Quinton-01: Consortium for Permafrost Ecosystems in Transitions

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CPET: background

• Southern Taiga Plains: one of the most rapidly warming regions on Earth, experiencing unprecedented human disturbance.
• Both factors have led to widespread permafrost thaw that has altered the hydrological cycle and transformed ecosystems.
• **CPET** science activities:
  • investigates hydrological and ecological changes resulting from permafrost thaw,
  • develops and mobilises knowledge of these changes,
  • develops predictive modelling tools, and
  • provides interactive training on these tools to our partners in industry, government and communities, including First Nations.
CPET: structure

- **Investigators**: J. Baltzer, A. Berg, J. Craig, W. Quinton
- **Collaborators**: S. Tank, K. Devito (both U. Alberta), R. Shincariol (Western U.), O. Sonnentag (U. Montréal), M. Hayashi (U. Calgary)
- **PDFs**: J. Mai, E. Abdeian, C. Pappas, J. Adams
- **Graduate Students**: 6 PhD, 8 M.Sc.
- **Governments**: NWT & BC
- **Agencies**: NSERC, GeoScience BC, BC Hydro, Water Survey of Canada, TransAlta
- **First Nations**: Dehcho FN, Liidlii Kue, Fort Nelson, Jean-Marie River, Sambaa K’e
- **Industry**: Nexen Energy
- **NGO**: Ducks Unlimited
Map indicating locations of 12 Areas of Interest (AOI) in the southern NWT and northeastern BC boreal peatland region: Baltzer, Berg, Quinton, Sonnentag
A significant ($p<0.05$) net decrease in forested area of 6.9% (152,939 m$^2$) occurred between 1971 and 2010.

Land cover change over a 10 km$^2$ subset of AOI 11, BC (59°46’N, 120°42’W)
A significant ($p<0.05$) net decrease in forested area of 11.6% (547,846 m$^2$) occurred between 1970 and 2010.

Land cover change over a 10 km$^2$ subset of Scotty Creek Basin, NWT (61°18’N, 121°18’W)
Scotty Creek Research Station

www.scottycreek.com/
Renewed infrastructure 2017 & 2018 (CANet)
- 3-km of boardwalk, stable AC power, accommodates 14+
Local capacity building & community engagement.
- High school field courses, coordination with Aboriginal initiatives, partnership agreements, convergence with TEK
- ~1000 person days per year
State-of-the-art research infrastructure
Long-term monitoring & focused experiments
- streamflow, water table and permafrost dynamics, water chemistry, snow surveys, vegetation composition and structure, etc.
CPET: Scotty Creek

- Comprehensive, high-quality data archives (1994- )
- CTFS-ForestGEO: global network of forest research plots to study forest function and diversity
CPET: Scotty Creek permafrost dynamics

Transect

- Transect lengths:
  - 42 m in 1999
  - 26 m in 2008
  - 18 m in 2015
Fire disturbance studies:

Figure 1. Comparison of the average SWE on a lake surface, burned and unburned plateau, from the March 26th March to May 9th 2015. The solid line values are from manual measurements, the coloured dashed line were estimated.

Figure 2. Example of mosaicked images of the fen area, from 18th April to 30th April.
Impact of seismic lines

linear disturbance (permafrost-free corridors)

- saturated, frozen peat
- saturated, thawed peat
- unsaturated, thawed peat

kilometres
CPET: Scotty Creek hydrology
Nested eddy covariance systems (CO₂, CH₄, LE, H):  
15 m (landscape-scale): boreal forest-bog  
1.9 m (ecosystem-scale): bog

Southern portion of the 152 km²-watershed: forested peat plateaus with permafrost (38%), and permafrost-free bogs (27%), fens (26%) and lakes (9%)
Recent findings (e.g., *Geophysical Research Letters, Agricultural and Forest Meteorology, Global Change Biology*)

- Permafrost thaw and wildfire: equally important drivers of boreal tree cover changes

- Regional atmospheric cooling and wetting effect of permafrost-thaw induced boreal forest loss

- Net warming effect of increasing landscape methane emissions from thawing permafrost during this century

- Thawing permafrost only marginally affects landscape carbon dioxide sink strength
Self-manufactured thermal dissipation (Granier) sap flux density probes: each sensor consists of a pair of 20 mm long, 2 mm diameter probes inserted in the conductive xylem (sapwood) about 10 cm apart. The upper probe is constantly heated and the temperature difference between the two probes is recorded (Granier, 1987).