H02: Recent advances in peatland hydrology, Part 1: Peatland restoration and ecohydrological processes

Conveners: Sarah Howie[1] and Pete Whittington[2]

Co-chairs: Sarah Howie[1], Pete Whittington[2], Maria Strack[3], and Jonathan Hughes[4]

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Session Description

Peatlands cover about 15% of Canada's land surface. Since peatlands act as CO_2 sinks, it has been suggested that conservation of undisturbed peatlands may be valuable in limiting CO_2 emissions globally. However, peatland disturbance has increased in recent years, particularly relating to ore and petrol extraction, agriculture, and forestry. Thus, a greater understanding of peatland ecohydrological processes and an improvement in peatland restoration techniques is critical to limiting greenhouse gas emissions from these disturbed sites and restarting the process of soil carbon accumulation. Peatland restoration began in *Sphagnum*-dominated bogs about 25 years ago, but has expanded in recent years to include fens and swamps as disturbance has been increasing in these wetland types. The goal of the session is to bring together peatland scientists to share lessons learned with the goal of improving current studies and restoration projects throughout the country. The session will also provide an opportunity to address key research gaps in this field. In particular, contributions will be welcomed that focus on the latest methodology and findings in ecohydrological studies of both undisturbed and anthropogenically disturbed peatlands (e.g. drainage, resource extraction, climate change), as well as novel peatland restoration techniques.

Primary Affiliation: Biogeosciences / Hydrology

NOTE: THIS DOCUMENT CONTAINS INFORMATION FOR ALL SESSION SUB-SECTIONS. PRESENTER ABSTRACTS ARE FOUND AT THE END OF THE DOCUMENT.

SCHEDULE MAY BE SUBJECT TO CHANGE.

ORAL SESSION H02a

Chairs: S. Howie, P. Whittington, M. Strack & J. Hughes **Room: ESB 1012**

Wednesday, May 31st

TIME	AUTHORS	TITLE
9:00	M. Hawes* & P. Whittington	Hydrological conditions pre- and post- surface re-contouring in a peatland restoration project, southeast Manitoba
9:15	T. Gauthier* & J. Price	Overcoming hydrological barriers in cut-over peatland restoration: mechanical compression reduces capillary barrier effect
9:30	A. Elves* & R. Hebda	Accelerated Sphagnum spp. regeneration in cutover cranberry fields, and repeat multi-spectral imaging survey
9:45	J.M. Waddington, B. Didemus & P. Moore	The effect of peat depth on peatland ecohydrological resilience to drought: survival of the thickest?
10:00	S. Howie & R. Hebda	Mire breathing as a useful measure in raised bog restoration
10:15	P. Whittington, D. Wiseman & C. McGorman	Using drones to assess soil moisture patterns following peatland restoration

ORAL SESSION H02b

Chairs: S. Howie, P. Whittington, M. Strack & J. Hughes **Room: ESB 1012**

Wednesday, May 31st

TIME	AUTHORS	TITLE
11:00	S. Wilkinson, P. Moore, D. Thompson & J.M. Waddington	Quantifying peatland ecohydrological tipping points to catastrophic peat burning
11:15	O. Carpino*, A. Berg, J. Adams & W. Quinton	Permafrost-thaw-induced forest loss across boreal peatland environments in the Canadian subarctic
11:30	A. Green*, G. Bohrer & R.M. Petrone	The effects of forest sheltering on peatland evapotranspiration in the Boreal Plains, Alberta, Canada
11:45	P. Moore, S. Wilkinson, N. Kettridge, R. Petrone, K. Devito & M. Waddington	Assessing the potential role of peat properties and peatland configuration in maintaining shallow water table in a sub-humid climate
12:00	S. Touchette*, M. Strack & I. Strachan	Carbon dioxide and methane exchange from a restored peatland: evaluating the role of graminoid species as a plant functional type

12:15	O. Volik*, R. Petrone, C. Wells & J. Price	Salinity change and long-term carbon accumulation in a saline boreal fen: implications from paleoecology to wetland reclamation in Athabasca Oil Sands Region

POSTER SESSION H02

Chairs: S. Howie, P. Whittington, M. Strack & J. Hughes **Room: ESB Atrium**

Tuesday, May 30th

Poster No.	AUTHORS	TITLE
P01-H02	E. Kessel, G. Sutherland, C.M. Wells, T. Weber & R.M. Petrone	Impacts of road construction and removal on the hydrologic and geochemical function of two peatlands within the Athabasca oil sands region, Alberta, Canada
P05-H02	R. Ingram & J. Waddington	Peatland recovery from wildfire in northern Alberta: Implications for reclamation design of oil sands mining leases
P02-H02	S. Touchette, M. Strack & I. Strachan	Impact of spatial variability on carbon dioxide and methane exchange from graminoid species in restored peatlands
P04-H02	G. Sutherland, R.M. Petrone and J.S. Price	Examining site-scale fluxes of carbon and water over the first four years of a constructed fen-upland watershed in Alberta, Canada.
P03-H02	M. Gaultier, J. Hughes and S. Howie	Inferring bog hydrology and soil chemistry using testate amoebae in the Fraser Lowland, British Columbia

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SUBMITTED ABSTRACTS

H02-01: **Hydrological conditions pre- and post- surface re-contouring in a peatland restoration project, southeast Manitoba**

Melanie Hawes*[1] and Pete Whittington[1]
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Abstract
Canada is the world's largest producer of horticultural peat, and Manitoba's contribution is ~13% of this total. Peat extraction requires drainage of the peatland (typically bogs) and the removal of the surficial vegetation. Bogs develop over 1000s of years due to a combination of hydroecological processes making conditions unsuitable for vegetation not adapted to a low pH and ombrotrophic nutrient level. Ironically, this also makes the reestablishment of bog species difficult, post extraction. Remnant peat extraction sites have been the focus for rigorous restoration efforts in Quebec and, more recently, Manitoba. A small, 250 x 250 m section of the Elma peatland, Elma North, was left un-restored in 2014 after four years of extraction. Wells and piezometers were installed in nests at 4 locations across Elma, and measurements were taken every ~5 days from July 30 through August in 2015. Topographic re-contouring on the peat surface occurred in September 2015, creating a grid pattern across Elma for water retention purposes. Wells and piezometers were reinstalled close to the four original locations, with additional wells (n=25) throughout the grid system, and measured every ~2-3 days from May to August in 2016. The average 2015 water level for the cutover section of Elma was < -122.5 cm, while the natural bog areas on the west and north perimeter of Elma averaged -53.5 cm with a SD (standard deviation) of 45.6 cm. After re-contouring, the 2016 average water level in the cutover area was 3.7 cm with a SD of 1.2, while the water levels in the natural areas averaged -18.5 cm below the surface with a SD of 1.9. Sphagnum moss requires water levels within ~40 cm of the surface for optimal growth. The surface re-contouring at Elma effectively promoted a raised water level for future Sphagnum establishment.

Presentation type: Oral presentation

H02-02: **Overcoming hydrological barriers in cut-over peatland restoration: mechanical compression reduces capillary barrier effect**

Tasha-Leigh Gauthier[1*], and Jonathan Price[2]

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Abstract
Ten years after restoration was implemented at the Bois-des-Bel peatland (BdB) in Quebec, there was limited hydrological connectivity between the regenerated *Sphagnum* moss and the remnant cutover peat due to the formation of a capillary barrier. This resulted in lower soil water content and decreased productivity of the regenerated *Sphagnum* moss compared to a natural analogue. This study evaluates the effectiveness of mechanical compression to ameliorate the capillary barrier effect. Hydraulic conductivity-soil water content relationships were determined for non-compressed and compressed cores of regenerated *Sphagnum* moss (n=5 cores of 4 depths). Laboratory compression resulted in a 5.5 cm (25%) moss height reduction, and a 49% increase in bulk density. Soil water retention increased at all sample depths, with the largest increase occurring directly above the cut-over peat. Theoretical pore size distribution showed a decrease in volume of larger pores (40-50 μm radius) and a subsequent increase in smaller pores (<20 μm radius) post compression. Based these results, two fields at BdB were compressed using a John Deere 6430 series tractor in Jan 2016, followed by hydrological monitoring May-Aug 2016. Field compression resulted in a moss height reduction of 8.5 cm (38%). Average soil moisture content in the compressed fields was consistently higher 2.5 cm below the cut-over peat (0.75), 2.5 cm above the cut-over peat (0.67) and 2.5 cm below the surface (0.25) than in the uncompressed field (0.32, 0.14 and 0.15, respectively). This increase in volumetric moisture content in the compressed profiles was due to a structural change in the moss. Increased moisture content in the compressed fields indicates that mechanical compression was successful in altering pore dynamics in *Sphagnum,* effectively addressing the capillary barrier effect.

Presentation type: Oral presentation

H02-03: **Accelerated *Sphagnum* spp. regeneration in cutover cranberry fields, and repeat multi-spectral imaging survey**

Andrew Elves[1*] and Richard Hebda[1]

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Abstract
This nascent study is aimed at understanding the link between spectral reflectance properties of four regionally significant *Sphagnum* spp. in a temperate maritime raised bog, and their position along the micro-topographical gradient of the peat surface. Establishing a link between light mediated ecophysiology and phenological cycling relies on plot level monitoring of both micro-meteorological and hydrological gradients. Reflectance values are captured from the moss canopy using a six-channel multi-spectral camera array. The array is designed to harness information encoded in discrete bandwidths of the electromagnetic spectrum associated with underlying ecohydrological and ecophysiological processes. This repeat multi-spectral imaging study (using four proven reflectance indices), monitors reflectance values in tandem with fine spatio-temporal scale measurement of peat water column drawdown, soil moisture, and peat-air interface humidity levels. Monitoring subsurface hydrological fluctuations and plot-scale micro-meteorological conditions allows for meaningful inferences to be drawn from species specific spectral responses. Species specific spectral signatures for the four *Sphagnum* spp., that occupy different positions along the hummock-hollow gradient, will be used to monitor the efficacy of a concurrent study aimed at accelerating the regenerative capacity of a cut-over peat surface. Establishing regionally relevant spectral response signatures for four indicator *Sphagnum* spp. may have significance for peatland monitoring initiatives along British Columbia's South Coast.

Presentation type: Oral presentation

H02-04: **The Effect of Peat Depth on Peatland Ecohydrological Resilience to Drought: Survival of the Thickest?**

James Michael Waddington[1], Ben Didemus[1], and Paul Moore[1]

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Abstract
Northern peatlands provide important ecosystem services (e.g. carbon storage, water storage, species at risk habitat). While these ecosystems are facing large increases in the areal extent and frequency of climate-mediated disturbances (e.g. wildfire, drought), they are generally resilient to these disturbances. Numerous autogenic ecohydrological feedbacks operate within peatlands that regulate their response to changes in seasonal water deficit. However, the foundational research upon which this peatland resilience framework understanding was based were undertaken in deep and large peatlands where a water table (WT) is ever-present. In contrast, little research has been undertaken on shallow and small scale peat-accumulating systems and as such their vulnerability to disturbance remains unknown. To address this research gap we examined the ecohydrological processes that controlled water storage dynamics and moss water availability in 18 peat-accumulating depressions of Canadian Shield rock barrens near Parry Sound, ON. The magnitude of WT variability was often several times greater in shallower bedrock depressions (< 50 cm deep) as compared to deeper 'bogs' (>70 cm deep). Sphagnum dominated 'vernal pools' (30-50 cm deep) had a WT variability two to three times greater than Sphagnum dominated bogs at WT depths > 20-25 cm. As compared to bogs, 'pits' (<15 cm deep) and vernal pools had greater rates of WT decline during drying intervals, deeper average WT depths when a WT was present, and extended periods of WT absence during the summer months. As such, moss growing in pits and vernal pools generally had lower near-surface water availability as compared to bogs. WT dynamics and moss water availability were generally weakly correlated to depression catchment size. The results of this study suggest that peat depth is an important control in determining peatland vulnerability to drought and may provide insight into adaptation strategies to minimize short-term vulnerability in shallow and/or recently restored peatlands.

Presentation type: Oral presentation

H02-05: **Mire breathing as a useful measure in raised bog restoration**

Sarah Howie[1] and Richard Hebda[2]

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Abstract
Oscillation of the peat surface (mire breathing) is an important mechanism for hydrological self-regulation in bogs. As the water table rises in the wet season, the peat body expands, raising the bog surface and increasing water storage. With seasonal drying the water table declines, the peat loses volume, and the bog surface drops, thereby keeping plant roots in close contact with the water table. Using anchored piezometers, we monitored the amplitude of the surface of a Pacific coastal temperate raised bog for several years. Piezometers were distributed in eight different plant communities, in both peat-harvested (n=22) and unharvested (n=44) sites, to determine how bog surface oscillation relates to water table depth and amplitude, and plant community composition. The multi-year average for bog surface oscillation ranged from 3 - 36 cm; the average oscillation was almost twice as high for harvested sites (mean: 16 cm) than for unharvested sites (mean: 9 cm). In unharvested sites, oscillation of the bog surface was most pronounced in sites where the water table was highest and most stable, and in sites with deeper peat. In harvested sites, bog surface oscillation was weakly related to the maximum depth to water table in the dry season. Plant community type was a significant predictor of bog surface oscillation in both harvested and unharvested sites. Bog surface oscillation could be an important metric for assessing the restoration capability or storage capacity of raised bogs in similar climatic settings.

Presentation type: Oral presentation

H02-06: **Using drones to assess soil moisture patterns following peatland restoration**

Pete Whittington[1], Dion Wiseman[1], Christine McGorman[1]

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Abstract
Understanding the spatial distribution of soil moisture, and maintaining sufficiently high soil moisture, is critical to the re-establishment of peatland vegetation on a post peat-harvested field. Unfortunately, the *in situ* measurement of soil moisture can be expensive, temporally/spatially limited, and laborious. Recent advances in UAV (unmanned aerial vehicles) technology have provided a cost-effective alternative for the acquisition of high resolution aerial images. Imagery obtained of the Elma North (SunGro Horticulture, south east Manitoba) restoration project show distinct variations in spectral reflectance believed to be indicative of soil moisture differences. Our objective was to determine if these images could be used to quantify spatial variations in soil moisture. Restoration began on the ~7.5 ha harvested (260 x 260 m) Elma North site in fall 2015. The site was subdivided into 418 cells (~12x12m) separated by small peat berms making a waffle-like pattern. Soil moisture was assessed by manually inserting a CS615 moisture content probe into the centre of the cell in every other row, and every other column (n=114 locations). The images (from a Phantom Vision 2+) were processed using Agisoft Photoscan and ArcGIS. A mask was created to eliminate non-peat materials (e.g., woody debris). A 1 m diameter buffer was applied to each soil moisture sampling location and the average spectral reflectance in the visible portion of the spectrum was obtained. These reflectance values were plotted against the actual soil moisture data (R^2 of 0.4) suggesting that even standard colour UAV imagery may be useful for identifying moisture content.

Presentation type: Oral presentation

H02-07: **Quantifying Peatland Ecohydrological Tipping Points to Catastrophic Peat Burning**

Sophie Wilkinson[1], Paul Moore[1], Dan Thompson[2] and James Michael Waddington[1].
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Abstract
Northern peatlands provide important global and regional ecosystem services acting as a long-term net carbon sink and regional surface water store. While northern peatlands have been shown to be generally resilient to wildfire due to an array of negative autogenic feedbacks, recent research suggests that the exceedance of ecohydrological 'tipping points' can induce severe burning and cause catastrophic regime shifts. Afforestation may invoke a strong positive feedback that reduces resilience and enhances smouldering propagation. Hence, there is an urgent need to quantify this peatland afforestation 'tipping point' to catastrophic peat burning. This research capitalised on both the 2016 Horse River wildfire and an experimentally drained peatland near Fort McMurray, Alberta. The peatland last burned in 1953, was drained in the 1970's with drainage ditches maintained until the 1980's. We examined afforestation and depth of burn (DOB) in three sites within the peatland: un-drained (UD), moderately drained (MD) and heavily drained (HD), selected based on drainage ditch density. Trees ranged from 45 to 55 years old which is consistent with time since last fire. Average basal diameters were 2.6 ± 1.2, 3.2 ± 2.0, and 7.9 ± 4.7 cm, and DOB was 2.5 ± 1.5, 11.3 ± 3.6 and 48.5 ± 4.6 cm for the UD, MD and HD sites, respectively. Basal area had the strongest relationship with DOB, with a linear relationship and r^2 of 0.72. Stand density did not strongly correlate with DOB and neither did distance from ditch, suggesting that tree size may be the best indicator of peatland vulnerability to high DOB. Nevertheless, our results suggest a threshold of drainage density and tree size exists which vastly decreases peatland resilience. We discuss the potential for utilizing fuel load adaptation strategies (e.g. thinning) as mitigation measures to enhance peatland ecohydrological resilience to severe burning.

Presentation Type: Oral presentation

H02-08: **Permafrost-thaw-induced forest loss across boreal peatland environments in the Canadian subarctic**

Olivia Carpino[1*], Aaron Berg[1], Justin Adams[2], William Quinton[3]

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Abstract
Permafrost distribution throughout the Canadian subarctic is not particularly well understood due to a combination of the remoteness and size of the region, spatial and temporal heterogeneity, limited data availability, and incomplete monitoring networks. These factors not only highlight the challenges associated with establishing a comprehensive understanding of the changing distribution of permafrost under the impacts of climate change, but also further emphasize the need to improve techniques of remotely capturing and analyzing permafrost distribution. Landcover, which is highly visible and easily identified through remote sensing data, has been proposed as an emerging methodology; where forest cover is often indicative of permafrost plateaus, while wetlands are underlain by permafrost-free ground. Recent warming throughout the subarctic boreal peatlands has led to rapid and widespread permafrost degradation and has also corresponded with a significant decrease in forest cover and wetland expansion. This study quantifies landcover change and net forest loss at 11 subarctic boreal peatland sites in the southern Northwest Territories and northeastern British Columbia between 1970 and 2010. Remote sensing-based change detection analyses were completed over 10km^2 areas of each site indicating variable patterns of net forest loss that ranged from 6.9% to 11.6% over the 40-year study period. These differential rates of landcover change may be explained through climatic or environmental factors that vary latitudinally across the selected sites. Augmenting our understanding of the unique conditions contributing to differential changes in forest and permafrost distributions are critical for predicting future interactions as well as developing new and more suitable monitoring techniques.

Presentation type: Oral presentation

H02-09: **The effects of forest sheltering on peatland evapotranspiration in the Boreal Plains, Alberta, Canada**

A. Green[1*], G. Bohrer[2], and R.M. Petrone[1]

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Abstract
Peatlands comprise approximately 50% of the total landscape of the Western Boreal Forest, including the sub-humid Boreal Plains (BP) zone. The BP experiences persistent water deficit conditions, prohibiting anaerobic conditions, which has the potential to increase decomposition, transforming the peatlands from carbon sinks to carbon sources. With evapotranspiration (ET) being the dominant source of water loss in the BP, it is necessary to understand the dynamics and controls on ET within these wetlands. Peatlands often experience turbulent sheltering from their surrounding upland forests, which results in spatially variable ET rates inside the peatlands, produced by zones of flow separation which suppress ET losses. Understanding the dynamics of peatlands and upland forests will allow us to assess the resiliency of hydrologic conditions under future climatic and land use scenarios. The use of the Regional Atmospheric Forest Large Eddy Simulation (RAFLES) allows for various wetland and upland forest configurations to be simulated at a high temporal and spatial resolution. Results have shown that wetlands with the same area and shape, but a different orientation to the dominant wind direction experience significantly different ET loss and spatial patterns of ET.

Presentation type: Oral presentation

H02-10: **Assessing the potential role of peat properties and peatland configuration in maintaining shallow water table in a sub-humid climate**

Paul Moore[1], Sophie Wilkinson[1], Nick Kettridge[2], Rich Petrone[3], Kevin Devito[4], Mike Waddington[1]

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Abstract
Peatlands in the Boreal Plains (BP) of Alberta are facing large increases in the severity, areal extent, and frequency of disturbance from both mining and wildfire. It has been shown that peatlands in the BP are critical for runoff generation at the catchment scale, making them a necessary component of the post-mining landscape. In a sub-humid climate, increased disturbance pressures are placing the future security of these critical ecosystems in doubt. Using data from 26 peatlands in the BP of Alberta, we parameterized a simple groundwater transmissivity model to assess under what conditions a shallow water table could be maintained in a perched system without connection to the regional water table. We used a Monte Carlo approach to evaluate a large number of parameter combinations, with individual parameter distributions informed by field measurements. The aim was to assess the importance of peat property layering, peat depth, properties at the upland-peatland interface, and hydrogeological setting on simulated water table distributions. The simulations were run with stochastic weather inputs allowing for realistic variations in rainfall, evaporative demand, and growing season length. We found that there were strong interactions between conditions at the beginning of the growing season and climate, necessitating low AET:PET ratios in order to support shallow water table conditions. The assessment of hydrogeologic setting shows that for a broad range of the phase-space tested, water table in peatlands on clay or low conductivity glacial till were relatively insensitive to peat properties and peatland spatial configuration. Conversely, the simulated water table distribution in peatlands overlying sandy silt varied significantly according to the depth dependence in peat properties.

Presentation type: Oral presentation

H02-11: **Carbon dioxide and methane exchange from a restored peatland: evaluating the role of graminoid species as a plant functional type**

Sabrina Touchette[1*], Maria Strack[1], and Ian Strachan[2]

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Abstract
One metric of peatland restoration is the re-establishment of a carbon sink. Conditions post-restoration may promote the establishment of vascular plants such as graminoids, often at greater density than would be found in undisturbed bogs. Although graminoid species are often grouped as one plant functional type, the greenhouse gas (GHG) exchange of individual species in restored ecosystems is not well quantified. In a restored peatland in central Alberta, we studied the GHG exchange (May to September 2016) using quadruplet collars in Beckmannia syzigachne (B.syz), Calamagrostis canadensis (C.can), Carex canescens (Cx.can), Eriophorum vaginatum (E.vag) and Scirpus cyperinus (S.cyp). The carbon dioxide (CO_2) flux of each species was measured with a clear chamber and an infrared gas analyzer. Methane fluxes were measured with the closed opaque chamber technique; CH_4 concentration was determined using a gas chromatograph in the lab. Results show the net ecosystem exchange of CO_2 (NEE), gross ecosystem photosynthesis and ecosystem respiration of S.cyp and Cx.can were significantly different from other species. Difference in NEE between perennial stages (e.g., vegetative, elongation, reproductive, and dormant) varied according to plant species. For each species, significant differences in flux were found between the stages, except for C.can. There was a significant difference in CH_4 flux between the dormant stage and other stages, and between the vegetative and reproductive stages. During the dormant stage, significant differences were observed between E.vag and every other species except S.cyp, with E.vag and S.cyp having the highest fluxes. Our evidence suggests that graminoid species should not be considered as a single group in a peatland model, as E.vag, S.cyp and Cx.can demonstrated significant differences in CO_2 and CH_4 exchange.

Presentation type: Oral presentation

H02-12: **Salinity change and long-term carbon accumulation in a saline boreal fen: implications from paleoecology to wetland reclamation in Athabasca Oil Sands Region**

Olena Volik[1*], Richard M Petrone[1], Corey M Wells[1, 2], Jonathan S Price[1]

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Abstract
An understanding of the main controls on long-term carbon accumulation in naturally saline peatlands can be useful for furthering peatland reclamation in the Athabasca Oil Sands Region where salinization complicates the construction of sustainable peatland ecosystems. As such, the long-term apparent rate of carbon accumulation (LARCA) within a naturally saline fen situated near Fort McMurray, Alberta was studied using two peat cores in order to recognize controls on carbon accumulation under a range of saline conditions. Changes in LARCA in the less saline part of the fen correlate well with long-term water table variability and appear to be unaffected as long as salinity is low (EC< 5 $mScm^{-1}$). The highest LARCA values were related to wet conditions; however, prolonged inundation coupled with high salinity (EC>10 $mScm^{-1}$) appear to negatively affect LARCA. In the southern more saline part of the fen, relationships between LARCA and hydrology are complicated by salinity >10 $mScm^{-1}$, which negatively affects net primary productivity. The northern less saline part of the fen has a LARCA of 29.67 gm^{-2} yr^{-1}, which is close to that in rich fens. However, LARCA in the more saline southern part is considerably lower (9.79 $gm^{-2}yr^{-1}$). Notable and abrupt shifts in LARCA in response to variations in salinity and water table suggests that saline fens, potential targets for reclamation, are dynamic systems sensitive to environmental change at regional and local scales.

Presentation type: Oral presentation

H02-13: **Impacts of road construction and removal on the hydrologic and geochemical function of two peatlands within the Athabasca oil sands region, Alberta, Canada**

Eric Kessel[1] George Sutherland[1], Corey M. Wells[1], Tobias Weber[2], and Richard M. Petrone[1]

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Abstract
Linear disturbances cover vast swaths of northeastern Alberta, where the majority of the land is wetlands with shallow and local hydrologic connections. Thus, the effects of road construction on wetland hydrological pathways can have significant implications on water movement and vegetation productivity within the region. However, little is known about the effect that roads have on wetland hydrology. Two fen peatlands in the Athabasca Oil Sand region were investigated to quantify the effects of linear infrastructure removal on peatland hydrogeochemical function, C sequestration, and system rebound. One fen peatland had the entire road removed in 2013 (Fen2013). The second fen peatland had portions of the road experimentally removed in 2011 (Fen2011). Both sites experienced a significant increase in bulk density (*p*b) for the peat column within the footprint of the removed road (RR) as compared to unimpacted peat (UP). The lack of an acrotelm in the RR resulted in low specific yields (Sy) within the near surface. At Fen2013 elevated nutrients and major ions were observed within the footprint of the road as well as in a downstream bog, suggesting the transport of nutrients into downstream systems following road removal. Peat subsidence in this area has also enhanced the potential for surface flooding under both wet and dry conditions. Similarly, along sections where the road was removed at Fen2011 an increase in nutrients and most major ions was observed in ground and surface water. Spatial patterns in elevated nutrient concentrations were tied to preferential flow through areas where the road was removed, and were coincident with spatial changes in vegetation communities and enhanced C sequestration relative to upstream areas as well as areas where the road was not removed. This study provides insight into the footprint extent of linear access infrastructure into up and downstream systems when hydrologic connections exist.

Presentation type: Poster

H02-14: **Peatland Recovery From Wildfire in Northern Alberta: Implications for Reclamation Design of Oil Sands Mining Leases**

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Abstract
Peatlands in the sub-humid Boreal Plains of Alberta exist at the limit of their climatic tolerance. They are therefore vulnerable to wildfire, especially at the interface between the peatland and forestland (margins) due to high peat bulk density and low moisture content. Deep burning at the margins may reduce a peatland's ability to recover to its previous state, leading to system shrinkage or collapse following fire. Previous research has identified small peatlands located on topographic highs composed of coarse sediments as 'hotspots' for deep burning, as these peatlands are not regularly connected to regional groundwater flow. The present study further examines the relationship between surficial sediment assemblages and the impact of wildfire on overlying peatlands. Peatland recovery following wildfire along a chronosequence was assessed at the interior and margin of 26 peatlands located at various positions on the post-glaciation landscape of Northern Alberta. This was accomplished using estimates of below ground carbon accumulation calculated through loss on ignition of peat above the uppermost charcoal layer in peat cores from each site. Underlying sediments were found to have little effect on below ground carbon accumulation rates in the interior of the studied peatlands; this is not expected to be the case for peatland margins, however, as shallower peat depths in these areas leads to a greater potential influence of surficial sediments on water table dynamics and peat properties. Results of this study will be used to identify peatland systems which are most resilient to wildfire, with implications for substrate selection of designed peatland systems during reclamation of oil sands leases. The stability of created peatlands through time on a landscape where wildfire is frequent is an important consideration in terms of both lasting ecosystem services and the potential risk to fire suppression and community safety that vulnerable systems would pose.

Presentation type: Poster

H02-15: **Impact of spatial variability on carbon dioxide and methane exchange from graminoid species in restored peatlands**

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Abstract
Peatlands are ecosystems that are known to be a net carbon sink largely controlled by the site's hydrology and saturated soil conditions. Drainage and peat extraction alters elevation and peat properties and therefore has an impact on the ecohydrological factors post-restoration. Spatial variability in water table position and chemistry could affect the vegetation distribution, and subsequently rates of carbon exchange. Graminoid species are known to be a pioneer plant post-restoration; however, individual species distribution on site according to the hydrology is not well quantified. A restored peatland in central Alberta was studied from May to August 2016, targeting Beckmannia syzigachne (B.syz), Calamagrostis canadensis (C.can), Carex canescens (Cx.can), Eriophorum vaginatum (E.vag) and Scirpus cyperinus (S.cyp). A vegetation inventory was conducted with transects distributed across approximately 0.24 km2 of the site. A grid of wells and piezometers were installed in the same area to characterize the hydrology. Additionally, quadruplet plots were installed to measure the carbon dioxide and the methane fluxes from three graminoid species that were present in both wet and dry areas (C.can, Cx.can, E.vag). Results show that graminoid species' distribution is correlated to hydrology. A higher water table promoted the establishment of graminoid species, especially for S.cyp. Other species, such as Cx.can, establish on site regardless of the hydrology. The spatial variability in hydrology did not directly affect the carbon dioxide flux for any of the measured species, but did impact the methane emissions with higher fluxes in wet areas. Furthermore, the hydrology will drive the peat accumulation and the moss distribution; important factors to consider for the success of restoration. Therefore, since the spatial distribution of graminoids is an important control on the productivity and net carbon exchange on site, spatial variability of hydrology needs to be considered planning restoration projects.

Presentation type: Poster

H02-16: **Examining site-scale fluxes of carbon and water over the first four years of a constructed fen-upland watershed in Alberta, Canada.**

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Abstract
Oil sands development in the Western Boreal Plains of northern Alberta includes widespread surface mining. More than 50% of the land cover impacted by this activity are wetlands--the majority of which are fen peatlands that provide key ecosystem functions in the form of carbon (C) storage, water regulation, and habitat provision. Recently, some oil sands companies have constructed fen peatland watersheds ~40 km north of Fort McMurray, AB. This research examines the initial trajectory of C and water fluxes between a 32 ha constructed Fen-Upland watershed and the atmosphere since its construction (2013-2016). The trajectory of the constructed system is evaluated relative to a variety of nearby natural reference fen-upland ecosystems over the same period. Results indicate that evapotranspiration (ET) rates from the constructed fen in 2013 (258 mm) and 2014 (287 mm) approximated ET measured at reference systems. In 2015 and 2016, with near-surface water levels maintained and rapid plant growth, ET rates from the constructed fen increased beyond observations at reference fens. This suggests sufficient hydrological self-regulation within the watershed as the region moves into what appears to be a drier period within the regional climate cycle. The constructed Fen was a C source (1 g C/m2/day) during the summer of 2013 and has subsequently shifted to a small C sink in 2014 (-0.3 g C/m2/day), 2015 (-2 g C/m2/day), and 2016 (-3 g C/m2/day). These rates of C sequestration are greater than rates (-0.5 to -1.5 g C/m2/day) observed at nearby reference fens over the same time period. In the constructed upland tough soils, low moisture content, and slow vegetation establishment have been the primary factors limiting C storage and ET. The upland has experienced a slow trend towards net C uptake, but remains a C source (2 g C/m2/day) to date.

Presentation type: Poster

H02-17: **Inferring bog hydrology and soil chemistry using testate amoebae in the Fraser Lowland, British Columbia**

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Abstract
Testate amoebae are sensitive indicators of bog hydrology and peat chemistry, such as surface wetness, depth to water table, and pH, and have been successfully used to infer changes in past conditions, but their application to the study of western North American bog hydrology is limited. Preliminary results from a study of testate amoebae along bog-fen transitions in the Fraser Lowland, BC, revealed a diverse assemblage (18 species) of testate amoebae in surface and subsurface peat, many of which are commonly used in other regions as proxies for water table depth in bogs (e.g., *Assulina muscorum*, *Cryptodifflugia oviformis*, and *Trigonopyxis arcula*). The presence of these indicator species suggests that a transfer function for water table depth using testate amoebae is possible for bogs of the Fraser Lowland. By quantifying testate amoebae assemblages in surface peat samples (uppermost 5-7 cm) collected along transects with known environmental data, we plan to develop a statistical transfer function that associates testate amoebae assemblages with water table depth and peat chemistry.

Presentation type: Poster