first group was able to use the recently acquired Direct Mercury Analyzer to measure mercury in their fish. Ta'an Kwach'an Council and Champagne and Aishihik First Nations are integrally involved in fish collections for this project and in the ongoing refinement of the communication of results. We have been developing our communication capacity, and are including Yukon Contaminants Committee, Yukon Environment (Fisheries) and Kwanlin Dun First Nation in discussions. As we move forward with this collaborative approach, we anticipate many new opportunities for value-added consultation and communication activities.

Key messages

- Mercury is declining over time in lake trout from Lake Laberge and Kusawa Lake, although there is considerable annual variation.
- In 2018 mercury levels in muscle from lake trout from Lake Laberge and Kusawa Lake averaged 0.25 and 0.24 $mg \cdot g^{-1}$, about half the recommended guideline level of 0.50 $mg \cdot g^{-1}$ for commercial sale (note that this represents only one fish from Lake Laberge).
- Arsenic concentrations in lake trout muscle decreased over time in Lake Laberge but not in Kusawa Lake, while selenium increased over time in Kusawa Lake but not in Lake Laberge. Both changes were small and likely of little biological significance.
- Newer contaminants (PFASs and PBDEs) as well as older organochlorine pesticides are currently being measured in samples collected in 2018.

Arctic Caribou Contaminant Monitoring Program

Project leader

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Project locations

- Kivalliq region, NU (Qamanirjuaq and Lorillard herds)
- Western Yukon (Forty-Mile herd)
- Northern Yukon (Porqupine herd)
- Sanikiluaq, NU
- Eastern Northwest Territories

Abstract

This project studies contaminant levels in caribou in the Canadian Arctic to determine if these populations remain healthy (in terms of contaminant loads), whether these important resources remain safe and healthy food choices for Northerners and if contaminant levels are changing over time. In 2018/2019 samples were collected from 16 Qamanirjuaq, 4 Lorillard and 18 Forty-Mile caribou and 11 Sanikiluaq reindeer. Twenty kidneys from the Bathurst caribou were also included in the analysis. Sample analyses for these collections had not been completed at the time this report was prepared. Porcupine, Qamanirjuaq and Forty-Mile caribou samples collected in the 2017/2018 year have been analyzed, and results are presented in this report. Toxic elements tended to be higher in cows than bulls. This difference is likely due to the relatively higher volume of food intake (and hence toxic element intake) by cows due to their smaller size and higher energetic requirements from parturition and lactation. Cadmium and zinc increased with age while mercury decreased with age in Porcupine caribou bulls. Lead continues to decline in both herds. Overall, mercury, selenium and zinc are increasing in the Qamanirjuaq caribou, although increases are slight and may be better described by a cyclic pattern, similar to that seen in the Porcupine caribou, which is not experiencing an overall increase in any of those elements. Toxic elements were present at very low concentrations in marrow from Porcupine caribou, much lower than those found in kidneys.

Perfluorinated sulfonic acids are declining over time in caribou liver (largely due to PFOS, which has been banned). Per- and polyfluorinated alkyl substances and polybrominated diphenyl ethers were present at very low levels in caribou liver. Levels of most contaminants measured in caribou kidneys were not of concern toxicologically, although renal mercury and cadmium concentrations may cause some concern for human health depending on the quantity of organs consumed. Yukon Health has advised restricting intake of kidney and liver from Yukon caribou; the recommended

maximum varying depending on herd (e.g. a maximum of 25 Porcupine caribou kidneys/year). The health advisory confirms that heavy metals are very low in the meat (muscle) from caribou and that caribou meat remains a healthy food choice. There have been no health advisories issued for caribou in NWT or Nunavut.

Key messages

- Levels of most contaminants measured in caribou tissues are not high enough to be of concern, although kidney mercury and cadmium concentrations may cause some concern for human health depending on the quantity of organs consumed. Caribou meat (muscle) does not accumulate high levels of contaminants, therefore, is a healthy food choice.
- Mercury concentrations in the Porcupine and Qamanirjuaq caribou are stable over the long term, although there is considerable annual variation.
- Concentrations of PFASs and PBDEs are low with respect to potential toxicity to caribou or those consuming caribou.
- This program will continue to monitor the Porcupine and Qamanirjuaq caribou herds annually to maintain hunter confidence in this traditional food and to better understand the dynamics of contaminants within this ecosystem (particularly mercury).

Community based seawater monitoring for organic contaminants and mercury in the Canadian Arctic

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Project locations

- Barrow Strait near Resolute Bay, NU (74.612, -95.026)
- Wellington Bay near Cambridge Bay, NU (69.2363, -106.4448)
- Beaufort Sea near Sachs Harbour, NT (71.9327, -125.3251)
- Antalâk Fiord in Labrador Sea near Nain, NL (56.4481, -62.0045)

Abstract

This project examines levels and time trends of contaminants in marine waters of Arctic Canada. The project started in May 2014 and built on previous work in Barrow Strait near Resolute in 2011 and 2012, thus presenting the only long-term seawater sampling program in the Arctic, comprising 9 years of data. Seawater samples for mercury, organophosphate ester flame retardants (OPE), and perfluoroalkyl substances (PFAS), were successfully collected from Barrow Strait near Resolute Bay under ice covered conditions (May-June 2018), Cambridge Bay in open water (July to August 2018), and Labrador Sea near Nain (Sept 2018) using Niskin samplers to obtain 1 L samples at various depths. While this method of active sampling is suitable for certain contaminants, passive samplers are used to determine persistent organic pollutants (POPs), specifically polybrominated diphenyl ether flame retardants (PBDEs), polyaromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). The passive samplers are comprised of thin plastic films and were deployed in two locations within Barrow Strait, Allen Bay in May-June 2018 and in Resolute Passage from November 2017 to May 2018 (192 days). Similarly, passive samplers were deployed in Wellington Bay (near

Cambridge Bay) in August 2017 and retrieved in August 2018, for sampling over a full year. Two sites were unsuccessful for passive sampler retrieval. The passive sampler deployed in August 2018 in Antalâk Fiord near Nain was discovered to have been removed prior to the intended retrieval date in September 2018. Poor weather and ice conditions prohibited our ability to deploy a sampler in Sachs Harbour (Beaufort Sea) where we typically conduct 30-40 days of sampling in August.

The major findings are that perfluorooctane sulfonate (PFOS) has declined to non-quantifiable levels since the mid-2000s in Barrow Strait. Other PFAS such as perfluorooctanoate (PFOA) have not changed between 2014 and 2018. Total PFAS concentrations are similar between Barrow Strait, Labrador Sea and Cambridge Bay. Akin to PFAS, OPE concentrations were fairly uniform between the three locations with the sum of OPEs ranging from 5 to 9 ng/L, however, ongoing sampling is required to evaluate the temporal trend. Mercury concentrations in Barrow Strait (2014-2018) remain unchanged compared to 10 years earlier (2004-2005). This project is continuing in 2019-2020 so that a long-term temporal data set can be developed. This data can be used to predict and better understand the impacts of changing ice, permafrost, and snow on contaminant levels in seawater.

Key messages

- Concentrations of numerous legacy and new/emerging persistent organic pollutants and mercury were measured in seawater samples from Barrow Strait near Resolute Bay, Nunavut and other Arctic locations.
- In Resolute Bay higher concentrations of 16 organophosphate ester flame retardants and plasticizers were found compared to brominated flame retardants.
- Levels of most of the perfluorinated alkyl substances (PFASs) analyzed show no temporal trend between 2005 and 2018; however, PFOS, which was used in aqueous film forming foams needed for firefighting, has decreased over this period, possibly due to international restrictions on production and usage.
- Mercury/methylmercury concentrations at Barrow Strait (2014-2018) remain unchanged compared to 10 years earlier (2004-2005).
- Methylmercury concentrations in seawater build up during the ice-covered period but decrease during the ice-free conditions, likely due to photodemethylation.
- Polycyclic aromatic hydrocarbons (PAHs) are much higher in concentration in the Arctic Archipelago and Labrador Sea (2.4 to 25 $ng \cdot L^{-1}$) compared to earlier reports in the northwestern Arctic and Chukchi Sea (0.030 to 0.090 $ng \cdot L^{-1}$).

Assessing persistent organic pollutants (POPs) in Canadian Arctic air and water as an entry point into the Arctic food chain

Project leader

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Project locations

Sampling took place on board the CCGS Amundsen in Hudson Bay between Churchill and Iqaluit, Leg 2a, see Figure 1; and the Central and Eastern Archipelago Leg 3, see Figure 2. Additionally, samples were taken in the Western Archipelago and Beaufort Sea from on board the CCGS Laurier, see Figure 3.

Abstract

In collaboration with ArcticNet, air, water, sediment and zooplankton samples were collected in the Canadian Archipelago during the summer of 2018. These samples were collected from on board the CCGS Amundsen in Hudson Bay and the central and eastern archipelago. Additional samples were collected in the western archipelago and the Beaufort Sea from on board the CCGS Wilfrid Laurier. These samples were collected to determine the occurrence and levels of persistent organic pollutants and to determine their spatial and temporal trends. The set of compounds that this report focuses on are organophosphate esters. These compounds are flame retardants and plasticizers. They are found in very high levels in Arctic air, water and sediment in comparison to the brominated flame retardants. Samples were also collected to determine the occurrence and levels of microplastics in water, sediment and zooplankton. A northern student from Rankin Inlet who attends Nunavut Arctic College in Iqaluit, was recruited and spent 10 days on board the Amundsen. While on board she learned how samples are collected for both persistent organic pollutants and microplastics. Samples are collected in the following ways:

- the air sampler is run for the entire cruise, where the filters are changed every two days;
- two types of water samples are collected, grab samples and passive samples. Grab samples are taken at the ocean surface and passive samples are taken using passive samplers at a depth attached to moorings that are deployed and left for a year. In 2018, we retrieved and deployed some passive water samplers in the Beaufort Sea, retrieved samplers from Cambridge Bay and Davis Strait and deployed samplers in Hudson Bay;

- sediment was collected with a box corer and the top 0-5cm was kept for analysis; and
- zooplankton samples were collected using Tucker nets, they were sorted and speciated while on the ship.

As part of the engagement and communication aspects of this project I visited Nunavut Arctic College in February 2018, taught a course on air and water sampling for persistent organic pollutants, this included classroom and hands-on sessions. I also visited Cambridge Bay in September 2018 with the Environment Minister, during this trip, I was able to engage and consult with many members of the community including a high school class, the mayor, the heritage society, the youth council and scientists at the CHARS facility.

Key messages

- Air, water (grab and passive), sediment and zooplankton samples were successfully collected from on board the CCGS Amundsen in the Hudson Bay and Central and Eastern Archipelago during the summer of 2018.
- Air and water (passive and grab) samples were collected from on board the CCGS Wilfrid Laurier in the Beaufort Sea.
- Air, water, sediment and zooplankton samples will be analysed for toxic contaminants including persistent organic pollutant on the Stockholm Convention list and the Chemical Management Plan priority compounds of emerging concern including the organophosphate esters. Additionally, selected water and sediment samples will be analysed for microplastics.
- Data will help establish trends for compounds of emerging Arctic concern, including the organophosphate esters and microplastics, and continues to monitor for trends of banned or restricted compounds.
- Generally, compounds banned under national and international regulations, such as the Stockholm Convention, are declining in Arctic air and water, whereas compounds currently being used are staying the same or in some cases increasing.
- Microplastics were found in all sample media including surface water, zooplankton and sediments in very deep regions of the Canadian Arctic.

Climate change, contaminants, ecotoxicology: interactions in Arctic seabirds at their southern range limits

Project leaders

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Project team

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Project location

Coats Island, NU

Abstract

Pagophilic (ice-associated) Arctic species are facing multiple stressors from climate change and toxic contamination. We investigated whether contaminants compounded the impact of climate change on wildlife by limiting their ability to respond to changes in ice availability. Our current study year (2018) had the latest hatch date on record and provided a strong contrast with 2017 (earliest year on record) and 2016 (average year). 55 thick-billed murres were tracked via GPS-accelerometers (four additional birds received GPS units but data was corrupt), and concentrations of hormones and mercury were measured in the plasma of 59 individuals. We also measured the concentrations of per-/polyfluoroalkyl substances (PFASs) in 21 birds and brominated flame retardants (BFR) in 30 birds. Levels of PFASs and BFRs were low, and unrelated to hormones or behaviour. Mercury levels were also unrelated to hormones or behavior. In contrast to a medium-ice year (2016, positive relationship) and low-ice year (2017, negative relationship), the high-ice year (2018) showed no relationship between T3 and Hg. We found no relationships between hormone levels and foraging behaviour. GPS tracks demonstrated that birds foraged to the north of the colony during incubation (when ice was present) and moved to forage to the northwest as chick-rearing progressed (when ice was no longer present). Based on our 2016-2018 data, we tentatively conclude that mercury may be influencing the ability of thick-billed murres to adjust to variation in ice cover, but only in years when ice leaves unusually early, and we look forward to finalizing our analyses and publishing these results in the coming months.

Key messages

Levels of BFRs and PFAS were quite low. However, mercury may influence the ability of murres to adjust to variation in ice cover via associations with hormones, but only when the ice leaves early. The underlying mechanism appears to vary among years of varying ice concentrations.

Plastics as a vector of contaminants (benzotriazole UV stabilizers) to Arctic seabird tissues and eggs

Project leaders

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Project locations

- Prince Leopold Island, NU
- Labrador Sea, NL

Abstract

Plastic debris is commonly ingested by seabirds, even in high Arctic waters, but only recently has attention turned to what the impacts may be of this ingested pollution. Since 2003, the Arctic seabird team has worked to identify which Northern marine bird species are vulnerable to ingesting marine plastic pollution. Importantly, there is increasing evidence that once marine plastic pollution is in the gut of seabirds, contaminants adsorbed to plastics are released, which may have negative effects on exposed wildlife. Now in its third phase, this project expands ongoing efforts to assess whether chemical contaminants are associated with ingested plastics, and as a consequence may be transferred to Arctic marine birds (northern fulmars; *Fulmarus glacialis*) and black-legged kittiwakes (*Rissa tridactyla*). Beyond the physical impact associated with plastics, there is also increasing awareness of the chemicals associated with marine plastic debris. Plastics are made from a number of chemical components such as UV stabilizers and phthalates. This third project phase examined concentrations of contaminants, known to be associated with plastic, in two species of seabirds. In this case, we targeted benzotriazole UV stabilizers (BZT-UVs), which are added to plastic to prevent colour change. We also targeted substituted diphenylamines (SDPAs) which are industrial antioxidants used in the automotive industry, including as additives to polyurethane foam (PUF). This is the first report of the different distribution patterns of SDPAs & BZT-UVs in seabirds from Canadian Arctic sites. The concentrations of ∑SDPAs in seabird livers (median 336 pg g^{-1}, wet weight (ww)) were significantly higher than the eggs (median 24 pg g^{-1}, ww) and the seal livers (median 38 pg g^{-1}, ww), suggesting liver was a primary tissue of SDPA accumulation in seabirds. This work builds on past work in the region and will further identify the potential risks marine plastics may pose to marine birds, and evaluate if eggs contain contaminants shown to be plastic-derived.

Key messages

- This is the first report of SDPAs and BZT-UVs in wildlife from Canadian Arctic sites.
- Seabird tissues showed higher concentrations of SDPAs than BZT-UVs.
- UV329 and UV350 were the predominant BZT-UVs.
- Greater levels of SDPAs were found in seabird livers than in their eggs.
- SDPAs and BZT-UVs are not strong candidate chemicals for long range transport; Their presence in Arctic seabirds may be due to association with small plastic particles.

A comparative assessment of relationships between priority contaminants and metabolomic profiles in polar bears (*Ursus maritimus*) and ringed seal (*Pusa hispida*) prey from Canadian High Arctic and Hudson Bay locations

Project leaders

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Project locations

- Polar bears (archived): Rankin Inlet, Whale Cove, Arviat, Chesterfield Inlet, Pond Inlet, Clyde River and Qikiqtarjuaq, NU
- Ringed seals (archived): Arviat and Resolute Bay, NU.

Abstract

Metabolomics measures hundreds of small, natural compounds (metabolites) created by metabolism in an animal or plant (e.g., sugars, amino acids, fatty acids, other lipids). These small compounds are "profiled" in a tissue of an animal and can change in response to differences in diet or health, and with contaminant exposure (among other things). This project expanded on previous investigations of Hudson Bay polar bears by comparing the metabolomic profiles of bears from the Western Hudson Bay (WHB) with those from the High Arctic (Baffin Bay) subpopulations. We also investigated how the metabolite profiles in the liver of polar bears relate to those of their major prey species (ringed seals), which may allow us to more clearly reveal relationships of metabolites with new and legacy persistent organic pollutants (POPs) and mercury, as well as providing information about how diet affects metabolite profiles in the Hudson Bay bears. When complete, this study will help us better understand which legacy and emerging contaminants are related to consistent biological changes, as indicated in the metabolite profiles of polar bears and seals. Our initial assessment has shown that the metabolite levels and patterns of the four groups of animals (High Arctic polar

bear and seals, and Western Hudson Bay polar bears and seals) were different enough to be easily identified. This demonstrated that there were measurable differences in the biology between these species, and between the subpopulations within the species. Fat-loving legacy POPs and newer POPs were measured in the liver of polar bears and seals. The results showed distinct differences between the High Arctic and WHB, although the patterns in the bears and seals were the opposite of each other and inconsistent between locations. For example, if a given contaminant was high in concentration in bears from the High Arctic it tended to be low in seals at that location, with the opposite pattern observed in the Hudson Bay. These patterns made identifying the contaminant-metabolite relationships more difficult but the preliminary results are encouraging. Because the differences in POP levels still created unique profiles in each group of animals, we were able to use them to investigate how they relate to changes in metabolite profiles. Consistent correlations were seen between the total levels of perfluorinated alkyl substances (PFASs) and fat-related metabolites and amino acids, suggesting that high levels of the PFASs were related to decreases in fat metabolism and increases in protein metabolism. Total mercury levels were also weakly correlated to some fat-related compounds that may be part of the response of the liver to stress or may simply be part of lipid metabolism. Once we have complete profiles of POPs, more specific relationships between POPs and metabolites will be investigated, however, the preliminary results showed some consistent relationships between contaminant exposures and metabolite levels and patterns. To introduce the concept of metabolomics to Northerners a metabolomics "fact sheet" ("Using Metabolomics to Study Contaminants and Diet in Nunavut Wildlife") was prepared that was developed with input from the Nunavut Environmental Contaminants Committee (NECC) and was later distributed at the NCP Results Workshop in Whitehorse, YT and discussed with those that were interested.

Key messages

- Metabolite profiles of polar bears from the High Arctic, Baffin Bay subpopulation were compared to those from the Western Hudson Bay subpopulation in order to expand on previous observations regarding relationships between metabolites and POPs and mercury from nearby subpopulations with similar exposures (Southern and Western Hudson Bay).
- We performed the same analyses in ringed seals from similar locations in order to assess dietary transfer of metabolites, POPs, and mercury, and to compare the POP-metabolite relationships between two important Arctic species.
- The profiles of metabolites of the four groups (High Arctic polar bear and seals, and Western Hudson Bay polar bears and seals) could be identified from each other using statistics, indicating significant differences between the species and between the populations/locations of bears and seals which were related to differences in the biology and toxicology (contaminant exposures) of the animals.
- In the liver of both species, total mercury (THg) and the åPFAS levels were the highest contaminant concentrations, followed by åCHL and the åPCB and åDDT, with smaller amounts of åHCH, åCBz, and the åPBDE.
- Several groups of legacy POPs were greater in the WHB bears, however, the THg and åPFAS levels were greater in the High Arctic bears, while the opposite pattern was observed in seals. Despite these differences, the levels have created unique exposure groups that can be used to investigate POP/THg-metabolite relationships.
- Final POP/THg profiles remain in process; however, preliminary analyses have found significant correlations between the åPFAS, THg and several major groups of metabolites related to fatty acid and protein metabolism as well as cellular signalling and inflammation responses.

Seabirds as a vector and concentrators of microplastics in Arctic ecosystems

Project leaders

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Project location

Qaqulluit National Wildlife Area, NU

Abstract

Plastic debris is now recognized as a common contaminant affecting marine ecosystems. Since 2003 the Arctic seabird team has worked to assess which northern marine bird species are vulnerable to ingesting marine plastic pollution. To date, a number of marine bird species have been shown to ingest plastics. Through these studies it has also been recently demonstrated that seabirds may shed ingested plastics in the form of microplastics in their guano. This suggests that seabirds may act as a vector for microplastic movement in the marine environment, and potentially to the terrestrial environment. To test if seabird excretion of microplastics is contributing to the accumulation of microplastics around seabird colonies, we worked with local Inuit hunters in Qikiqtarjuaq, Nunavut to collect biotic and environmental samples from around two seabird colonies known to have birds with high plastic ingestion rates. Seabird, air, water, sediment, and blue mussel samples were collected below the cliff-side colonies, and at increasing distances from the colony edges. This work builds on past work in the region and will further identify how microplastics are distributed and move through Arctic ecosystems. Preliminary data has shown that microplastics are present in air, water, sediment and blue mussel samples. The seabird samples have not yet been processed. As we continue to process and analyze these samples, we will look for significant trends in microplastic concentrations as it relates to the distance from seabird colonies.

Key messages

- This is the first report of microplastics in the environment directly around seabird colonies in the Canadian Arctic sites.
- Preliminary data has shown that microplastics are present in air, water, sediment and blue mussel samples.
- This data will help examine if seabirds are acting as concentrators of microplastics in the coastal environment.

Snowpack mercury mass balance over the spring melt period, Iqaluit, Nunavut

Project leader

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Project location

Iqaluit, NU

Abstract

The purpose of this two-year project is to improve understanding and predictive modelling of the fate of mercury in end-of-winter Arctic snowpack through intensive monitoring of the surface to air exchanges of mercury prior to and throughout the spring melt period. The study was conducted near the community of Iqaluit, NU, South Baffin Island. In Arctic coastal regions such as this, mercury cycling is strongly influenced by marine aerosols and the enhanced atmospheric deposition rates associated with springtime atmospheric mercury depletion events, which have not yet been reported on Baffin Island. Two spring field-seasons were conducted in 2017 and 2018. The 2017 field season was initiated in late spring after the onset of snowmelt, and results demonstrated very low snowpack emissions, apart from a single short-lived emission peak immediately following a snowfall event. In 2018, approximately two months of flux data were collected, beginning in late April, well in advance of the snowmelt period. Results from the 2018 field season corroborated initial findings from 2017, demonstrating that snow-air emissions of gaseous elemental mercury at this coastal marine study site are primarily associated with re-emission of freshly deposited Hg in snow. Over the two-month monitoring period, 100% of the mercury deposited via wet deposition was re-emitted via gaseous elemental mercury (GEM) efflux, with no further net-loss from the snowpack.

Key messages

- During the 2017 and 2018 study periods, significant snowpack-air efflux of GEM from Arctic spring snowpack were observed following wet (snowfall) mercury (Hg) deposition events.
- In 2018, snow-air exchanges of GEM resulted in a net loss of mercury from the snowpack surface during the pre-melt period, and a net gain of mercury from the atmosphere during the melt period, implying that the onset of snowmelt causes the surface to air efflux of GEM to cease.
- Over the two-month monitoring period in 2018 the total snowpack surface to air efflux of Hg was equal to the total inputs of Hg via snow and rain, causing no net change in the mass balance of the snowpack associated with surface-air exchanges.
- Inputs of Hg via rainfall and wet snowfall in late June 2018 substantially offset cumulative snowpack Hg losses via GEM efflÅux over the entire monitoring period and were not associated with re-emission events typical of May and early June when air and snow surface temperatures were below 0^{o}C.

Temporal trends of emerging pollutant and mercury deposition through ice and sediment core sampling

Project leaders

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Project locations

Mount Oxford Plateau, Ellesmere Island, NU (82.179°N, 72.956°W)
Lake Hazen, Ellesmere Island, NU (81.783°N, 71.011°W)

Abstract

Contaminants produced and emitted in southern regions can travel through the atmosphere and deposit in the Arctic. Remote Arctic ice caps preserve these chemicals and allow us to understand trends in transport and deposition. This project collected ice cores from the Mount Oxford icefield on Ellesmere Island in the Canadian High Arctic, as well as sediment cores from Lake Hazen located downstream of the ice field. Mercury and emerging pollutants were measured in ice and sediment cores. We observed that perfluoroalkyl substances (PFAS) were deposited to the Oxford icefield in all years from 1967 to 2014. Most PFAS increased from the mid-1980s to present. The organophosphate ester flame retardants/plasticizers (OPEs) were lower in concentration at the Oxford icefield compared to our earlier findings in the Devon Ice Cap. Furthermore, OPEs had varying temporal trends with some OPEs showing no trend while others indicated an increasing deposition. The chlorinated OPEs increased until the mid-2000s and then decreased. Future work will focus on relating temporal trends in contaminants to changes in production/emissions as well as climate change variables.

Key messages

- Perfluoroalkyl substances (PFAS) and organophosphate ester flame retardants (OPE) were measured in ice cores from the Mount Oxford icefield on Ellesmere Island
- Perfluoroalkyl sulfonic acids are declining in Mount Oxford since 1990 whereas perfluoroalkyl carboxylic acids are increasing since 1985
- Chlorinated OPE displayed a parabolic trend in deposition flux to Mt. Oxford, increasing from the early 2000s with peak fluxes occurring in ~ 2010, followed by a decline
- Increased mercury accumulation in Lake Hazen sediment through increased glacial melt and runoff.

Communications, Capacity, and Outreach

Yukon Contaminants Committee (YCC) CIRNAC Yukon Regional Office Coordination

- **Project leader**
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- **Project team**
  Yukon Contaminants Committee (YCC) including: Ellen Sedlack, CIRNAC (Chair), James MacDonald, Council of Yukon First Nations (Co-Chair), Dr. Mary Vanderkop, Yukon Government, Sabrina Kinsella, Yukon Government, Dr. Brendan Hanley, Yukon Government; Mary Gamberg, independent consultant and researcher.
- **Project location**
  Whitehorse, YK

Abstract

The YCC has operated since 1991 and continues to keep residents of the Yukon informed of the Northern Contaminants Program's initiatives. In 2018-2019 the YCC continued to work with Yukon Health authorities and researchers on contaminants in traditional food sources and continued to support three Yukon communities (White River First Nation, the First Nation of Nacho Nyäk Dun and Taku River Tlingit First Nation) involved in research of long-range contaminants in wildlife in their Traditional Territories.

Key messages

- Our traditional/country foods are safe to eat.
- Levels of contaminants are generally low in the Yukon Territory.
- New contaminants are emerging globally due to climate change and monitoring and we must continue to ensure traditional food are safe to eat.
- The YCC has spent the past 26 years communicating results of the Northern Contaminants Program Yukon residents and contributing to national and international publications.
- The YCC is considered to be the point of contact for long-range contaminant issues in the Yukon.
- The work of the NCP continues to be relevant at the local, regional, national, and international level.
- Yukon First Nations have a role to play in contaminant research through leading or partnering and contributing to this research.

Northwest Territories Regional Contaminants Committee (NWTRCC)

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Project location

Northwest Territories, Canada

Abstract

In the 2018-2019 year, the Northwest Territories Regional Contaminants Committee (NWTRCC) continued to fulfill its mandate of assisting in communicating results of research to NWT residents and providing input on proposed research projects from a social and cultural lens. The NWTRCC held a number of in-person and teleconference meetings to meet its objectives. Members also worked independently in the communities they represent to share research and where possible identify community research priorities with regards to long-range contaminants.

Key messages

- Through its social-cultural review of all NWT-based Northern Contaminant Program (NCP) proposals, the NWTRCC ensures northern and Indigenous interests are being served by scientific research conducted in the Northwest Territories, and results of these studies are shared with communities in a culturally-appropriate way.
- The NWTRCC continues to highlight the need to integrate Traditional Knowledge in all stages of research projects, and to ensure research helps to address community concerns about whether the water is safe to drink and country foods are safe to eat.

Nunavut Environmental Contaminants Committee (NECC)

Project leaders

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Project location

Nunavut, Canada

Abstract

The NECC represents the Northern Contaminants Program (NCP) in Nunavut to ensure that northern and Inuit interests are being served by scientific research conducted in Nunavut, and to serve as a resource to Nunavummiut for information on long-range contaminants in Nunavut.

The NECC attended the in-person NCP Management Committee (MC) meetings in Nain, Labrador in April 2018; in Ottawa, Ontario in November 2018; Ottawa, Ontario in March 2019 as well as in the meeting via teleconference on October 11, 2018. The NECC hosted a productive in-person meeting in Iqaluit, NU in October 2018 for the review of the mid-year reports and hosted another face-to-face meeting for the social-cultural review of NCP proposals in Iqaluit, NU in February 2019.

The NECC participated in the NCP-funded Wildlife Contaminants Workshop (*Wildlife Contaminants Workshop – building contaminants research capacity in Nunavut*) in Iqaluit, NU (September 2018) and in the NCP-funded Arviat Workshop (*Learning about ringed seal health from contaminants science and Inuit Qaujimajatuqangit: an educational workshop in Arviat, Nunavut, and Regional NCP Workshop in Arviat*) in October 2018.

The NECC provided feedback to NCP-funded researchers on communications, met face-to-face with NCP-funded researchers to discuss their respective proposals/projects, and attended seminars/ workshop held by NCP-funded researchers.

Key messages

- The NECC has spent the past 20 years assisting researchers to communicate results of the NCP funded research to Nunavummiut and contributed to national/international publications.
- Through its social-cultural review of all Nunavut-based NCP proposals, the NECC ensures northern and Inuit interests are being served by scientific research conducted in Nunavut.
- The NECC aims to serve as a resource to Nunavummiut for long-range contaminants information in Nunavut.
- This year, the NECC attended several internal and external meetings, participated in two capacity-building activities funded by NCP, and met or corresponded with numerous NCP-funded researchers to provide feedback on projects and communication materials.

Nunavik Nutrition and Health Committee (NNHC): coordinating and learning from contaminants research in Nunavik

Project leaders

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Project team

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Project location

Nunavik, QC

Abstract

The Nunavik Nutrition and Health Committee (NNHC) is a long-standing committee that has evolved and adapted over the years. Since its creation in 1989, the regional committee has broadened its perspective toward a more holistic approach to contaminants, nutrition and health issues, and has linked to the Northern Contaminant Program. Today, the NNHC acts as an advisory committee to the director of Public Health on issues related to its areas of expertise. The committee provides guidance, establishes liaisons with research groups and communities, and orients research work on regional priority issues. Moreover, the committee facilitates and, when pertinent, undertakes research-communications activities on contaminants, nutrition, and health. Making research relevant to *Nunavimmiut* needs and interests as well as protecting and promoting public health in Nunavik are among the main NNHC priorities. This year, with the Northern Contaminants Program's (NCP) support, the NNHC and the region were able to play a central role in the interpretation and outcomes of the Qanuilirpitaa? 2017 Health Survey (Qanuilirpitaa?) results related to contaminants, nutrition, and health. Extensive regional efforts to mitigate lead and mercury exposure were also pursued this year. These efforts aim to protect the subgroups of the population which are more at risk, including pregnant women and their unborn babies as well as children.

Key messages

- The NNHC is the key regional committee for health and environment issues in Nunavik.
- The NNHC advises the Nunavik Director of Public Health about educating the public on food, nutrition and health issues, including the benefits and risks (such as contaminants) associated to country food consumption.
- The NNHC continues to be active within the NCP, reviewing and supporting research in the region, ensuring liaison with researchers and helping in the communication of research results in a way that is appropriate and meaningful to *Nunavimmiut*.

Northern Contaminants Researcher, Nunatsiavut

Project leader

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Project team

Rodd Laing- Director of Environment, Nunatsiavut Government ; Paul McCarney- Research Manager, Nunatsiavut Government; Carla Pamak- Inuit Research Advisor, Nunatsiavut Government; Joey Angnatok- Mentor, Harvester, Nunatsiavut Government; Derek Muir- Environment and Climate Change Canada; Vacant- Community Outreach Manager, Nunatsiavut Government; Chaim Andersen- Community Climate Change Liaison/Immapivut Community Coordinator, Nunatsiavut Government; Max Liboiron- Associate Vice- President (Indigenous Research), Assistant Professor, Geography, Memorial University

Project location

Nain, NL

Abstract

The Northern Contaminants Researcher (NCR) is a core component of the Nunatsiavut Government. Based at the newly renamed Nunatsiavut Research Centre, within the Environment Division of the Department of Lands and Natural Resources, the NCR works inter-departmentally and across communities, in part through the Nunatsiavut Government Research Advisory Committee (NGRAC) to help Inuit of Nunatsiavut better understand contaminants within the region. This includes some Northern Contaminants Program (NCP) funded projects and how these projects relate to Inuit health and wellbeing. In partnership with the Nunatsiavut Government Research Advisory Committee, the NCR disseminates essential information on contaminants and research projects throughout the region and is the first point of contact for contaminants related information. This proposal is a prescribed priority activity within the NCP and builds on the capacity that has been developed in the region to facilitate an even greater level of management and ownership of research in Nunatsiavut. This funding ensures the continuation of both the NCR position as well as the NGRAC and complements other NCP research programs ongoing or previously implemented in the region, including water, air, ringed seal, Arctic char, and Micro/Marine Plastics monitoring. All of our monitoring programs include a Traditional Knowledge component, as this knowledge is essential to properly understanding trends and issues, and is the best record of historical information throughout our region.

All of our NCP research programs and meetings are coordinated through the NCR at the Nunatsiavut Research Centre on an annual basis. Most importantly, this position ensures there is a trusted, consistent point of contact who will actively engage Nunatsiavimmiut while disseminating contaminants related information within the context of the many other related issues and initiatives in the region.

Key messages

- The NCR continues to be the main contact for any concerns relating to contaminants, health, and environmental issues. Any individual expressing interest in contaminants, which is becoming more common, will have the opportunity to be trained in the field and research opportunities will be provided to them.
- The NCR continues to build capacity through the community freezer and the Going Off, Growing Strong program (Aullak Sangilivalliannatuk), traditional hunting, and through collaboration with educators in the communities.
- The NCR employs focused health messaging, based on the results of the Inuit Health Survey and Integrated Regional Impact Studies (IRIS) 4 report.
- The NCR continues to work effectively with coworkers including the Inuit research Advisor (IRA), Research Manager and Community Outreach Manager to achieve NCP objectives.

Coordination, participation and communication: evolving Inuit Research Advisor responsibilities in Nunatsiavut for the benefit of Inuit and their communities

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- **Project location**
  Nunatsiavut, NL

Abstract

The Inuit Research Advisor for Nunatsiavut continues to serve as the first step in a more coordinated approach to community involvement and coordination of Arctic science and represents a new way of knowledge sharing and engagement of Inuit in Arctic science. The Nunatsiavut Government (NG) encourages researchers to consult with Inuit Community Governments in the five Nunatsiavut communities, Rigolet, Makkovik, Postville, Hopedale, and Nain, as well as NG departments in developing more community-based research proposals. Comprehensive reviews of proposals involve NG departments and Inuit Community Government(s)/Corporation(s).

Together with IRAs in the other Inuit regions of Canada, the Nunatsiavut IRA works towards achieving a new way of knowledge sharing and engagement of Inuit in Arctic science in the region. In addition to NCP support, the program is co-funded by ArcticNet and the Nunatsiavut Government.

Key messages

- The IRA co-coordinates the Nunatsiavut Government Research Office, serving as the first point of contact for all researchers conducting work in Nunatsiavut and requiring contact with, or assistance from, the Nunatsiavut Government.
- The IRA is the Chair and administrator of the Nunatsiavut Government Research Advisory Committee (NGRAC). The IRA has communicated with over 71 researchers from 1st April 2018 to 31st March 2019. This year the IRA has chaired 12 NGRAC meetings, one of which was a face to face meeting in Nain.
- The IRA served as liaison, contact, and assistant to research projects taking place in Nunatsiavut. This assistance ranged from linking the researchers with appropriate individuals and/or organizations such as NG departments and Inuit Community Governments in Nunatsiavut, assisting researchers in the field, obtaining samples to providing input on research proposals and plans.
- The IRA has also served as liaison for partners such as Inuit Tapiriit Kanatami (ITK), Inuit Circumpolar Council (ICC) Canada, Nunatsiavut Inuit Community Governments/ Corporations, researchers, students, and other organizations.

Inuit Research Advisor for the Inuvialuit Settlement Region

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- **Project location**
  Inuvik, NT

Abstract

By virtue of grant funding from ArcticNet and a tri-party funding contribution agreement between the Northern Contaminants Program (NCP), the Indigenous Community Based Climate Monitoring Program (ICBCMP), and Environment and Climate Change Canada (ECCC), the proposed regional and national activities for the Inuit Research Advisor (IRA) were completed as planned in 2018-2019. These activities included completing annual IRA duties specified by the NCP and ArcticNet. The IRA also undertook membership duties on various Inuit/Indigenous Committee's, including the IRC Research Committee (IRC RC), NWT Regional Contaminants Committee (NWT RCC), Inuit Tapiriit Kanatami's (ITK) Inuit Qaujisarvingat National Committee (IQNC), and ArcticNet's Inuit Advisory Committee (AN IAC). New Committee memberships/participations in 2018-2019 include the IRA being recently appointed to ArcticNet's Research Management Committee (AN RMC) in April 2018, the NWT Climate Change Committee (NWT CCC) in June 2018, and the NCP Management Committee (NCP MC) in March 2019, by the Chair and CEO of IRC. Most recently, the IRA joined the new NCP Beluga Sub-Committee in December 2018. In addition to IRA and Committee work, the IRA led internal IRC regional research initiatives, including coordinating the Research Committee, and working to resolve governance issues within the NCP and ArcticNet. The resolution of these governance issues has resulted in more equitable committee representation for Inuvialuit in both programs, a new regional review processes under development for both programs, as well as national level coordination between ITK and Inuit Nunangat in the coming fiscal year.

Key messages

- The IRA continues to participate and serve as a representative of the IRC in key NCP activities. (i.e. NWT Regional Contaminants Committee teleconferences and in person meetings, mid-year reviews, and other events such as this year's risk management workshop.
- The IRA served as liaison, contact, and assistant to research projects taking place in Inuvialuit Settlement Region.
- The NWT RCC has changed the Committee's Terms of Reference to remove the election and appointment process for the Chair and Vice-Chair. This process only allowed two Indigenous members to represent all Indigenous members of the Committee, including Dene Nation, who has a seat on the Committee. The new governance structure includes the Dene Nation, Metis Nation, and the Inuvialuit regions Co-chairing and equally representing their regions on the NWT RCC and the NCP Management Committee.
- The IRC will hold a regional Inuit NCP workshop, as well as develop a regional review process for proposals received by the IRC Research Committee

Nunavik Inuit Research Advisor: building health and environment research capacity in the Nunavik region

Project leaders

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Project team

Nunavik Nutrition and Health Committee (NNHC); Makivik Corporation; Inuit Tapiriit Kanatami (ITK); ArcticNet

Project location

Nunavik, QC

Abstract

The Nunavik Inuit Research Advisor (IRA) is essential in continuing to coordinate and enhance community involvement with Arctic science in Nunavik. The Renewable Resources, Environment, Lands and Parks Department of the Kativik Regional Government (KRG) houses the IRA position. The IRA works in close collaboration with the Nunavik Nutrition and Health Committee (NNHC), the Nunavik Board of Health and Social Services (NRBHSS), the Kativik School Board (KSB), and the Makivik Research Center. Facilitating research, at the project level, by assisting researchers from the Northern Contaminants Program (NCP) and ArcticNet, and by updating communities in advance of upcoming research. The Nunavik IRA, like the other IRAs in Inuit regions of Canada, strive to share knowledge and engage Inuit in Arctic science and research. NCP and ArcticNet co-funds the Nunavik IRA position.

Key messages

The Nunavik Inuit Research Advisor (IRA) is essential in linking the Nunavik residents and the Arctic Nunavik scientific research members. Enhancing and benefiting both parties through this coordinated approach ensuring the perspectives and needs of Nunavummiut are prioritized and respected.

Wildlife Contaminants Workshop – building contaminants research capacity in Nunavut

Project leaders

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Project team

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Project location

Iqaluit, NU

Abstract

We held the Wildlife Contaminants Workshop (WCW) for students of Nunavut Arctic College's Environmental Technology Program (ETP) in Iqaluit, Nunavut in the fall of 2018. The WCW is an experiential training model that employs a variety of tailored hands-on, interactive methods to build awareness, competency, knowledge, and skills within this core group of frontline environmental practitioners. The WCW teaches fundamental aspects of environmental contaminants research, communication, and assessment within the broader context of ecosystem, public, and wildlife health, and in relation to Inuit knowledge, practices and values. In 2018, the WCW again combined lectures, interactive lab activities, and group discussions around wildlife contaminants monitoring, risk communication and human health. The main focus of the 2018 workshop was on one contaminant that has a long history of monitoring in Canada (mercury) and one emerging contaminant (plastic pollution). The long-term goal of the WCW is to build capacity among this group of Nunavut's future environmental managers and decision makers. The workshops enable attendees to effectively interpret and evaluate contaminants information and to convey that information to community members.

Key messages

- The Wildlife Contaminants Workshop is a collaborative program that aims to teach future workers in Nunavut about environmental contaminants and develop skills to communicate those ideas.
- The foci of the 2018 workshop were on one contaminant that has a long history of monitoring in Canada (mercury) and one emerging contaminant (plastic pollution).

Learning about ringed seal health from contaminants science and Inuit knowledge: an educational workshop in Arviat, Nunavut

Project leaders

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Project locations

- Arviat, NU (2018-2019)
- Sachs Harbour, NT (2017-2018)
- Resolute Bay, NU (2016-2017)

Abstract

This project addressed a shared interest among Nunavummiut and scientific researchers in enhancing communications and community capacity building related to contaminants research on ringed seals. On October 23-24, 2018, we delivered an educational workshop on ringed seals in Arviat, Nunavut, where annual core monitoring of ringed seals takes place under the Northern Contaminants Program (NCP). This workshop was held at the Levi Angmak Elementary School and the Qitiqliq Middle School. The objective was to engage students, Elders, scientific researchers, school personnel, and the local Hunters and Trappers Committee in learning about ringed seals from both Inuit knowledge and scientific perspectives. The workshop allowed NCP research scientists working on contaminants in ringed seals to share information about their work with Arviammiut and students from the Levi Angmak Elementary School and the Qitiqliq Middle School. It also provided an opportunity for Inuit Elders to share their knowledge with students and researchers in seal ecology and traditional methods for butchering seals, preparing seal skin, and identifying abnormalities in harvested game. This two-day event employed a combination of short interactive presentations, laboratory activities, group discussions, storytelling, games, and a ringed seal booklet activity. These activities taught participants core concepts, issues, and methodology related to the study and understanding of ringed seal health from both scientific and Inuit perspectives. One student from the Arctic College Environmental Technology Program (ETP) in Iqaluit, and one

graduate student from the University of Manitoba, co-led the Arviat workshop as a way to increase the capacity of northern students and early career scientific researchers to engage meaningfully with northern communities in contaminants research. We evaluated this workshop through a written survey and informal discussions with participants. In doing so, we identified some best practices for communicating contaminants research with Inuit youth. This project will contribute to expanding collaboration and communication between northern residents and researchers working on contaminants in Arviat and Inuit Nunangat, and supporting the development of innovative methods of community engagement around contaminants monitoring in wildlife.

Key messages

- An educational workshop on ringed seals involving students, Inuit Elders, scientific researchers, school personnel, the local Hunters and Trappers Organization was held at the Levi Angmak Elementary School and the Qitiqliq Middle School, Arviat, Nunavut, in October 2018.
- Scientific researchers and Inuit Elders worked together with students, school personnel, and community members to share their knowledge about contaminants in ringed seals and learn from Inuit knowledge about seal ecology and traditional methods for butchering seals, preparing seal skin and identifying abnormalities in harvested game.
- Local students actively engaged with several types of interactive classroom activities (presentations, ringed seal dissection, seal skin preparation, laboratory activities, group discussions, storytelling and games), and school personnel welcomed researcher engagement in the classroom.
- Best practices for sharing information about contaminants research with northern schools through workshops include: (a) planning workshop in collaboration with community partners; (b) having a flexible approach to workshop programming; (c) developing teaching tools that can be easily adapted to various age groups; (d) preparing educational material that can be left with teachers once workshop is over; (e) taking the time to introduce concepts that are new to students (e.g., contaminants, bioaccumulation, biomagnification); and (f) implementing a mix of hands-on activities and short presentations.
- Participation of one student from the Arctic College Environmental Technology Program in Iqaluit and one graduate student from the University of Manitoba contributed to increasing the capacity of northern students and early career scientific researchers to engage meaningfully with northern communities in contaminants research in Inuit Nunangat.
- We developed an illustrated ringed seal booklet that can be shared with northern students to enhance their knowledge of ringed seal ecology and raise their awareness about northern contaminants.

Regional NCP Workshop in Arviat

Project leaders

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Project team

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Project location

Arviat, NU

Abstract

The goals of the NCPs Communications, Capacity, and Outreach subprogram is to support and facilitate activities and initiatives that:

a. raise awareness of contaminants in the North from long-range sources and the work that is under way to address the issue;

b. help to support food choice decisions among consumers of traditional/country foods; and

c. build capacity in the North to participate in and/or contribute to addressing these issues.

With these goals in mind, the Arviat Regional Workshop was designed to integrate experiences from past workshops, open houses and events that incorporate a variety of concepts. This includes many themes under the NCP, including contaminants, wildlife ecology, physical processes in the Arctic, and climate change to be delivered to a range of community members in Arviat. An open house and evening gathering were held in Arviat in October 2018, that featured hands-on activities and presentations on three important wildlife species in the community: polar bears, seals, and caribou and featured NCP scientists from each project. About 75 community members (mostly students) came through the open house while about 150 participated in the evening gathering. An Inuit Qaujimajatuqangit (IQ) workshop was given to the visiting researchers by the Aqqiumavvik Society of Arviat, providing insight into new ways of developing research protocols in Northern communities that will increasingly align with Inuit values and IQ principles and ensure that Northern research is carried out in a collaborative, respectful, and effective manner.

Key messages

- Presenting results of NCP projects in a coordinated fashion in the form of a workshop is an effective way of communicating results to communities in a larger scientific and social context.
- Community engagement is essential to the successful implementation of contaminants research projects in the North.
- Developing awareness of IQ is crucial to ensuring that research protocols are increasingly aligned with Inuit values.

Program Coordination and Indigenous Partnerships

Council of Yukon First Nations participation in the Northern Contaminants Program

Project leader

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Project team

Members of the Yukon Contaminants Committee include the following: Mary Vanderkop, Ainslie Ogden, and Dr. Brendan Hanley, Yukon Government; Mary Gamberg, private consultant and researcher; Ellen Sedlack, Government of Canada; and 1 or 2 yet to be identified representatives of a Yukon First Nations.

Project location

Whitehorse, YK

Abstract

The Council of Yukon First Nations (CYFN) continues to be an active member of the Northern Contaminants Program (NCP) Management Committee through responding to requests for information, participating in regional Yukon Contaminants Committee meetings and activities, informing Yukon First Nations and Renewable Resources Councils about the annual call for proposals, maintaining the Yukon NCP website, and working with NCP researchers currently active in the Yukon Territory.

The CYFN participated in the fall meeting of the NCP Management Committee, along with the regionally hosted Yukon Contaminants Committee meetings. At the CYFN General Assembly in Mayo, Yukon, there was a booth set up displaying the NCP pop-up along with background materials. The CYFN assisted in the review of all proposals wanting to undertake research in Yukon, and participated in the ongoing strategic planning of the Yukon Contaminants Committee.

Key messages

- Our Traditional Country Foods are safe to eat.
- Levels of contaminants are generally low in the Yukon Territory.
- We need to continue monitoring as new contaminants are being released into the atmosphere and water which may cause challenges in the future.
- The effects of climate change on contaminant mobility and loading needs to be tracked.
- The work of the NCP continues to be relevant at the local, regional, national, and international level.
- Yukon First Nations have a role to play in contaminant research through leading or partnering in such research and contributing Traditional Knowledge.

Dene Nation participation in the Northern Contaminants Program

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- **Project location**
  Dene National Office, Yellowknife, NT

Abstract

This project is working towards building plans to build capacity and knowledge about contaminants within Denendeh through the development of a Dene workshop, and continued participation in the NCP Management Committee and NWT Regional Contaminants Committee (NWTRCC). The Dene National Assemblies and Dene Leadership meetings will engage its members and citizens on contaminant issues. Furthermore, there will be input on the direction that research in Denendeh should take from the Environment Committee and other appropriate bodies that partner with the Dene Nation. All relevant and appropriate information is, and will be, posted on the website to provide awareness of funded activities and the results.

Key messages

- The NCP is in place to ensure the security of traditional food and water, you can determine what contaminants should be studied, where, when and by whom.
- Dene Nation plans to build capacity and knowledge about contaminants within Denendeh. This will include the preplanning meeting for a future workshop that will involve the Dene Nation Health, Elders and Environment committees as well as Denendeh youth, the Indigenous representatives of the NWTRCC and the staff of the Dene Nation National Office.

Inuit Tapiriit Kanatami national coordination

Project leader

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Project team

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Project locations

Ottawa, ON
Inuit Nunangat, Canada

Abstract

Since the beginning of the Northern Contaminants Program (NCP) in 1991, Inuit Tapiriit of Kanatami (ITK) has participated in the program as managing partners. This partnership continues to be fruitful and effective both for Canadian Inuit and to the Northern Contaminants Program (NCP). As the national political voice for Canadian Inuit, ITK continues to play multiple roles within the NCP. For example, ITK provides guidance and direction to Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) and the other NCP partner's (Health Canada, Department of Fisheries and Oceans Canada, Environment and Climate Change Canada, etc.) bringing Inuit interests to the NCP management and liaison committees of which we are active members. As a result, the NCP can better respond to the needs and concerns of Inuit. In addition, ITK is dedicated to facilitating appropriate, timely communications about contaminants in the North. ITK also works with their Inuit partners at the Inuit Circumpolar Council (ICC)-Canada on the international stage to persuade nations to reduce their generation and use of persistent organic pollutants (POPs) and Heavy Metals (Mercury, Lead etc.) that end up in the Inuit diet. Furthermore, ITK works with other research programs to ensure that research on contaminants is conducted in a coordinated approach.

Key messages

- This project wants to provide a voice for Inuit Nunangat during NCP discussions.
- The project team wants to continue to be an active and constructive member of the NCP Management Committee.
- It is important to have a communications structure in place that ensures that contaminants issues, NCP research, and NCP results are communicated to Inuit and that Inuit are represented at key regional, circumpolar, and international meetings and initiatives.

- It is important to contextualize contaminant information in a broader communication process using the Inuit Knowledge Centre and other ITK structure (i.e. National Inuit Committee on Health (NICoH)).
- Support is needed to enable Inuit to develop confidence when making informed decisions about country food use.
- Coordination of contaminants activities with other research programs is crucial.

Inuit Circumpolar Council – Canada activities in support of circumpolar and global contaminant instruments and activities 2018-2019

Project leader

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Project team

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Project location

Ottawa, ON

Abstract

This report outlines ICC Canada's activities funded by the Northern Contaminants Program (NCP) in the fiscal year 2018-2019. ICC Canada is working nationally and internationally to address the issue of contaminants in the Arctic. National activities include support to the NCP on the Management Committee, blueprint and proposal reviews. Internationally, ICC Canada continued its activities related to the United Nations Environment Programme (UNEP). Work on the Stockholm Convention on Persistent Organic Pollutants (POPs) and Minamata Convention on Mercury is ongoing, with ICC Canada attending the 14th POP Review Committee (POPRC) in October 2018, and giving a platform presentation during a side event at the second Conference of the Parties of the Minamata Convention. ICC Canada continued to support Arctic Council activities and attended several meetings of the Arctic Monitoring and Assessment Programme (AMAP). ICC Canada was very active on the Sustaining the Arctic Observing Networks (SAON) Board, the SAON Executive Committee, and continued working on the organizing committee of the Arctic Observing Summit (AOS).

Key messages

- ICC Canada actively supported NCP by working on the Management Committee, Environmental Monitoring, Human Health, and Community Based Monitoring technical review committees.
- ICC Canada attended the 14th POP Review Committee (POPRC) meeting, provided input in POPRC working group documents, and informed the NCP and AMAP about POPRC work.
- ICC Canada attended the second Conference of the Parties (COP-2) of the Minamata Convention and gave a platform presentation during a side event on monitoring activities on how Inuit are impacted by mercury in the Arctic, as well as outlined monitoring activities in the Arctic under NCP and AMAP.
- ICC Canada actively contributed to the Arctic Council related work, attended the Arctic Monitoring and Assessment Programme (AMAP) Working Group and Heads of Delegation meetings, SAON meetings, teleconferences of the SAON Executive Committee and teleconferences of the Arctic Observing Organizing (AOS) Committee.
- ICC Canada was very active in the AMAP Human Health Assessment Group (HHAG) and the Mercury Expert group, and is leading a chapter on risk communication for the upcoming AMAP Assessment on Human Health in the Arctic, as well as co-leading a chapter on Indigenous perspectives for the upcoming AMAP Mercury Assessment.