Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada

Synopsis of Research

Conducted under the 2016–2017 Northern Contaminants Program:

Abstracts and Key Messages

Canada

Synopsis of Research Conducted under the 2016-2017 Northern Contaminants Program: Abstracts and Key Messages

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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 2016-2017 Northern Contaminants Program: Abstracts and Key Messages* provides a summary of the activities and preliminary results of each project funded under the NCP between April 1, 2016 and March 31, 2017.

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 2016-2017), 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; and the benefits/risk evaluation of country food consumption. Projects were carried out using a variety of methodologies including fieldwork, laboratory analysis, community based monitoring, Indigenous Knowledge workshops, and much more.

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 contributes to 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 2016-2017 Northern Contaminants Program: Full Report*, which is available through the NCP Publications Database at www.aina.ucalgary.ca/ncp. All individual project reports have been 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.

25 YEARS ANS

Northern Contaminants Program

Programme de lutte contre les contaminants dans le Nord

Introduction

The Northern Contaminants Program (NCP) engages Northerners and scientists in researching and monitoring of long-range contaminants in the Canadian Arctic, that is, contaminants that are transported to the 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 four federal departments (Environment and Climate Change Canada, Fisheries and Oceans, Health 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), five regional contaminants committees, and Canada's only 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 $4.1 million annual 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

In 2016-2017, the NCP celebrated its 25th anniversary of funding contaminants research and communications activities in northern Canada. 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 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 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 assessments 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 next reports in the CACAR series, *Contaminants in Canada's North: State of Knowledge and Regional Highlights*, and *Human Health 2017* will be released in 2018.

International Impact

The NCP effort to achieve international controls of contaminants has remained strong throughout the program's history. The NCP continues to generate data that allows Canada to play a leading role, particularly through cooperative actions under the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP), in the following initiatives:

1. The legally binding POPs protocol, under the United Nations Economic Commission for Europe (UN ECE) Convention on Long-range Transboundary Air Pollution, was successfully negotiated and signed by 34 countries (including Canada) at the UN ECE Ministerial conference in Arhus, Denmark in June 1998. Canada ratified this agreement in December 1998.

2. A legally binding global instrument on POPs under the United Nations Environment Programme (UNEP) was completed with the signing of the POPs Convention in Stockholm, Sweden, May 23, 2001; the UNEP Stockholm Convention on POPs entered into force in May 2004.

3. The Minamata Convention on Mercury, a legally-binding agreement to cut emissions and releases of mercury to the environment, entered into force on August 16, 2017. The convention was signed by Canada in October 2013 and on April 7, 2017, Canada became the 41st country to ratify the treaty. The NCP made important contributions to this historic signing and ratification, through use of its data, information and expertise, and will continue to play a role in monitoring the effectiveness of the Convention. The first meeting of the Conference of the Parties to the Minamata Convention on Mercury (COP1) from September 24 to 29, 2017, discussed procedures and directions for the implementation of the Convention.

10 Key Findings of the Northern Contaminants Program

(from *Contaminants in Canada's North: Summary for Policy Makers, 2015*)

1. Concentrations of 'legacy POPs' are generally going down across the Arctic.

2. As 'new POPs' come under regulation, their levels in the Arctic decline.

3. Mercury levels in the Arctic are stabilizing but are still several times higher than during pre-industrial times.

4. Climate change can affect how POPs and mercury cycle in the Arctic environment and accumulate in wildlife.

5. The complex movement of contaminants in the Arctic environment and wildlife is now better understood.

6. Current levels of POPs and mercury may be a risk for the health of some Arctic wildlife species.

7. While exposure to most POPs and mercury is generally decreasing among Northerners, mercury remains a concern in some regions.

8. Traditional/country foods continue to be important for maintaining a healthy diet for Northerners.

9. Environmental exposure to contaminants in the Arctic has been linked to health effects in people.

10. Continued international action is vital to reducing contaminant levels in the Arctic.

Current Directions of the Northern Contaminants Program:

(adapted from *Contaminants in Canada's North: Summary for Policy Makers*, 2015)

In terms of *Environmental Monitoring and Research, the NCP*

- is continuing to play a critical role in the detection of new chemical contaminants of concern to the Arctic and will continuously review and refine its list of contaminants of concern.
- is enhancing the measurement of long-term trends of mercury and POPs by filling gaps in geographic coverage.
- is carrying out more research to understand the effects of climate change and predict their impacts on contaminant dynamics and ecosystem and human health risks.
- is supporting the expansion of community-based monitoring projects that build scientific capacity in the North and optimize the use of traditional knowledge.

In terms of *Human Health Research, Monitoring and Risk Assessment*, the NCP

- is addressing ongoing public health concerns related to contaminants and food safety, in partnership with territorial/regional health authorities by:
  - weighing the risks associated with exposure to POPs and mercury against the wide ranging benefits of consuming traditional/country foods; and
  - expanding monitoring of contaminant exposure among human populations across the North, and research on potential health effects in collaboration with Northern communities, to provide current information to public health officials.

In terms of *Communications and Outreach*, the NCP

- is communicating research results and information about contaminants and risk to Northerners in the context of broader environmental (e.g. climate change) and health messages. Timely and culturally sensitive messages are being developed and communicated in association with regional health authorities and other appropriate spokespeople; these communication initiatives will be evaluated for their effectiveness.
- is ensuring that NCP data and information is effectively communicated to key international networks, such as AMAP, and the Global Monitoring Plans under the Stockholm and Minamata Conventions for the purpose of evaluating the effectiveness of global regulations.

Human Health

Development of blood guidance values for persistent organic pollutants for the Canadian Arctic

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Abstract

The Inuit Health Survey (2007-2008) collected data on blood levels of heavy metals and persistent organic pollutants (POPs) in adult participants from the Canadian north. The population-level risks of contaminant exposures can be assessed using biomonitoring equivalents (BEs), which are the corresponding internal concentrations of oral health-based reference values or concentrations of the points of departure (PODs) used to derive oral health-based reference values. The purpose of this project is to develop new BEs for chlordane and toxaphene and to use these values to assess the biomonitoring data collected in the Canadian north with respect to population-level risks. During the 2014-2015 fiscal year information needed to derive BEs, such as intake reference standards, was collected from the published and grey literature. Several reference values were available from organizations such as Health Canada, the United States Environmental Protection Agency (U.S. EPA), and European authorities. Also developed was a pharmacokinetic modeling strategy and identification of pharmacokinetic parameters needed to model internal contaminant behaviour based on absorption, distribution, metabolism, and excretion. During the second year of the project 2015-2016, the collected data was used to carry out one-compartment pharmacokinetic modeling to derive BEs for individual chlordane and toxaphene isomers. The BEs were compared with biomonitoring data from the Inuit Health Survey and the Canadian Health Measures Survey (CHMS) Cycle 1 (2007-2009). The approach was finalized at a team working meeting held at Health Canada in November 2015. Results were presented at the Northern Contaminants Workshop in December 2015 and at the Northern Contaminants Program: Human Health Monitoring and Risk Communication Workshop in November 2016. In the third and final year of the project, we have further refined the BEs based on population-specific body fat percentage data for the general Canadian and Inuit populations; we compared the population-specific BE values with biomonitoring data from the CHMS and HIS; we conducted a dietary analysis of important sources of those contaminants; and we developed preliminary, physiological-based pharmacokinetic (PPBPK) models that more realistically simulate chlordane pharmacokinetics.

Key Messages

- Population-specific BEs were developed for the general Canadian and Inuit populations for chlordane (cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane) and toxaphene (Parlars No. 26, 50, 62) using a one-compartment pharmacokinetic model. The population-specific BEs were close to the generic BEs based on 70 kg weight and 25% body fat.
- The population-specific BE values for chlordane and toxaphene have been compared with biomonitoring data from the CHMS, Cycle 1 (2007-2009) and the IHS (2007-2008).
- The comparisons included whole population, population subgroups, and regional analyses for the Inuvialuit Settlement Region (ISR), Nunavut, and Nunatsiavut.
- Among the general Canadian population, no exceedances of BE values were observed for either chlordane or toxaphene.
- Results for the Inuit population will be presented to our Inuit partners before release.

Do country food nutrients protect against mercury toxicity and cardiometabolic diseases? Integrating data from cutting-edge science and mobilizing knowledge towards Nunavimmiut health (year 3)

Project Leader

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Abstract

Despite a decreasing temporal trend over the last decades, methylmercury (MeHg) exposure in the Inuit population of Nunavik is still among the highest in the world. Country foods from the marine food chain are the major source of this exposure, but country food are also exceptionally rich in nutrients such as selenium (Se) and omega-3 polyunsaturated fatty acids (n-3 PUFA). Through an interdisciplinary program incorporating nutrition, epidemiology, toxicology, oceanography and implementation research, we are addressing the complex issue of benefits and risks of country foods in the Inuit population of Nunavik, especially with regard to cardiometabolic diseases and Se-Hg interactions and respective toxicity. This year, in addition to continuing the integration of data obtained during our 2012-2016 program, we have conducted key work centred mainly on better defining the origin in the Arctic marine food chain of selenoneine, a new selenocompound recently identified in Inuit blood and beluga mattaaq by our team, and the interaction between this compound and methylmercury in red blood cells. These results will improve our capacity to develop and implement interventions that aim to promote the benefits of country foods of marine origin, while minimizing MeHg toxicity in this population.

Key Messages

- Selenoneine levels in red blood cells of Nunavimmiut are related to their beluga mattaaq consumption;
- Selenoneine levels are significantly higher in women compared to men;
- Additional country food analyses did not reveal important selenoneine sources other than beluga mattaaq;
- Preliminary in vitro experiments were conducted to study the methylmercury-selenoneine interaction.

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 1 of 3)

Project Leaders

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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 three-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 show that up to 23% of participants had blood Hg levels above the Health Canada guideline (≥ 8 $\mu g \bullet L^{-1}$), and among these, three participants presented very high blood Hg (≥ 20 $\mu g \bullet L^{-1}$). Sequential hair Hg analyses show important monthly variations in Hg exposure, from 0.1 to 23.1 $\mu g \bullet g^{-1}$. Temporal profiles seem to be more comparable among participants from specific communities, possibly where local country food access and consumption is more similar. A few participants had blood lead (Pb) above the most recent level of concern (≥ 5 $\mu g \bullet dL^{-1}$). Up to 60% of participants presented iron deficiency and 39% had anemia, among which almost all were classified with iron deficiency anemia. All study results will be available and presented to Nunavimmiut and health professionals in winter/spring 2018.

Key Messages

- Up to 23% of participants had blood Hg levels above the Health Canada guideline.
- Sequential hair Hg analyses show important monthly variations in exposure.
- A few participants still had blood Pb concentrations above the most recent level of concern.
- 60% of participants presented iron deficiency and 39% presented anemia.

Quantifying the effect of transient and permanent dietary transitions in the North on human exposure to persistent organic pollutants and mercury

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Abstract

The "Arctic dilemma" describes the difficulty of weighing the benefits of country foods with concerns about contaminants. Indigenous Arctic populations gain tremendous nutritional and cultural benefits from eating traditional foods derived from marine mammals, while, at the same time, these food items are a significant source of exposure to persistent organic pollutants (POPs) and methylmercury (MeHg). We have developed numerical modeling tools that relate contamination of food (including traditional country food and food imported from the South) to contaminant concentrations in humans. With the help of these models it is possible to assess the impact of dietary adjustments on contaminant exposure and nutrient intake. In this project year, we developed a numerical modeling tool for MeHg, which is very easy to use, and applied this tool for POPs to explore the effect of substituting one traditional food item with other items. We further explored how traditional preparation techniques for beluga whale blubber impact its nutritional value and contaminant load. Because of their limited effect on contaminant burden, preparation methods cannot serve as a means to mitigate contaminant exposures. Instead, it may be advisable to have vulnerable subpopulation eat foods from younger, male animals.

Key messages

- We have developed a 'user-friendly' modeling tool for assessing human exposure to methylmercury via the diet. We plan to engage in an external review of the tool during the 2017-18 project year followed by wider efforts to disseminate the model to interested parties and other stakeholders.
- Temporary substitution of traditional food items derived from marine mammals can have beneficial impacts on exposure to methylmercury in the short-term, but need to be balanced against the potential changes to intake of key nutrients. Establishing baseline exposure to contaminants and nutrient intake is key when attempting to devise beneficial dietary substitution advisories.
- Traditional preparation techniques for beluga whale blubber were found to have only a limited effect on contaminant burden. It appears that preparation methods cannot serve as a means to mitigate contaminant exposures and it may therefore be advisable to recommend that vulnerable subpopulations consume younger, male animals when possible.

Genetic polymorphisms to improve interpretation of contaminant exposure and risk in Inuit

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Abstract

The goal of this three-year project is to better understand how Inuit biologically process contaminants. The ultimate goal is to arm public health decision makers with knowledge to help identify the most susceptible subpopulations and make informed and objective risk assessments. The central hypothesis was that analysis of single nucleotide polymorphisms (SNPs) in environmentally-responsive genes that help the body 'process' toxicants will increase understanding and utility of exposure biomarkers of mercury, PCBs, and other persistent organic pollutants. Over the past three funding years we have collected samples from some members of the Inuvialuit community (N=288 participants) who participated in the 2007-2008 International Polar Year Inuit Health Survey as well as participants from Nunavik (N=669 participants) as part of the 2004 Qanuippitaa Survey. In most participants blood contaminants (Hg, Cd, Pb, Se, DDE, PCB-153) and fatty acids (DHA, EPA) levels were related to genetic polymorphisms (~150 SNPs), while considering pertinent covariates. Several polymorphisms emerged to be influential thus indicating that environmentally responsive genes can influence contaminant and nutrient biomarker levels. Reports are currently being finalized and shared with community members prior to broader dissemination.

Key Messages

- ~150 genetic polymorphisms were characterized in Inuit who participated in the 2007-2008 International Polar Year Inuit Health Survey and the 2004 Qanuippitaa Survey
- These polymorphisms hail from biological pathways associated with, for example, the transport and metabolism of contaminants and cardiovascular health.
- Composition of many of the genetic polymorphisms was different when compared against other populations such as Caucasians and Asians.
- Some genes are associated with changes in blood levels of mercury, cadmium, lead, DDE, PCB153, and fatty acids DHA and EPA.
- This type of information needs to be considered in risk assessments and decision making.

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

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Abstract

Throughout the second year of the study, we implemented biomonitoring research in five communities in the Northwest Territories and visited a total of nine communities. Our team consulted with three Sahtú communities (Norman Wells, Tulita, Fort Good Hope) and four Dehcho communities (Hay River First Nation, West Point First Nation, Kakisa, Fort Providence) regarding the expansion of the project and their potential participation in 2016-2018. Building upon prior consultations in 2015-2017, our research team traveled to the participating communities (Hay River Reserve, West Point, Fort Providence, Kakisa and Deline, NT) for data and sample collection. Additionally, our research team traveled to the first participating community of last year (Jean Marie River First Nation, NT) to return results to the leadership and participants, during a public meeting and during one-to-one sessions. With the assistance of local research coordinators and nurses, we collected blood, urine, and/or hair samples from 314 participants. Participants also completed a risk perception questionnaire and two dietary surveys (24-hr Recall, Food Frequency Questionnaire). Data analysis of the Year 2 results (metals in blood/urine; persistent organic pollutants (POPs) in blood; mercury in hair; dietary surveys) is currently underway. In collaboration with regional, territorial, and federal partners, results will be returned to Year 2 participating communities in Fall 2017.

Key Messages

- Additional consultations with leaders and community members were held in Deline, Norman Wells, Tulita, Hay River, West Point, Kakisa, and Fort Good Hope to discuss their potential participation in the biomonitoring project in 2016-2018.
- Year 1 results were returned to participating individuals and communities in fall 2016.
- Between November 2016 and February 2017 (Year 2), 314 participants from K'atl'odeechee First Nation, West Point First Nation, Fort Providence, Kakisa and Deline, NT provided hair, blood, and/or urine samples for contaminants and nutrients analyses.
- Year 2 samples are currently being analyzed for mercury (hair), metals and metalloids (blood, urine), and POPs (blood).
- Year 2 results will be returned to participating individuals and communities in fall 2017.

Community Based Monitoring and Research

Variable fish mercury concentrations in the Dehcho: Effects of catchment control and invertebrate community composition

Project Leaders

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Abstract

Fish, benthic invertebrate, zooplankton, sediment, and water samples were collected from Sanguez Lake and Willow Lake in the Dehcho region, NT in August 2016. Water and sediment samples were also opportunistically collected at Big Island and/or Ekali lakes. Laboratory analyses are ongoing, and sample collections will continue at Big Island and Ekali lakes in 2017. Preliminary analyses reveal that fish mercury concentrations are higher in Sanguez Lake than in Willow Lake. Catchment characteristics differ substantially between the two geographic regions of interest in this study (Mackenzie lowlands and Horn Plateau). Higher methylmercury in sediment than water in the Horn Plateau lakes suggests in-lake control on mercury availability to biota, while the opposite in the lowland lakes suggests a strong catchment source of methylmercury. Current and future results in this combined catchment and food web study will be used to better understand spatial differences in fish mercury concentrations in the region, and to generate better predictions of fish mercury concentrations resulting from anthropogenic stressors, such as climate change and resource development.

Key messages

- In lake sediments, the Horn Plateau Lake (Willow) had lower total mercury, but higher methylmercury than the Lowland lakes (Ekali and Sanguez).
- In contrast, mercury concentrations in water were lower in the Horn Plateau lakes (Big Island and Willow) than the two lowland lakes (Sanguez and Ekali), both for total mercury and methylmercury (dissolved and unfiltered).
- Northern Pike and Lake Whitefish had higher concentrations of total mercury in Sanguez Lake compared to Willow Lake.
- Catchment characteristics differ between the Mackenzie lowlands lakes (Sanguez and Ekali) and the Horne Plateau lakes (Big Island and Willow).

Community-based monitoring of Arctic Char in Nunatsiavut: Increasing capacity, building knowledge

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Abstract

Ringed seals and sea-run arctic char continue to make up a large portion of the diet of Labrador Inuit due to the drastic reduction of the George River Caribou herd and subsequent ban on hunting of the herd imposed by the Newfoundland and Labrador Government in 2013. Given the importance of arctic char to both the diet of ringed seals and Labrador Inuit, monitoring of these fish in Nunatsiavut is essential. This community-based monitoring project continues to expand on previous NCP work on contaminant trends in sea-run char conducted by Environment and Climate Change Canada, including a capacity building component and an additional sampling location that has now been sampled for two years. Twenty fish were captured at two locations, Nain and Saglek Fjord, just before they returned inland from feeding in the ocean. The char were caught and processed by local community members, with support from staff at the Nain Research Centre, Parks Canada and Nunatsiavut Conservation Officers. The data from this project are being used for a variety of purposes including providing the necessary information for dietary advice, understanding contaminant loads, and investigating how contaminant loads are changing as a result of regional changes being experienced due to climate change and increased industrial development.

Key Messages

- This project is a regionally led community-based monitoring program sampling arctic char, while building capacity and addressing contaminant concerns of Labrador Inuit, and providing valuable data to the NCP.
- This project is result of collaboration of harvesters, community members, youth, Conservation Officers, Parks Canada, Environment and Climate Change Canada and staff of the Nain Research Centre.
- Continued progress towards addressing the recommendations of the ArcticNet IRIS report that community-based monitoring of arctic char should exist to ensure the population is monitored and healthy for consumption.

Tłı̨cho̜ Aquatic Ecosystem Monitoring Program (TAEMP)

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Abstract

The Tłı̨cho̜ 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. TAEMP, a successful community-driven program, meaningfully involves community members in conducting contaminants-related research, including the science-based collection of samples, and observations using both Tłı̨cho̜ and scientific knowledge to address the question: «Are the fish safe to eat and the water safe to drink?»

In September 2016, a five-day on-the-land monitoring camp returned to Snare Lake, near the community of Wekweètì, with the camp situated further west than where the 2012 TAEMP camp was located. The 2016 participants returned to locations on Snare Lake where sediment and water sampling occurred in 2012 to allow for comparative sampling, as well as to three new locations as requested by community members. 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. Gravesites were visited by camp participants, though unfortunately youth had to depart camp a day earlier than expected, preventing participation in all planned cultural activities. A results workshop open to the public was held in Wekweètì in March 2017 to present the results to camp participants and to interested community members. Elders and support staff also visited Alexis Arrowmaker School to talk with students.

Fish tissue analysis indicated mercury levels were low in both Lake Trout (łiwezǫǫ̀) and Lake Whitefish (łih), with Lake Trout samples having the highest concentrations overall. None of the species' tissue samples showed levels of mercury that were considered abnormal for northern lakes. Comparison of 2016 results to 2012 results showed no appreciable change in mercury concentration. Water and sediment results supported the expectation that water and sediment quality is "good" (i.e. not abnormal) in Snare Lake.

Key Messages

- The fish tissue analyses showed that mercury levels were low in both Lake Trout and Lake Whitefish, fish species typically consumed by residents of Wekweètì. 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 Snare Lake. No water or sediment contaminant levels were considered to be abnormal.
- Wekweètì community members were pleased with the implementation of the program, citing the importance of continued monitoring near their community.
- Community members were pleased that results of sampling were presented in Wekweètì, and that analyses indicated that fish, water, and sediment quality were good (i.e. not abnormal).
- Non-statistical comparison of the 2012 to 2016 results suggests that there are no major changes in the quality of fish, water, or sediment. A return to Wekweètì in 2020 will allow for further tracking of potential changes.

Enhancing community-based monitoring of ecosystem changes in the ISR through the bridging of western scientific knowledge with local and traditional ecological knowledge

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Abstract

The Inuvialuit are leaders in beluga whale monitoring and research. This study was developed to ensure that local and traditional ecological knowledge (LEK and TEK) about beluga whales would be recorded to enhance existing programs in the Inuvialuit Settlement Region (ISR) in the Northwest Territories. The beluga monitoring programs in Darnley Bay and Kugmallit Bay provided ideal platforms for ensuring that the knowledge held by the Inuvialuit is recorded alongside or in addition to scientific measurements and samples. A comprehensive beluga-monitoring program in the ISR will provide key data on changes in the ecosystem through the use of biological, LEK, and TEK indicators.

The outcomes from this project were linked to the long-term beluga monitoring program. A suite of indicators for beluga health and habitat use were developed and are being piloted in the ISR beluga monitoring program. The indicators include observations made by the beluga harvest monitor about whale condition and observations made by harvesters while hunting and travelling. Beluga habitat use mapping indicated that opportunistic reporting of beluga observations inadequately reflected beluga

presence/absence; therefore, beluga and fish monitors and field research camps could report marine observations during field-based activities to strengthen monitoring of the marine environment.

Community perspectives and knowledge on the characteristics of healthy belugas, general areas of beluga habitat use, and annual beluga sightings were synthesized and presented to the communities and renewable resource boards through oral presentations and the distribution of a brochure in March 2017. A community report is being prepared for distribution in Fall 2017. These materials were developed with the support from the Inuvialuit Game Council, Fisheries Joint Management Committee and Fisheries and Oceans Canada and in consultation with key knowledge holders in the three participating communities.

Key Messages

- A suite of indicators for beluga health and habitat use were developed in the Inuvialuit Settlement Region and piloted in the regional beluga monitoring program.
- Local indicators of beluga health include observations about the condition of harvested beluga such as blubber thickness, protrusion of backbone, discolouration of internal organs/muktuk/skin, texture of muscle and blubber/uqsuq, and smell of the abdominal cavity.
- Beluga habitat use mapping indicated that opportunistic reporting of beluga observations inadequately reflected beluga presence/absence; therefore, beluga harvest and fish monitors, and science field teams are encouraged to report marine observations made during monitoring activities.
- A mobile app was successfully developed using Survey123 for ArcGIS to record beluga sightings and marine observations in the ISR.
- Local observations and Traditional Ecological Knowledge about beluga whales were synthesized and distributed in Spring 2017 through public meetings in Inuvik, Paulatuk, and Tuktoyaktuk, and presentations to the Hunters and Trappers Committees as well as the Inuvialuit Game Council.

An East Hudson Bay Network research initiative on regional metal accumulation in the marine food web

Project Leaders

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Abstract

Communities in East Hudson Bay are concerned about ecosystem changes observed in recent decades, particularly related to sea-ice and oceanographic conditions, and also about potential impacts of contaminants from long-range atmospheric transport and regional human activities. The Arctic Eider Society's Community-Driven Research Network (CDRN) has been established to measure and better understand large-scale cumulative environmental impacts in East Hudson Bay and James Bay. Building on CDRN collaborations and activities in five communities (Sanikiluaq, Kuujjuaraapik, Inukjuak, Umiujaq, Chisasibi), this NCP project is generating new information on contaminants (specifically metals) that provide a regionally-integrated perspective on metal exposure in the East Hudson Bay and James Bay marine environment. The five communities are sampling coastal bioindicator species (blue mussel, common eider) annually for three years. Offshore bioindicators (ringed seal, herring gull, plankton, fish) are additionally being collected from Kuujjuaraapik and Sanikiluaq. These locally-important bioindicators of metal accumulation will be used to characterize geographic and habitat-specific variation (coastal and offshore zones) in the marine environment. Community-driven execution of biological collections as well as parallel ecosystem measurements on sea ice and water will allow for more integrated research in the context of environmental change.

Key messages

- In the second year of this project (2016), blue mussels, common eiders, Arctic cod, marine sculpin, and plankton were collected by community team members in East Hudson Bay.
- Tissues were analyzed for levels of mercury and other metals (such as lead and cadmium).
- Information on the project and animal collections has been posted on a web-based platform called Interactive Knowledge Mapping Platform (IK-MAP; https://arcticeider.com/map#).

Mercury in seaweed and lichens from the home range of the Qamanirjuaq caribou

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Abstract

This is a project that was suggested and recommended by the Northern Contaminants Program Management Committee in 2015. Qamanirjuaq caribou have higher mercury concentrations than many other Arctic caribou herds. Usually caribou get most of their mercury from lichens, but local elders described the Qamanirjuaq caribou eating seaweed from the seashore. Since seaweed is known to accumulate some metals, the caribou may be getting additional mercury from this source. This project was designed to explore traditional knowledge held by hunters/elders from the Kivalliq region regarding caribou consuming seaweed, and then to use that knowledge in designing collection protocols for seaweed in the five communities in the region. Lichens and mushrooms were also collected, to determine how much mercury is coming from those dietary sources. Elder interviews and sample collections were carried out by two former students of the Environmental Technology Program at Nunavut Arctic College, Iqaluit. Project results will be presented to each community in the fall of 2017.

Key Messages

- Qamanirjuaq caribou could be getting high levels of mercury from eating seaweed.
- Elders have observed caribou eating seaweed and are concerned about the health of the caribou.
- Results from this study will be presented to participating communities in the fall of 2017.

Environmental Monitoring and Research

Northern Contaminants Air Monitoring: Organic pollutant measurements

Project Leader

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Abstract

The atmosphere is the most rapid pathway for organic pollutants to reach the remote Arctic. This project is a continuous monitoring program which measures contaminants in Arctic air since 1992. Measuring how much organic pollutants are present in Arctic air over time will provide information on whether their air concentrations are decreasing, increasing or not changing over time; where these chemicals have come from; how much from which region; and what climate conditions influence their movement to the Arctic. Results from this continuing project are used to negotiate and evaluate the effectiveness of international control agreements and to test atmospheric models that explain contaminant movement from sources in the South to the Arctic. Starting in 2006, we have extended the program 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. Flame retardants (FRs) such as polybrominated diphenyl ethers (PBDEs) started to show declining trends in air after 2012 and non-BDE FRs are frequently detectable in air at Alert but concentrations are very low. As a follow-up study for the measured time trends of PFASs at Alert presented in last year's report, we tried to trace the sources of perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) in air at Alert. Results suggested that PFOS at Alert was influenced by air masses transported from land while PFOA was dominated by oceanic air masses. A passive flow-through sampler (FTS) specifically designed for use in cold environments has been deployed at Little Fox Lake, Yukon, since August 2011. Sampling at this site is continuous and ongoing.

Key Messages

- Air monitoring for organic pollutants continued at Alert, Nunavut, and Little Fox Lake, Yukon, and measurements are ongoing.
- Air concentrations of flame retardants (FRs) such as polybrominated diphenyl ethers (PBDEs) started to decline at Alert after 2012.
- Non-BDE FRs are frequently detectable in air at Alert but concentrations are very low and high blank levels in some years prevented the determination of time trends.
- Source region analysis suggested that PFOS at Alert was influenced by air masses transported from land while PFOA was dominated by oceanic air masses.

Mercury measurements at Alert and Little Fox Lake

Project Leader

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Abstract

Mercury (Hg) is a priority pollutant in Canada and of concern in Arctic regions. The Arctic receives Hg via long range transport from source regions, primarily from outside of Canada. Our results from atmospheric Hg concentration measurements at Alert, Nunavut show a median decreasing trend of (-0.821 ± 1.39 % per year for the past 21 years). In contrast, Hg concentrations at Little Fox Lake, Yukon show an increasing median trend (+1.47% ± 0.33% per year for 9 years). The pattern of the monthly trend has changed but the overall trend in concentration at this site remains on the increase. At Alert, Hg continues to show a distinct seasonal decrease in gaseous elemental Hg (GEM) in the spring. Concurrently, seasonal patterns in shorter-lived Hg species (reactive gaseous Hg, or RGM, and particle-bound Hg, PHg) continue to show a peak in PHg during early spring and a peak in RGM in late spring. Shorter-lived Hg show enhanced deposition of mercury to the snow at the same time. The project team worked with the Regional Contaminants Committees in both Nunavut and the Yukon to discuss project plans and ideas for this work.

Key Messages

- Atmospheric mercury concentration measurements have been collected at Alert, Nunavut since 1995 and at Little Fox Lake, Yukon since 2007.
- Gaseous elemental mercury levels at Alert have decreased annually since 1995 to present and at Little Fox Lake have increased annually from 2007 to present.
- Seasonal variability in the atmospheric mercury continues to be reported at both Alert and Little Fox Lake.
- The data collected as part of this program will be 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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Abstract

This project measures pollutants, namely persistent organic pollutants (POPs) and mercury, in the air at multiple locations across Canada's North. When POPs and mercury enter the ecosystem, they may affect the health of northerners. Currently, there are few locations in Canada's Arctic where these pollutants are being measured. Pollutants are carried through the air from more southerly regions to the Arctic, and expanding the number of locations where they are measured will provide more information about where they come from and how they are changing over time. To increase the geographical coverage and to obtain a more comprehensive picture of the levels of pollutants, passive sampling methods are used. Passive air samplers (PASs) are a low-cost, low-maintenance way to monitor air pollutants and therefore ideally suited to the Arctic environment. This method is also suitable for involving students or other interested persons in sample collection, enhancing communication between the project team and local communities as well as creating training opportunities for Northern students. The project will ramp up over a few years, eventually producing air concentrations of multiple pollutants at a network of sites across the north. Passive air samplers and sampling material were sent to seven sites across the North to start air sampling in October 2014. At the onset of the project, some issues were encountered that resulted in delayed starts but most sites are currently in full operation and we continue to work on resolving the issues to get all

sites up and running. Field tests for developing a passive mercury air sampler are progressing well. A northern student has been engaged to research on Indigenous Knowledge in the Yukon region which may be used in the air monitoring projects for POPs and mercury. Project Principal Investigators visited Iqaluit (Nunavut), Whitehorse (Yukon) and Cambridge Bay (Nunavut) to discuss with the respective Regional Contaminants Committees and community leaders about the project plans and site selections. They also conducted communication/ capacity building activities, including lectures at the Yukon College (YK), Nunavut Arctic College (Iqaluit and Cambridge Bay) and the Kiilinik High School in Cambridge Bay.

Key Messages

- Passive air sampling equipment has been sent to 7 arctic sites and most stations were in operation since October 2014.
- Project Principal Investigators visited Iqaluit (Nunavut), Whitehorse (Yukon) and Cambridge Bay (Nunavut) to discuss with the respective Regional Contaminants Committees and community leaders about the science activities and communication/outreach plans under this project. They also conducted communication/capacity building activities, including giving lectures at the Nunavut Arctic College, Yukon College and the Kiilinik High School in Cambridge Bay.
- Organochlorines (OCs) are frequently found in air samples collected in 2015. Hexachlorobutadiene (HCBD), hexachlorobenzene, (HCB), pentachloronitrobenzene (PCNB), pentachloroanisole (PCA), 2, 4-dibromoanisole (DBA), and 2, 4, 6-tribromoanisole (TBA) were found in all passive air samples collected and the concentrations are consistent with those found previously in other studies.

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

Project Leaders

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Abstract

This project addresses the following major questions: (i) how are concentrations of legacy contaminants, such as polychlorinated biphenyls (PCBs) and other persistent organic pollutants (POPs) as well as mercury, changing over time in ringed seals and (ii) are trends similar across the Canadian Arctic. The presence and trends of new contaminants are also investigated. The project currently involves annual sampling at Sachs Harbour, Resolute Bay, Arviat, and Nain. All sampling is done by local harvesters and coordinated by Hunters and Trappers Associations in each community. The 2015-16 report focused on updates for trends of polychlorinated naphthalenes (PCN), polybrominated diphenyl ethers (PBDEs) and other emerging flame retardants as well as for perfluoroalkyl substances (PFAS) in ringed seals. In this 2016-2017 report, updated trends of mercury and PCBs in ringed seal tissues are presented. The addition of a traditional knowledge component to this long-term monitoring project is also discussed.

Results of this core monitoring project indicated that concentrations of legacy PCBs continued to decline slowly. Mercury concentrations in liver and muscle varied from year to year but overall were not increasing. The annual measurements of contaminants in Arctic ringed seals have demonstrated that these pinnipeds are very good indicators of changing uses and production of chemicals widely incorporated in consumer and industrial products.

In 2016, a one-day educational workshop on ringed seal health was successfully organized at the Qarmartalik School in Resolute Bay. This project engaged youth, elders and scientific researchers in learning about ringed seals from both Inuit Qaujimajatuqangit and scientific perspectives. Collaboration between the current Environmental Monitoring project and an NCP Communications, Capacity and Outreach project provided the cost effective opportunity to create this educational workshop and enhance local capacity building, communications, and the integration of traditional knowledge in contaminants research on ringed seals.

Key Messages

- Polychlorinated biphenyls continue to decline slowly in blubber of ringed seals.
- Mercury concentrations in liver and muscle vary from year to year but overall are not increasing in ringed seals.
- Synergies between NCP Environmental Monitoring and Communications, Capacity and Outreach programs provide a cost effective opportunity to enhance local capacity building, communications and the use of traditional 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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Abstract

The polar bear (Ursus maritimus) is the top predator of the arctic marine ecosystem and food web. Starting in 2007 ongoing in 2016-2017, this project samples on a biennial or annual basis, and continues to assess longer-term temporal trends and changes of NCP priority persistent (legacy and emerging) organic and elemental pollutants (POPs) in polar bears focusing on the southern and western Hudson Bay (Nunavut) subpopulations. For emerging POPs that are currently banned or regulated (e.g. under the treaty of the Stockholm Convention on POPs) and are NCP priority contaminants/POPs, for example tetra- to octa-brominated diphenyl ether (PBDE) flame retardants (FRs), both subpopulations continue to show a gradual decreasing trend from 2009 to 2016 for the sum (Σ) PBDE concentrations. Although quantifiable in the low ppb up until 2013, hexabromocyclododecane (HBCDD) has not been detectable in fat samples from 2014 to 2016 collections. Similarly and again in 2016, many non-PBDE and replacement or re-emerging FRs were not detectable as well. Since 2007 and including 2016, PFOS and sum (Σ) PFCA concentrations remained high (approaching or surpassing the ppm level) and have not temporally decreased in bear liver. A sub-set of 2016-2017 samples were analyzed for a suite of polychloronaphthalenes (PCNs) to complement data from 2013-2014 bear data, but concentrations were at the low ppb level. The present 2016-2017 monitoring year is an even year and thus legacy POPs (i.e., PCBs, chlordanes, DDTs and ClBzs) were also monitored (in fat) as well as total mercury (in liver). When compared to previous years, 2016-2017 legacy POP levels were basically unchanged. To more clearly reveal temporal trends, emerging POP concentration variance due to confounding factors is also being determined from collected data for age, sex, body condition, time of collection, lipid content, and

diet and food web structure (via carbon and nitrogen stable isotope ratios and fatty acid profiles). Northern peoples are integral partners as they carry out the annual harvest of polar bears and provide the collected tissue samples for this legacy and emerging POP/Hg monitoring.

Key Messages

- For western Hudson Bay bears as of 2016, the levels for ΣPCBs, ΣDDTs, ΣCHLs, α-HCH, β-HCH and ΣClBzs (in fat) were generally similar to those in samples going back to 2001. ΣPCBs and ΣCHLs continued to remain high in ppm (lipid weight corrected) concentrations.
- Trends for SPBDE concentrations (in fat) increased from 1991 to late 2000s for western Hudson Bay bears, but then decreased from 2010 to 2014, and appeared to be leveling off at about 50 $ng \cdot g^{-1}$ (lipid weight) between 2014 and 2016. Temporal trends were similar for southern Hudson Bay bears (2007-2008 to 2016 period); although for the southern subpopulation ΣPBDEs remained at about 80 $ng \cdot g^{-1}$ (lipid weight) between 2014 and 2016, and thus are at somewhat greater concentrations relative to the western subpopulation.
- HBCDD was consistently at low ppb levels in bear fat over the years 2001 to 2013, but was not detected in 2014, 2015 or 2016 samples for all bears. BB-153 concentrations were quite high in comparison to Σ_4PBDE concentrations in most years including 2016.
- Among the 22 PFASs analyzed (in liver) the concentrations were consistently greater for PFOS and SPFCAs (low levels of PFOA but mostly C_9, C_{10} and C_{11} PFCAs) in the Hudson Bay bears sampled over the period of 2007 to 2016.
- In the liver and in samples from 2010 through 2016, PFOS concentrations (800 to 2500 $ng \cdot g^{-1}$ (wet weight)) were consistently greater than for ΣPFCAs (500 to 1400 $ng \cdot g^{-1}$) among all bears in 2016, and thus there were no obvious increasing or decreasing trends for ΣPFCAs and PFOS for both subpopulations of bears over the 2007-2016 period.
- From 2002 through 2016, THg concentrations in the liver ranged from 5 to 25 $\mu g \cdot g^{-1}$ (wet weight) and were generally unchanged and slightly greater in bears from western versus southern Hudson Bay.

Update on mercury levels in Hendrickson Island and Sanikiluaq beluga

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Abstract

Samples of liver, kidney, muscle and muktuk of beluga whales collected in 2016 were analyzed for total mercury and selenium. Levels of mercury remained similar to ranges established in previous years. Of the organs analyzed in this study, liver typically had the highest concentrations of mercury, followed by kidney, muscle and muktuk. For example, the mean concentration of total mercury in 14 liver samples of beluga from Hendrickson Island in 2016 was 38.35 ± 28.50 $\mu g \bullet g^{-1}$ while that of muktuk from the same animals was 0.34 ± 0.17 $\mu g \alpha g^{-1}$. Data from these samples were added to the growing database on concentrations of these elements in organs of arctic marine mammals. The database now contains information on over 1401 arctic beluga from several locations over the period of 1977 to 2016. Mercury content varies among species, among individual animals, and among organs within an animal. This variation makes rigorous detection of differences among animals, places, and times statistically difficult. Detection of differences among samples is further complicated by the fact that mercury accumulates with age so that older animals usually have higher levels than younger ones from the same location. Consequently comparison of mercury levels among different groups of beluga requires adjustment for differing ages, thus accurate age data are essential. The additional samples obtained each year improve the chances of detecting differences if they are real and reduce the chances of reporting apparent differences if they are not real. Usually the chemical analyses are completed prior to the age determinations and so there is a lag in interpretation of the data.

Key Messages

- New data were obtained on total mercury in organs of beluga from Hendrickson Island (HI) and Sanikiluaq (SK).
- The mean level of mercury in 2016 liver samples from the HI animals was 38.35 ± 28.50 $\mu g \bullet g^{-1}$. The mean age of these same whales was 15.3 ± 7.3 years. Mercury in muscle was lower than that in liver with a mean concentration of 1.65 ± 1.07 $\mu g \bullet g^{-1}$.
- In spite of the lower values in HI muscle, all of them still exceeded 0.5 $\mu g \bullet g^{-1}$, the concentration long used to regulate the sale of commercial fish in Canada.
- Of the 3 organs analyzed in the HI animals, muktuk contained the lowest levels of total mercury with a mean 0.34 ± 0.17 $\mu g \bullet g^{-1}$. 21 percent of the samples (3 of 14) were at or exceeded 0.5 $\mu g \bullet g^{-1}$.
- Unlike liver, total mercury in muscle and muktuk is equivalent to MeHg (i.e. THg = MeHg). MeHg is the form of mercury that bioaccumulates and is toxic.
- The mean mercury concentration in Sanikiluaq liver samples was 15.07 ± 10.83 $\mu g \cdot g^{-1}$, Muscle levels were lower, with a mean of 1.03 ± 0.52 $\mu g \bullet g^{-1}$ and mercury in muktuk were even lower with a mean concentration of 0.32 ± 0.20 $\mu g \bullet g^{-1}$.

Temporal trends of contaminants in Arctic seabird eggs

Project leader

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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, and thick-billed murre eggs have been monitored at Coats Island in northern Hudson Bay since 1993. Concentrations of polychlorinated dibenzo-p-dioxins, furans, and non-ortho PCBs declined between 1975 and 2014 in eggs of thick-billed murres and northern fulmars from Prince Leopold Island. Concentrations of polychlorinated naphthalenes also declined between 1975 and 2014 in eggs of thick-billed murres from Prince Leopold Island. Polychlorinated naphthalenes accounted for only a relatively small amount of the total toxicity calculated for dioxin-like compounds measured in the murre eggs.

Key Messages

- Concentrations of polychlorinated dibenzo-p-dioxins, furans, and non-ortho PCBs, as well as their associated toxic equivalents (TEQs), declined between 1975 and 2014 in eggs of thick-billed murres and northern fulmars from Prince Leopold Island.
- Concentrations of polychlorinated naphthalenes (PCNs) and their associated TEQs also declined between 1975 and 2014 in eggs of thick-billed murres from Prince Leopold Island.
- The total TEQ-PCN accounted for only a small amount of the total toxicity calculated for dioxin-like compounds measured in the murre eggs.

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

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Abstract

This study is investigating trends in mercury concentrations (and metals) in sea-run (anadromous) Arctic char from the domestic fishery at Ekaluktutiak (Cambridge Bay). Although mercury concentrations are low in these Arctic char, we are continuing to monitor them as part of our investigations as to how mercury concentrations are influenced by changes in climate, air circulation patterns, and Asian and other mercury emissions. Mercury concentrations remain low although they appear to be slightly higher in cooler years when fish have lower body weights relative to their length. Continued monitoring will provide us with a stronger data set to assess trends. As in previous years, 20 Arctic char were harvested from the sea by local fishermen from the Hunters and Trappers Organization (HTO) and provided to us for analyses. As part of these studies, we continued our lake trout and Arctic char collections from Grenier Lake, again involving Ekaluktutiak HTO and utilizing ECCC funds. We continued to collaborate with others investigating features of Arctic char biology and their environment, including working with Les Harris who is conducting stock assessments on the major river/lake systems supporting the commercial fishery; Donald McLennan with the Canadian High Arctic Research Station who is working to develop a monitoring program on Grenier Lake; and Milla Rautio, Université du Québec à Chicoutimi, who is conducting biodiversity and productivity studies (including fatty acid studies) in Grenier and other nearby lakes. We also are contributing to mercury monitoring in char at Nain.

Key Messages

- Mercury concentrations remain low in sea-run char harvested from the domestic fishery at Cambridge Bay.
- Char inhabiting Grenier Lake in summer have somewhat lower condition factor and slightly higher mercury concentrations than fish caught from the sea. Some char caught in the lake are feeding suggesting that they are resident fish.
- Mercury concentrations are moderately high in lake trout from Grenier Lake, possibly because these fish are very old.
- Temporal variability in mercury concentrations appear to be related to temporal variability in condition factor and climate.

Temporal trends of persistent organic pollutants and mercury in Landlocked Char in high Arctic lakes

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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 collected annually from lakes (Amituk, North, Small, and Resolute) near the community of Resolute Bay on Cornwallis Island and in Lake Hazen in Quttinirpaaq National Park on Ellesmere Island. In 2016, arctic char samples were successfully collected from all lakes except Lake Hazen. With the addition of our 2016 results, we've found that declining mercury trends observed in char over the period of 2005 to 2013 in Amituk, Hazen, North, and Resolute lakes have stopped and concentrations have levelled off or increased slightly from 2014 to 2016. Concentrations of fluorinated substances in char have generally declined since 2008-09 but the trends vary among lakes and specific chemicals. The year to year variation in concentrations of both mercury and fluorinated substances in Arctic char may be influenced by factors such as earlier ice out, increased catchment runoff, and changes in benthic invertebrate abundance.

Key Messages

- While concentrations of mercury concentrations in landlocked Arctic char still show overall declining trends since 2005, levels have recently levelled off or increased slightly.
- Concentrations of fluorinated substances in char have generally declined since 2008-09 but the trends vary among lakes and specific chemicals.
- The year to year variation in concentrations of mercury, fluorinated substances, and legacy POPs in Arctic char may be influenced by climatic factors.

Spatial and long-term trends in persistent organic contaminants and metals in Lake Trout and Burbot from the Northwest Territories

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Abstract

Our Great Slave Lake Northern Contaminants Program study is measuring trends in mercury, other metals, persistent organic pollutants (POPs) and other contaminants of concern in Lake Trout and Burbot from three locations in two regions of Great Slave Lake. 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 were obtained from the domestic fishery at Fort Resolution (West Basin). In addition, under our other studies, we continue to investigate mercury concentrations in Burbot at Lutsel K'e and Northern Pike at Fort Resolution. Mercury concentrations remain relatively low in these fish and previously reported trends of mercury increase have become less apparent. We worked on a series of posters to present our mercury findings in a clear and more understandable way; as part of this we met with several community organizations in the fall to discuss our study results and poster design. The concentrations of POPs and other contaminants of concern are declining, particularly ΣDDT and ΣHCH in Lake Trout (commercial fishery, Lutsel K'e) and Burbot (Fort Resolution). We continue to work with Fort Resolution (water intake study) and Lutsel K'e (Stark Lake concerns), and contribute to related studies being conducted by other researchers including mercury trends in fish in Dehcho lakes and Great Bear Lake.

Key Messages

- Mercury concentrations remain relatively low (average <0.5 $\mu g \bullet g^{-1}$) in Lake Trout, Burbot, and Northern Pike from Great Slave Lake.
- A few years ago, mercury concentrations appeared to be increasing in Lake Trout and Burbot, but there is less evidence of a temporal increase in recent years.
- Persistent organic pollutant concentrations are declining, particularly in West Basin fish.

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

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Abstract

Tissues from burbot collected at Fort Good Hope (Rampart Rapids) in December 2016 were analysed for Hg, Se and As. Data from this time point was combined with the existing metal data (1985, 1988, 1993, 1995, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015) together covering a time span of 31 years. No significant correlation between length and mercury concentration was observed with muscle or liver for either sex. Mean Hg concentrations in muscle and liver over the entire data sets were 0.364 ± 0.143 (n = 678) and 0.099 ± 0.085 (n = 684) $\mu g \cdot g^{-1}$, respectively. Muscle mercury levels are below the recommended guideline level of 0.50 $\mu g \cdot g^{-1}$ for commercial sale.

Key Messages

- Mean Hg concentrations in muscle and liver over the entire data sets were 0.364 ± 0.143 (n = 678) and 0.099 ± 0.085 (n = 684) $\mu g \bullet g^{-1}$, respectively.
- Since the mid-1980s, an approximate 2- and 3-fold increase in mercury concentrations has been measured in Fort Good Hope burbot muscle and liver, respectively.
- Muscle liver and mercury levels are below the recommended guideline level of 0.50 $\mu g \cdot g^{-1}$ for commercial sale.
- ΣHCB, ΣHCH, ΣDDT, ΣCHB and ΣPCB wet weight concentrations (±SD) in $ng \cdot g^{-1}$ for the 2015 liver samples were 5.25 (2.94), 0.47 (0.18), 8.89 (2.98), 4.54 (7.67) and 14.84 (6.10), respectively.

Trace metals and organohalogen contaminants in fish from selected Yukon lakes: A temporal and spatial study

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Abstract

Lake trout muscle samples collected from two Yukon Lakes, Kusawa and Laberge, were analysed for a range of organohalogen (OCs/PCBs/BFRs/FOCs) and heavy metal (Hg/Se/As) contaminants. Currently heavy metal time trend data from Laberge and Kusawa Lake trout muscle covers 23 years, with 20 and 18 time points, respectively. The mean Hg levels over the entire data sets for the Laberge and Kusawa samples were 0.47 ± 0.21 (n=218) and 0.40 ± 0.29 (n=204) $\mu g \bullet g^{-1}$, respectively. In both lakes, levels are below the recommended guideline level of 0.50 $\mu g \bullet g^{-1}$ for commercial sale. No significant trends have been observed in Lake Laberge over the last 22 years. In Kusawa Lake, after a significant drop in the length adjusted mean Hg trout muscle concentrations in 2001, no significant trends have been observed. The current length adjusted mean Hg concentration is now at its highest level since 1999. Analysis of the HOCs in the 2016 muscle tissue is in process.

Key Messages

- Currently heavy metal (mercury, selenium and arsenic) time trend data from Laberge and Kusawa Lake trout covers 23 years, with 20 and 18 time points, respectively.
- The mean Hg levels over the entire data sets for the Laberge and Kusawa samples were 0.47 ± 0.21 (n=218) and 0.40 ± 0.29 (n=204) $\mu g \bullet g^{-1}$, respectively. In both lakes, levels are just below the recommended guideline level of 0.50 $\mu g \bullet g^{-1}$ for commercial sale.
- No significant trends have been observed in the Laberge over the last 22 years.
- In Kusuwa Lake, after a significant drop in the length adjusted mean Hg trout muscle concentrations in 2001, no significant trends have been observed. The current length adjusted mean Hg concentration is now at its highest level since 1999.

Arctic Caribou Contaminant Monitoring Program

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Abstract

This project investigates 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 2016/17 samples were collected from 23 Porcupine, 40 Qamanirjuaq, 23 Bluenose West and 10 Ahiak caribou. Samples were taken from an additional 20 Qamanirjuaq cows immediately post-rut to explore the possible effect of mercury on pregnancy. Sample analyses for these collections had not been completed at the time this report was prepared. Porcupine, Qamanirjuaq, Bluenose East and Dolphin & Union samples collected in the 2015/16 year have been analyzed, and results are presented in this report. Age was positively correlated with renal Cd and Zn in the Porcupine, Qamanirjuaq and Beverly caribou. Renal lead declined over time in those three herds as well. Mercury appears to be stable over the long term in the Porcupine and Qamanirjuaq herds. Toxic elements tended to be higher in cows than bulls, 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. Levels of most elements 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 this remains a healthy food choice.

Key Messages

- Levels of most elements measured in caribou tissues are not 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 and is a healthy food choice.
- Mercury concentrations in the Porcupine and Qamanirjuaq caribou appear to be stable over the long term.
- This program will continue to monitor the Porcupine and Qamanirjuaq caribou herds annually to maintain confidence in the health-related safety of 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

Project Leaders

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Abstract

This proposal addresses a knowledge gap that was identified under the NCP "Blueprint", related to the lack of data on levels and time trends of contaminants in the marine waters. The project started in May 2014 and built on previous work in Barrow Strait near Resolute in 2011 and 2012. The project became a core monitoring project last year. Seawater samples for a full suite of contaminants were successfully collected from Barrow Strait under ice covered conditions (May-June) and from open water (August-September 2016) using (i) passive samplers (thin plastic films) deployed for 5 to 6 week periods, (ii) large volume water samplers (200 L), and (iii) Niskin samplers to obtain1 L samples at various depths. A full suite of collections were carried out in Anaktalak Fiord near Nain using passive and Niskin samplers in the open water season in July. Passive samplers were successfully deployed in Wellington Bay near Cambridge Bay, in Barrow Strait, and in the Beaufort Sea near Sachs Harbour in open water in August 2016. Analysis of stain repellent and industrial additive (perfluorinated) chemicals shows that PFOS has declined to non-detectable levels since the mid-2000s. Mercury concentrations at Barrow Strait (2014-2016) remain unchanged compared to 10 years earlier (2004-05). This project is continuing in 2017-2018 so that a long term temporal data set can be developed that 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.
- Very low concentrations of brominated flame retardants were found in seawater using passive samplers (plastic films) at Resolute Bay.
- Phosphorus based flame retardants were detected in seawater for the first time at Resolute Bay.
- Analysis of stain repellent and industrial additive (perfluorinated) chemicals has been completed and showed that PFOS has declined to non-detectable levels since the mid-2000s.
- Mercury/methylmercury concentrations at Barrow Strait (2014-2016) remain unchanged compared to 10 years earlier (2004-05).

Investigation of the toxic effects of mercury in Arctic char

Project Leader

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Abstract

In the Canadian Arctic, mercury (Hg) concentrations in the tissues of landlocked Arctic char are elevated with ~30% of the sampled populations exceeding toxicity thresholds. Starting in 2011, with NCP funding, we began collecting tissues from landlocked Arctic char from "NCP focal ecosystem lakes" on Cornwallis Island in cooperation with the "core" monitoring project (Muir, Köck, Kirk and Wang) to determine whether wild populations are indeed experiencing Hg toxicity. To build upon our previous work, we measured biomarkers of oxidative stress (GSH-Px, SOD, and TBARS) in the livers and brains of Arctic char sampled from four lakes on Cornwallis Island (Small, 9-Mile North, and Amituk) in 2016. Mean GSH-Px activity was significantly higher in the livers of Amituk Lake char than in char from the other three study lakes, which could be a response to high levels of hepatic Hg. Across lakes, GSH-Px activity was significantly correlated with total Hg in the livers of Arctic char. Conversely, the activity of SOD was not related to hepatic concentrations of Hg. Lipid peroxidation (measured as TBARS) was highest in the livers of fish from the lowest Hg lake, which may be due to other metals present in the system. None of the biomarkers measured in char brains varied significantly across lakes or with concentrations of Hg. Additionally, we sampled and analyzed blood from Arctic char for Hg, in order to determine whether it could be used as a non-invasive biomarker. Results indicate that both total Hg and methylmercury in blood are highly correlated with total Hg in other tissues of Arctic char, and therefore it is suitable to use blood to estimate Hg concentrations in other tissues.

Key Messages

- We sampled landlocked Arctic char from four lakes on Cornwallis Island, which span a gradient of mercury contamination.
- We measured biomarkers of oxidative stress in livers and brains of Arctic char sampled along the mercury gradient as a measure of effect.
- Blood was collected to determine if its mercury levels could be used to estimate mercury levels in other tissues.
- We noted differences in biomarkers within the livers of Arctic char sampled along the mercury gradient, which may be related to both mercury and other metals present in the fish.
- Biomarkers in Arctic char brains were not related to concentrations of mercury.
- Mercury concentrations in blood were highly correlated with concentrations in other tissues, suggesting that blood can be collected and used to estimate mercury in other tissues without killing the fish.

Impact of climate change on the mobilization and bioaccumulation of persistent organic pollutants in arctic freshwater systems

Project Leaders

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Abstract

Legacy persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), and other emerging pollutants such as perfluoralkyl substances (PFASs) were measured in snow, water, and char samples collected from selected areas of Cape Bounty lakes, rivers, and surrounding ecosystems. An intense sampling campaign covering pre-melting, melting, and open lake waters conditions (May-June-August 2016) was carried out to assess POPs levels in order to study the main controls on the remobilization of organic pollutants from the terrestrial environment into two lakes and their main tributaries at Cape Bounty. Overall, the patterns of legacy and emerging pollutants in snow and water were dominated by low molecular weight PCB congeners and short chain PFAS rather than heavier compounds, suggesting long-range atmospheric transport of POPs is the main vector for the introduction of these chemicals in Cape Bounty ecosystem. Snow and lake ice cover were also found to be an important reservoirs of legacy PCBs, as sharp increases of PCB concentrations were detected in East and West rivers and lakes during melting processes compared with pre/post melting measurements.

Although fish lipid content has declined significantly in West Lake, with the lowest values associated with high turbidity (2013-2016). No statistically significant differences were observed in West and East Lakes on the concentrations of total PFASs in water, which may reflect the high solubility of these compounds. Temporal trends (2008-2016) of PCBs in char from East Lake showed significant declining trends, as expected due to the past national and regional bans. This contrasts with significant increases of PCBs in char from West Lake, probably due to greater inputs of PCBs bound to terrestrial carbon, associated with permafrost disturbances (e.g huge input of dissolved organic and particulate carbon) occurring in West Lake and its watershed. Temporal series of PFASs (2008-2015) on char showed declining trends in both lakes, which suggest that disturbances occurring in West Lake and its catchment are not significantly altering the temporal trends of emerging PFASs in char. This change is probably a result of the smaller affinity of these chemicals to organic carbon.

Key Messages

- Legacy POPs such as PCBs and emerging pollutants (PFASs) were measured for the first time in snow, water and arctic char samples collected at Cape Bounty (Melville Island).
- Snow melting is an important input of PCBs to riverine and lake water.
- Fish lipid content has declined significantly in West Lake likely due to the associated high lake turbidity.
- The time series (2008-2015) of PFAS showed declining trends in Arctic char from East and West Lakes
- Temporal trends (2008-2016) of legacy PCBs in char from East Lake showed significant declining trends while significant increases were observed in West Lake, likely associated to major ongoing disturbances in West Lake and catchment.

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

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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. In particular, 38 thick-billed murres were tracked via GPS-accelerometers, and concentrations of hormones, mercury, and brominated flame retardants (BFRs) were measured in all 38 individuals. Per-/polyfluoroalkyl substances (PFAS) levels were measured in the plasma of 10 individuals. Levels of BFRs and PFASs were low, and unrelated to hormones or behaviour. However, mercury levels were associated with pre-trip levels of circulating triiodothyronine (T3) hormones. The pre-trip levels of T3 were associated with foraging behaviour; higher levels of T3 were associated with higher diving rates. We found no associations with corticosterone. GPS tracks demonstrated that birds were foraging near regions of floating ice, which may improve foraging success and lower diving rates. Thus, mercury was positively associated with T3, which may relate to increased diving rates away from ice concentrations. Based on our 2016-17 data, we tentatively conclude that mercury may be influencing the ability of thick-billed murres to adjust to variation in ice cover, and we will further examine that hypothesis in 2017 with a larger sample size and different environmental conditions.

Key Messages

- Levels of BFRs and PFAS observed were quite low.
- However, mercury may influence the ability of murres to adjust to variation in ice cover via associations with hormones.

Plastics as a vector of contaminants in Arctic seabirds

Project Leaders

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Abstract

Plastic debris is commonly ingested by seabirds, even in high Arctic waters, but only recently has attention turned to what the impacts of this ingested pollution may be. There is increasing evidence that once marine plastic pollution is in the gut of seabirds, plastics release contaminants that may have negative effects on wildlife. We assessed how plastic-associated chemical contaminants may be transferred to Arctic food webs via ingested plastics in Arctic marine birds (northern fulmars; *Fulmarus glacialis*). This work was done through the use of samples already in hand and stored at the National Wildlife Research Centre (Environment and Climate Change Canada, Ottawa, ON). Although plastics are both a source and a vector for chemical contaminants in marine animals, little work has been done in the Arctic region beyond initial plastic ingestion studies. Marine plastic debris has been listed by the United Nations Environment Program (UNEP) as one of the most important emerging environmental concerns, and the Arctic Monitoring and Assessment Program (AMAP) working group of the Arctic Council has included marine plastics in their upcoming emerging contaminants assessment. Therefore studies demonstrating the extent and impact of plastics are critical to both domestic and international chemical assessment activities. This work is also relevant to informing studies on the health of harvested species.

Key Messages

- There are a large variety of synthetic polymers entering the Arctic food web through seabird ingestion of plastic debris.
- While visual sorting methods group plastics into categories based on physical characteristics, FTIR results demonstrate that within these groups there can be a number of polymer types.

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

Project Leader

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Abstract

Organophosphate ester (OPEs) flame retardants and plasticizers are receiving increased attention due to their presence in remote locations including the Canadian Arctic. The widespread global distribution of OPEs is believed to arrive through various mechanisms including oceanic transport, and air transport in the gas phase and on fine particles. Air, water, sediment and zooplankton samples were collected between 2007-2016 in the Canadian Archipelago as part of ArcticNet and the Northern Contaminants Program. Samples were mainly taken from on board the CCGS Amundsen but also at Resolute Bay in the lower arctic and Alert in the high arctic. This coordinated sampling helps us understand how OPEs are introduced into the arctic food web. OPEs most frequently detected in the arctic environment were tri-phenyl phosphate (TPhP), tris(2-chloroethyl) phosphate (TCEP), tris(2-chloropropyl) phosphate (TCPP), tris(1,3-dichloro-2-isopropyl) phosphate (TDCiPP) and ethyl-hexyl diphenyl phosphate (EHDPP). Levels of OPEs were very high compared to other flame retardants including poly brominated biphenyl esters (PBDEs).

Key Messages

- Organophosphate esters are abundant in arctic air, water (dissolved and particulate), zooplankton, and sediment.
- OPEs arrive in the arctic through atmospheric and oceanic transport and end up on land, ocean and ice.
- Different environmental compartments have different proportions of the OPEs indicating different transport and deposition processes.
- It is difficult to assess atmospheric deposition processes (i.e. air water gas exchange and dry particle deposition of OPEs) due to issues with air sampling methods.

The effect of retrogressive thaw slumps on the delivery of high loads of toxic methylmercury to downstream freshwater systems in the Peel Plateau region, NT

Project Leaders

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Abstract

On the Peel Plateau, retrogressive thaw slumps (RTS) are thermokarst disturbances that can cover areas up to multiple hectares, and mobilize thousands of cubic meters of permafrost-derived sediments over multiple decades. We are studying the effect of RTS activity on the concentrations of total (THg) and methyl (MeHg) mercury downstream of slumps. The potential mobilization of mercury (Hg) as a result of RTS activity is of interest because neurotoxic MeHg is known to bioaccumulate in organisms, and biomagnify as it makes its way up the food web. We find that slumping substantially increases both THg and MeHg downstream of slumps, with increases in THg as much as 600-fold and MeHg as much as 4-fold, downstream of slumps when compared to pristine, upstream sites. We further find that this increase can persist for up to 3 km downstream. The concentrations of MeHg that we observe – as high as 3 $ng \bullet L^{-1}$ – are among the highest measured to date in uncontaminated sites in Canada. However, this increase in THg and MeHg that we observe is entirely particle associated; in filtered samples, both dissolved THg and MeHg decrease downstream of slumps, suggesting that the substantial particles released by slumping may provide an adsorptive surface that sequesters Hg. Thus, although slumping appears to enable the release of both THg and MeHg into contemporary biogeochemical cycles, or the production of MeHg in slumped materials, its particle association may mean that it is not readily available for uptake by organisms.

Key Messages

- Permafrost slumping appears to significantly increase both THg and MeHg downstream of slumps on the Peel Plateau, NT.
- Increases are almost entirely associated with the particulate form. Downstream of slumps, Hg appears to be sequestered on particles, and dissolved Hg decreases downstream of slumps.
- Elevated levels of total (particulate + dissolved) THg and MeHg persist for up to 3 kilometers downstream.
- The rise in THg and MeHg downstream of slumps occurs following the onset of slumping in the early summer, and continues throughout the thaw season.
- MeHg might be microbially produced in slumped environments.

Glacier and soil/permafrost thaw inputs of mercury and emerging organic contaminants to a pristine high Arctic watershed in Quttinirpaaq National Park, northern Ellesmere Island, Nunavut

Project Leaders

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Abstract

The high Arctic continues to receive a wide range of contaminants released by human activities in more southerly latitudes and industrialized nations around the world. Thankfully, due to emission regulations and bans in their usage, concentrations of certain legacy contaminants have been declining in the high Arctic. However, a number of contaminants such as mercury (Hg), as well as new, emerging and yet unregulated persistent organic pollutants (POPs), such as certain poly- and perfluorinated alkyl substances (PFASs) and organophosphorus flame retardants (OPFRs), continue to be of priority concern. Furthermore, it now appears that climate change is also influencing the long-range transport, fate, and bioaccumulation of contaminants like Hg and POPs in the Arctic. Recent Northern Contaminants Program funding has allowed us to quantify elevated winter atmospheric loadings and springtime runoff of total Hg (THg: all forms of Hg in a sample), methylmercury (MeHg: the toxic and bioaccumulating form of Hg) and PFASs to the pristine Lake Hazen high Arctic watershed in Quttinirpaaq National Park, Northern Ellesmere Island, Nunavut, as well as examine how that runoff changed concentrations of those contaminants in Lake Hazen during the important spring

bloom of biological activity under the lake ice. Building off our work in summer 2015, we continued sampling glacier and soil/permafrost thaw inputs of Hg to this watershed in July-August 2016. From a socio-economic perspective, understanding present-day contaminant loadings, water quality and climate change impacts is important for predicting how the abundances and quality of certain organisms used as Inuit traditional foods may be altered by future human activities.

Key Messages

- Filtered (dissolved) concentrations of both THg and MeHg in glacial river water were much lower than unfiltered concentrations, suggesting that the majority of THg and MeHg in glacial runoff is particle bound or mineral in origin. As such, THg and MeHg concentrations increased with increasing river flow and erosion intensities.
- Along a continuum that allowed us to quantify how soil/permafrost thaw water quality changes as it moves across the landscape prior to discharging into Lake Hazen, we found that small lakes and wetlands were both sites of active microbial Hg methylation. Unlike glacial rivers, a much larger portion of the MeHg was in the dissolved phase and not particle bound, making the MeHg much more readily bioavailable for bioaccumulation in these systems.
- MeHg concentrations were extremely low throughout the water column after the height of summer glacial melt and soil/permafrost thaw inputs, all of which were higher in MeHg concentration. THg concentrations throughout the upper water column after the height of summer glacial melt and soil/permafrost thaw inputs were also very low. However THg concentrations began to increase below 150 m depth in the lake, paralleling increases in turbidity, again suggesting that THg was of mineral origin and associated with particles transported by glacial rivers. Dense and turbid glacial runoff enters into Lake Hazen, and then plummets rapidly to the bottom of the lake.

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

Project Leader

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Abstract

People living on Lake Melville are concerned about contaminant levels in country foods they harvest, especially methylmercury (MeHg: the toxic form of mercury that biomagnifies through food webs), and projected increases in methylmercury resulting from hydroelectric power development on the Churchill River. Lake Melville is also 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. We are utilizing combined analyses of mercury, methylmercury, carbon and nitrogen stable isotopes with perfluorinated alkyl substance (PFAS) and PCB congener analyses, to 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 further climate-induced alterations.

71 seal samples were collected during harvests by local hunters during 2013-2016 and were analyzed for mercury, methylmercury and mercury stable isotopes. A subset of these samples was analyzed for PFASs and PCBs. Average MeHg concentrations in the liver and muscle of Lake Melville seals were 150 ± 205 and 119 ± 145 $ng \bullet g^{-1}$ wet weight (ww), respectively, with 14 of 71 liver samples and 10 of 71 muscle samples surpassing the Canadian frequent consumer guideline of 200 $ng \bullet g^{-1}$ ww. Average Hg concentrations in Lake Melville ringed seals are lower than those recently reported for 14 communities across the Canadian Arctic, likely because seals sampled to date are mostly pups. Hg concentrations

are comparable to those recently reported in pups at other Labrador locations. Results from Hg stable isotope analyses demonstrate that Lake Melville seals obtain food from both inland and marine sources. PFAS concentrations in Lake Melville pups are higher than those in Greenland and PFAS show an annual increasing trend from 2013 to 2016 in contrast to PFAS temporal trends in marine mammals from other areas of the Canadian Arctic. We are continuing this project in 2017-2018 so that adult seals can be sampled and 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 to predict 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. They are particularly concerned about methylmercury and predicted increases in methylmercury resulting from hydroelectric power development on the Churchill River.
- This project analyzes mercury, methylmercury, carbon and nitrogen stable isotopes, perfluorinated alkyl substances, and polychlorinated biphenyl in the Lake Melville food web, including ringed seals.
- Information from the project allows the researchers to determine 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.
- Average methylmercury concentrations in the liver and muscle of Lake Melville seals (mostly pups <1 year in age) were 150 ± 205 and 119 ± 145 $ng \bullet g^{-1}$ wet weight, respectively, and are comparable to those recently reported in pups at other Labrador locations.
- PFAS concentrations in Lake Melville pups are higher than those in Greenland. In addition PFAS show an annual increasing trend from 2013 to 2016 in contrast to PFAS temporal trends in marine mammals from other areas of the Canadian Arctic.
- 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.

Metabolomic consequences of elevated PCB exposure in ringed seals (*Pusa hispida*) in Labrador: an expanded toxicological repertoire to characterize health impacts

Project Leaders

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Abstract

Causal evidence linking PCBs to adverse health effects in free-ranging marine mammals is generally confounded by the highly complex contaminant mixtures to which they are exposed. A local PCB "hotspot" on the Labrador coast provided a rare opportunity to evaluate the effects of PCBs on the health of a marine mammal as this chemical dominated their persistent organic pollutant (POP) burdens. The release of approximately 260 kg of PCBs by a military radar facility over a 30 year period (1970-2000) contaminated some local marine biota, including 60% of the ringed seals (*Pusa hispida*) along the coast. A select suite of genes measured in ringed seals from Labrador revealed a strong relationship between the profiles of gene transcripts that play a role in animal health and PCB concentrations, suggesting that some adverse effects have been caused by this local PCB source. Threshold values were calculated for these genes, with the most conservative value being 1370 $ng \bullet g^{-1}$ (lipid weight). Approximately 14% of the seals in the region exceeded this threshold. In the present study, we examined 254 metabolites to add further insight to the consequences of PCBs on ringed seal health. These included 18 energy metabolism metabolites, 18 endogenous steroid metabolites, 21 amino acids, 22 biogenic amines, 40 acylcarnitines, 89 phosphatidylcholines, 15 sphingomyelins, Σhexose, 13 bile acids, and 18 fatty acids in liver, plasma, and serum samples collected from 43 ringed seals in the affected area. Preliminary metabolomics results suggest that variability between metabolites is explained by PCB concentrations and the year of collection. Those sampled during 2010, an unfavourable ice condition year, differed from the other sampling years. The dominance of PCBs in the seals studied enabled an assessment of the effects of this chemical on metabolites involved in regulating the health of a highly mobile predator, something that is rarely possible in the world of complex mixtures. Our findings add mechanistic insight into the nature of PCB toxicity in seals, and additional evidence for a widespread impact associated with the release of PCBs from the Labrador radar facility.

Key Messages

- 42 liver samples, 39 plasma samples, and 10 serum samples were analyzed for concentration levels of 236 metabolites in 42 ringed seals that were collected along the northern Labrador coast in the summers of 2009 to 2011.
- Ringed seal metabolomics results suggest that variability between metabolites is attributed to year of collection with those collected during 2010, an unfavourable ice condition year, differing from the other years.
- Fatty acid metabolites in ringed seals in 2010 are lower relative to other sample years, suggesting possible changes in feeding ecology of seals in 2010.
- Adult male ringed seal metabolomics results suggest that variability between metabolites is attributed to PCB concentrations.
- Energy metabolism, amino acid and bile acid metabolites were altered in ringed seals exposed to increasing concentrations of PCBs.

Communications, Capacity Building and Outreach

Yukon Contaminants Committee (YCC)

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Abstract

Since 1991, the Yukon Contaminants Committee (YCC) has and continues to keep the Yukon people informed of the Northern Contaminants Program's (NCP) initiatives. Over the past 24 years, the YCC has communicated the results of the Northern Contaminants Program to the people of Yukon and contributed to national and international publications. The YCC is considered to be the point of contact for contaminant issues in the Yukon.

In addition to their ongoing role as the point of contact between the residents of the Yukon and the NCP, the YCC is responsible for reviewing all regional proposals for socio-cultural merit. The YCC also assists with fiscal co-ordination of projects funded within the Yukon and works with researchers to create communications strategies for research results within the Yukon.

This year the YCC hosted a two-day workshop in March 2017 in Whitehorse, Yukon to raise the profile of the NCP and YCC. Past and present research projects were highlighted with a number of researchers attending to showcase their work and provide information to Yukon residents. Communities also had the opportunity to become members of the YCC and strategize the YCC's direction for the coming years.

Key Messages

- Over the past 24 years, the YCC has communicated the results of the Northern Contaminants Program to the people of Yukon and contributed to national and international publications.
- The YCC is considered to be the point of contact for contaminant issues in the Yukon.

Northwest Territories Regional Contaminants Committee (NWTRCC)

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Project Team

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Abstract

The Northwest Territories Regional Contaminants Committee (NWTRCC) represents the Northern Contaminants Program (NCP) in the Northwest Territories (NT) ensuring that northern and Indigenous interests are being served by scientific research conducted in the Northwest Territories, and to serve as a resource for long-range contaminants information in the Northwest Territories.

NWTRCC was represented by Tim Heron, Emma Pike, Carmon Bessette, Linna O'Hara, Brett Elkin, as well as a Dene Nation Representative, when attending the NCP Management Committee (MC) meetings in April and/or October 2016. NWTRCC hosted a productive social-cultural review of NCP proposals on February 14-15, 2017 in Yellowknife. A total of 15 people (including two via conference call) participated in the face-to-face meeting and 24 NT-based proposals were reviewed.

NWTRCC had representation at the NCP human health and risk communication workshop held in Ottawa November 22 and 23, 2016. Emma Pike, Linna O'Hara, Andrea Corriveau, Eric Loring and Shannon O'Hara attended.

NWTRCC provided feedback to NCP researchers on communications (i.e., summary reports, posters, and information pamphlets) intended for community dissemination. In addition, the NWTRCC met face-to-face with NCP-funded researchers to discuss their respective proposals/projects and how they were progressing throughout the year.

Key Messages

- Through its social-cultural review of all NT-based 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.
- The NWTRCC aims to serve as a resource to NT residents for long-range contaminants information in the Northwest Territories.

Nunavut Environmental Contaminants Committee (NECC)

Project Leaders

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Project Team

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Abstract

The NECC represents the Northern Contaminants Program (NCP) in Nunavut (NU) 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 long-range contaminants information in Nunavut.

NECC attended the NCP Management Committee meetings in April and October 2016. NECC hosted a productive social-cultural review of NCP proposals on February 22-24, 2017 in Iqaluit. A total of sixteen people (including three community members) participated in the face-to-face meeting and thirty-two Nunavut-based proposals were reviewed. A total of eight Environmental Technology Program (ETP) students were able to participate on a rotational basis.

NECC participated in the annual Wildlife Contaminants Workshop at the Nunavut Arctic College (NAC) in September 2017; supported travel for an ETP student to go to Resolute Bay to attend the seal health workshop (C-12) in October 2016; and attended the NCP human health and risk communication workshop in November 2016.

NECC provided feedback to NCP researchers on communications (i.e., summary reports, posters) intended for community dissemination, met face-to-face with NCP-funded researchers to discuss their respective proposals/projects, and attended seminars/workshop held by NCP researchers.

Key Messages

- 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.

Nunavik Nutrition and Health Committee: Coordinating and learning from contaminants research in Nunavik

Project Leader

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Project Team

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Abstract

The Nunavik Nutrition and Health Committee (NNHC), originally named the PCB Resource Committee, was established in 1989 to deal with issues related to food, contaminants, the environment, and health in Nunavik. Since its inception, the committee has broadened its perspective to take a more holistic approach to environment and health issues inclusive of both benefits and risks. Today, the committee acts as the review and advisory body for health and nutrition issues in the region and includes representation from many of the organizations and agencies concerned with these issues, as well as those conducting research on them. The committee provides guidance and acts as a liaison for researchers and agencies, from both inside and outside the region; directs work on priority issues; communicates with, and educates the public on health and environment topics and research projects; and represents Nunavik interests at the national and international levels. All activities are conducted with the goal of protecting and promoting public health in Nunavik, through more informed personal decision-making.

Key Messages

- The Nunavik Nutrition and Health Committee is the key regional committee for health and environment issues in Nunavik.
- The committee advises the Nunavik Public Health Director about educating the public on food and health issues, including benefits and risks associated with contaminants and country foods.
- The committee 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.

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

- **Project Leader**
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- **Project Team**
  Rodd Laing, Environment Division, Nunatsiavut Government; Elizabeth Pijogge, Northern Contaminants Researcher, Nunatsiavut Government

Abstract

The Inuit Research Advisor (IRA) 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 are initiated involving appropriate NG departments, 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 52 researchers from April 1st, 2016 to March 31st, 2017. 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, 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.

NCP communications, capacity and outreach projects for policy makers and Inuvialuit communities in the ISR

Project Leader

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Project Team

Duane N. Smith, Jenn Parrott, Jiri Raska, Evelyn Storr, Inuvialuit Regional Corporation, Inuvik, NT

Abstract

In 2016/17, the Inuit Research Advisor (IRA) position went through a departmental transition within Inuvialuit Regional Corporation (IRC) with the recent establishment of a new Research Division within our organization. From January 2016 to the end of February 2017, the IRA position continued to be housed in the Community Development Division under the supervision of Evelyn Storr and Jiri Raska. Then from March 2017 until present, the Research Division was moved to the 2nd floor of the Inuvialuit Corporate Center and is now being led by Jenn Parrott, Research Manager of the Research and Community Support Division. This new office location is ideal due to its close proximity to the Joint Secretariat and Inuvialuit Game Council offices as our three offices are each involved with NCP research. Within this time frame, the Inuit Research Advisor has continued to conduct the activities as outlined in IRC's annual proposal submission to NCP.

In 2016-17, the IRA completed the following activities:

- Attended and participated in the social and cultural proposal review of proposals in Yellowknife in February 2017. At this meeting, Shannon O'Hara was re-nominated and accepted the role of Vice Chair of the Northwest Territories Regional Contaminants Committee (NWTRCC).
- Attended and participated in NCP's risk management communications workshop held in Ottawa in November 2016 to learn about the NCP initiatives in place across the north in risk management by listening to presentations and participating in group break-out sessions.
- Developed an NCP specific Power Point presentation for use during communication and outreach activities and presented this to the NWT RCC during the February 2017 meeting. There was good feedback and suggestions to improve it were given. Overall, the presentation was very well received by the Committee, which led to regional reps requesting that the NCP include more metrics in results given to communities in regards to funding social-cultural deliverables.
- Provided continued support and assistance to researchers who have funded NCP projects, specifically those outlined in the proposal (i.e. Trevor Lantz, Laurie Chan, Hayley Hung, Derek Muir).

Key Messages

- The IRA is now well integrated into the research landscape within the ISR through the transition into a new Research Division that has taken place and has continued conducting duties as outlined in appendix 1, 2 and 3 of annual proposal submitted to NCP.
- 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 continues to deliver on funded projects, and has successfully completed the new NCP specific PowerPoint presentation which was presented to the NWTRCC in February 2017.
- The IRA has not had the opportunity to deliver any regional communication products or in person presentations to our six communities in a couple years and would like to be able to go through an evaluation process in order to continue to offer this information to the region again. Any specific direction and advice that could be offered from any members of the NWTRCC or the Management Committee would be appreciated.

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, ArcticNet

Abstract

The Nunavik Inuit Research Advisor (IRA) continues to serve as the first step in a more coordinated approach to community involvement and coordination of Arctic science in Nunavik. The IRA position is housed within the Renewable Resources Department of the Kativik Regional Government and works closely with the Nunavik Nutrition and Health Committee, the Nunavik Board of Health and Social Services, and the Makivik Research Center. The objective of the IRA position is to help facilitate research, at the program level, by assisting researchers from the Northern Contaminants Program (NCP) and ArcticNet, and by updating communities in advance of research. Together, with IRAs in the other Inuit regions of Canada, the Nunavik IRA works towards achieving a new way of knowledge sharing and engagement of Inuit in Arctic science and research. In addition to NCP support, the Nunavik IRA position is co-funded by ArcticNet.

Wildlife Contaminants Workshop: Linking wildlife and human health through a hands-on workshop

Project Leaders

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Project Team

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Abstract

We delivered an environmental contaminants training workshop for students in Nunavut Arctic College's Environmental Technology Program in Iqaluit from September 26 to 30, 2016. The workshop employed classroom lectures, group discussions, and interactive laboratory activities to teach core concepts, issues, and methodology related to the study and assessment of chemical contaminants in the Arctic environment from both scientific and Inuit perspectives. Students learned directly from Northern Contaminants Program research scientists about how contaminant trend monitoring programs are designed and conducted. Students also received hands-on training in specific methods for arctic char sampling and organic contaminant analysis. Students also took part in a unique dialogue with an experienced elder/hunter about traditional methods used to assess animal health and to determine the safety and quality of country foods. Throughout the workshop students learned methods for assessing health risks posed by contaminants in country foods, and participated in developing strategies to communicate contaminants research and health information to specific target audiences in Nunavut. A formal evaluation of the workshop found that student self-assessed knowledge of and ability to communicate about contaminant issues as well as dissection skills related to contaminant analysis increased in association with the instruction provided.

Key Messages

- The Wildlife Contaminants Workshop was held at the Nunavut Arctic College as part of the Environmental Technology Program in September 2016.
- Students, elders, community members, and researchers were involved in the workshop with the purpose of building shared knowledge and understanding of contaminants in northern wildlife.
- A structured evaluation was completed to determine the workshop's effectiveness in improving student understanding of northern contaminant research as well as enhancing student lab/dissection skills, communication skills, and critical thinking.
- Student self-assessed knowledge of and ability to communicate about contaminant issues as well as dissection skills related to contaminant analysis were all found to have improved during the workshop.

Learning about ringed seal health from contaminants science and Inuit Qaujimajatuqangit: An educational workshop in Resolute, Nunavut

Project Leaders

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Project Team

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Abstract

This project addresses a shared interest among Nunavummiut and scientific researchers in enhancing communications and community capacity building related to contaminants research on ringed seals. A workshop was held at the Qarmartalik School in Resolute Bay, Nunavut in the fall of 2016 with the objective of engaging youth, elders, community members and scientific researchers in learning about ringed seals from both Inuit Qaujimajatuqangit and scientific perspectives. The workshop involved students, elders, scientific researchers, school personnel and the local Hunters and Trappers Organization in a variety of activities designed to give students opportunities to learn about the local environment and wildlife from different perspectives. The main goal of this workshop was to allow scientists working on a NCP core monitoring project on contaminants in ringed seals to share information about the ongoing project with northern residents (with a focus on youth in particular), and provide an opportunity for Inuit elders to share with students their knowledge of seal ecology, and traditional methods for butchering seals, preparing seal skin, and identifying abnormalities in harvested game. The event included interactive presentations made by scientific researchers, as well as seal dissection and seal skin preparation activities guided by local elders. Through a series of surveys and discussions, the project also aimed to identify and inform communication practices and the development of innovative methods of community engagement around contaminants monitoring in wildlife.

Key Messages

- Integration of Inuit Qaujimajatuqangit to the core ringed seal monitoring NCP project was done through a community workshop.
- Teachers, community members, elders and students worked with researchers to increase local capacity in understanding contaminants in ringed seals and its preys.
- Students actively engaged with several types of classroom activities that involved learning about contaminants in the environment and ringed seals.
- Teachers welcomed researcher engagement in the classroom and encouraged the use of science to help improve literacy and numeracy skills.
- Teaching tools that re-enforced the use of vocabulary of English and Inuktitut in relation with ringed seals were welcomed and encouraged by school personnel.

Program Coordination and Indigenous Partnerships

National coordination and administration of the Northern Contaminants Program and facilitation of international action related to the long-range transport of contaminants into the Arctic

Project Leaders

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Project Team

Northern Contaminants Program Secretariat, Members of the NCP Management Committee (Council of Yukon First Nations, Dene Nation, Inuit Circumpolar Council – Canada, Inuit Tapiriit Kanatami, Crown-Indigenous Relations and Northern Affairs Canada, Environment and Climate Change Canada, Health Canada, Fisheries and Oceans Canada, Government of Yukon, Government of the Northwest Territories, Government of Nunavut, Kativik Regional Government, Nunatsiavut Government, ArcticNet), Yukon Contaminants Committee, NWT Regional Contaminants Committee, Nunavut Environmental Contaminants Committee, Nunavik Nutrition and Health Committee, Nunatsiavut Health and Environment Research Committee, Arctic Monitoring and Assessment Programme Secretariat, Arctic Institute of North America, and Canadian Polar Data Network

Abstract

The Northern Contaminants Program (NCP) engages Northerners and scientists in research and monitoring of long-range contaminants in the Canadian Arctic, and in making use of the data generated to: (a) assess ecosystem and human health in order to address the safety and security of traditional country foods that are important to the health and traditional lifestyles of northern communities; and (b) inform policy, resulting in action to eliminate contaminants from long-range sources. The NCP Secretariat, within Crown-Indigenous Relations and Northern Affairs Canada, provides the administrative, financial, and logistical support and coordination required to deliver the NCP within Canada, and facilitates Canada's action internationally with respect to initiatives and regulations related to the long-range transport of contaminants into the Arctic. Highlights for 2016-2017 included: (i) funding decisions from the April 2016 Management Committee meeting resulted in funding for 52 projects; (ii) the NCP Human Health Monitoring and Results Communication Workshop held November 22-23, 2016 in Ottawa enabled a dialogue among Indigenous people, researchers, Territorial / Regional Health authorities, and various federal departments, to identify human health biomonitoring needs in the North and how to better incorporate contaminant risk communication into health promotion communication; (iii) the addition of microplastics as a contaminant of emerging concern for the purposes of the NCP; (iv) the removal of the 3-year limit on community based projects; (v) progress on the writing and production of two new reports in the

Canadian Arctic Contaminants Assessment Report 2017 series; "Contaminants in Canada's North: State of Knowledge and Regional Highlights" and "Human Health"; (vi) initiatives to mark the 25th anniversary of the NCP; (vii) finalization of the "Principles and Guidelines for Data Management for Polar Research and Monitoring" document which describes the expectations of data archiving for NCP funding recipients; (viii) successful completion of the Phase10 Interlaboratory QAQC study involving 44 analytical labs (including 29 Canadian and 15 international labs) and release of the Phase9 report; (ix) Continued contributions to the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP), through which NCP data and information are put into a circumpolar context and used to inform policy decisions by the Arctic Council; (x) use of NCP data by the POP Review Committee as evidence for basis of recommendations with respect to Deca-BDE going forward for consideration to the UN Stockholm Convention on POPs, and to advance the evaluation of SCCPs and PFOA; (xi) information on NCP mercury monitoring and research was contributed to the Canadian National inventory that was submitted to UNEP Minamata Convention for presentation at the seventh Intergovernmental Negotiating Committee meeting held in March 2017 in Jordan; and (xii) on April 9, 2017 Canada ratified the Minamata Convention, becoming the 41st country to do so.

Key Messages

- The NCP Secretariat provides the administrative, financial, and logistical support and coordination required to deliver the NCP.
- The NCP facilitates international cooperation to identify the significance of long-range contaminant sources and their transport pathways and potential impacts on the environment and human health, and assists with the implementation and development of appropriate international controls on emissions and discharges of contaminants of significance to Canadian northern populations.
- The Minamata Convention on Mercury, a legally-binding agreement to cut emissions and releases of mercury to the environment, was ratified by Canada on April 7, 2017. Through use of its data, information and expertise, the NCP made important contributions towards this historic agreement.
- The Stockholm Convention on Persistent Organic Pollutants (POPs) is an international treaty that entered into force in May 2004, which aims to eliminate or restrict the production and use of POPs. The NCP plays a significant role in producing data that is used to evaluate candidate POPs for the Stockholm Convention.
- NCP continues as Canada's main contributor on contaminant issues to the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP). Contaminants-related efforts in 2016-2017, under the US chairmanship of the Arctic Council, were focused on the production of the AMAP assessments on: Chemicals of Emerging Arctic Concern; Biological Effects of POPs and Mercury on Wildlife; and Adaptation Actions for a Changing Arctic (regional reports).

Council of Yukon First Nations participation in the Northern Contaminants Program

Project Leaders

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Project Team

Yukon First Nations; Yukon Contaminants Committee which includes (Mary Vanderkop, Ainslie Ogden, and Dr. Brendan Hanley, Yukon Government; Mary Gamberg, private consultant and researcher; Ellen Sedlack, Government of Canada; Derek Cooke, Ta'an Kwäch'än Council)

Abstract

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

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 and these contaminants 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 contaminant research and contributing Traditional Knowledge.

Dene Nation participation in the Northern Contaminants Program

- **Project Leader**
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- **Project Team**
  Bill Erasmus, Dene National Chief/Assembly of First Nations Regional Chief NWT

Abstract

Dene Nation received funding from the Northern Contaminants Program (NCP) for the fiscal year 2016-2017. The funds supported Dene Nation's participation with the NCP Management Committee and the NWT Regional Contaminants Committee (NWTRCC). The funding was available through the Program Coordination and Aboriginal Partnerships envelope.

Dene Nation received this funding to participate in two NCP Management Committee meetings at Whitehorse, YK and Ottawa, ON as well as NWTRCC meetings and teleconferences. In addition, the funding was also provided in order for Dene Nation to report to its Leadership meetings and to the National Assembly, provide information to the communities as needed, enhance communications with the NWTRCC, and to participate with NCP working committees addressing traditional knowledge and other topics.

Key Messages

- Dene Nation participated on the NCP Management Committee.
- Dene Nation participated on the NWTRCC.
- Dene Nation provided advice to NCP on contaminant issues in the communities.
- Dene Nation acted as a liaison between NCP activities and the Dene Nation membership.

Inuit Tapiriit Kanatami National Coordination

Project Leader

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Project Team

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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 the Northern Contaminants Program (NCP). As the national political voice for Canadian Inuit, ITK continues to play multiple roles within the NCP. These roles include but are not limited to the following:

- ITK provides guidance and direction to CIRNAC and the other NCP partner's (HC, DFO, ECCC, 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.
- ITK is dedicated to facilitating appropriate, timely communications about contaminants in the North.
- ITK 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) that end-up in the Inuit diet.
- ITK works with other research programs to ensure that research on contaminants is conducted in a coordinated approach.

Key Messages

- ITK provides a voice for Inuit Nunangat during NCP discussions.
- As an active and constructive member of the NCP Management Structure, ITK ensures that contaminants issues and NCP research and results are communicated to Inuit, and that Inuit are represented at key regional, circumpolar and international meetings and initiatives.
- ITK contextualizes contaminant information in a broader communication process using the Inuit Knowledge Centre and other ITK structures (i.e NICoH)
- ITK develops the confidence of Inuit in making informed decisions about Country food use.
- ITK coordinates contaminants activities with other research programs.

Inuit Circumpolar Council - Canada: Activities in support of circumpolar and global contaminants instruments and activities

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Abstract

This report outlines ICC Canada's activities funded by the Northern Contaminants Program (NCP) in fiscal year 2016-17. 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, and input into the Canadian Arctic Contaminants Assessment IV (Human Health) report. Internationally, ICC Canada continued its activities related to the United Nations Environment Programme (UNEP). Work on the Stockholm Convention on Persistent Organic Pollutants (POPs) is ongoing, with ICC Canada attending the 12th POP Review Committee (POPRC) in September 2016. 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 continues to lead the SAON task force on community-based monitoring.

Key Messages

- ICC Canada actively supported NCP by working on the Management Committee, Environmental Monitoring and CBM technical review committees, and led Chapter 4 (on Chemical management, risk management, and contaminant communication) for the CACAR IV report (Human Health).
- ICC Canada attended the 12th POP Review Committee (POPRC) meeting, provided input in POPRC working group documents and informed the NCP about POPRC work.
- ICC Canada actively contributed to Arctic Council related work, attended the Arctic Monitoring and Assessment Programme (AMAP) Working Group and Heads of Delegation meetings, SAON meetings, and teleconferences of the SAON Executive Committee.

- ICC Canada was very active in the AMAP Human Health Assessment Group (HHAG) and co-led “Chapter 6 on Risk Communication for the AMAP Assessment 2015: Human Health in the Arctic”. A special issue was published from this assessment in the International Journal of Circumpolar Health, including a paper on risk communication (led by ICC Canada).

- A publication on mercury isotopes in ice cores and snow samples to identify mercury pathways and sources to the Arctic (Historical variations of mercury stable isotope ratios in arctic glacier firn and ice cores (Zdanowicz et al. 2016) was published in 2016 in the journal Global Biogeochemical Cycles.

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