CSI Husky Lakes - an update on mercury transfer in food webs of a unique Arctic estuary, the Husky Lakes (NT).

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Introduction

The Husky Lakes watershed (HLW) is a 'true' Arctic watershed, located entirely North of 66°.

Lakes in the HLW region are important to the people of Tuktoyaktuk and Inuvik. Popular for local fishermen are Yaya Lake, Big Lake, Noell Lake and the Husky Lakes.

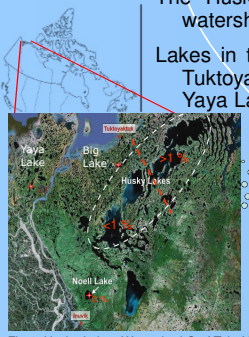


Fig 1: Husky Lakes Watershed S of Tuk, NT. Red digits indicate the salinity of Husky Lakes water. Asterisks identify additional study sites.

A salinity gradient (of 0.0-1.8%) exists within the HLW (Mills et al. 2008), as a result of marine inputs from Liverpool Bay to the lake.

Noell Lake Trout + 0 % salinity + CVC = [Hg]?

Lake trout is commonly harvested and known to grow faster and larger in this marine-influenced part of HLW (Mills et al. 2008).

Detailed information about the transfer of mercury in HLW food web and concentrations in harvested fish is limited.

Long term goal Identify the processes that drive mercury transfer and that respond to cumulative impacts in the HLW.

Short term goals 1. Provide baseline information on the HLW cryosphere, food webs, and mercury concentrations, and their interactions. 2. Further work with existing Inuvialuit Knowledge (IK) on subsistence fishing and use of the Husky Lakes. 3. Combine both knowledge bases to help develop future strategic monitoring.

Community involvement

- Inuvik-based co-lead: Aurora Research Institute (ARI).
- Consultation, public meetings, scoping sessions, and TK interviews.
- Regular updates to stakeholders in Tuktoyaktuk and Inuvik in public meetings or presentations (FJMC, ARI, ILA, TCC, HTC's).
- Hiring and training of local people for field work ('50:50 rule').
- Inuvialuit Knowledge (IK) is used to select sampling locations, timing and parameters within our scientific sampling efforts.

Relevance and benefits to the Inuvialuit Settlement Region

- ✓ Directly addresses research needs of the community.
- ✓ Highlight and preserve TK on ice and fish in the HLW.
- ✓ Know the range of contaminants in fish from HLW.
- ✓ Training and capacity building in relevant sampling methods.
- ✓ Pilot-project (2011-14) for community-based long term monitoring.




2011-13 Components, progress

1. Traditional Knowledge via semi-directed interviews.

- ✓ Semi-directed interviews with 14 local experts on IK of HLW ecology.
- ✓ 24 hours audio recording of IK on ice conditions, lake ecosystem, fish composition, fish health, fish habitat, and food webs.
- ✓ Mapping of local fishing locations and areas of significance to study the HLW food webs and ecosystem.
- ✓ Qualitative analyses identified common & emerging themes in IK shared by interviewees
- ❑ Verification by interviewees to ensure IK was documented accurately and interpreted correctly.
- ❑ Interview maps digitized into a GIS database for future use by researchers and communities.

2. Ice conditions, water chemistry, and water quality profiles determined to infer lake productivity.

- ✓ Abiotic data (Ice thickness and YSI) recorded Nov 11 – Sept 12.
- ✓ Analysis pending [Hg] data.

Husky Lake Trout + 1.8 % salinity + CVC = [Hg]

3. Food web analysis using stable isotopes of N and C.

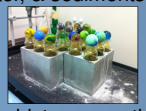
- ✓ Littoral & benthic invert community sampled (Nov 11, May & Aug '12).
- ✓ Invert and selected fish freeze dried analysed for C + N.

4. Mercury concentrations in fish

- ✓ 440 total fish collected in 2012 at all 4 study lakes.
- ✓ 108 Husky Lakes collected (Nov '11+ May 12 + Aug 12).
- ✓ Subset of fish analysed for [THg] using Tekran CVAFS system.
- ✓ [THg] Results compared to existing DFO data (1992, 2002).
- ✓ Monte Carlo dietary intake model built using Crystal Ball (v11.1, Oracle) according to [Hg] in Lake trout caught in Husky Lakes.
- ✓ EPA+DHA [Hg] obtained from literature (Lake Superior Lake trout)
- ✓ Estimated HgT exposure from Husky Lakes Lake trout if consumption ranged between 75 and 750 g/wk (uniform distribution).

5. Mercury Stable Isotopes – 'fingerprint'

- ✓ Variations of Hg SI ratios, a tool capable of indicating Hg processes and/or sources (Yin et al. 2010), determined in biota, water, & sediments.
- ✓ Selected samples extracted and analysed.
- ✓ Reveal lake-specific Hg 'fingerprint' in fish.



6. Fish ages and movement

- ✓ Fish ages and otolith microchemistry will elucidate life history, growth rates and movement of individual fish within the HLW, aiding the interpretation of [Hg].
- ✓ Otoliths extracted and analysed on laser-ablation ICP MS
- ✓ HL Lake Trout movement data – see Kissinger et al. poster

Results and discussion

Poster layout by N. Gantner: 'Cross-section' of Husky Lakes including stylized ice cover, salinity gradient, food web structure, and variable fish size.

Ice-conditions and limnology

- HL ice thickness ranges from 0-8ft during the year.
- Ice thickness did vary among lakes and basins.
- Salinity ranged from 0.1-17ppt in Husky lakes
- All lakes appeared mixed at time of sampling.
- Analysis and comparison to earlier studies at HL.

Mercury concentrations in Lake Trout

- Lake Trout mean [THg] = 0.13 (±0.06) µg/g ww (Fig. 1A) in 2011-12.
- [Hg] in HL Lake Trout remain low over a 17-year period (1995-2012).
- Lake Trout from HL can be frequently consumed without exceeding the HgT guideline established by JECFA (Fig.1B)

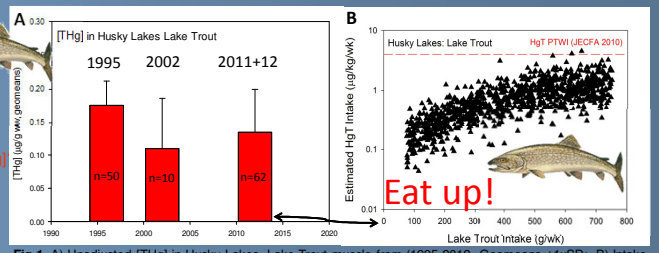
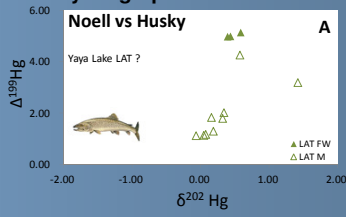


Fig 1. A) Unadjusted [THg] in Husky Lakes Lake Trout muscle from (1995-2012, Geomeans ±1xSD; B) Intake estimates of HgT from Husky Lakes Lake Trout. Dashed red line: Provisional tolerable weekly intake.

Mercury 'fingerprint' in Lake Trout



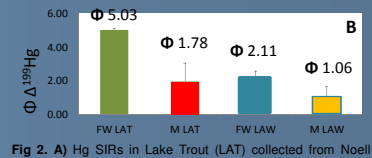
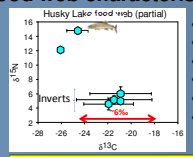
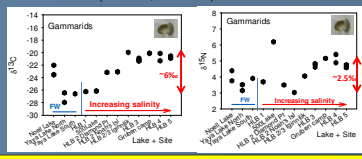


Fig 2. A) Hg SIRs in Lake Trout (LAT) collected from Noell Lake in 2009 (freshwater lake, n = 3) and Husky Lakes in 2011 (marine, n=3). **B)** Φ is calculated as the average MIF (Δ^{199}Hg) offset from sediment (freshwater n=4, marine, n=3) to fish in freshwater lakes (LAT n=3, LAW n=3) and marine influenced lakes (LAT n=9, LAW n=6).

Food web characteristics



- $\delta^{15}N_{LAT}$=14.8±0.5‰
- $\delta^{13}C_{invert}$ ±3.0‰
- $\delta^{13}C_{invert}$ ↓ in ↑ sal
- $\delta^{15}N_{invert}$ ±1.3‰
- $\delta^{15}N_{invert}$ ↑ in ↑ sal
- Baseline = ?



Knowledge gain

1. Use existing IK to aid study design, field work and interpret measurements.
2. Baseline information on mercury concentrations in harvested fish.
3. Mercury 'fingerprint' in fish, reflecting either variable Hg sources or differences in Hg processes (e.g., light conditions) in the water column.
4. Elucidate HLW food web interactions with water conditions and mercury.
5. Life history and extent of lake trout movement within the Husky Lakes.

HEALTH, ENVIRONMENT & INDIGENOUS COMMUNITIES RESEARCH GROUP

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References: ACIA 2005; Mills et al. 2008 DFO CTRFAS 2778; Yin et al 2010 AG 25:1467-77; Roux et al 2013

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