Influence of hydrological connectivity and ditches on nutrient transformations and export during peat harvesting in a sub-humid, glaciated, boreal landscape

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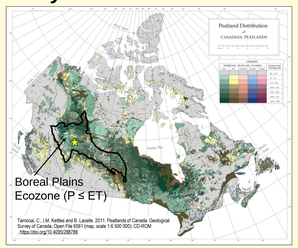
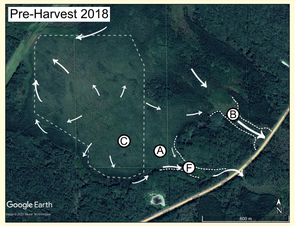
Background

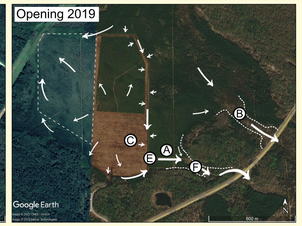
- Peat harvesting changes peatland hydrological & physicochemical properties
- Concern about nutrient loading & water quality degradation downstream[1,2]
- Conflicting findings & unknown effect of opening, extraction on water quality[3,4]
- Different climate, relief, & geology (ditch substrate), flooding from beaver (*Castor canadensis*) dams → explain variability?

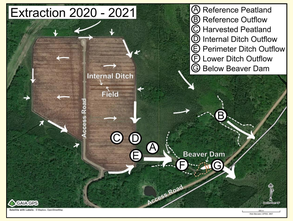
➢ ***How do peatland hydrological connectivity, ditch substrate, & peat physicochemical properties affect nutrient availability & mobility?***



Study Site & Methods



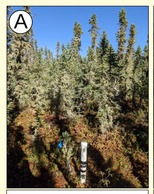




- Sun Gro Horticulture, Avenir, Alberta, Canada; sub-humid climate (P ≤ ET)
- Before-after impact study & systematic, stratified sampling
- Surface, deep water; in-field, outflow; reference, harvested

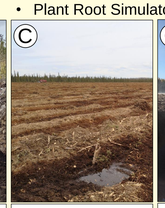
Measurements

- Temperature, aeration, ice depth
- Water level, flow
- Water chemistry
  - Dissolved & particulate N, P, C
  - Major ions, pH, EC, TSS
- Plant Root Simulator probes [5]

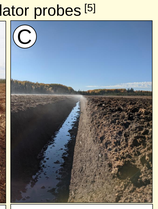


Natural Peatland

Perimeter Ditch



Mulched Field

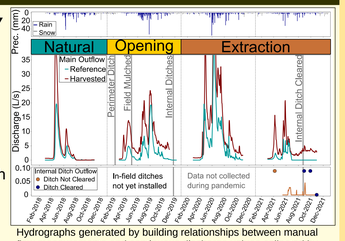


Internal Ditches

Results

Hydrological Connectivity

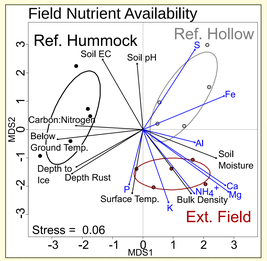
- Change in flow timing
  - Summer-dominated reference outflow dries up
  - Continuous flow at harvested outflow
- Change in flow volume
  - More baseflow → export ↑
  - More flow → Beavers establish dams
- Harvested field can disconnect



Hydrographs generated by building relationships between manual flow measurements and continuous discharge values collected by the Government of Canada at Amisk and Logan Rivers.

In-Field Changes

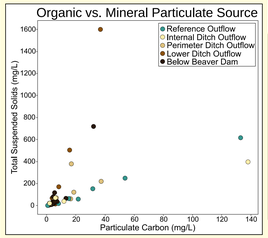
- Evidence of decomposition
  - High temperature, bulk density
  - Higher P & NH_4^+ availability

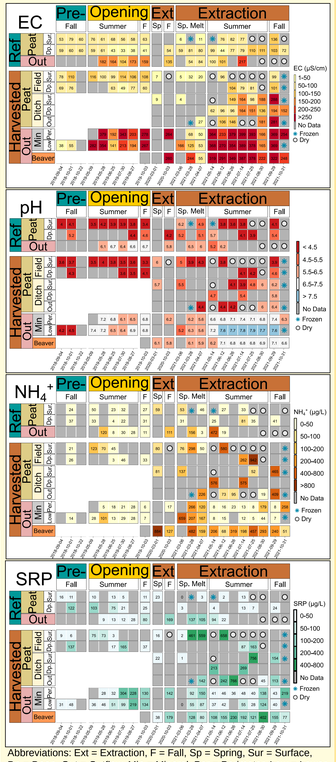


Indirect gradient analysis with NMDS ordination. Peat **physicochemical** variables ordinated; **nutrient availability** vectors correlated using ordination scores.

Ditch Substrate & Beaver

- Higher pH, EC mineral ditches
- SRP & NH_4^+
  - High in extracted peat field
  - Low in mineral ditch
  - High after beaver dam
- Organic vs. mineral particulate





Abbreviations: Ext = Extraction, F = Fall, Sp = Spring, Sur = Surface, Dp = Deep, Out = Outflow, Min = Mineral, Per = Perimeter, Low = Lower

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Opening peatlands & extracting peat

- *Increases* subsurface **hydrological connectivity**
- *Increases* & *extends* **flow** → *higher* **export**
- *Increases* **nutrients** in peat porewater

- BUT! -

Final outflow **chemistry** & **export** driven by

➢ **Ditch substrate**

✓ *Influences* nutrient form & concentration

➢ **Beaver dam creation**

✓ *Mobilizes* reduced nutrient forms

Finding an effect is challenging in water limited systems!

View Abstract

Reference Outflow (Organic)

Internal Ditch Outflow (Organic)

Perimeter Ditch Outflow (Mineral)

Lower Ditch Outflow (Mineral)

Outflow Below Beaver Dam