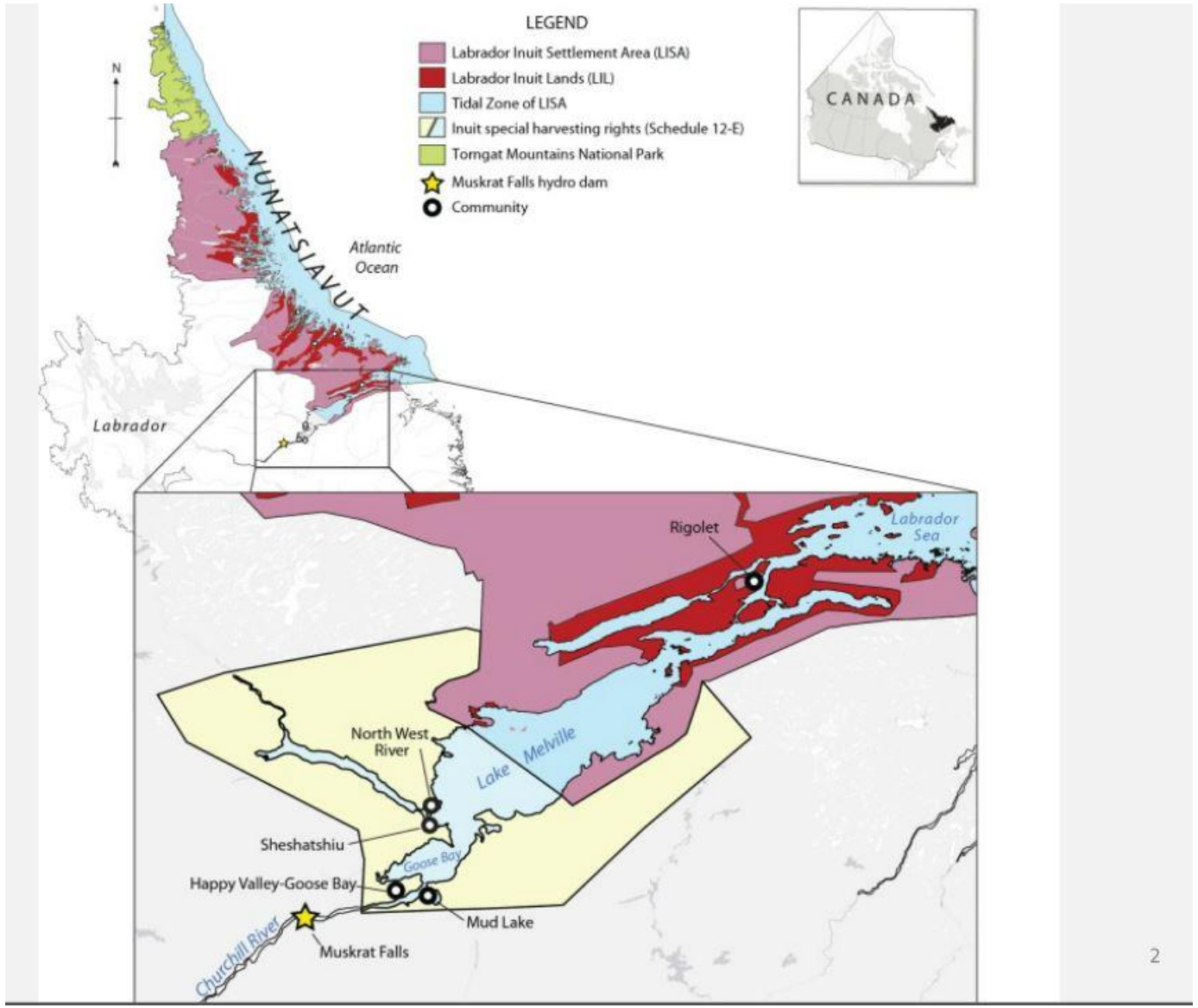
LAKE MELVILLE: AVATIVUT, KANUITTAILINNIVUT (OUR ENVIRONMENT, OUR HEALTH)





LEGEND
Labrador Inuit Settlement Area (LISA)
Labrador Inuit Lands (LIL)
Tidal Zone of LISA
Inuit special harvesting rights (Schedule 12-E)
Torngat Mountains National Park
Muskrat Falls hydro dam
Community
N
CANADA
NUNATSIAVUT
Atlantic Ocean
Labrador
Rigolet
Labrador Sea
North West River
Lake Melville
Sheshatshiu
Goose Bay
Happy Valley-Goose Bay
Mud Lake
Churchill River
Muskrat Falls

Muskrat Falls hydro dam

Lake Melville research program

What did the project tell us?

Funding

Lake Melville: Avativut, Kanuittailinnivut Research Program

University of Manitoba

Memorial University

Tides Canada

ArcticNet

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Nunatsiavut Research Partnership and Capacity Building Program

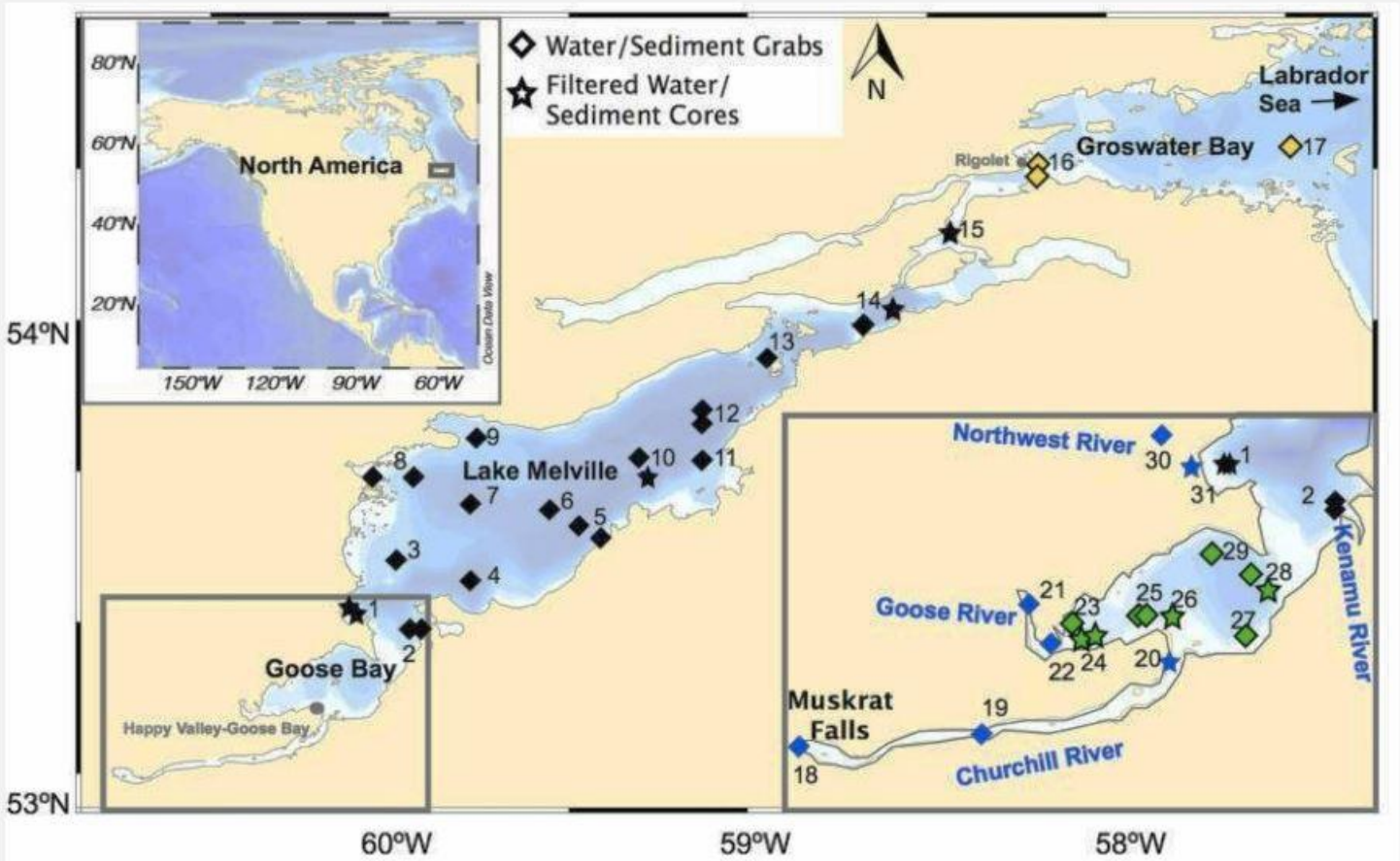
Biogeochemistry of Global Contaminants HARVARD

NIEHS National Institute of Environmental Health Sciences

Lake Melville Research Program


Angnatok
101491

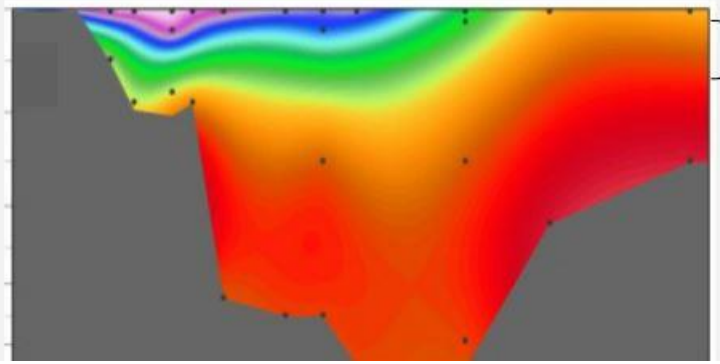
Field sampling in Lake Melville (2012-2014)



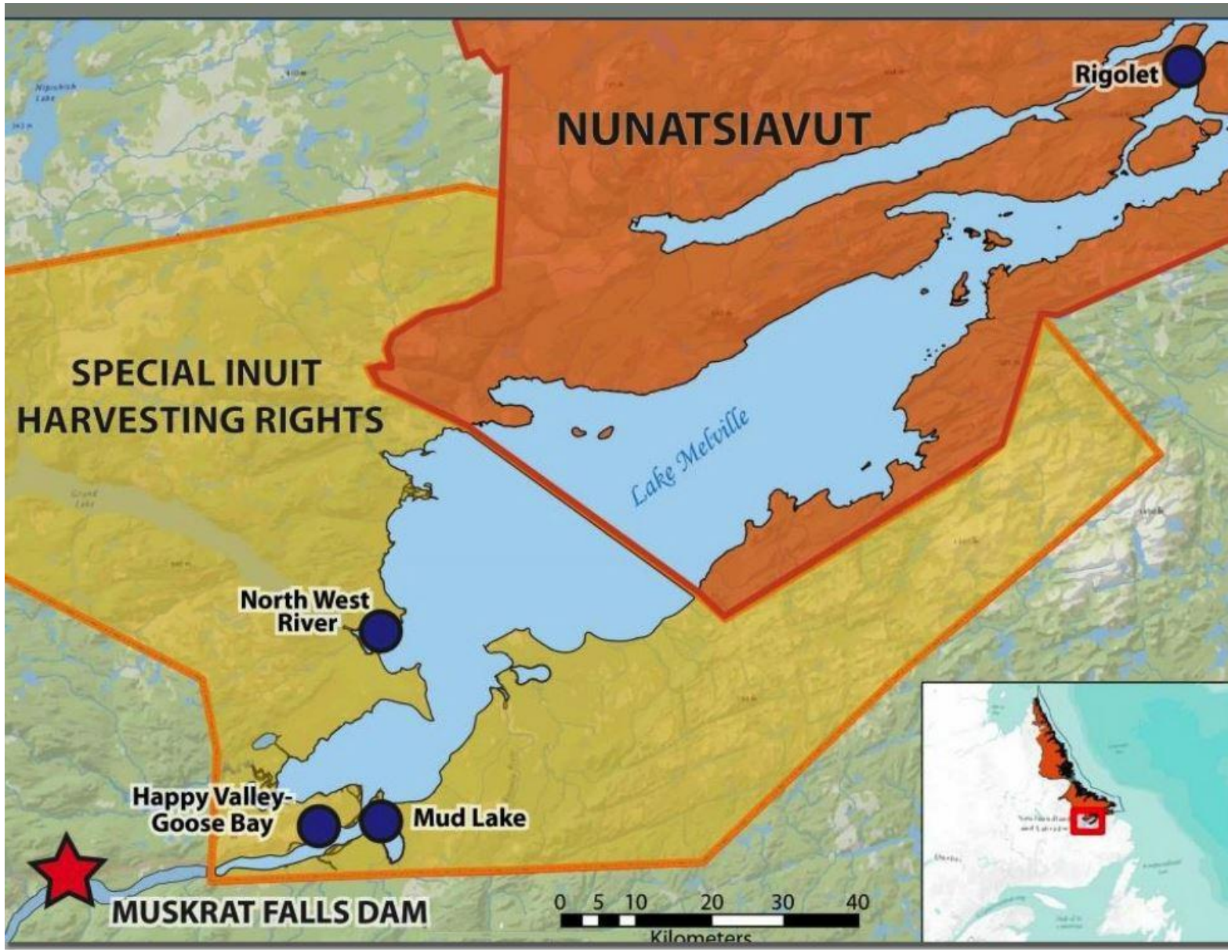
First observations of Lake Melville - 2012

- Lake Melville dynamics driven by large freshwater input from rivers.
  - Freshwater discharged at the mouth of the Churchill river moves across the entirety of Lake Melville

SALINITY:



Sediments and organic carbon

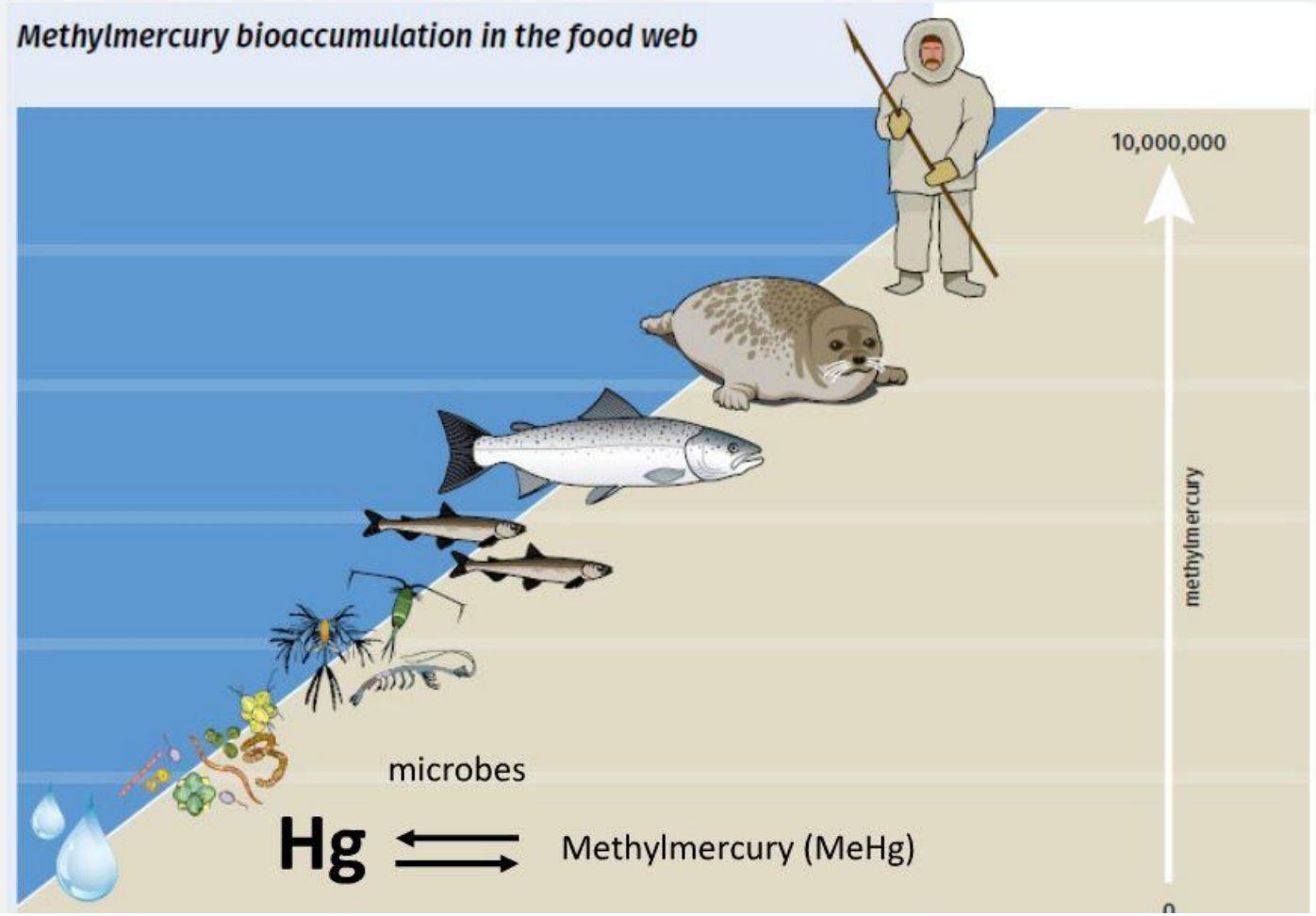

NUNATSIAVUT
Rigolet
SPECIAL INUIT
HARVESTING RIGHTS
Lake Melville
North West
River
Happy Valley-
Goose Bay
Mud Lake
MUSKRAT FALLS DAM
0 5 10 20 30 40
Kilometers

The form of mercury determines its health impact

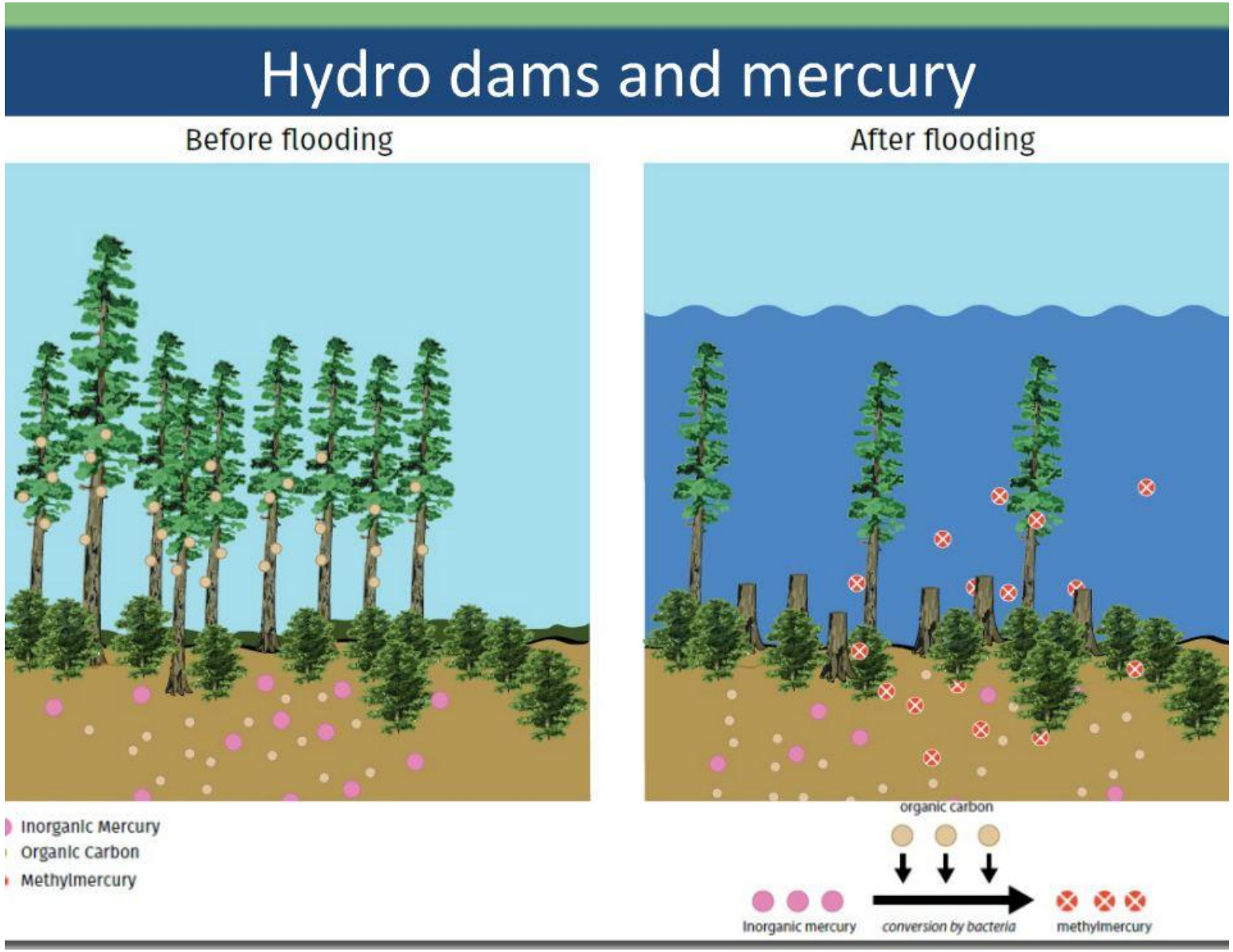
- Inorganic mercury
  (i.e., quicksilver and Hg^{II})
  - Low absorption (0.01 – 7% avg)

- Methylmercury
  - High absorption (>90%)
  - Primarily a central nervous system toxin

Key Inuit concern - Methylmercury

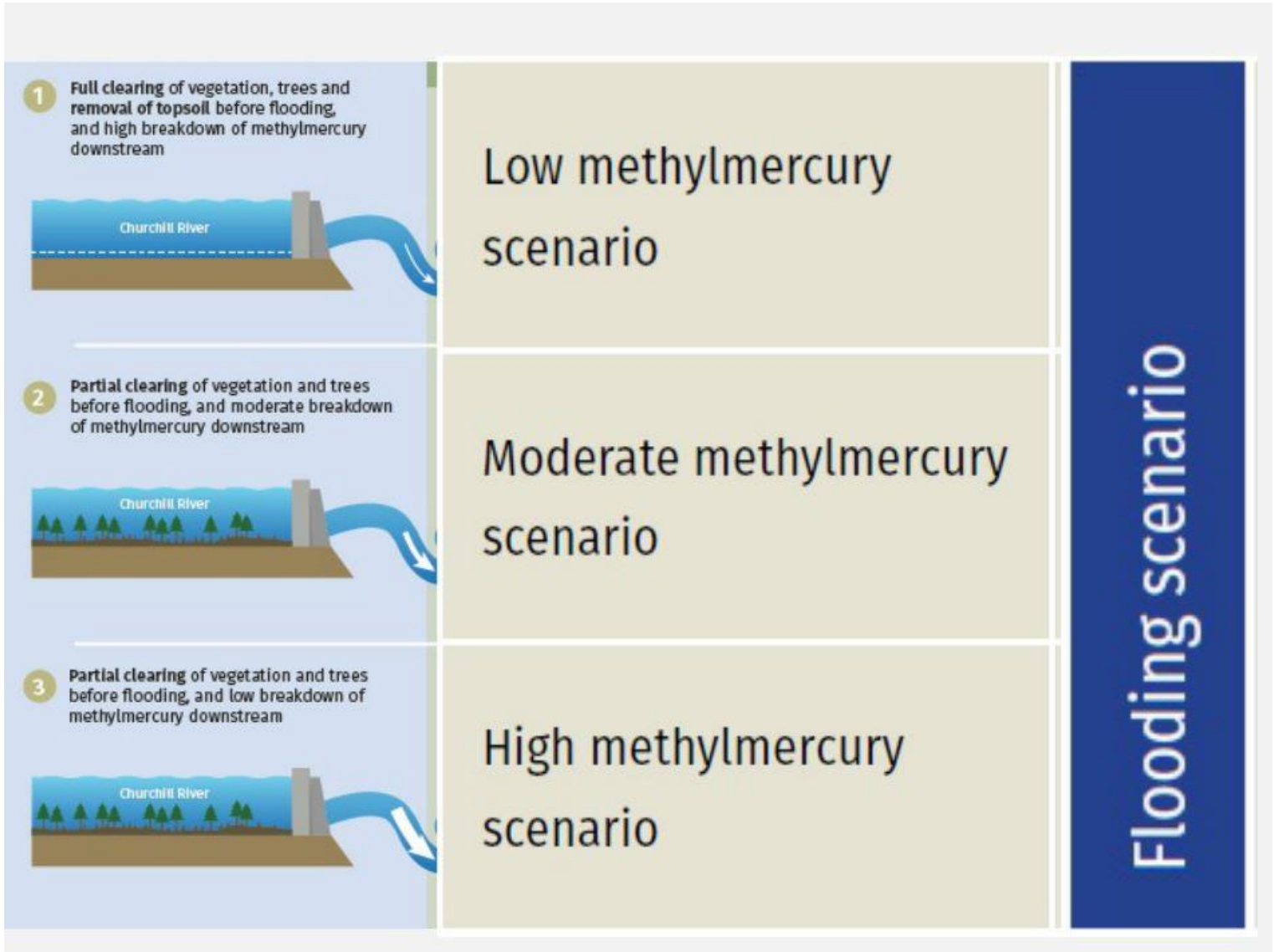


Hydro dams and mercury



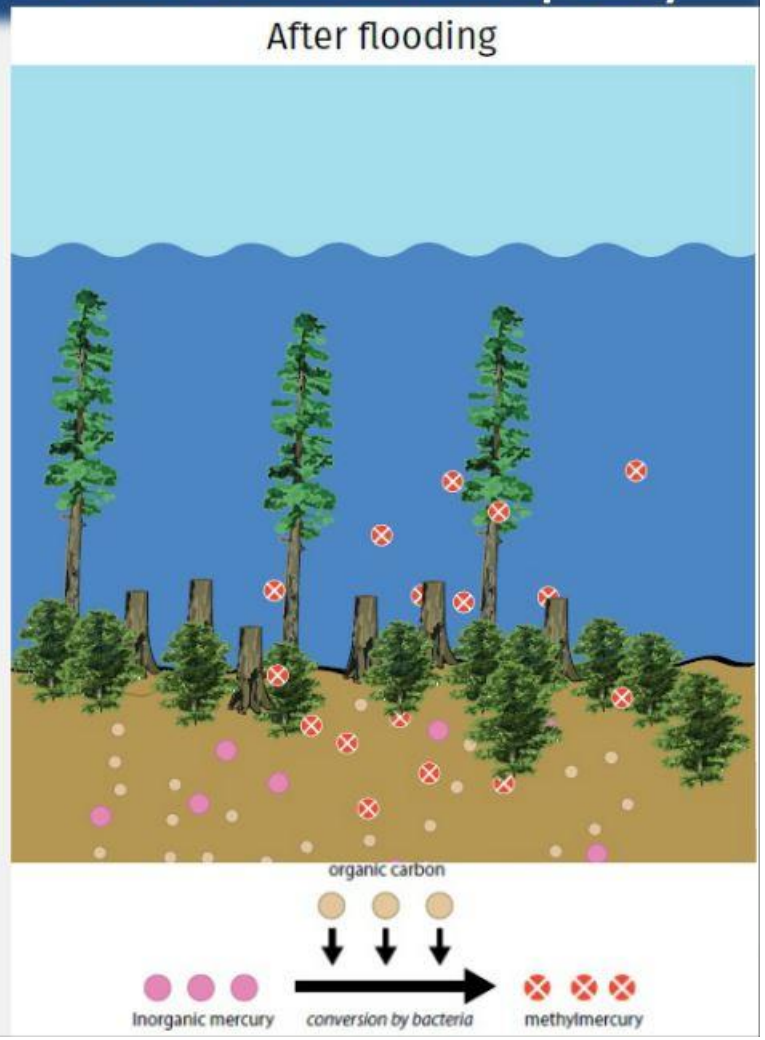
Components of impacts analysis

1. Pulse of methylmercury in the flooded reservoir
2. Accumulation of methylmercury in the downstream environment (Lake Melville)
3. Uptake of methylmercury in country foods (birds, fish, and seal)
4. Current and projected Inuit methylmercury exposure

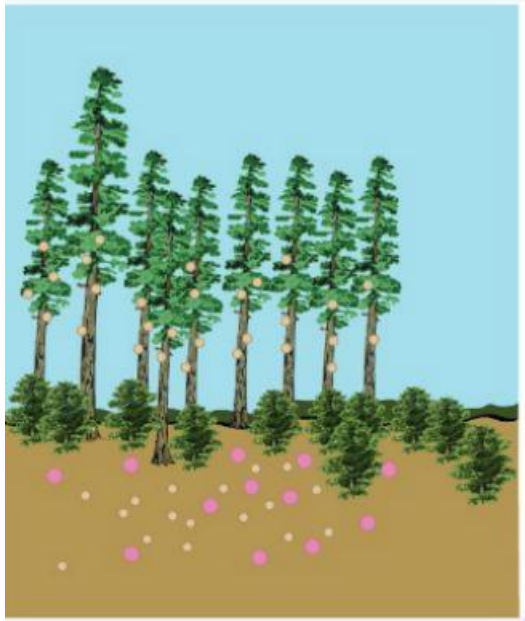

1 Full clearing of vegetation, trees and removal of topsoil before flooding, and high breakdown of methylmercury downstream
Churchill River
Low methylmercury scenario
2 Partial clearing of vegetation and trees before flooding, and moderate breakdown of methylmercury downstream
Churchill River
Moderate methylmercury scenario
3 Partial clearing of vegetation and trees before flooding, and low breakdown of methylmercury downstream
Churchill River
High methylmercury scenario
Flooding scenario

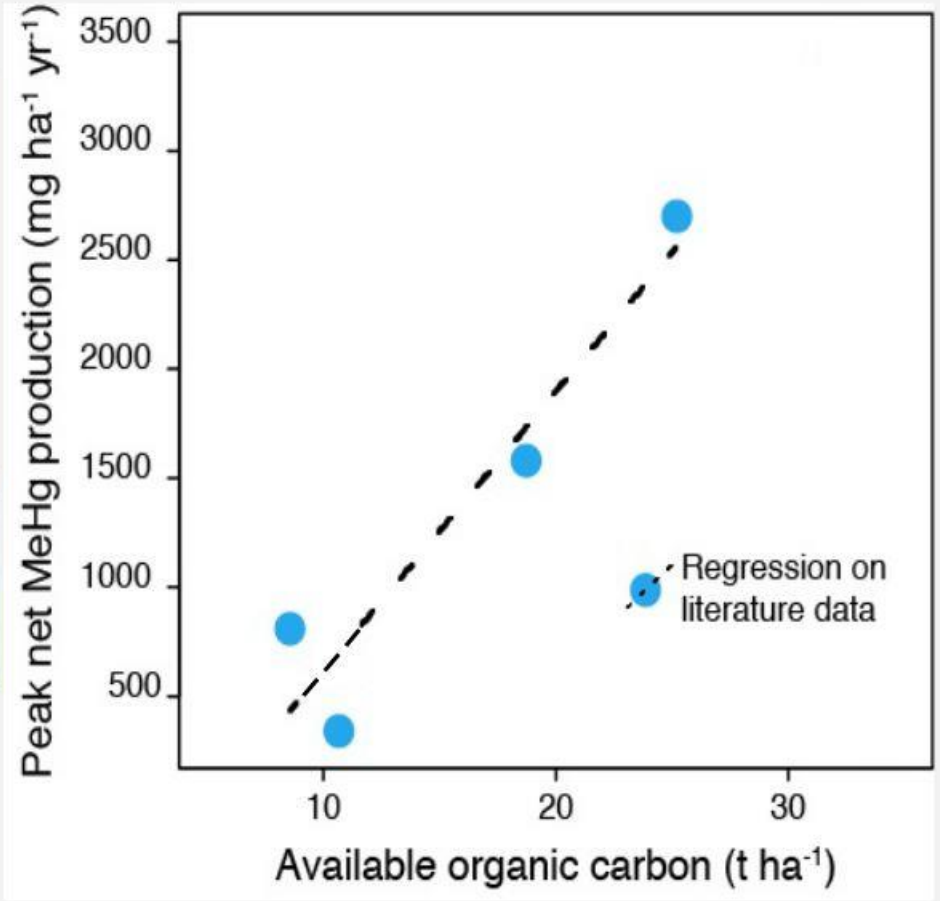
MeHg in Flooded Reservoir Increases Rapidly

Rapid increase in methylmercury in river water above saturated soils 3-days after flooding



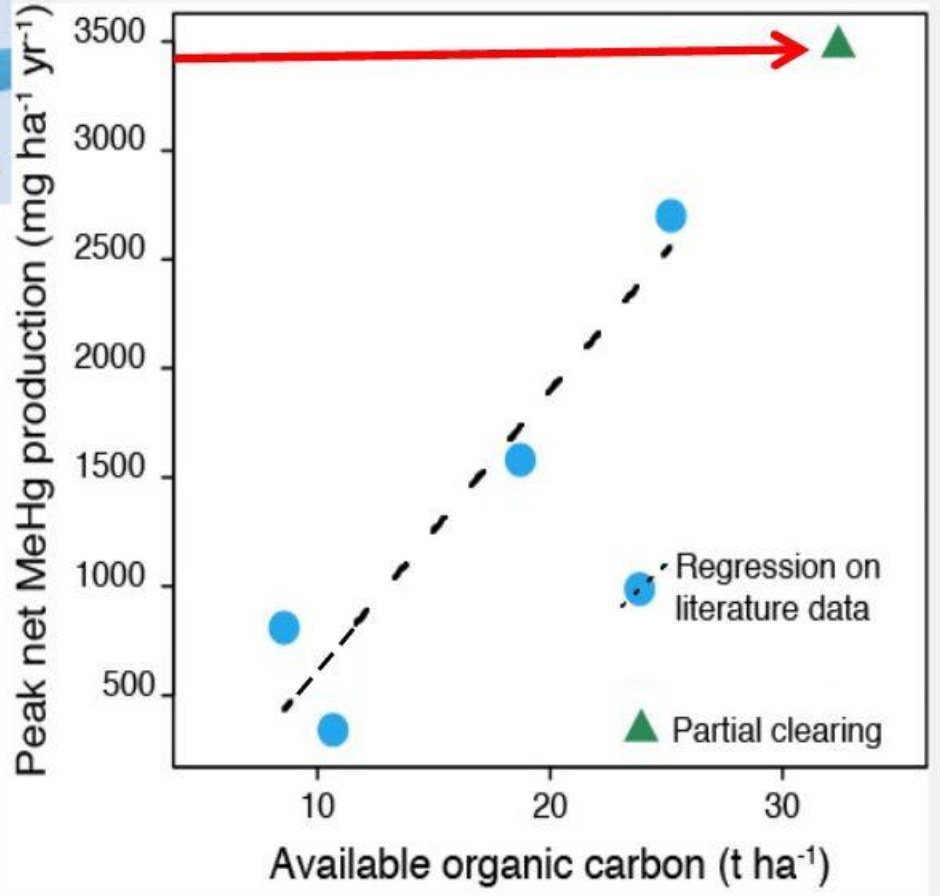
Magnitude of Reservoir Methylmercury Pulse





Magnitude of Reservoir Methylmercury Pulse

Partial clearance

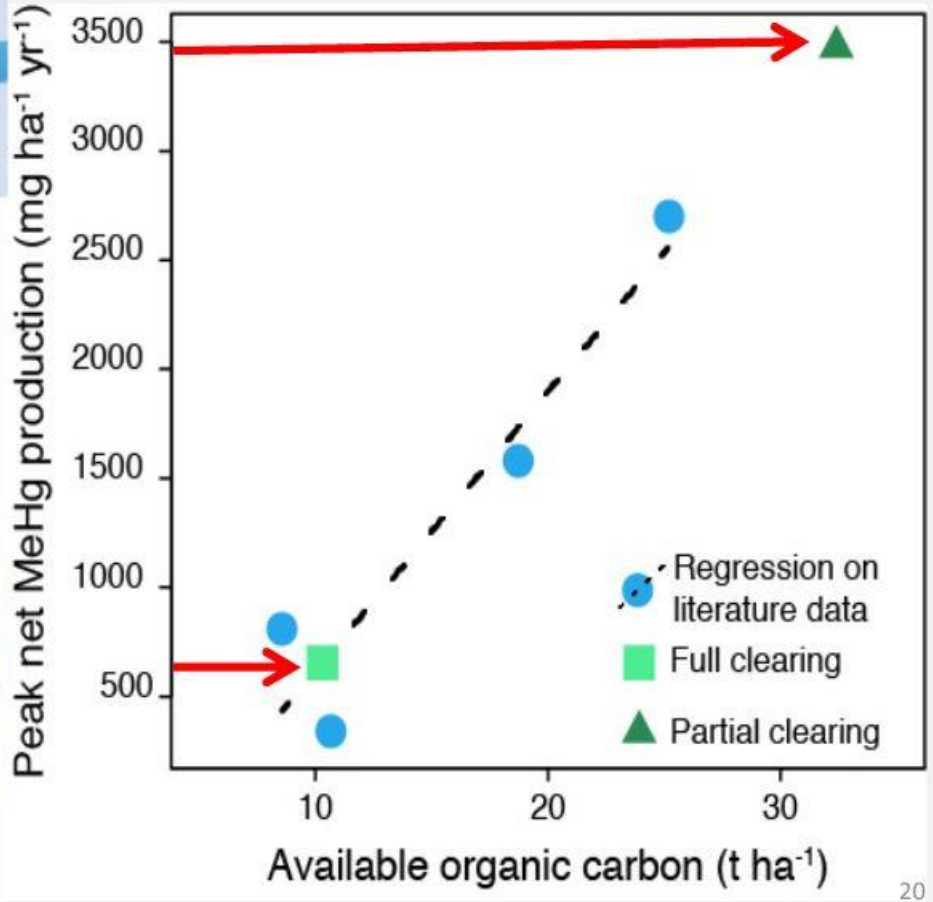


Magnitude of Reservoir Methylmercury Pulse

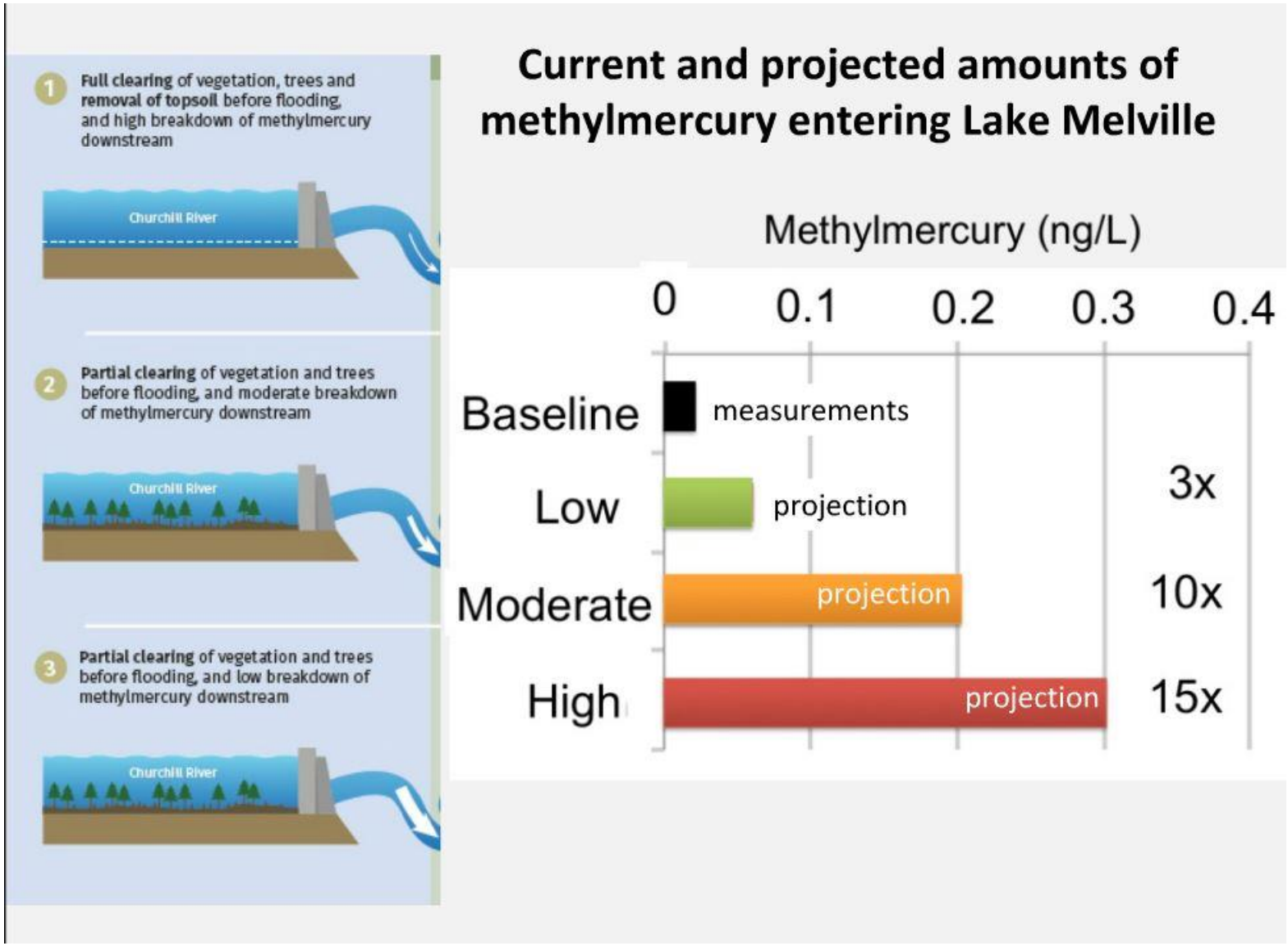
Partial clearance

Difference in amount of reservoir clearance results in much lower methylmercury production

Full clearance



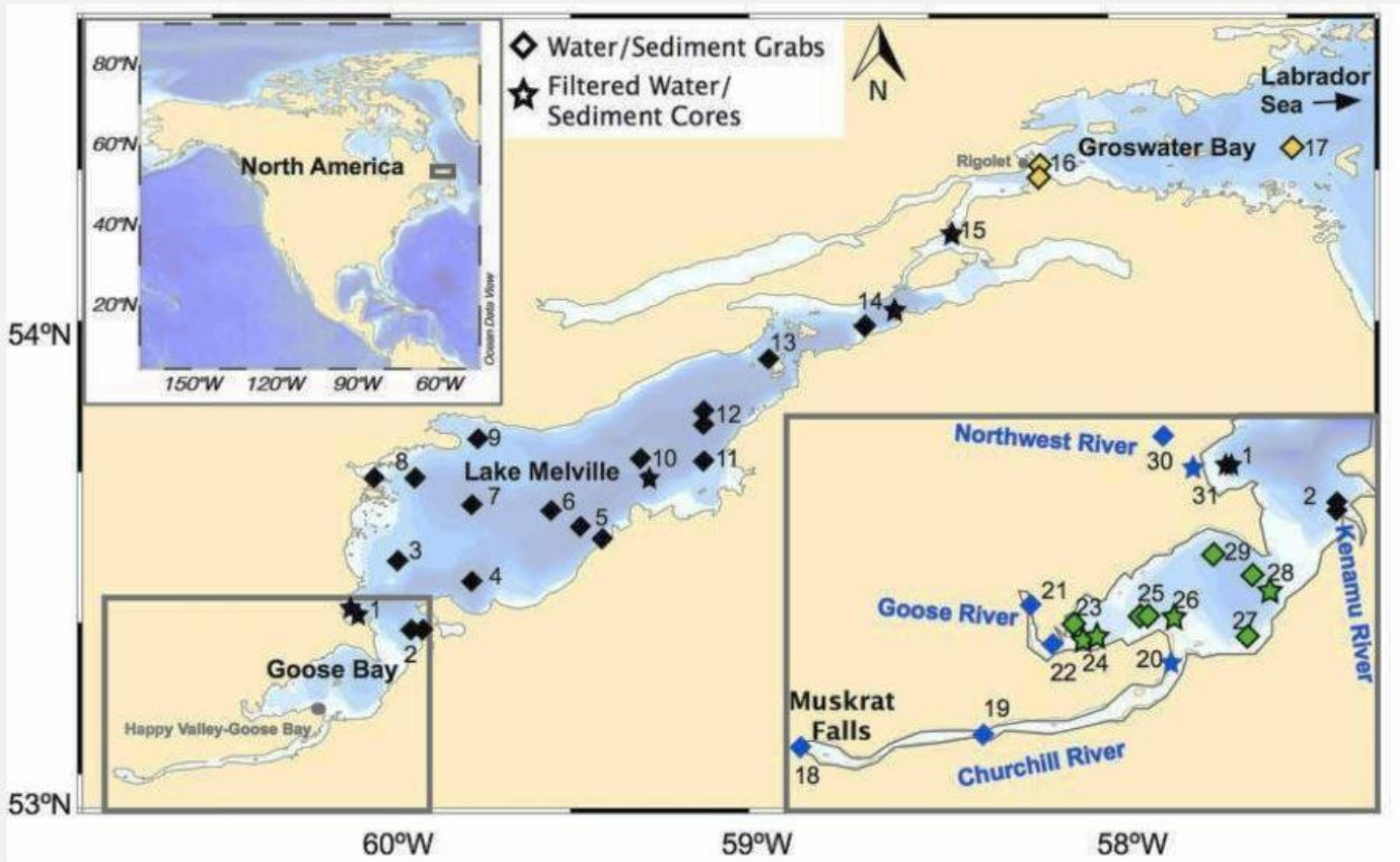
Methylmercury in Churchill River


1 Full clearing of vegetation, trees and removal of topsoil before flooding, and high breakdown of methylmercury downstream
Churchill River
2 Partial clearing of vegetation and trees before flooding, and moderate breakdown of methylmercury downstream
Churchill River
3 Partial clearing of vegetation and trees before flooding, and low breakdown of methylmercury downstream
Churchill River
Current and projected amounts of methylmercury entering Lake Melville
Methylmercury (ng/L)
0
0.1
0.2
0.3
0.4
Baseline
measurements
Low
projection
3x
Moderate
projection
10x
High
projection
15x

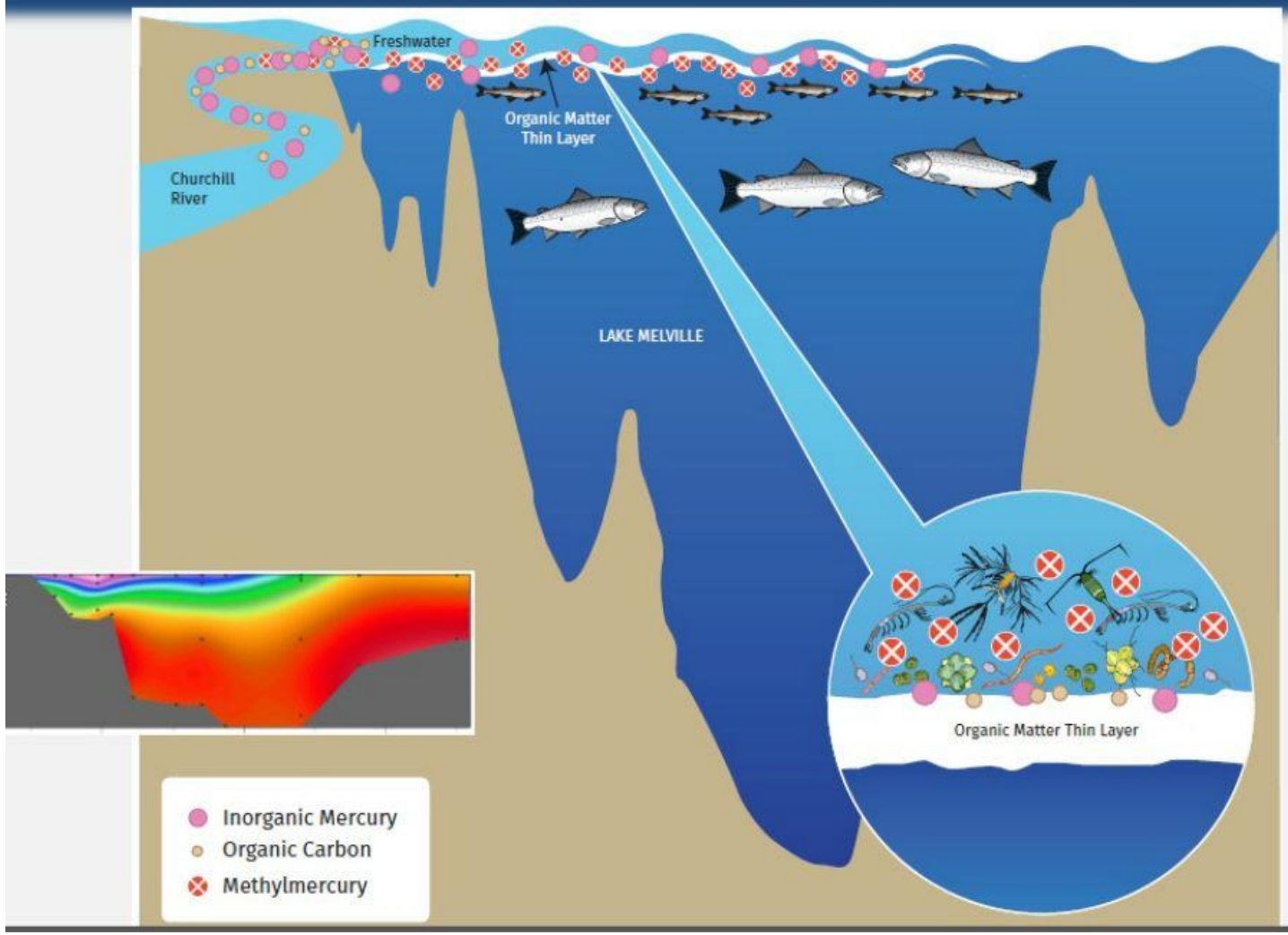
Components of impacts analysis

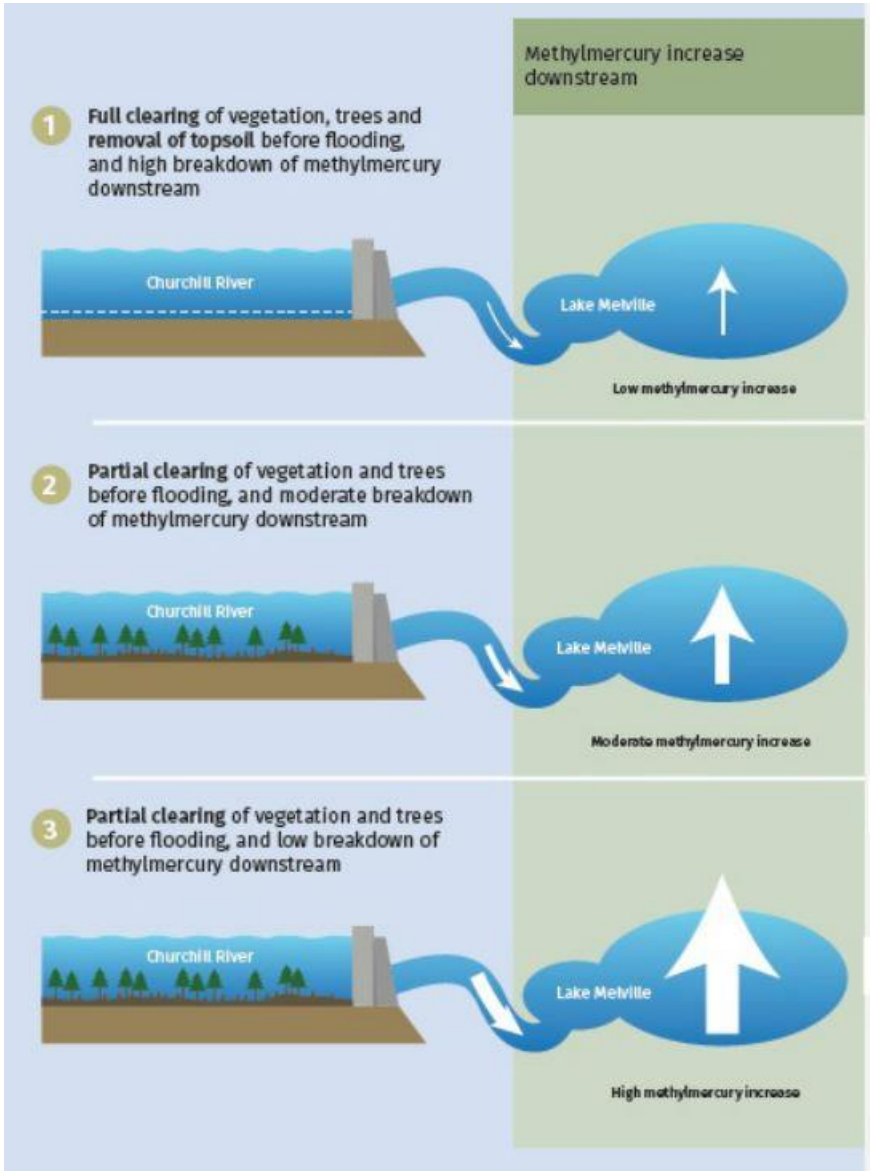
1. Pulse of methylmercury in the flooded reservoir
2. Accumulation of methylmercury in the downstream environment (Lake Melville)
3. Uptake of methylmercury in country foods (birds, fish, and seal)
4. Current and projected Inuit methylmercury exposure

Field sampling in Lake Melville (2012-2014)



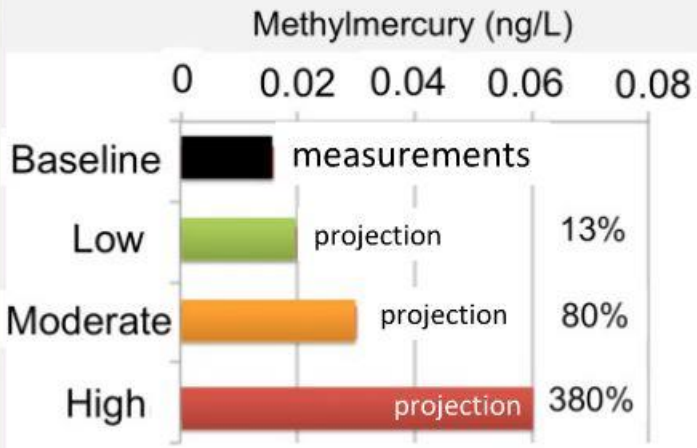
Distribution and production

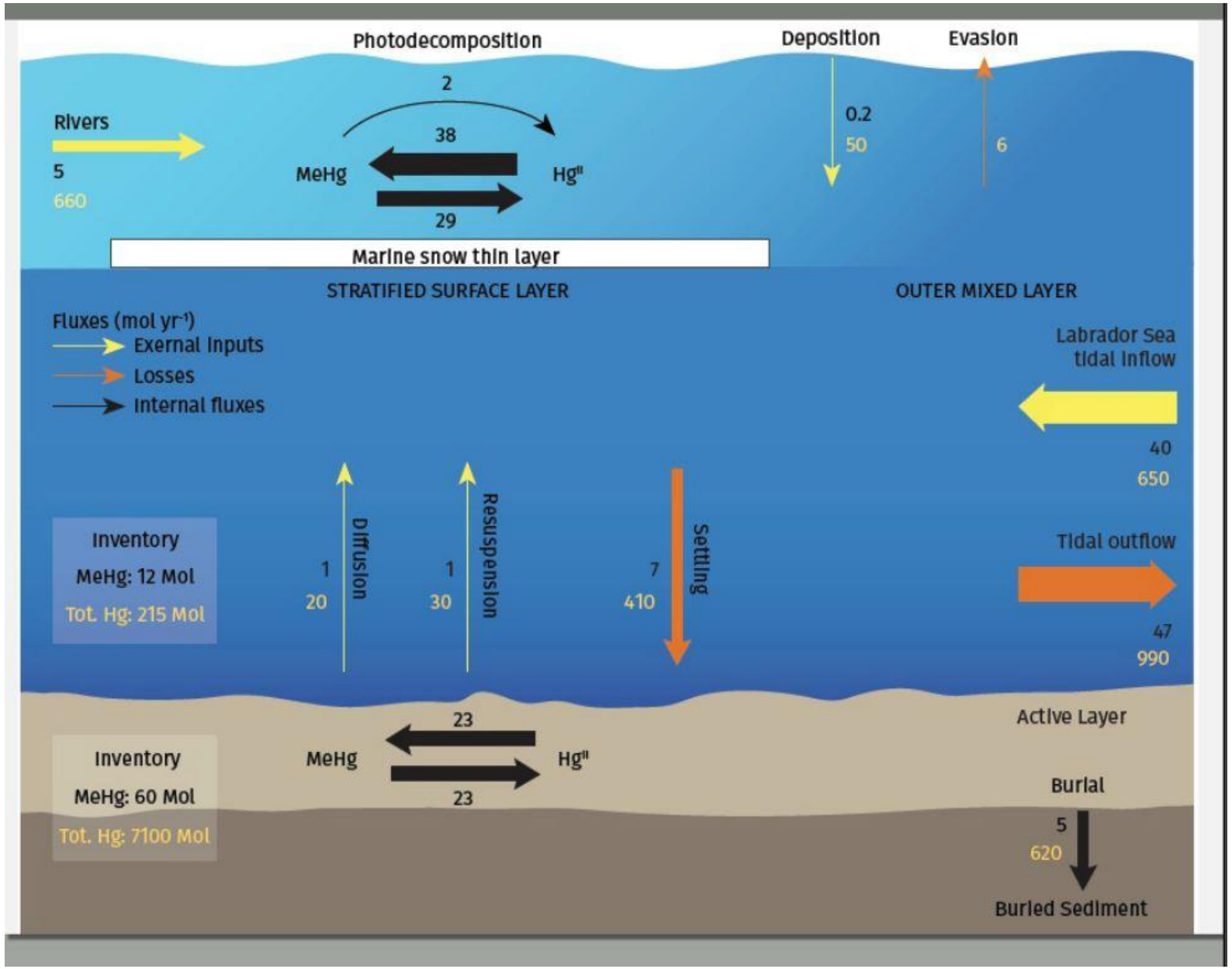




"*Lake Melville is not included within the Assessment Area as there will be no change in flow or salinity, water temperature, ice or other physical disturbance beyond the mouth of the Churchill River from this Project.*" (Nalcor Energy 2009)

Increase in Lake Melville surface water methylmercury

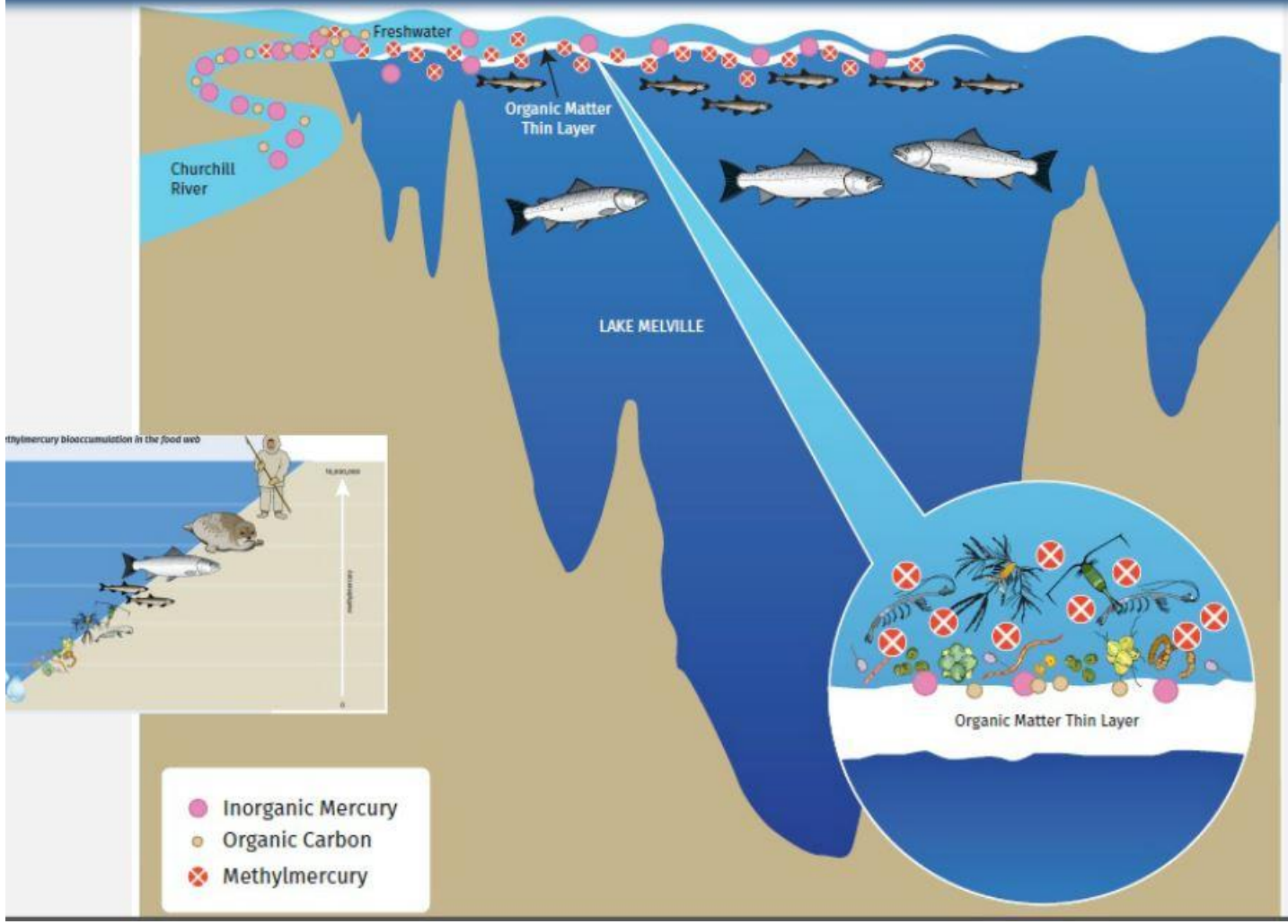



Photodecomposition
Deposition
Evasion
2
Rivers
38
0.2
50
6
5
660
MeHg
Hg^{II}
29
Marine snow thin layer
STRATIFIED SURFACE LAYER
OUTER MIXED LAYER
Fluxes (mol yr^{-1})
Exernal Inputs
Losses
Internal fluxes
Labrador Sea
tidal inflow
40
650
Inventory
MeHg: 12 Mol
Tot. Hg: 215 Mol
Diffusion
1
20
Resuspension
1
30
Setting
7
410
Tidal outflow
47
990
Active Layer
23
Inventory
MeHg: 60 Mol
Tot. Hg: 7100 Mol
MeHg
Hg^{II}
23
Burial
5
620
Buried Sediment

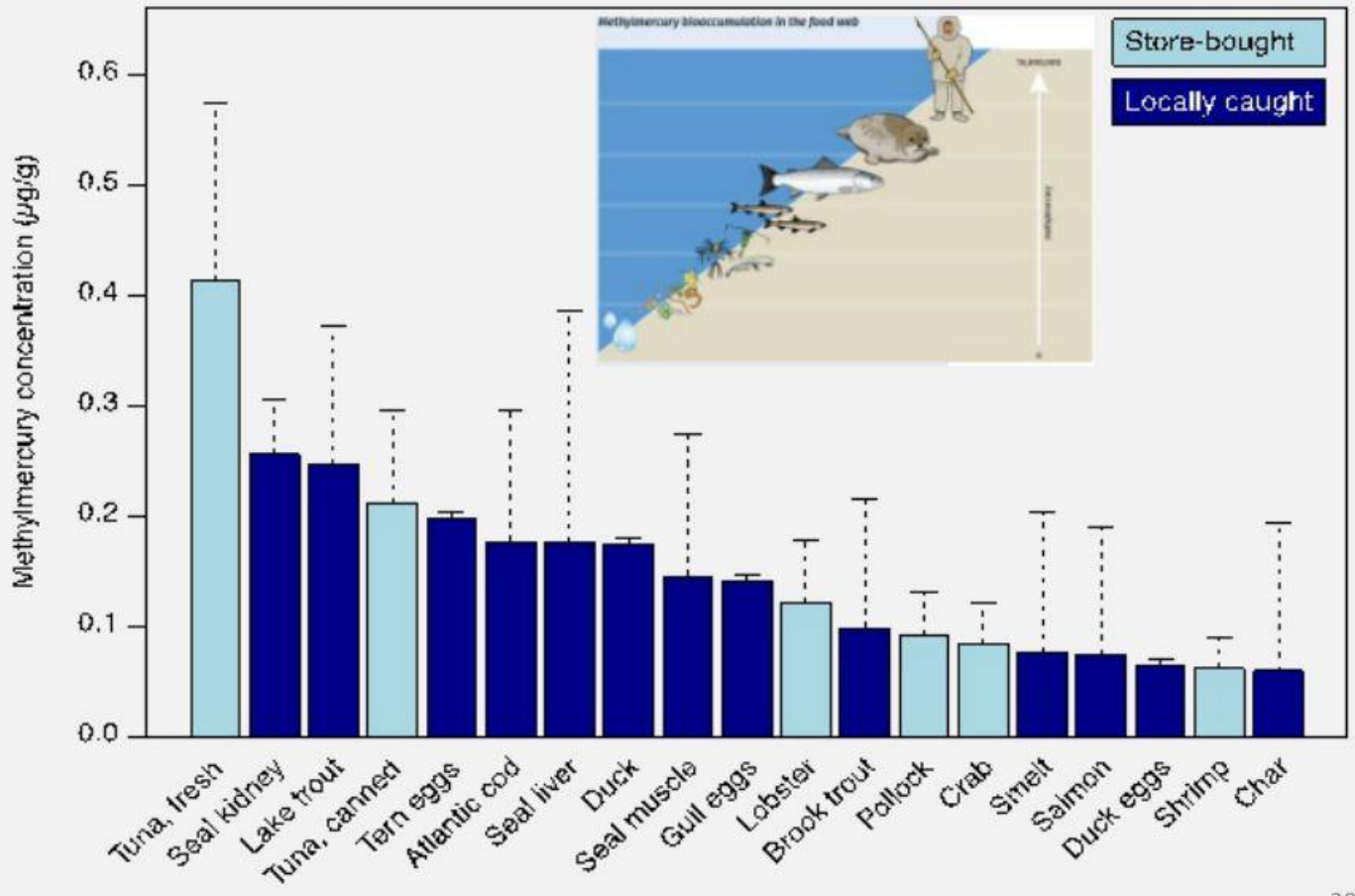
Components of impacts analysis

1. Pulse of methylmercury in the flooded reservoir
2. Accumulation of methylmercury in the downstream environment (Lake Melville)
3. Uptake of methylmercury in country foods (birds, fish, and seal)
4. Current and projected Inuit methylmercury exposure

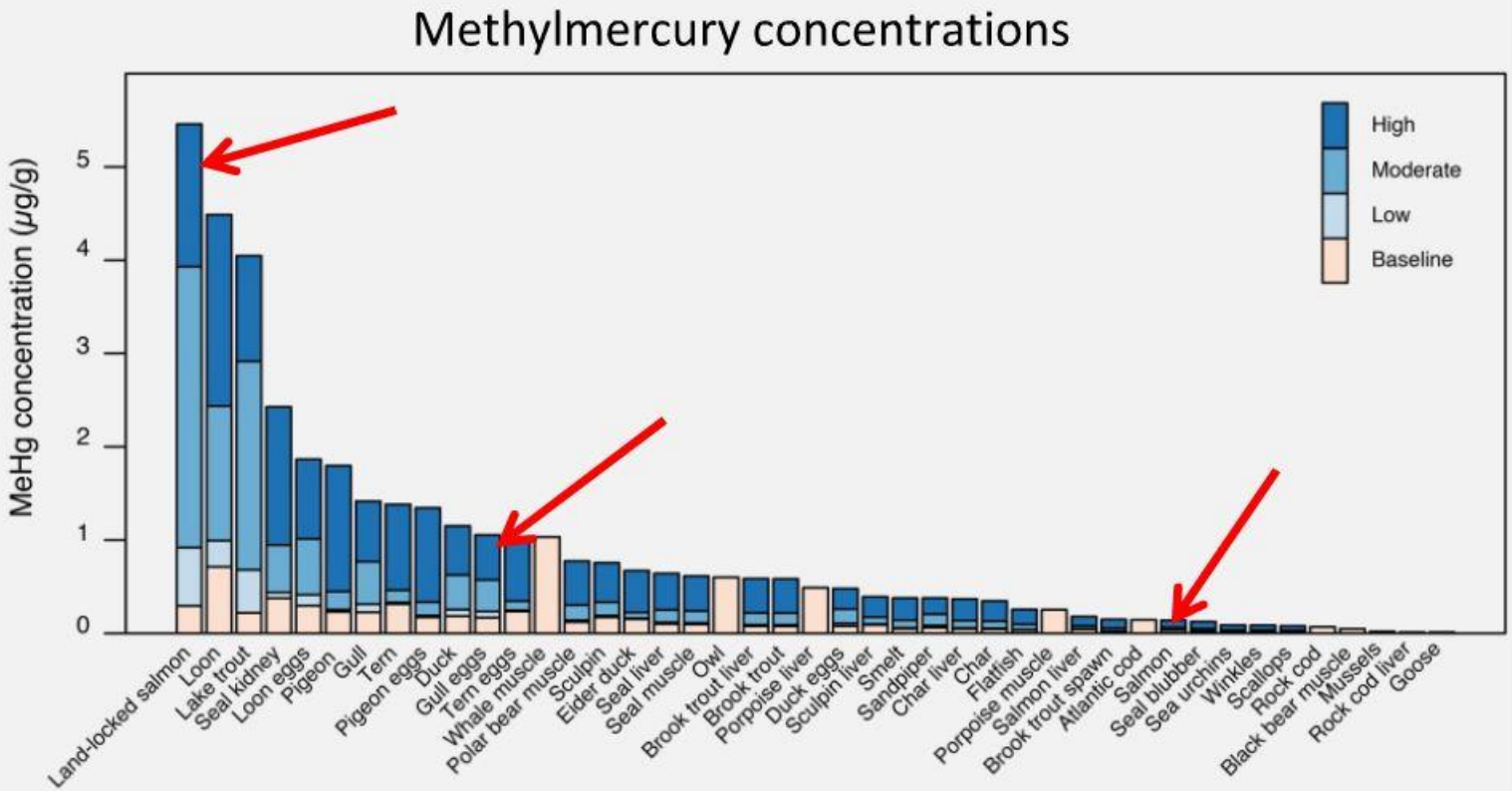
Uptake into country foods



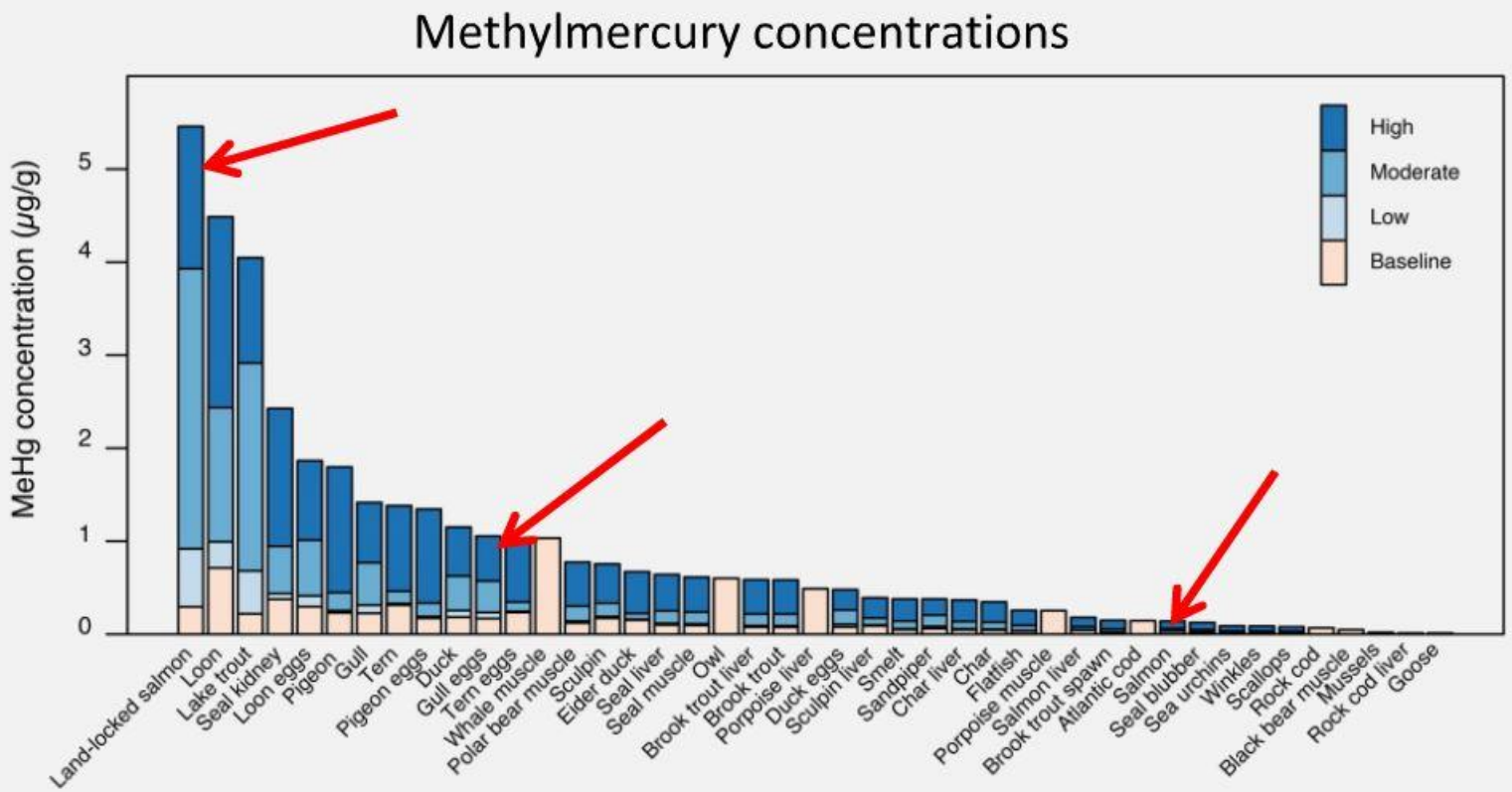
Methylmercury in frequently consumed foods



MeHg change in country foods due to flooding



MeHg change in country foods due to flooding



Exposure = MeHg concentration x amount eaten

Components of impacts analysis

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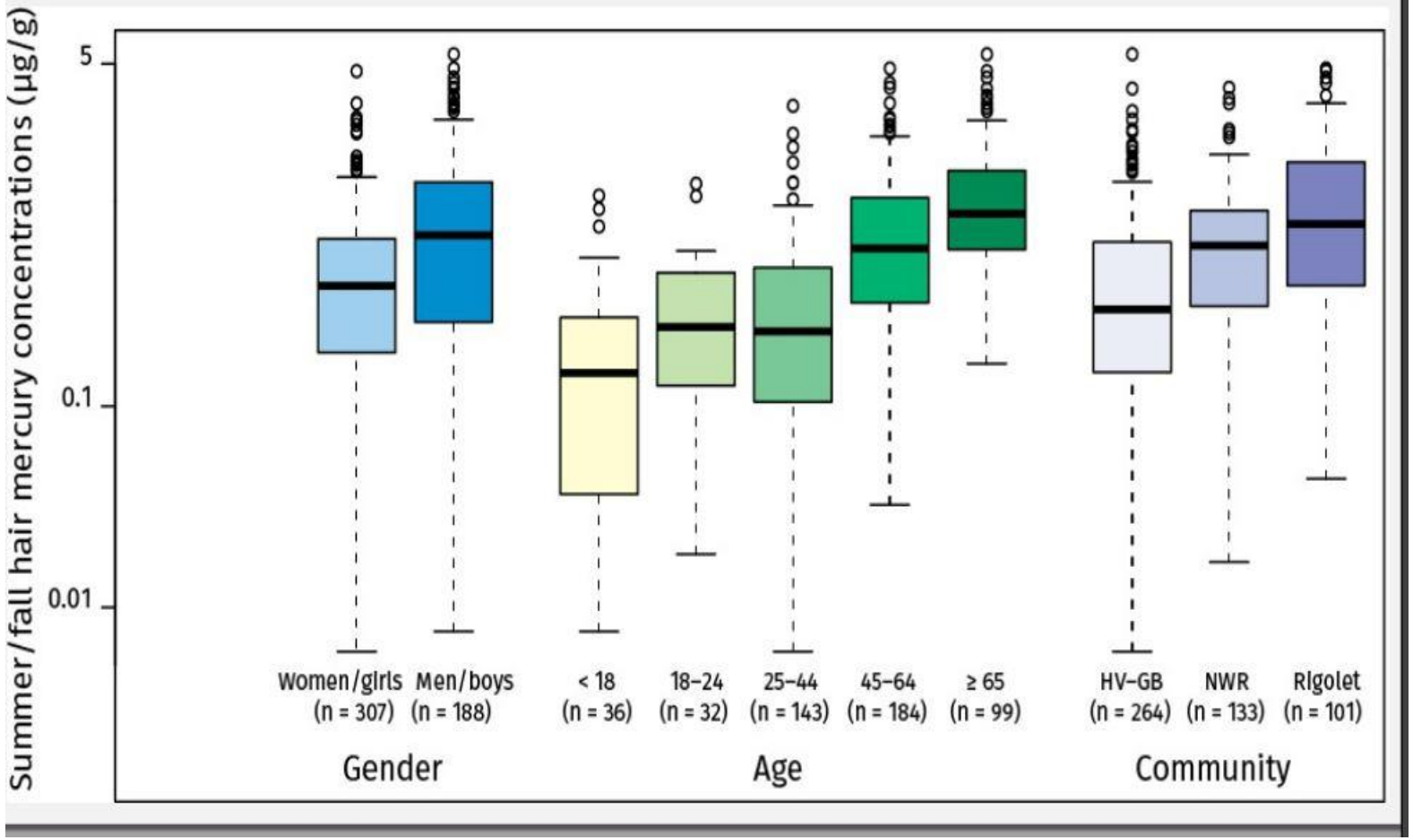
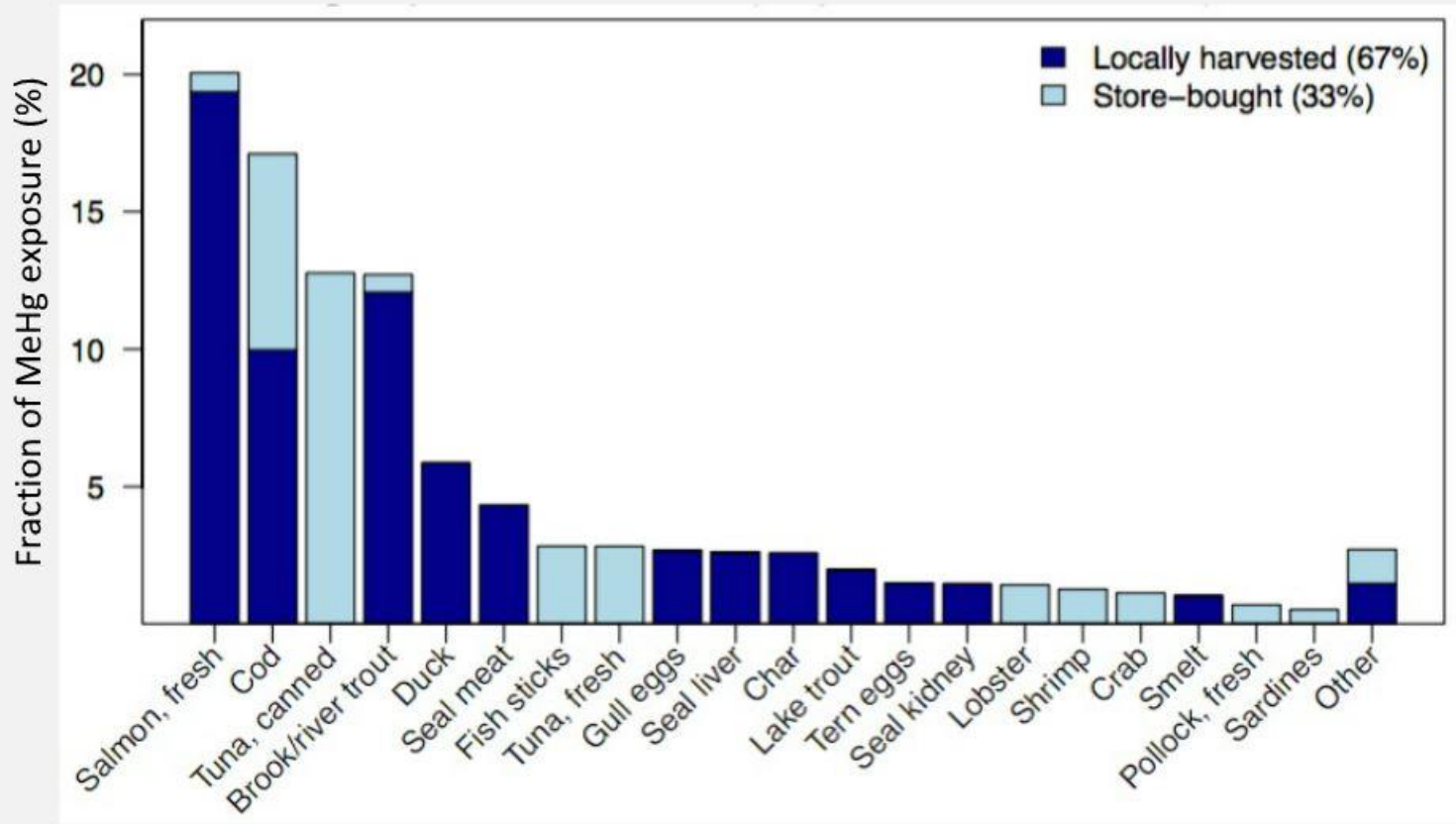
4. Current and projected Inuit methylmercury exposure

Variability in Inuit diet drives ranges in MeHg exposure

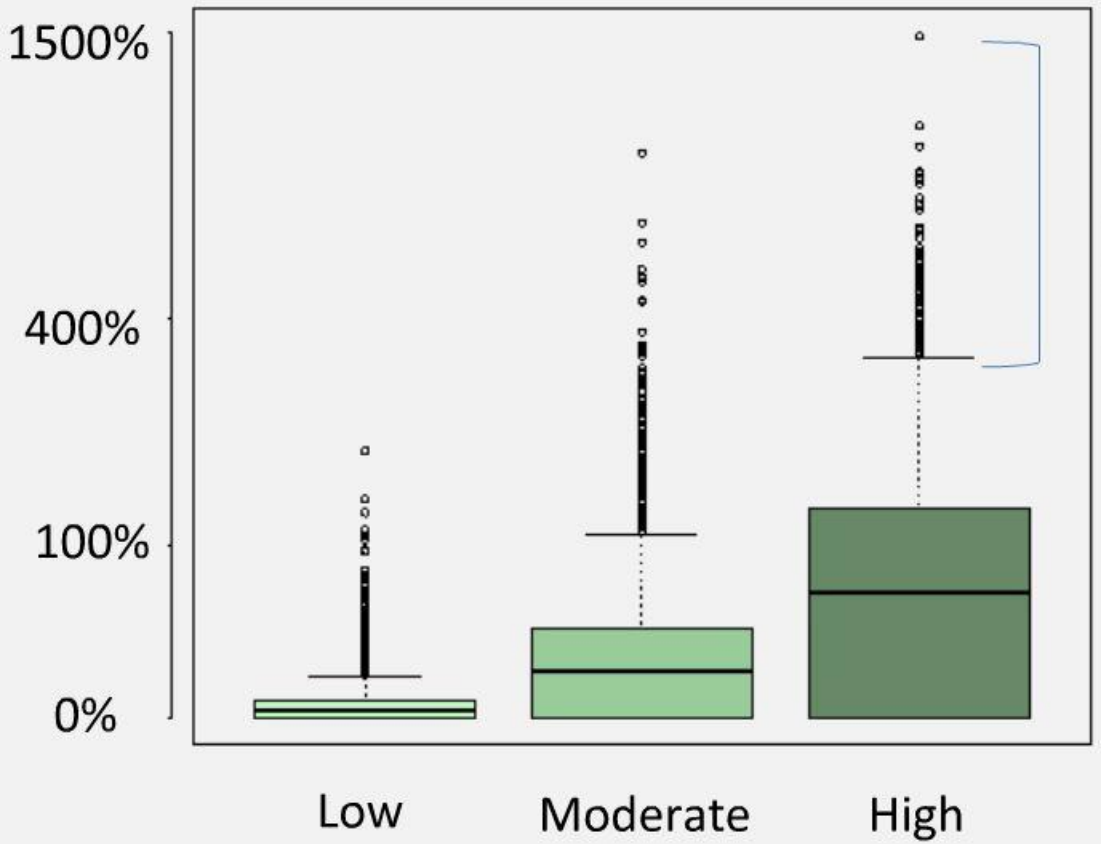
19% of the total Inuit population in the region; June/July and Sept/Oct, 2014)



Country foods = 67% of current methylmercury intake

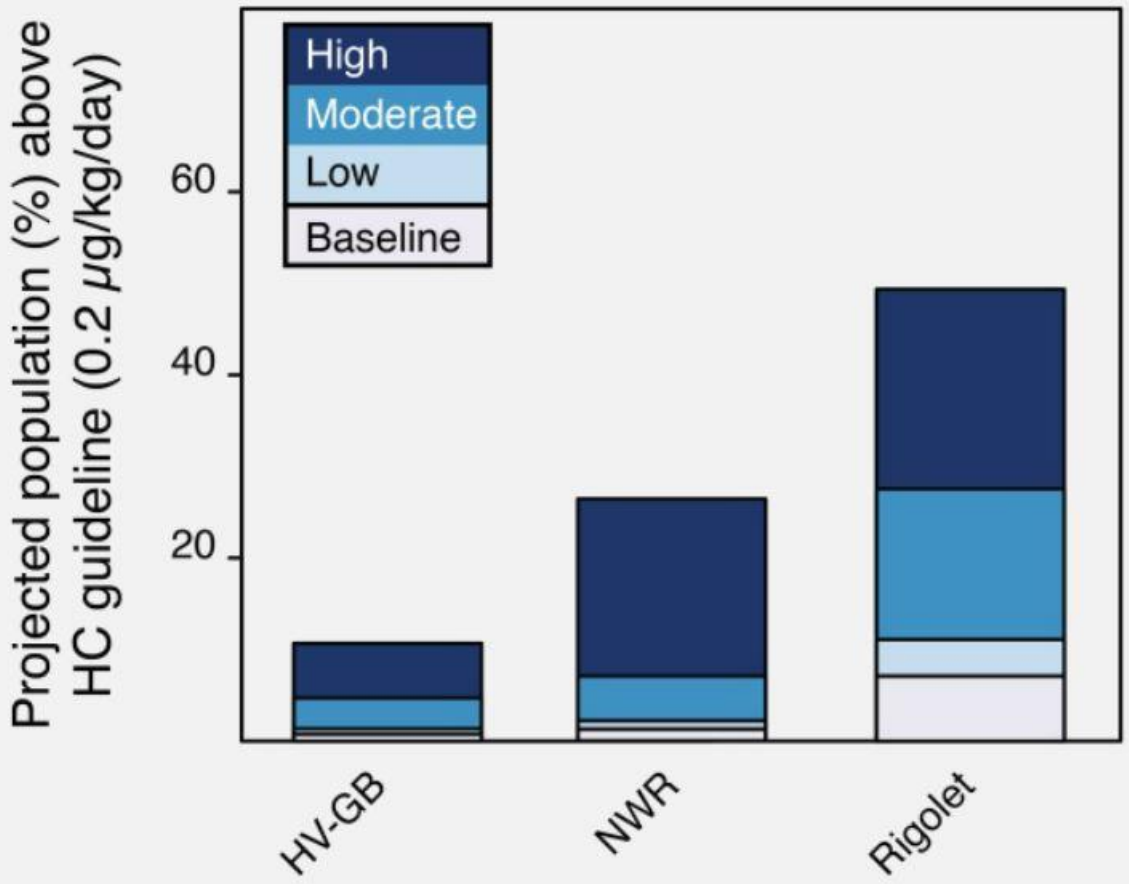


Estimated changes in Inuit Exposures from Flooding of Muskrat Falls



Impact greatest on those who eat most country food and live most traditional lifestyle

Fraction of Inuit > methylmercury guideline



Comparison of Human Heath Risk Assessments: current exposure

Lake Melville (Harvard Univ.)

- >1000 participants
- Inuit or child/spouse of Inuit
- Diet survey & hair samples
- 3 seasons in 1 year (2014)
- With reservoir clearing
  - The expected number of Inuit exceeding national guideline will decrease by two-thirds

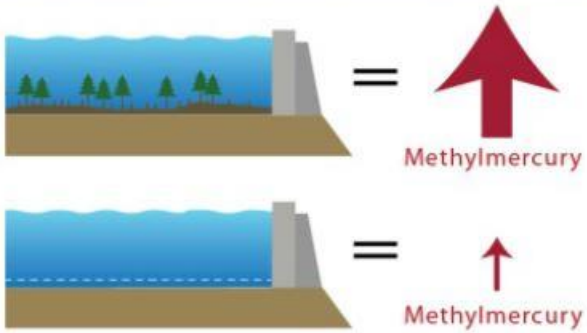
Nalcor Energy (Golder Assoc.)

- 293 participants
- 196/293 (66%) Aboriginal*
- Diet survey & hair samples
- Winter only (2014/15)
- No conclusions can be made about Inuit-specific future exposure or those most vulnerable

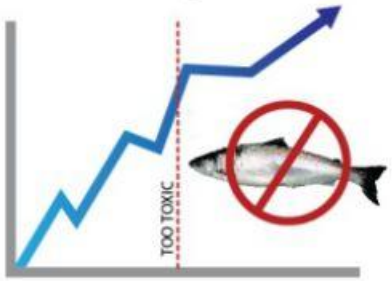
Nunatsiavut Government's science-based recommendations to Make Muskrat Right

Governments to require Nalcor to:

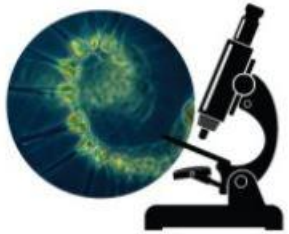
1. Fully clear the Muskrat Falls reservoir of wood, brush, vegetation, and topsoil before flooding to mitigate increases in methylmercury exposures for downstream Inuit populations, as recommended by the environmental assessment panel



2. Negotiate an Impact Management Agreement with Inuit, as recommended by the environmental assessment panel



3. Establish an independent Expert Advisory Committee for advising on downstream monitoring and mitigation



4. Grant Inuit joint decision-making authority over downstream environmental monitoring and management