# Understanding the impacts of environmental change and human development in the Tathlina watershed

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# Tathlina and Kakisa watersheds

# A region that has warmed considerably in the last 50 years…

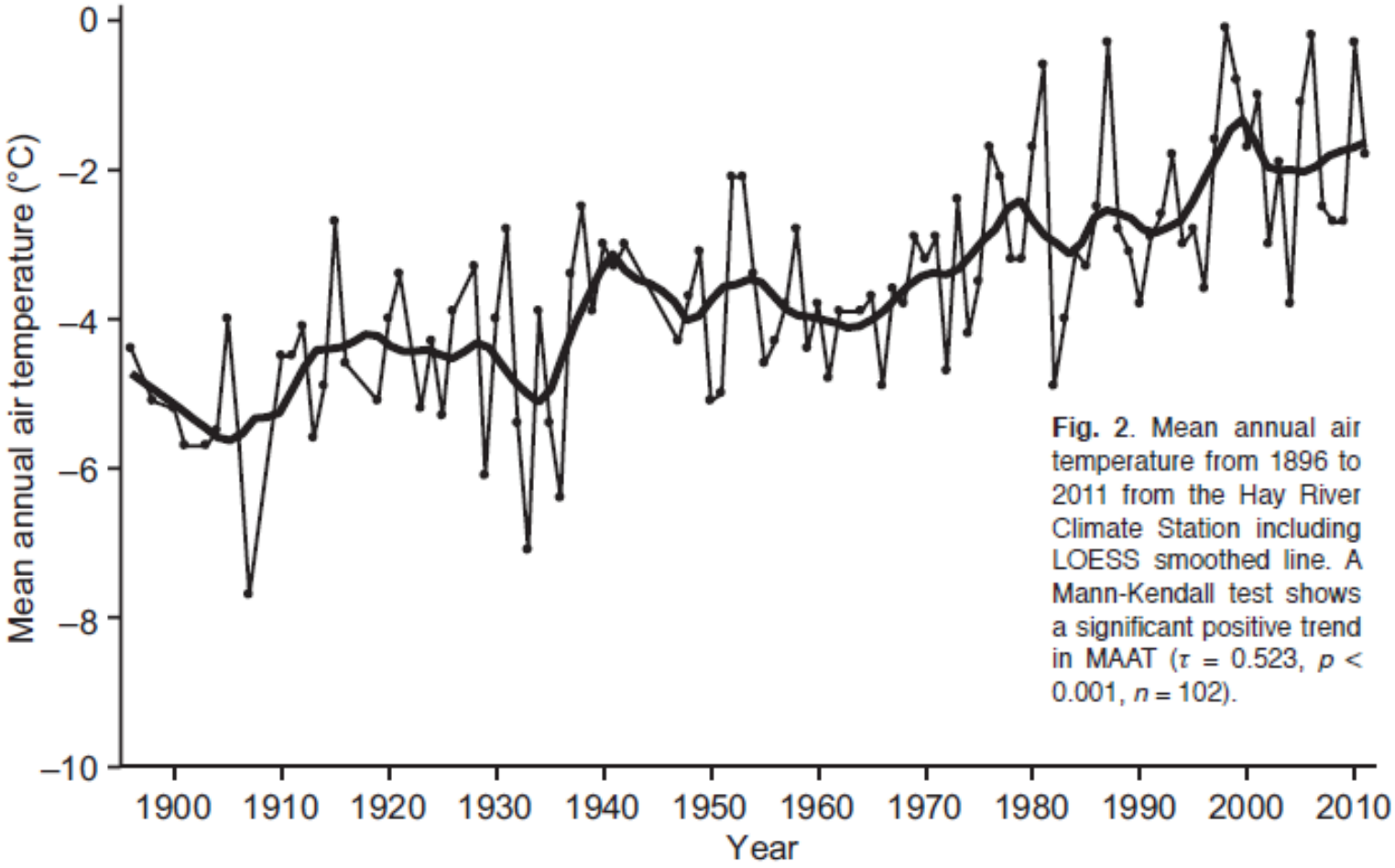
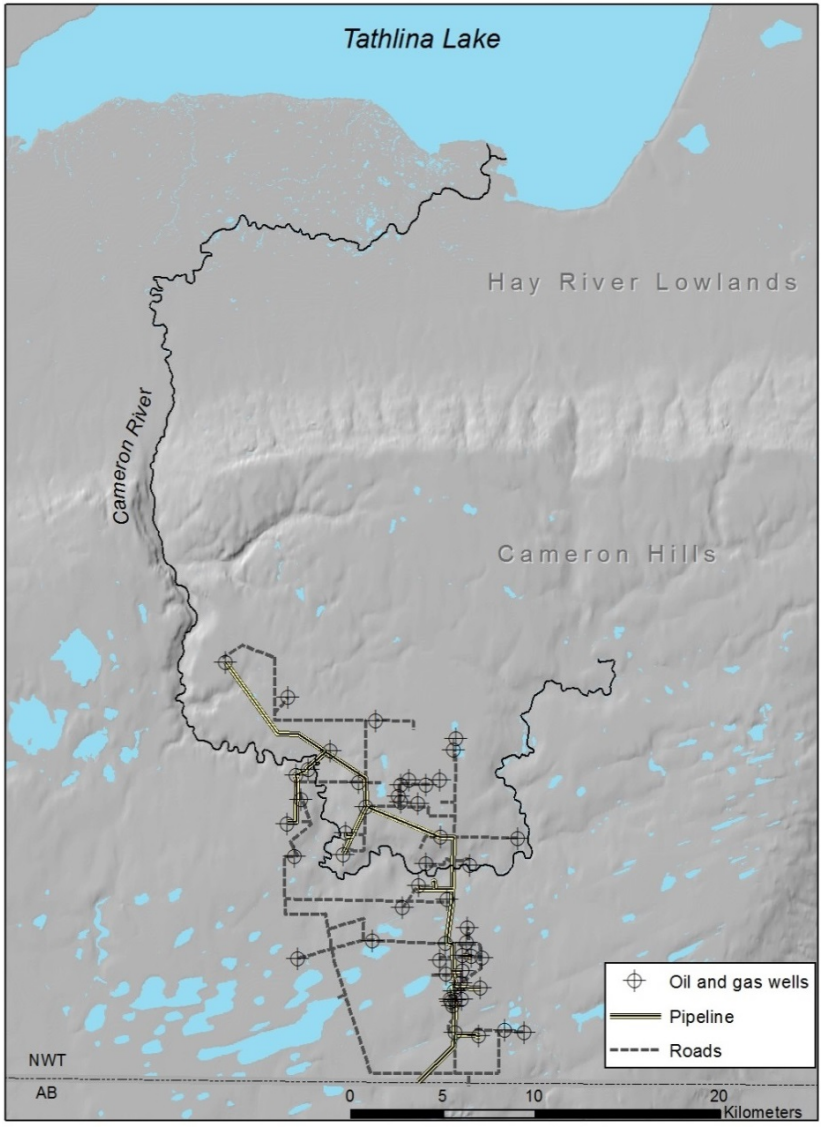



**Fig. 2.** Mean annual air temperature from 1896 to 2011 from the Hay River Climate Station including LOESS smoothed line. A Mann-Kendall test shows a significant positive trend in MAAT ($\tau = 0.523$, $p < 0.001$, $n = 102$).

Coleman et al., 2015

# is undergoing rapid environmental change…

# significant oil and gas development…



# and the traditional territory of the Ka’a’gee Tu First Nation

Photos courtesy of  Pat Kane

“Is the water safe to drink and are the animals and fish safe to eat?”

The influence of a changing landscape on lakes and rivers?

The influence of upstream development?

# Program structure

Project Coordination
Ka'a'gee Tu First Nation and CIMP

KTFN
Research questions
Local support and knowledge
Field assistance

CIMP
Scientific lead
Liaising with researchers
Technical advice

Academic, government and community partners
*Experts on specific research questions*

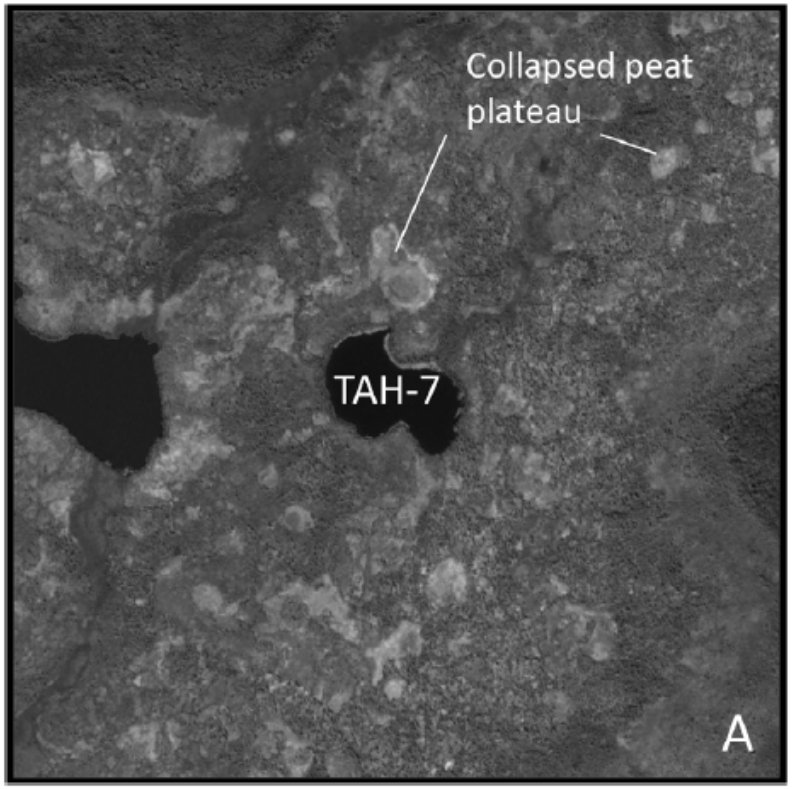
# How do we detect impacts?

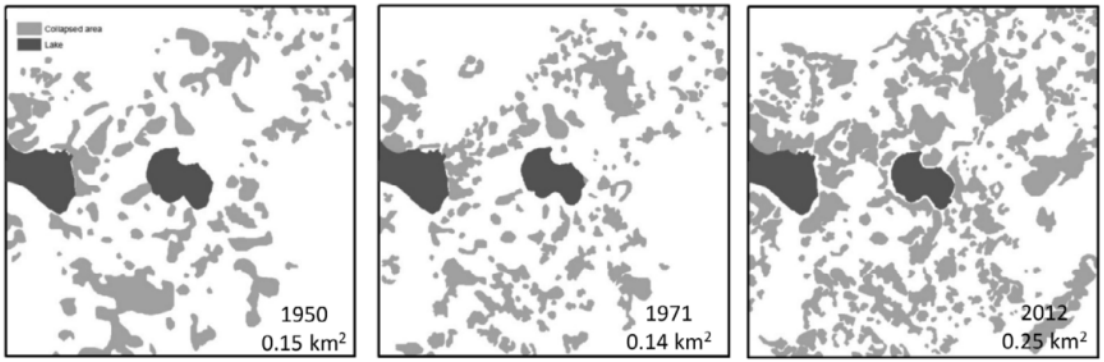
Measure things that don't belong
(or should only be there in small amounts)

Compare changes over time (or space)

# ENVIRONMENTAL CHANGE

# Collapse of permafrost supported peat plateaus leads to wetter fen environments




Large increase in collapsed areas 1971-2012

Coleman et al., 2015

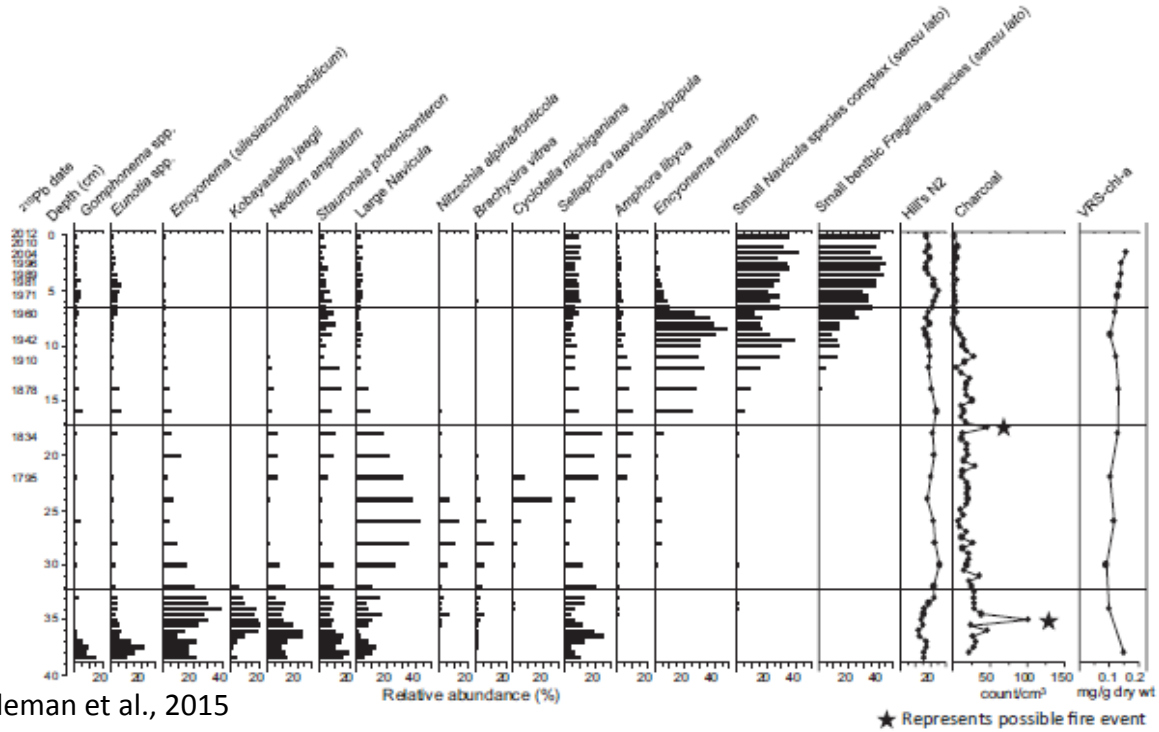
# Impacts to the aquatic environment

Observed changes in:

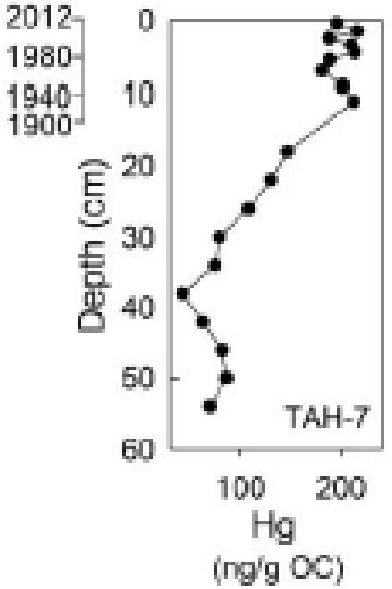
Biology of the lake

Terrestrial organic matter

Sedimentary mercury




Coleman et al., 2015




Korosi et al., 2015

# Tathlina Lake

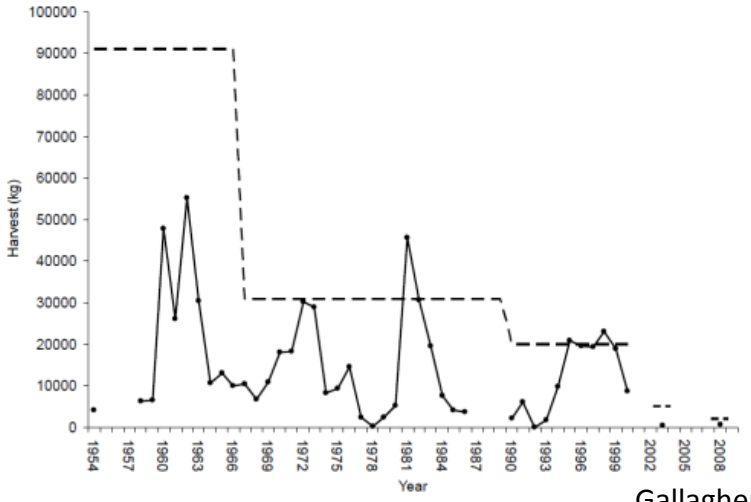
*a unique and important place*

Photos: Pat Kane

# Tathlina Lake
## *a unique and important place*

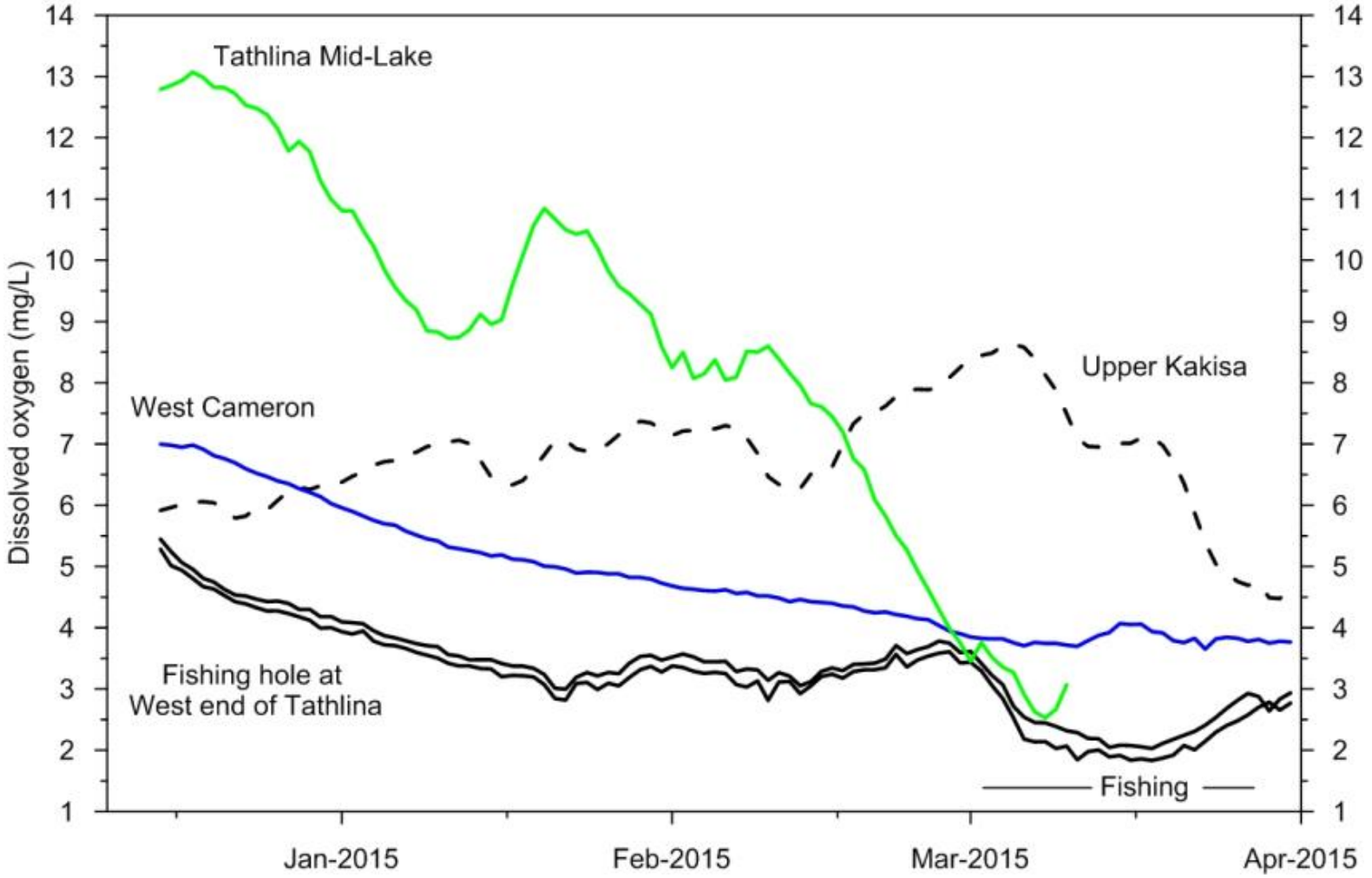


- Large lake (30 x 20 km)
- High productivity
- Shallow (~1.5m deep)
- Supports commercial fishery
- Historic fluctuations in fish stocks

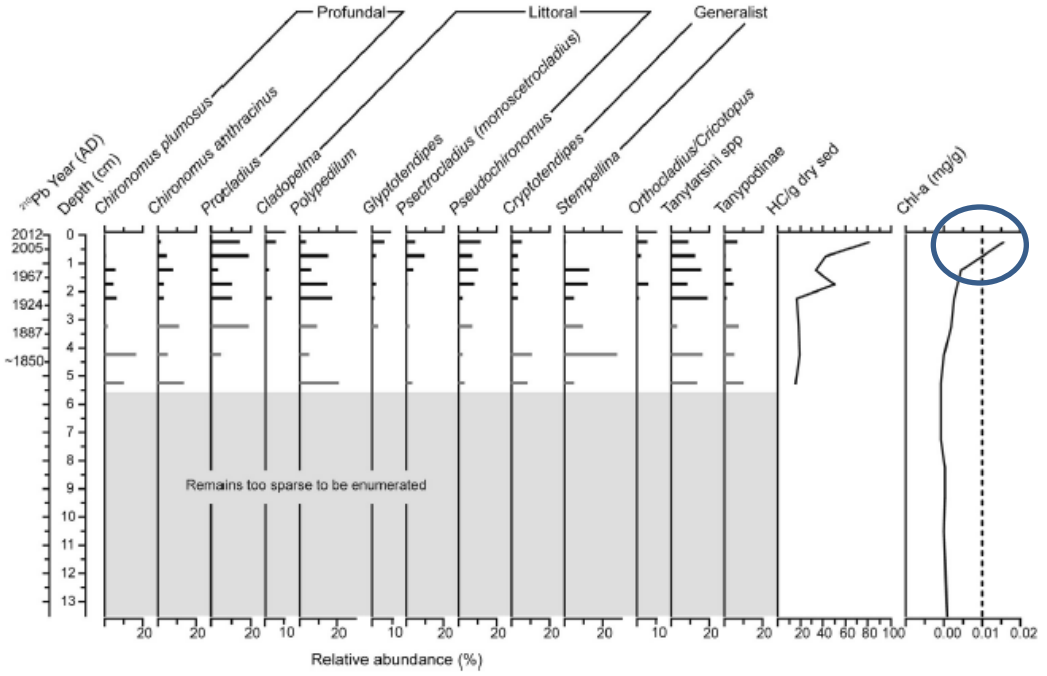



Gallagher et al., 2012

# Aquatic environment is exposed to very low oxygen conditions during winter



# The lake supports ecology that is tolerant of these conditions




Stewart et al., 2015

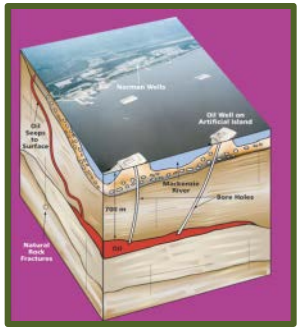
# What are the impacts with a warming climate?

# Measuring the impact of oil and gas development on aquatic systems in the Cameron Hills

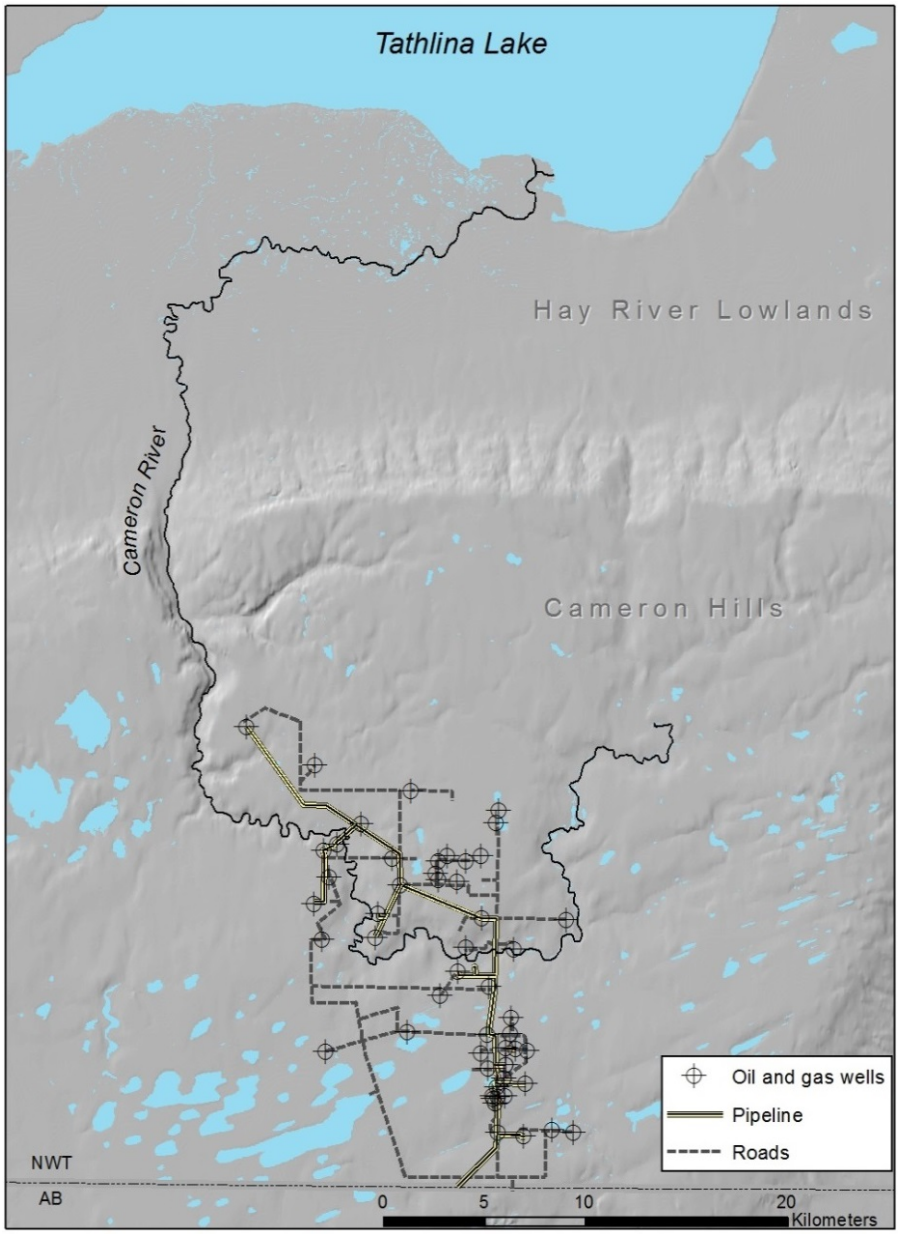
# Polycyclic Aromatic Hydrocarbons (PAHs)

**Pyrogenic**

**Petrogenic**




# Oil and gas operations in the Cameron Hills




Medium scale operation

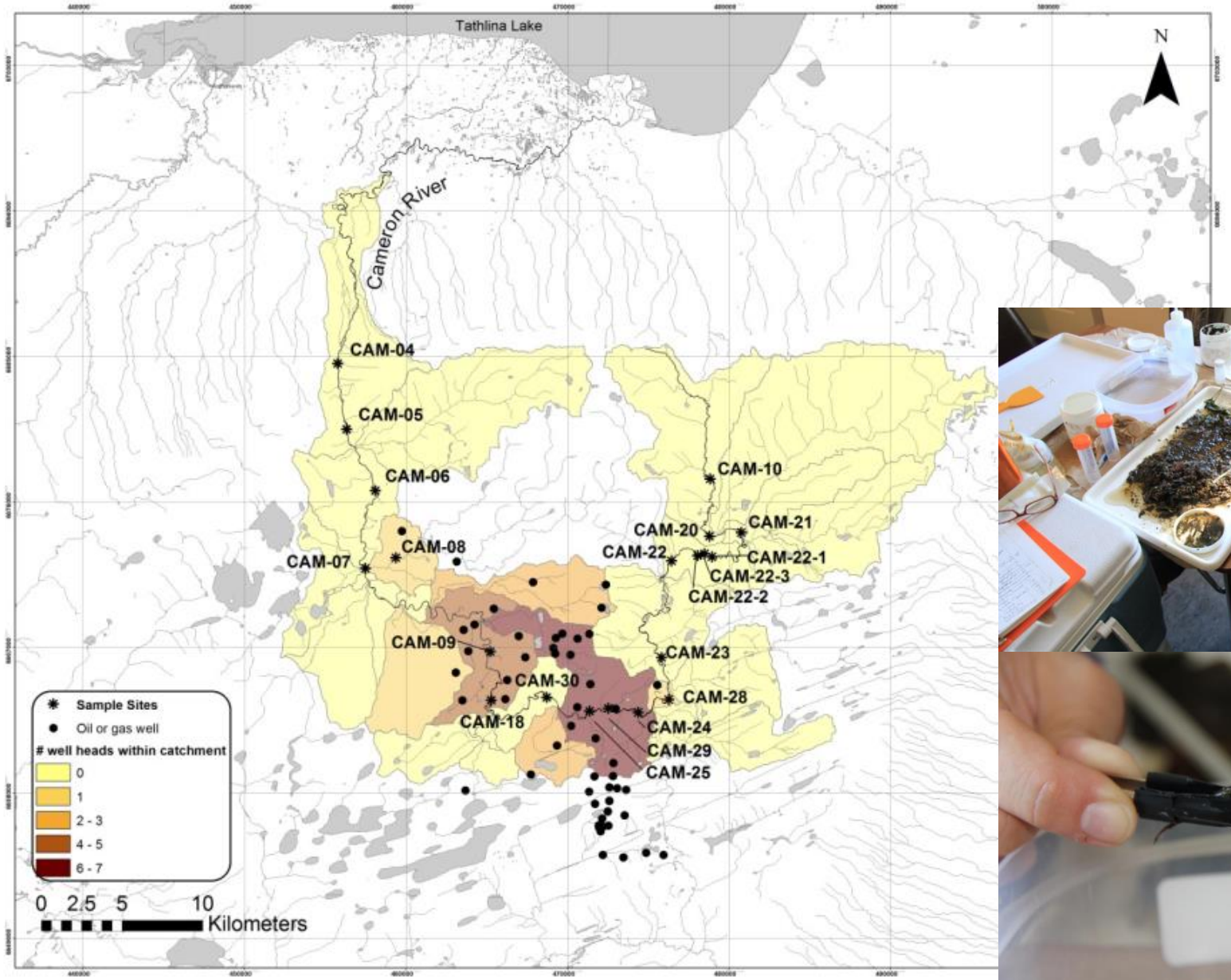
- Operations currently suspended
- Exploration began in 1960's
- By 2013 - 55 oil and gas wells
  - 5 producing wells in 2013

Ancillary development

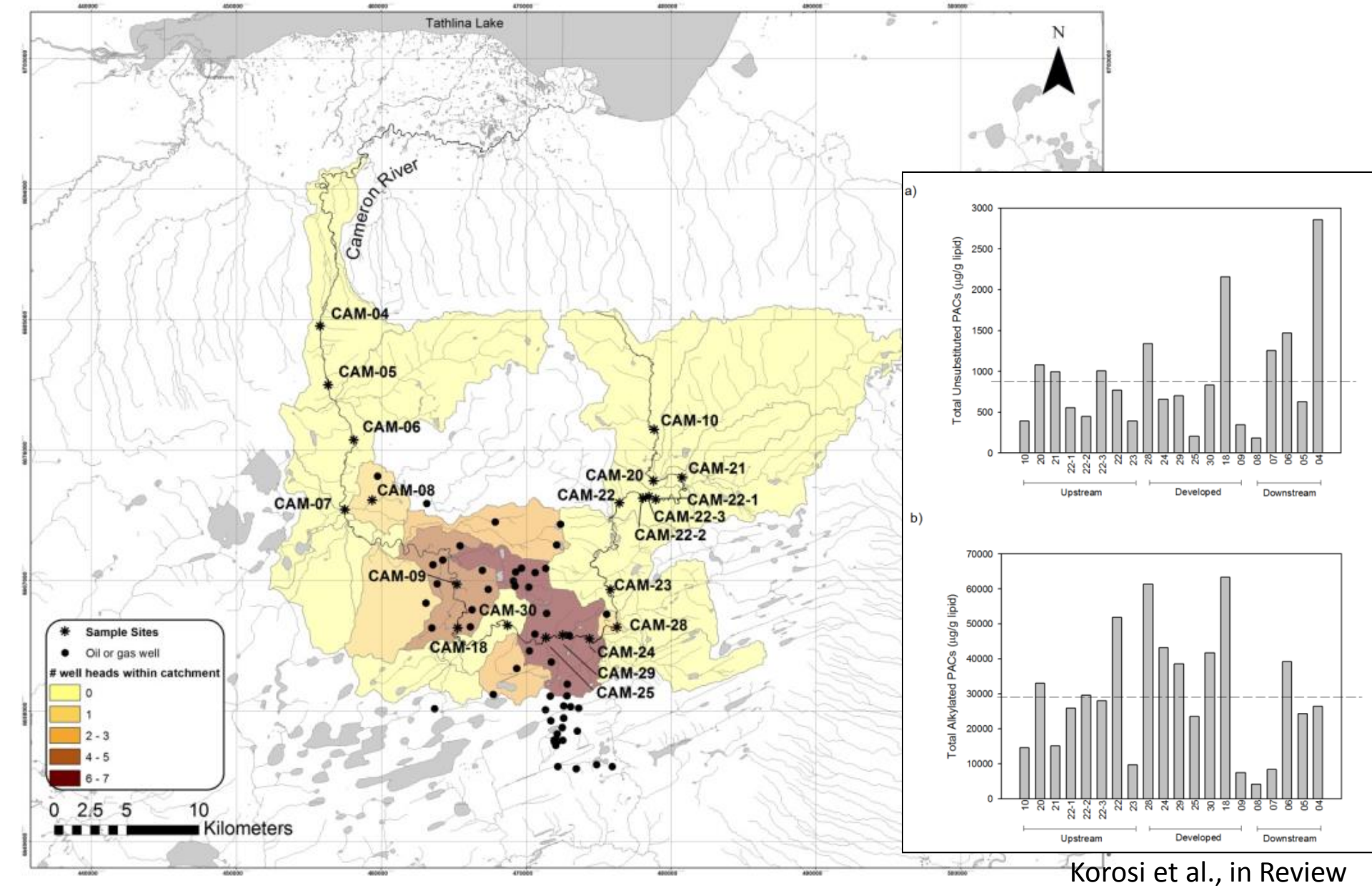
- Seismic lines
- Roads
- Pipeline
- Sumps
- Quarries

# The Cameron River

# Contaminant burdens in benthic invertebrates




# Contaminant burdens in benthic invertebrates




Korosi et al., in Review

# Disturbed vs undisturbed catchments

## Tracking historical contaminant loading

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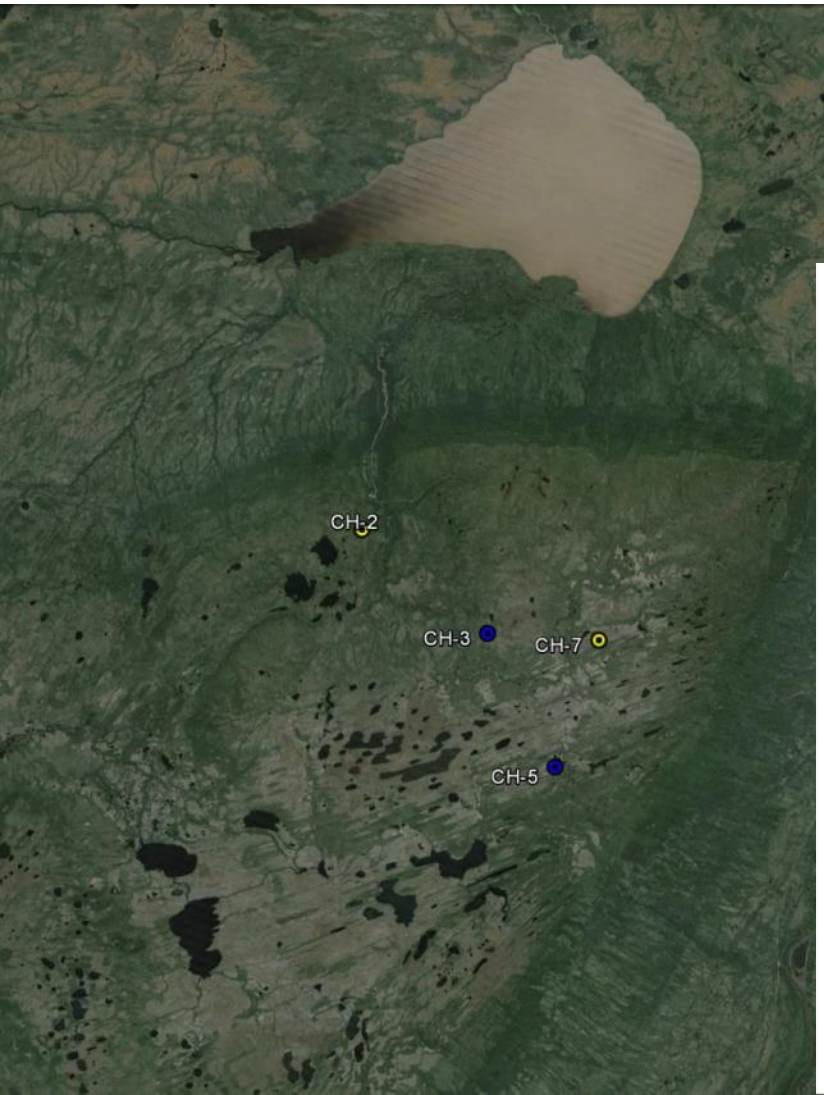
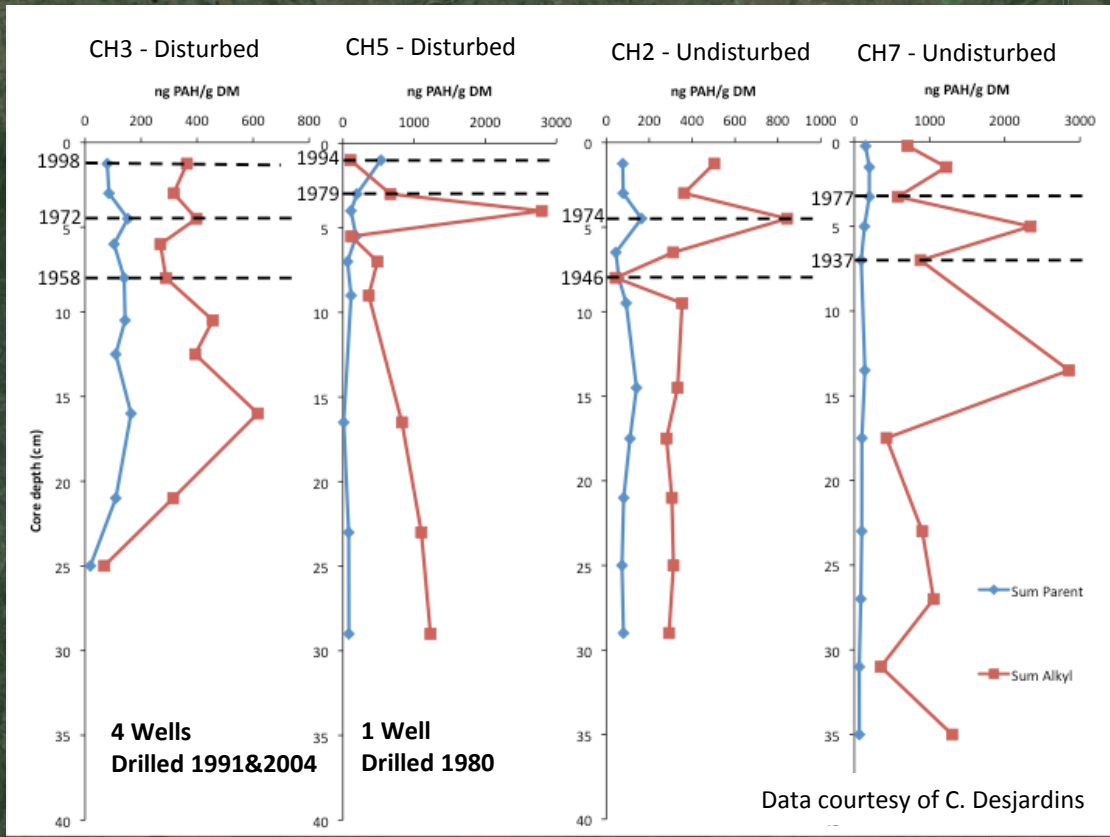
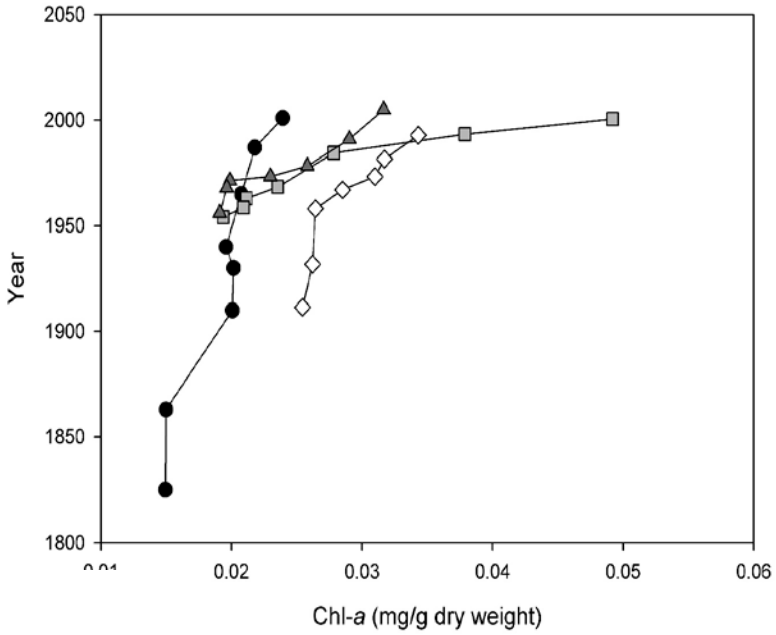



Data courtesy of C. Desjardins

# Common theme across the study area

## Ecological changes in lakes associated with warming climate




Coleman et al. In Prep

# Regional water quality monitoring program


# Regional water quality monitoring
## "*Watching the waters*"


Continuous instream measurements

- DO, Conductivity, Turbidity, pH

Quarterly water quality sampling

- Metals, nutrients, physical parameters

# Key Messages

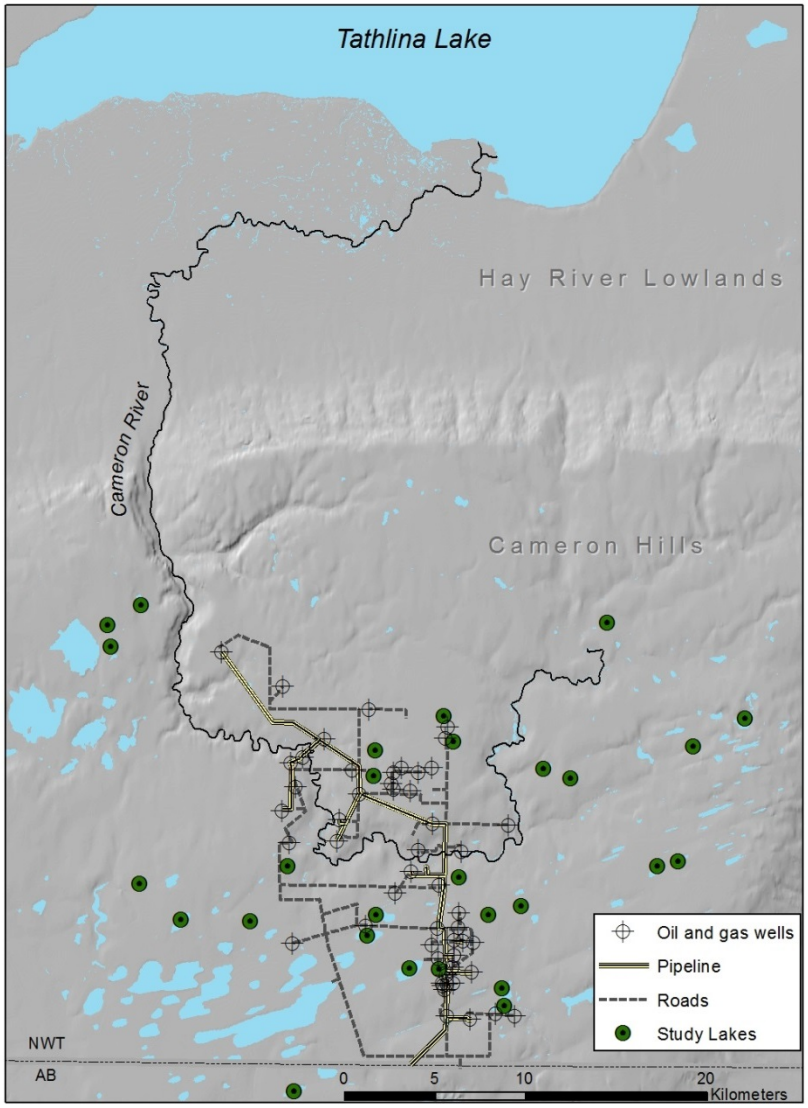
- Substantial landscape change in the Hay River lowlands east of Tathlina Lake
- This has impacted aquatic systems
  - Evidence of increasing terrestrial organic matter and sedimentary mercury
- Little evidence of PAH loading to lakes and streams of the Cameron Hills
- Widespread evidence of ecological changes associated with climate warming


Kakisa: Darcy Simba, Fred Simba, Frank Bonnetrouge, George Simba, Anita Chicot, Gabe Chicot, Tarek Chicot, Chris Chicot, Peyton Simba, Peter Redvers

Funding: NSERC, NWT CIMP, WLU, Queen's, UOttawa

Additional analyses: Cyndy Desjardins, David Eickmeyer, Grant Harrison

# Incidental impacts of oil and gas operations




# Incidental impacts from oil and gas operations