Ryan Bergin Mercury Report

June 12, 2019

Assessing the levels of mercury within edible plant and fungi species of Iqaluit, Nunavut and surrounding areas

Objectives:

To date, while there are numerous published articles on the impacts of mercury in Arctic wildlife species, literature on the accumulation in edible plant species is very limited, and, to our knowledge, nonexistent for edible mushroom species of the Canadian Arctic. The main objectives of this study are to evaluate the mercury content in edible plant and fungal species and the corresponding soils of the Canadian Arctic and estimate the potential intake risk of mercury by consumers.

Community based research conducted from July 23, 2018 until August 4, 2018 assessed the levels of mercury (Hg) within naturally growing, edible plant and fungi species of Iqaluit, Nunavut. Samples were taken at eight locations including: Sylvia Grinnell Park, the Road to Nowhere, the Boat Launch, the Old Airport, the Hill, the Nunavut Research Institute (NRI), the Creek and the Island as shown in Figure 1.

Upon continuation of the project from 2018, another field season in July 2019 will be completed and additional plant and fungi species will be sampled. The objectives are to assess the corresponding rhizosphere soils of plant and fungi species to determine whether the mercury accumulated within these species is absorbed from the soil or atmospheric in nature.

Methods:

Samples were harvested using a trowel and placed in a labelled bag, with equipment cleaned between each sample. Samples were placed in coolers and transferred to the NRI where they were separated into different components (leaves, roots, stems, and flowers), if possible, before Hg analysis. Samples were then dried at room temperature (~26-30°C) in a vented oven for >48 hrs and ground using a mortar and pestle. Approximately 50 mg of sample was weighed into a boat and placed in the DMA-80 Hg analyzer which determined the concentration of Hg in the sample. Students and local community members assisted with sampling, processing, preparing and analyzing plant and fungi samples. All data was gathered at the NRI and transferred back to Queens's University where it was analyzed and compiled into a written research article. Values <0.005 ppm indicate levels below the detection limit of the Hg analyzer.

Plant and fungi samples to be collected in July 2019 will follow the exact same method described above. For the soil samples, a trowel will be used to loosen the soil around the plant and placed in a labelled bag. The roots and mycorrhizae will be shaken free of all soil. Soil samples will be analyzed using the exact same method as for plant analysis.

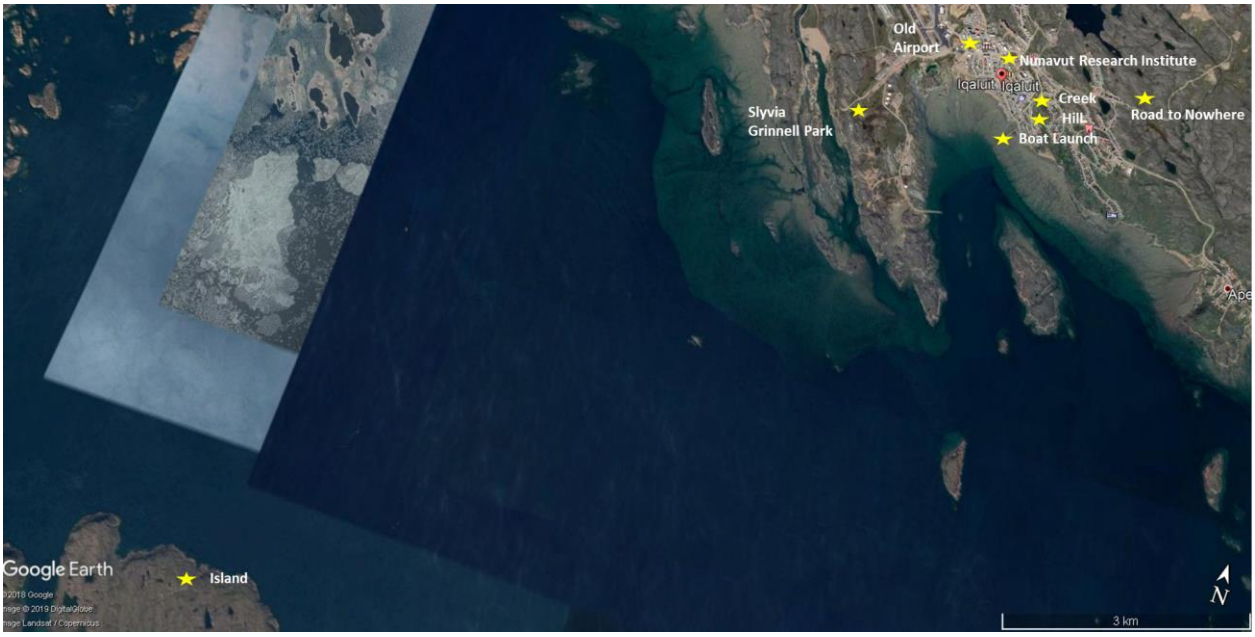

Figure 1. The eight sampling locations in Iqaluit, Nunavut. Map obtained and altered from Google Earth.

Results from 2018:

In total from the 2018 field component, 44 samples from 18 plant species, five samples from four lichen species and 74 samples from five fungal (mushroom) species that are edible and naturally occurring were identified by local community members, collected and assessed for mercury levels (Table 1). Hg data was compiled at Queen's University. Individual plant samples ranged from <0.005 ppm Hg dw (below the detection limit of the mercury analyzer) in the combined sample of *Dactylina arctica* (Arctic finger lichen) to 0.39 ppm Hg dw in a flower sample of *Pyrola grandiflora* (large flowered wintergreen). There was no obvious difference between concentrations of plant samples taken from the eight locations. Overall, the mean Hg concentrations of all plant samples were <1 ppm dry wt. Additionally, the mean Hg concentrations of all edible plant components were <0.5 ppm.

Table 1. Common and Latin names for plant and fungal species sampled in Iqaluit, Nunavut during the summer 2018.

Common Name	Latin name
Common dandelion	*Taraxcum officinale*
Dwarf fireweed	*Chamerion latifolium*
Arctic willow	*Salix arctica*
White mountain heather	*Cassiope tetragona*
Arctic thrift	*Armeria maritima subsp. sibirica*
Mountain sorrel	*Oxyria digyna*
Arctic poppy	*Papaver radicatum*
Large-flowered wintergreen	*Pyrola grandiflora*
Prickly saxifrage	*Saxifraga tricuspidata*
Yellow oxytrope	*Oxytropis maydelliana*

Arctic bladder campion	*Silene involucrate*
Alpine bistort	*Bistorta vivipara*
Nodding saxifrage	*Saxifraga cernua*
Arctic cotton grass	*Eriophorum scheuchzeri*
Crowberry	*Empetrum nigrum subsp. Hermaphroditum*
Lapland lousewort	*Pedicularis lapponica*
Labrador tea	*Rhododendron tomentosum subsp. Decumben*
Rockweed	*Fucus distichus*
Arctic finger lichen	*Dactylina arctica*
Snow lichen	*Flavocetraria nivalis*
Whiteworm lichen	*Thamnolia vermicularis*
Common puffball	*Lycoperdon perlatum*
Giant puffball	*Calvatia cretacea*
Sculpted puffball	*Calvatia sculpta*
Saffron webcap	*Cortinarius cf. croceus*
Mica cap	*Coprinellus micaceus*
Black lichen	*Unknown*

There was a wide range of mercury concentrations seen in the fungi analyzed, which varied between species and whether the species is considered a puffball. Individual fungal samples ranged from <0.005 ppm Hg dw. in a stem sample from *Cortinarius croceus* to 8.14 ppm Hg dw, in a single *Lycoperdon perlatum* sample.

The highest mean mercury concentrations of all species were found in the puffball species at 3.52 ± 2.0 ppm dw and 2.22 ± 1.59 ppm dw in the *Lycoperdon perlatum* and *Calvatia cretacea*, respectively. The lowest levels were found in *Cortinarius croceus* and *Coprinellus micaceus* at 0.23 ± 0.44 and 0.21 ± 0.16 ppm Hg dw, respectively, two non-puffball species. When considering the highest accumulating species on a wet weight basis, the mean mercury concentrations in the puffball species *Lycoperdon perlatum* and *Calvatia cretacea* (~78% moisture) were 0.88 ± 0.97 ppm ww and 0.43 ± 0.37 ppm ww, respectively. According to Health Canada (2018), the maximum allowable levels of Hg in food sold in Canada ranges from 0.5- 1 ppm wet wt.

Conclusion:

Various levels of Hg have been found in plant and fungal species of Iqaluit, Nunavut. This project is one of the first extensive studies assessing Hg contamination within plant and fungal species of the Canadian Arctic, as previous research efforts have primarily focused on fish and wildlife populations. Further analysis is needed to understand the effects of Hg accumulation on the surrounding human and wildlife populations as well as the route of Hg uptake into these plant and fungal species.

Research Outputs:

This research will be included in an individual chapter of a masters thesis to be prepared by Ryan Bergin through the School of Environmental Studies at Queen's University. This

chapter will eventually be submitted and published as a single article in journal. Additionally, an extensive report as well as a single page briefing document will be prepared and submitted to the NRI for distribution to locals and the community. Gathering additional samples in July 2019 will further complete the study of mercury accumulation in the Arctic and allow for further insights into the accumulation pathway of mercury and distribution within the individual species.

Acknowledgments:

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References:

Health Canada. (2018). Mercury in fish. Retrieved from the Government of Canada's website: https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/chemical-contaminants/environmental-contaminants/mercury/mercury-fish.html