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Renew

in this issue:

2 Erosion study making its way across Canada
5 Ninety years of history at the Breton Plots
10 A look at 100 years of soil science

UNIVERSITY OF ALBERTA
DEPARTMENT OF
RENEWABLE RESOURCES

CELEBRATING 100 Years of Soils

A message from the Chair

This year marks several significant milestones in the Department of Renewable Resources: the 100th Anniversary of soil science education and research, the 90th Anniversary of the Breton Research Plots, and the 57th Anniversary of the Ellerslie Research Station.

To acknowledge these achievements, and the partners and staff who have helped realize them, we have dedicated this issue to showing how soils touch so many aspects of our work. From agriculture, to forestry, to land reclamation and conservation, soils are the lifeblood of our ecosystems. Our staff and students are making important contributions to the field of soil science. As a Department, we are continually investing in research capacity related to soils, with new research laboratories, infrastructure, and academic staff who bring innovative ideas and energy to the Department.

I would also like to take this opportunity to thank one specific individual, Dick Puurveen. Dick has been with the Department for 27 years. As our Off-Campus Research Facility Manager for 19 years he has played an instrumental role in the successful operation of our facilities and in the high-quality research these facilities support. Many of the studies highlighted in this issue would not have been possible without his dedication, leadership, and commitment.

I hope you enjoy seeing the history and the future of our Department blended throughout this issue of Renew.

Dr. Ellen Macdonald
Chair, Department of Renewable Resources

Soil **erosion experiment** making its way **across Canada**

It's an assignment few graduate students even dream of. Identify communities from coast to coast that depend on forests for their drinking water. Travel to as many of the sites in Canada as possible. Carefully set up experiments to track and compare these diverse ecosystems. Make a difference for communities.

While the assignment may be rare, it's one that Jennifer Hall and Erin Humeny were keen to accept. They are currently making their way across Canada assessing erosion potential of a wide range of resource roads in forested areas. The goal is to identify sites with high erosion potential and develop prioritization tools to inform management action.

"We hope to develop tools to better manage limited resources," said Humeny.

The crew is using a creative technique. They head to the field armed with a sprinkler head, a trough, and gallons of water. By using standardized methods, the duo captures information about the quantities, physical characteristics, and chemical composition of runoff. They use this information to predict where challenges might arise for downstream reservoirs or small communities.

"Many smaller communities don't have sophisticated treatment facilities, so they need to protect their source waters," said Hall.

Hall and Humeny have already sampled on Vancouver Island, throughout British Columbia, and down the east slopes of the Rocky Mountains. This summer they will head to Nova Scotia, New Brunswick, and Quebec. They anticipate having results from their work within the next 18-24 months.

The study is part of the forWater Network, funded through a NSERC Strategic Network Grant. Hall and Humeny are supervised by Dr. Axel Anderson, Government of Alberta seconded Assistant Professor and Water Program Lead at fRI Research.

Depth-to-water index useful for estimating **carbon stocks** in conifer forests

A recent study has determined that the depth-to-water index, which is commonly used by forestry companies for harvest planning, is also useful for predicting soil carbon stocks, particularly in Alberta's conifer forests.

Graduate student Paul Sewell, Professor Dr. Sylvie Quideau and Associate Professor Dr. Miles Dyck found that as conifer forests became wetter, the carbon stocks in the mineral soils increased. The research team believes the results, and the depth-to-water index, can be used to avoid practices that result in the loss of carbon stocks and can inform progressive harvesting prescriptions.

The study was funded by NSERC with support from the EMEND partners.

International **collaboration** seeks to develop **soil health** metrics

The Soil Health Institute has launched an international campaign to survey 120 soil science plots throughout North America with a goal of developing standardized metrics for reporting on soil health.

"Soil health is a topic that is gaining in popularity. The idea is to develop a test, or series of tests, to assess soil health in a standardized way, much like we do for people," said Dr. Miles Dyck, an Associate Professor in the Department of Renewable Resources who is one of over 100 scientists collaborating on the project.

The Breton Plots, an agricultural research station west of Edmonton, will serve as one of 17 locations in Canada, where sampling is being led by Department of Renewable Resources Alumna, Dr. Charlotte Norris.

Carbon release from **thawing peatlands** shows variability based on history

A new study suggests that carbon release from thawing permafrost peatlands in boreal western Canada is not as high as found in other regions. PhD student Liam Heffernan and Dr. David Olefeldt, Assistant Professor in the Department of Renewable Resources, found the potential carbon impact of thawing permafrost is affected by the history of how peatlands form, and by the new vegetation growth on recently thawed sites.

The study is linked to the fact that Canada's arctic ecosystems have experienced increasing temperatures as a result of climate change. This in turn, is leading to high rates of soil slumping, lake formation and thawing of permafrost peatlands. In some regions, this permafrost thaw has led to significant emissions of carbon dioxide and methane.

However, Heffernan and Olefeldt have found there are important nuances to this story. Northern peatlands have a wide range of histories, and Heffernan has found this affects how much carbon might be released as peatlands thaw. The sites in Heffernan's study gained permafrost thousands of years after the peatland had formed, meaning decomposition had already been occurring for many years and much of the remaining carbon was locked into the site. In contrast, studies showing large carbon releases have taken place on sites with less decomposition prior to permafrost formation. Since the carbon was stored more recently on these sites, it is more likely to be released during thawing.

When asked what this means for climate change projections and the implications of potential carbon release, Olefeldt stated that he and his colleagues see permafrost thaw as an important climate nudge, rather than a climate bomb.

"The release of greenhouse gases from permafrost thaw will not in itself drive future climate change, but it will further amplify climate change caused by human emissions," said Olefeldt.

The study was supported by the Campus Alberta Innovates Program (CAIP) and an NSERC Discovery Grant to Dr. Olefeldt.

The Breton Plots – celebrating 90 years of meaningful contributions in agriculture

It was 1929 and University of Alberta soil science professor, Dr. F.A. Wyatt, was looking to set up research plots in an area with unique soils where settlers were struggling to grow crops. One landowner, Mr. Ben Flesher, was swayed to offer up a portion of his land near the town of Breton, Alberta. It is rumoured that Flesher told Wyatt he could have "the whole damned thing, because it was no good anyway."

This event marked the beginning of what is now known as the Breton Plots, a long-term research site that celebrates its 90th anniversary this year. In scientific research, the anniversary is heroic. It positions the humble Breton Plots as one of the top 10 longest running agricultural soil experiments in North America. As colleagues reflect on the past 90 years, they see a legacy of commitment across institutions, positive impacts on local farm families, and a fair share of healthy conflict among scientific peers.

The location of the Breton Plots is not typical for an agricultural research site. The plots are located on what are called Gray Wooded soils (Gray Luvisols), which are located at the transition from the aspen parkland to the boreal forest. The soils are not ideal for agriculture because they possess different physical and nutrient characteristics compared to the rich productive soils in central and southern Alberta. Despite these drawbacks, Gray Wooded soils were critical for advancing agriculture and settlement, and scientists were determined to figure out how they could help local farmers grow productive crops on newly cleared land.

One of the most significant outcomes came within the first decade of research at the plots. Wyatt had been studying the effect of fertilization with ammonium sulfate on crops and concluded that nitrogen was key to successful crop growth on the wooded soils. His colleague, Dr. J.D. Newton, was certain the positive effects were a result of the sulfur within the ammonium sulfate, not the

nitrogen. The debate among peers surfaced publicly, with each publishing a paper in the same journal issue demonstrating their respective interpretations. Over time, sulfur became widely recognized as a key nutrient for farming these tricky wooded soils.

In subsequent years, research at the Breton Plots explored the effects of cropping systems, zero tillage, and fertilization regimes on crop production and soil quality. A local farmer noted this research as contributing directly to the viability of crop production from Breton to Cochrane. The Fleshers themselves have stated their family would have never been able to establish their farm in the Breton area without the insights from the Breton Plots.

While sustaining the plots for the past 90 years hasn't been easy, the research site has recently benefited from two important events. The Flesher family donated an additional 60 acres to the research station in 2015, 30 acres of which have already been used to establish research trials on carbon sequestration, perennial rye, and hemp. The Breton Plots Endowment Fund has also grown over time with contributions from individuals, municipalities, and the provincial government, providing much needed funding used to sustain operations.

"The future, therefore, seems bright," said Dr. James Robertson, Professor Emeritus who oversaw many research projects at the Breton Plots over the course of 25 years.

The key to the success for future generations of students working at the Breton Plots, stated Robertson: "One has to have one's eyes open to see things we might not expect."

Trace metals detectable in **tree wood** could help inform oil sands reclamation

Scientists and managers looking to evaluate how trees grow on soils containing low levels of bitumen have a new tool at their disposal. Graduate student Marc La Fleche, Assistant Professor Dr. Justine Karst and Professor Dr. William Shotyk found that by sampling a tree's wood they can detect when tree roots interact with trace metals contained within bituminous soils.

The technique relies on a simple principle. When trees grow into soil layers containing the target metals, they may take up some metals through their roots. La Fleche found that under these conditions, chemical signatures are recorded in the wood of trees and can be analyzed using a simple tree core.

The implications are highly relevant to land reclamation within the oil sands region of Alberta. During reclamation, soils with low levels of bitumen – those that are not economical to process – can make up the underlying landform in reclamation sites. By taking tree cores and subsequent soil samples, researchers and managers will be able to monitor when tree roots encounter bitumen within soils, and understand how trees respond once this occurs.

The study was funded by Canada's Oil Sands Innovation Alliance (COSIA) and NSERC.

Salvage logging impacts soil fungal communities, **seedling growth**

A new study has shown that doubling up on disturbance isn't good for soil fungal communities or tree seedling performance. Graduate student Jackson Beck and Dr. Nadir Erbilgin, Professor in the Department of Renewable Resources, found that salvage logging of mountain pine beetle-killed forests leads to soil microbial communities that are significantly different from those found after natural wildfires or in adjacent non-salvaged forests.

Beck and Erbilgin collected soil samples from sites that experienced wildfire, harvesting, mountain pine beetle outbreaks, or salvage logging of beetle-killed stands. The soils were collected and taken back to the lab to see how these disturbances and practices impacted seedling growth, survival, and total biomass.

The analysis showed a gradient of responses. Seedlings grown in soils from wildfire sites performed the best, while seedlings grown in soils from salvage-logged stands performed the poorest. Further investigation showed that changes in soil fungal communities may explain these different responses. Wildfire stands had soil fungal communities the most like adjacent non-disturbed plots, while salvage-logging significantly changed the soil fungal communities.

The findings could have implications for seedling growth following salvage logging in mountain pine beetle-killed stands. Specifically, Beck stated that

changes in the soil fungal communities may reduce seedling growth over time.

A potential next step is to study the use of soil inoculations to re-establish microbial communities after salvage logging.

The study was funded by a NSERC Strategic Partnership Grant and a Alberta Conservation Association Biodiversity Challenge Grant.

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A legacy left behind – The **Ellerslie Research Station**

The Ellerslie Research Station, a site which served as the lifeblood for local farmers and consultants looking to improve agricultural practices, has officially closed after 57 years. The station is making way for urban development and a new provincial hospital in Southwest Edmonton.

The list of important contributions from the research station is substantial, ranging from studies in forensic anthropology to agricultural soils. But Ellerslie is perhaps best known for its field schools, which brought provincial agricultural staff and local farmers together for hands-on training courses.

"When I think of Ellerslie, I think of the synergy between provincial and university staff," said Dick Puurveen, the Off-Campus Research Facilities Manager for the Ellerslie Research Station.

During the years of the field school, Ellerslie was transformed into a large-scale laboratory. Provincial staff carefully planted hundreds of plots that demonstrated the impacts of disease, weed control, and other factors on the performance of various crops. Local farmers and agricultural consultants left the field school empowered to identify and address issues in their own crops.

The field schools ended in 1999, but the research station quickly took on new life, supporting research in agriculture, soil science, reclamation, and forest science by university scientists and partners.

"Ellerslie in more recent decades had many external users, including fertilizer companies, crop breeders, and herbicide companies," said Puurveen.

This close connection between the University and the agricultural sector provided students with meaningful interactions with potential employers. Many students, in turn, gained rewarding employment in industry, government, consortiums or consulting services.

Fortunately, the closure of the Ellerslie Research Station isn't all doom and gloom. Rather, it marks a transition to a new era of agricultural research. In 2008 the Bocock family donated 800 acres north of St. Albert to the University of Alberta. The University has been transitioning research programs to this field station in order to continue to inform modern agricultural practices for decades to come.

A brief look at the history of soil science at the **University of Alberta**

1919 Department of Soil Science is established with Dr. F.A. Wyatt as its first Chair

1929 Breton Research Plots established

1962 Ellerslie Research Station established

1971 Department of Forest Science established

1994 Department of Renewable Resources formed through the merger of the Departments of Forest Science and Soil Science

1995 Environmental and Conservation Sciences BSc Program created

2003 Bentley Lecture in Sustainable Agriculture established

2008 800 Acre St. Albert Research Station established on the Bocock Family Farm

2019 Department of Renewable Resources has 36 Faculty, approximately 200 graduate students, and Dr. Ellen Macdonald as Chair

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Credits:
Content: Matthew Pyper
Fuse Consulting Ltd.
Photos: David Olefeldt (p.2), Charlotte Norris (p.3)
Jennifer Hall (p.4), Dick Puurveen (p.5,6,9)
Marc La Fleche (p.7), Jackson Beck (p.8)

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Department of Renewable Resources
University of Alberta
751 General Services Building
Edmonton, AB T6G 2H1
CANADA

Phone: 780-492-4413

Fax: 780-492-4323

www.rr.ualberta.ca

UNIVERSITY OF ALBERTA
FACULTY OF AGRICULTURAL,
LIFE & ENVIRONMENTAL SCIENCES

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