Impacts of linear disturbance on wetland functions

Impact of linear disturbances on boreal wetland carbon and greenhouse gas exchange

Maria Strack
Acknowledgements

Peatlands in Canada

Wetland area
- < 5%
- 5-10%
- 10-25%
- 25-40%
- 40-65%
- > 65%

114 million ha
12% of land area

150 – 160 billion tonnes C
Linear disturbance in wetlands alters local controls on ecosystem function

- Edge effects: Anna Dabros
- Habitat impacts: Stuart Slattery
- Cumulative effects– in the context of climate change: Hedvig Nenzen
Linear disturbance and C exchange: Access roads

How to build better roads – Bev Gingras
Access roads: impacts on GHG emissions?

How do roads affect peatland GHG exchange and can culverts mitigate induced emissions?
Access roads: impacts on GHG emissions?

Plant community, water table position, hydraulic gradients, hydraulic conductivity, CO$_2$, CH$_4$ exchange, soil enzyme activity and phenolics, DOC concentration, biomass/NPP
Access roads: Water table

**BOG**

**FEN**

Vegetation community will also be affected - see poster by Jorden Fanson

WT position between upstream and downstream areas

- Bog: downstream WT (-18 cm) was significantly ($p < 0.05$) lower than -4 cm and -13 cm in upstream & natural areas.
Access roads: CO$_2$ exchange

BOG

FEN

Saraswati, PhD candidate
See poster on enzymatic activity
Access roads: CH$_4$ exchange

Blockage of water flow and changing plant and soil conditions may also alter dissolved organic carbon pools - see poster by Michael Wrubleski
Linear disturbance and C exchange: Cutlines
Linear disturbance and C exchange: Cutlines

Study site: Google Earth
**Cutlines: ecohydrological conditions**

<table>
<thead>
<tr>
<th></th>
<th>ON ROAD</th>
<th>NORTH (upstream)</th>
<th>SOUTH (downstream)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil temperature (5 cm; °C)</td>
<td>17.3 (0.6) a</td>
<td>14.5 (0.7) ab</td>
<td>13.1 (0.5) b</td>
</tr>
<tr>
<td>Date of thaw (top 30 cm)</td>
<td>Prior to May 12</td>
<td>May 12 to Jun 10</td>
<td>May 12 to Jun 25</td>
</tr>
<tr>
<td>WT (cm)</td>
<td>-4.4 (1) a</td>
<td>-22.6 (2.9) b</td>
<td>-14.1 (1.9) c</td>
</tr>
<tr>
<td>Total understory vascular plant cover (%)</td>
<td>55 (5) a</td>
<td>35 (2) b</td>
<td>44 (2) c</td>
</tr>
<tr>
<td>Understory moss cover (%)</td>
<td>20 (5) a</td>
<td>60 (4) b</td>
<td>50 (4) b</td>
</tr>
<tr>
<td>Understory graminoid cover (%)</td>
<td>53 (3) a</td>
<td>2 (1) b</td>
<td>3 (1) b</td>
</tr>
<tr>
<td>Tree biomass (kg/m²)</td>
<td>0 a</td>
<td>2.3 (0.3) b</td>
<td>0.9 (0.2) b</td>
</tr>
</tbody>
</table>
Cutlines: CH₄ emissions

Strack et al., 2017, Global Change Biology
Summary and Future Research Needs

• Impacts specific to wetlands have not been well-quantified
  • Linear disturbance are distributed across the boreal forest in Canada indicating that impact on peatland function is extensive

• Hydrological changes related to flow blockage and compression alter GHG exchange, with CH$_4$ flux generally increased by linear disturbance

• More research needed on a range of peatland types, disturbance types (width, aspect, extent of compression) to better estimate regional and cumulative impacts