Quantifying the Effect of Transient and Permanent Dietary Transitions in the North on Human Exposure to Persistent Organic Pollutants

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Background

The main route of human exposure to persistent organic pollutants (POPs) is via our diet. Thus, what foods we eat and where they come from are key determinants of POP exposure risk.

This relationship between diet and exposure is especially important for aboriginal Arctic populations, whose diet often includes traditional food items characterized by significant POP levels, such as ringed seal, narwhal, and beluga whale[1]. In fact, traditional food contaminant concerns have partly caused community trends of eating less of these items while increasing imported food consumption[2]. This dietary transition behaviour has contributed to declining POP levels among Northern populations[3], but has also coincided with increased rates of obesity and reduced nutrient intake[1].

In addition to long-term, population-wide dietary transitions among aboriginal Arctic groups, short-term individual dietary changes can also impact POP exposures. For example, temporary compliance with governmental dietary advisories, such as those regarding maternal fish consumption during pregnancy and nursing[4]. At present, the only consumption advisory published for Northern populations recommends that expectant, pregnant, and nursing women eliminate ringed seal liver intake due to mercury concerns[5]. No advisories for aboriginal Arctic groups currently exist for POPs.

Our past work has investigated how dietary transitions can potentially contribute to decreasing POP levels among Northern populations[6], and assessed the impact of temporary dietary changes on POP exposure among temperate mothers and their children[7]. Our current project goals are to extend this work by quantifying the impact of dietary transition behaviour in two real aboriginal Arctic communities using biomonitoring data, and extending our temperate dietary change work to Northerners by devising plausible traditional food substitution scenarios for POP-based advisories.

References

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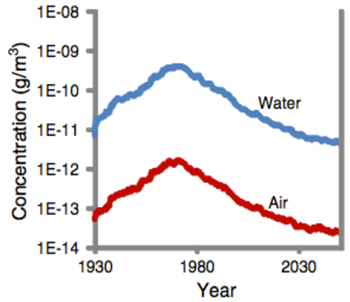
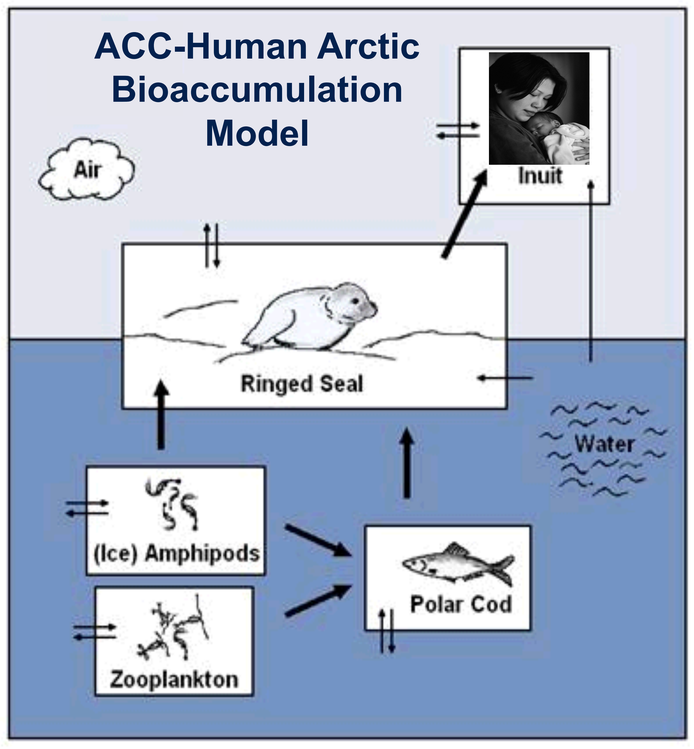
1. Our Modeling Approach

Using descriptions of global POP emissions we first estimate **Arctic environmental concentrations** through time; the below example is for polychlorinated biphenyl (PCB) 153, a chemical with peak Arctic levels predicted in the year 1974. Next, Arctic POP concentrations serve as inputs to the food chain model **ACC-Human Arctic**. POPs readily accumulate in organism lipid tissue, with concentrations regularly increasing substantially from one level of a food chain to another, termed **bioaccumulation**. As many traditional foods represent lipid-rich mammals consuming at high positions within food chains, aboriginal Arctic humans possess an elevated risk for POP exposure and toxicity.



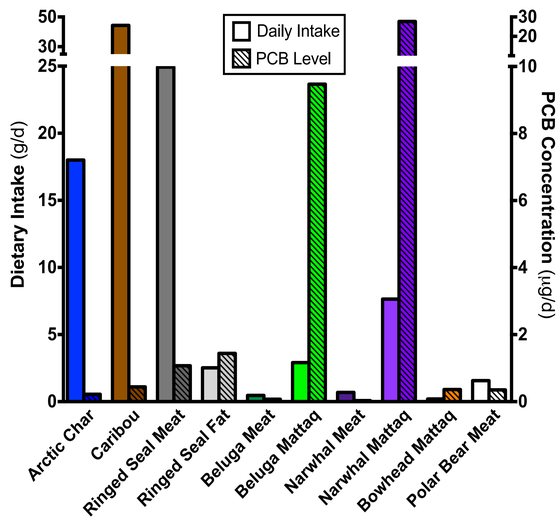
Arctic Environmental POP Levels

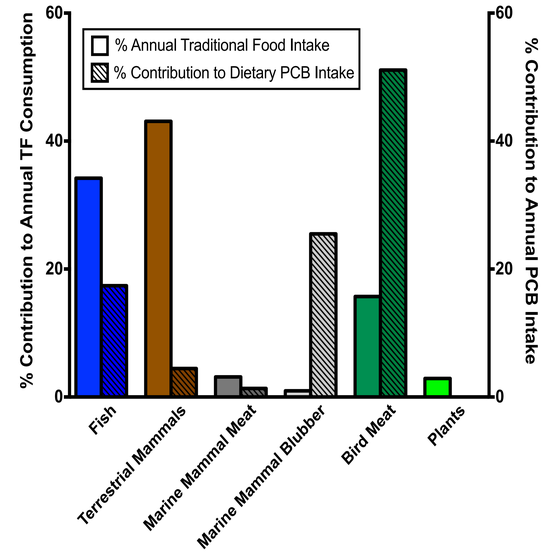


To more holistically simulate dietary transitions and changes in aboriginal Arctic populations we must **expand** our current food chain bioaccumulation approach. Based on biomonitoring data, we are currently developing distinct bioaccumulation models for **caribou**, **beluga whale**, **narwhal**, and **Canada goose**, while a **bowhead whale** model was recently completed.

2. Biomonitoring Data

Dietary questionnaire information and POP exposures from two maternal/infant health projects by health authorities from the **Baffin region** of Nunavut (1996-2007) and the **Inuvik region** of the Northwest Territories (1998-2006) will be used to **evaluate** our modeling approach using **measured biomonitoring data**. The coastal communities of Baffin were characterized by high consumption of, and POP exposure from, marine mammals, while the inland communities of Inuvik were characterized by greater consumption of, and POP exposure from, terrestrial animals and birds.





Baffin + **Inuvik**

3. An Expanded ACC-Human Arctic Food Chain