Alberta NAWMP Partnership

Science Stories

Grazing Cattle, Stored Carbon and Wetlands Go Hand in Hand

The perennial plants that blanket well-managed grazing landscapes do much more than provide forage for livestock. They store carbon in the soil, provide wildlife habitat, maintain biodiversity, prevent soil and nutrients from being carried away by wind and water, and protect watershed health. An added bonus to this impressive set of natural benefits – or ecosystem services – is that grazing landscapes favour wetland conservation.

Furthermore, wetlands in grazing landscapes actually amp up the ecosystem services generated by these landscapes. But amp up by how much? A research project is working to fill that information gap, with help from the Alberta NAWMP Partnership's Science Fund and other funders.

"By filling this important information gap, we hope to increase understanding of the considerable ecosystem services that sustainable grazing landscapes provide to society as a whole," explains Dr. Pascal Badiou, a Research Scientist with Ducks Unlimited Canada (DUC) who is leading the project.

(L and R). Badiou's project is the first time that advanced greenhouse gas monitoring technologies called flux towers have been used in smaller, fresh water, mineral soil wetlands. Photos: Pascal Badiou, Ducks Unlimited Canada.

"Communicating our research results to consumers could bolster confidence in the environmental sustainability of the Canadian beef industry. And that could help towards ensuring that the remarkable array of ecosystem services provided by grazing landscapes and their wetlands – services that we all benefit from – are conserved for the long term."

Wetlands in grazing landscapes

"Canada has lost a tremendous number of wetlands. Much of that loss has occurred in agricultural landscapes of the Canadian Prairies where wetlands have been drained to try to increase annual crop production. Where we see a lot of wetlands remaining intact seems to overlay with intact pasture, grassland and forest landscapes. That makes sense because you need access to water for livestock production," explains Badiou.

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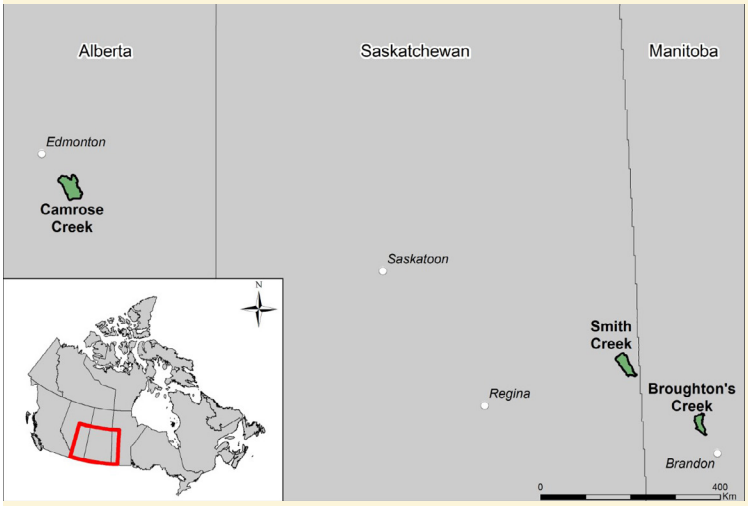
"The wetlands in grazing landscapes provide ecosystem services above and beyond those from the grassland, pastureland or forest they are embedded in. Wetlands play important roles in carbon cycling and climate regulation, and water quality and quantity regulation, and they are hot spots for waterfowl production and biodiversity."

But those wetland benefits have not been well documented. So Badiou is leading the Prairie Ecosystem Services Project to quantify the contributions of wetlands in livestock production landscapes.

For this project, Badiou has brought together researchers from across western Canada. Their diverse areas of expertise range from wetland ecology, ecosystem services and biogeochemistry, to greenhouse gas monitoring, micrometeorology and environmental modelling, to beef cattle production systems.

The collaborating researchers include: Dr. Lauren Bortolotti with DUC; Drs. Aaron Glenn, Roland Kroebel, Tim McAllister and Sarah Pogue with Agriculture and Agri-Food Canada; Drs. Kim Ominski and Marcos Cordeiro at the University of Manitoba; Dr. Sara Knox from the University of British Columbia; and Dr. Matthew Bogard at the University of



The locations of the project's three study watersheds. Image: Ducks Unlimited Canada.

Lethbridge. Environment and Climate Change Canada also has some involvement.

A deep dive into three watersheds

The project is currently taking place in three agricultural watersheds: Camrose Creek in Alberta, Smith Creek in Saskatchewan, and Broughton's Creek in Manitoba.

"Those watersheds were chosen for a variety of reasons. One, they are watersheds where DUC has previously worked and we have historical data on some of the wetlands in those watersheds. We also have LiDAR – a really detailed digital elevation product – for the watersheds," Badiou says.

"As well, those three watersheds are located in the Prairie Parkland Region, which tends to be the region where we see the highest densities of wetlands."

Tracking greenhouse gas fluctuations

"The project's primary focus is on the carbon storage and greenhouse gas emissions of wetlands within grazing landscapes," he notes. "We have traditionally seen higher greenhouse gas emissions from wetlands embedded in cropland versus those in grassland systems, but that has not been systematically studied [until this project]."

In each of the three watersheds, the project team is measuring the greenhouse gas emissions from 16 wetlands, eight within cropland and eight within grassland and/or pastureland.

In addition, the team has installed special monitoring technologies called flux towers in the middle of two wetlands – one in cropland and the other in grazing land – in the Broughton's Creek watershed.

"We are deploying flux towers for the first time in these types of smaller, fresh water, mineral soil wetlands, to look at whole-ecosystem greenhouse gas fluxes. That is really exciting because there is still a huge amount of uncertainty around the amount of methane [an important greenhouse gas] that is produced from these wetlands," notes Badiou.

"The techniques we have used in the past, such as chamber-based technologies, don't do a really good job at measuring the actual methane emissions from these wetlands. By using advanced micrometeorological techniques, we hope to do much better at resolving the actual methane fluxes from these types of wetlands in these landscapes."

The solar-powered flux towers are equipped with a series of very sensitive sensors that really rapidly measure carbon dioxide and methane, as well as wind speed, velocity and direction. "By fusing the measurements of vertical and horizontal wind movement and the very rapid measurements of carbon dioxide and methane in the little air packets circulating past the sensors, we can determine how much carbon dioxide and how much methane are leaving the system or being picked up by the system and over what area."

Measuring other ecosystem services

The project team is also assessing water quality, water quantity and biodiversity benefits from wetlands in grazing versus cropping landscapes.

Healthy wetlands improve water quality by trapping runoff and filtering out eroded soil particles, nutrients, pesticides and other contaminants. Wetlands help regulate surface water quantities as they catch, store and slowly release runoff, and some of the stored water percolates into the soil, replenishing soil moisture and groundwater resources.

In the three watersheds, the team is collecting and analyzing water quality samples, and they are using DUC wetland inventories to estimate water volumes. Then they will compare the water quality and quantity data for grazing versus cropping landscapes.

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The project has installed flux towers in two wetlands – one in cropland and the other in grazing land – to measure whole-ecosystem greenhouse gas fluxes. Photos: Pascal Badiou, Ducks Unlimited Canada.

Wetlands are also exceedingly important for biodiversity. Many wildlife species on the Canadian Prairies rely on wetlands for at least part of their life cycles, including the large numbers of breeding waterfowl that migrate to the region every spring.

As an indicator of biodiversity, the project team is determining the proportion of waterfowl produced from wetlands in the grazing landscapes. Then they will model the waterfowl productivity impacts of converting these landscapes to annual crop production. The resulting information could help DUC and other wildlife organizations in targeting conservation program planning and delivery to areas at high risk of conversion to cropland. As well, the information could be used in support of the development of policies and programs to encourage conservation of grazing landscapes and their embedded wetlands.

In addition, the team is mapping wetland habitat within the cattle grazing landscapes of the three watersheds. They will be scaling up those findings to the entire Prairie Parkland Region, and estimating the wetland ecosystem services from grazing landscapes in this region.

In the next few years, Badiou and his team are also hoping to expand the project beyond the three watersheds into more southerly prairie locations, possibly southeastern Alberta or southwestern Saskatchewan, to capture data on some of the other cattle grazing landscapes in Canada.

Cattle and landscape stewardship

This research has important implications for sustaining the ecosystem services generated from intact grassland and wetland landscapes.

"The beef industry is facing increased scrutiny in terms of the carbon footprint of beef consumption, with some people advising consumers to switch from beef to chicken or vegetarian options as a way to reduce greenhouse gas emissions associated with food production. The flip side of that is the need to help society understand the key role of beef producers in sustainably managing Canada's grassland, pastureland and rangeland landscapes," says Badiou.

In sustainable grazing management systems, cattle producers adjust grazing timing and intensity to maintain healthy, productive plant cover that supports cattle herds as well as providing wildlife habitat, protecting the soil from erosion and storing carbon in the soil. Cattle producers not only conserve wetlands as a source of livestock water but also develop livestock watering systems that deliver clean water to cattle while protecting the wetland's water quality for fish and wildlife.

"Beef producers' stewardship of these landscapes contributes to natural climate solutions, prevention of excess water and nutrients from leaving watersheds, and support of wildlife habitat and biodiversity," he explains.

Badiou concludes, "Sharing the results of our research could help consumers become aware of the environmental value of sustainable management of pasture and rangeland landscapes and the tremendous importance of such landscapes to society. Our research results could also be used in developing incentive programs or environmental markets, such as carbon markets, to encourage protection of grasslands and their wetlands."

Such initiatives can help ensure that Prairie grasslands and wetlands – and their tremendous range of ecosystem services – are conserved for the long term to benefit everyone.

Funding from Alberta NAWMP's Science Fund was instrumental in getting this project started and leveraging support from other agencies. The project's other funders include the Beef Cattle Research Council, Ag Action Manitoba, the Manitoba Conservation and Climate Fund, Agriculture and Agri-Food Canada, and the Natural Sciences and Engineering Research Council of Canada.