
Monica Pazerniuk – University of Manitoba, Department of Fisheries and Oceans Canada (DFO) Gary Stern – Department of Fisheries and Oceans Canada (DFO), University of Manitoba

Introduction

Hudson Bay (HB) is one of the largest inland shelf seas with a vast coastal freshwater region. HB and its drainage basin receive enhanced loadings of contaminants from land and river runoff, as well as long range atmospheric transport. Mercury may become the most important contaminant in the system as the climate warms. This is due to the release of Hg from frozen basin soils upon warming, through changes in wetland distribution and/or hydro reservoir flooding. These are stimulating enhanced microbial methylation of inorganic Hg (II) to methyl (MeHg), which is a toxic form of Hg that bioaccumulates.

Total mercury concentrations and stable isotopes were Quantified in biological samples collected during the 2003 and 2004 MERICA cruises. Churchill 2005 winter ice camp and during the ArcticNet Leg 2 HB cruise aboard the CCGS Amundsen (Sept 14 – Oct 27 2005). Water column measurements of salinity, and total mercury at various depths were also reported in an effort to better quantify physical and biological processes within the HB pelagic food web.

Methods

Water

Water samples were collected at particular depths in the water column using the Rosette in an effort to capture significant water column features. The “clean hands dirty hands” method of sampling was used in order to minimize sample contamination. Water for HgT was collected in 50 ml Falcon tubes pre-spiked with 250 µl ultra pure HCl (33-36%). Samples for methyl mercury were collected in 1 L amber bottles spiked with 5ml ultra pure HCl (33-36%). Samples were kept cold but not frozen until analysis at the University of Manitoba Ultra-Clean Trace Elements Laboratory (UCTEL) for trace level contaminants. Other nutrients including salinity, trace metals, OCs and 15N were analyzed at various analytical laboratories (data not shown).

Zooplankton and fish juveniles

See figures 1 and 2 for MERICA and ArcticNet cruise transects. Oblique, vertical, and Rectangular Mid-water Trawl (RMT) nets were deployed to obtain a representative sample of each station. Zooplankton were sorted into families and kept frozen in Whirpaks bags at -20°C. Sub-samples of each family were baked in an oven at 60°C overnight (to remove excess moisture) and were sent to the University of Winnipeg for stable isotope analysis. Remaining samples were freeze dried and analyzed (dry weight) by CVAA for Hg at DFO.

Adult fish and marine mammals

Samples were obtained from subsistence hunters in northern communities surrounding HB. Sub-samples of liver and muscle tissue from the 2005 hunts are in the process of having lipids removed before they are analyzed for stable isotopes. The remaining muscle tissue from 2003 – 2004 was analyzed (wet weight) by CVAA for Hg at DFO.

Results

2003 – 2004 MERICA

Mean total mercury (HgT) in HB surface water (10m) was lower in west HB compared to east HB (see figure 1 graph: Longitudinal HgT gradient HB 2003 water). Mean HgT in Hudson Strait surface water at stations HS16, 17 was 1.05 ± 0.01 ng/l, which was lower than mean HgT in Hudson Strait surface water (1.6 ± 0.8 ng/l) at stations HS11,18 (data not shown).

Mean HgT concentrations for zooplankton family Hyperiadeae (Themisto spp) were higher for HB proper compared to Zooplankton family Themisto (see figure 1 graph: Spatial HgT for 2003-2004 zooplankton). Mean HgT levels for Calanus spp. were similar in HB proper and Hudson Strait. The lower HgT levels for Calanus spp. was similar in HB proper and Hudson Strait. The lower HgT levels for Calanus spp. were compared to Hyperiadeae (Themisto spp) (mean was 0.18 µg/g) at stations HS1,18 (data not shown).

Higher concentrations of HgT in HB proper zooplankton families compared to Churchill Strait may be explained by the major river influences driving up the HgT concentration in HB. Including the Churchill, Nelson, and Great Whale Rivers. The more depleted δ13C levels for zooplankton in HB proper compared to Churchill Strait are indicative of more terrestrial influence due to fast flowing water runoff from rivers in HB proper. Themisto spp. had higher δ13C values and therefore higher calculated trophic levels than Calanus spp. (on average due to the carnivorous diet of Themisto spp). Regional FWMFs were calculated however the slopes of the graphs were entirely dependent on the higher trophic level fish and marine mammals, which makes apparent differences suspect. More investigation is needed in this area.

The significantly lower δ13C values for large Anonyx in Churchill 2005 is due to the fact that they are caught on this ocean floor i.e. in a more boreo-ice environment compared to the other zooplankton collected. Most of the biomass from the Churchill 2005 collection is a mixture of phytoplankton and ice algae, therefore a lower HgT level is expected for these samples.

Acknowledgements

This project was made possible with the financial and logistic support of ArcticNet, the University of Manitoba, and Department of Fisheries and Oceans Canada. Special thanks to York/Smith Consultации Inc. and Environment Canada for the support during the summer season as well as the HTF for assistance in obtaining marine mammal samples. Thankyou Zou Zou Chow, Alirah Hara and Gary Stern for their endless support.

Summary

1. Water total mercury concentrations in East Hudson Bay were higher than in West Hudson Bay in 2003.
2. Total mercury concentrations in two abundant zooplankton families (Hyperiadeae and Copepods) were higher in Hudson Bay compared to Hudson Strait in 2003 and 2004 due to the flow of the strong North Atlantic current.
3. Spatial HgT for zooplankton were more depleted in Churchill Bay compared to Hudson Strait due to a higher terrestrial influence caused by water runoff from rivers.
4. Food Web Magnification Factors (FWMFs) were calculated to be 3.74 for East Hudson Bay and 2.66 for West Hudson Bay in 2003.

5. Results from Churchill 2005 displayed depleted δ15N values for pelagic zooplankton compared to benthic amphipods and higher levels of HgT in Anonyx and Hyperiadeae families compared to the biomass.
6. Samples from the ArcticNet Leg 2 cruise 2005 are in process (figure 2).

Future

More fish species from HB are required in order to completely map out the pelagic food web. Methods for fishing alternative to trawling off the Amundsen include angling and netting from local community fishing vessels. The quest for representative samples of Arctic Cod and other pelagic fish species continues. Further size comparisons among Themisto spp. in relation to HgT may provide insight to bioaccumulation within this zooplankton family.

Reference


Acknowledgements

This project was made possible with the financial and logistic support of ArcticNet, the University of Manitoba, and Department of Fisheries and Oceans Canada. Special thanks to York/Smith Consultations Inc. and Environment Canada for the support during the summer season as well as the HTF for assistance in obtaining marine mammal samples. Thankyou Zou Zou Chow, Alirah Hara and Gary Stern for their endless support.

Figure 2. ArcticNet cruise transects 2005 - Biological samples collected.

Figure 1. MERICA cruise transects 2003-2004 and results highlights.