Rangeland Research Institute

2024-2025 Annual Report

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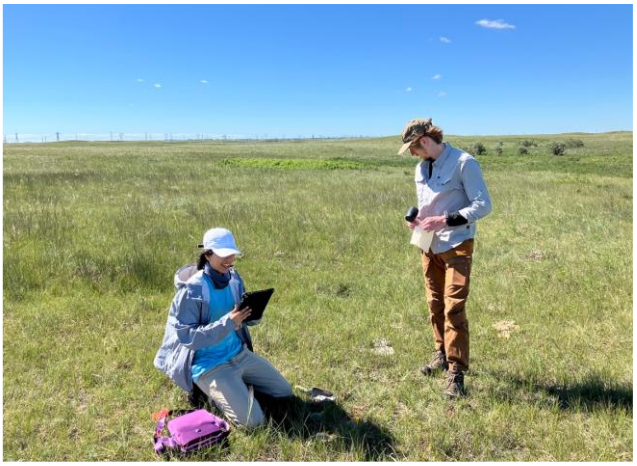
Cover photo: Undergraduate student, Aidan Dachuk, walks through native grassland at the Mattheis Research Ranch. Aidan spent the summer taking plant community cover assessments, soil cores, and plant biomass for many research projects.

Photo by Lisa Raatz

1. Introduction

The Mattheis and Kinsella Research Ranches were busy with research activity in 2024 as the Climate Action Through Grazing (CAT-G) project was initiated. Using primary support from Genome Canada, Genome Alberta, and Results Driven Agricultural Research, this multi-disciplinary project is being done at the two University of Alberta research ranches and compares rotational and continuous grazing systems at large, operational scales, in triplicate form at each location. The study is expanding on prior work done on public and private rangelands across Canada that suggests cattle grazing, particularly when done using pulses of grazing and lengthy intermittent rest, may favor improved range and pasture health, including soil carbon storage. The study is quantifying grazing system impacts on a wide variety of agronomic and ecological responses, including plant community productivity, composition, plant species richness and biodiversity, soil chemical and physical attributes together with soil microbial communities, greenhouse gas emissions, and cattle grazing behavior, as well as beef production metrics. There are more than 15 active lead researchers, including several that were funded by the Rangeland Research Institute (RRI) through the Competitive Grants Program, that are also using these large-scale experimental systems to further our understanding of rangeland ecology and management phenomenon. Importantly, the project relies on a host of post-docs, graduate students, and undergraduates to complete this ambitious undertaking.

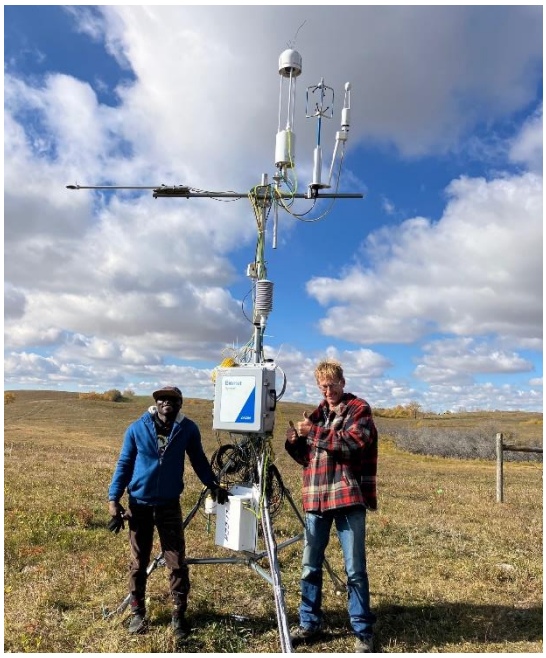


Members of the Wagner lab carrying out vegetation surveys as part of the RRI project on seed dispersal. Photo from Viktoria Wagner.

The RRI continues to focus on facilitating research, teaching, and outreach. Many other research projects and teaching activities have taken place in the past year on both U of A ranches as well as on public and private lands across the western Prairies to expand our understanding about rangeland ecosystems. This report summarizes key activities undertaken by the RRI from April 1, 2024 through March 31, 2025, and includes a summary of research activities, including three research profiles of recently completed projects; a summary of communication and outreach activities; capacity building; and a financial summary.

2. Research

Research remains the primary mandate of the Rangeland Research Institute (RRI). The RRI continues to make funding research a priority by offering grants every second year through the Competitive Grants Program at the University of Alberta. Many recent projects funded by the RRI are listed in Table 2.1 and relate to investigating differences in season-long and rotational grazing systems as part of the multi-disciplinary Genome Canada supported project Climate Action Through Grazing (CAT-G) taking place at the Mattheis and Kinsella Research Ranches. Research also occurs on private land, such as the Alberta Agri-systems Living Lab (AALL) and Central Prairie Living Lab (CPLL) funded by Government of Canada – Climate Action Solutions, and in partnership with farmers and ranchers from across Alberta and Saskatchewan. The Living Labs projects are unique because they facilitate co-development agreements between researchers and producers to implement on-farm management changes to determine how these best practices reduce greenhouse gas emissions, increase carbon sequestration, improve soil health, enhance forage production and availability, and many other on-farm benefits.



PhD student, Bismark Asante-Badu, and Dick Puurveen with one of two greenhouse gas flux towers at Kinsella Ranch that are part of the CAT-G and AALL projects. This research will assess greenhouse gas emissions and uptake by grasslands under rotational and continuous grazing systems. Photo by Lisa Raatz.

Research also occurs on public land, such as at the Stavely and Onefour Research Ranches, which were historically managed by the Government of Canada but transitioned back to the Alberta Government in 2015. In 2016, the province signed a Memorandum of Understanding with the University of Alberta to ensure these locations will still be accessible for conducting research and to continue their long legacy of rangeland research in western Canada, which dates to the 1920's at Onefour and the 1940's at Stavely.

While the RRI did not solicit a call for research proposals in 2025, there was one invited proposal from Dr. Erick da Silva Santos. Erick recently joined ALES as a Forage, Pasture, and Grassland researcher and his, along with other two-year projects that were initiated in 2024, are listed in Table 2.1. Projects that are still ongoing are listed in Appendix I. Select projects that have recently been completed are summarized in the following Research Profiles (Section 3).

Table 2.1. Competitive Grant proposals that were awarded funding from the RRI over the period March 2024 through February 2025.

Researcher(s)	Project title	Location(s)
Santos	Belowground dynamics of Cicer milkvetch: Grass mixtures under different harvest managements	Mattheis Ranch
Chang, An	Interactive effects of heatwave and grazing intensity on GHG emissions from grasslands	Kinsella Ranch
Nielsen, Haughland, Pyle	The effect of biological soil crusts on rangeland ecosystem function: Punching above their weight or decimal dust?	Mattheis and Kinsella Ranches
Thilakarathna, Carlyle, Cahill, Fitzsimmons, Bennett	Effect of grazing management on soil nitrogen cycling genes, nitrogen fixation, and belowground nitrogen transfer	Mattheis and Kinsella Ranches
Wagner	The role of cattle as endozoochorous seed dispersers	Mattheis and Kinsella Ranches

Heat wave enclosures at the Kinsella Research Ranch in 2024. Drs. Scott Chang and Zhengfeng An are investigating plant and soil responses to simulated heat waves with and without defoliation (simulated grazing). Photo by Zhengfeng An.

There was increased use of the housing facilities by staff and students engaged in research and teaching at the Mattheis and Kinsella Research Ranches in 2024, largely because of increased research activity from the CAT-G project. Housing use is summarized in Table 2.2. The Mattheis Ranch had just under 700 person-days of use, mostly by those from the University of Alberta (Faculty of Agricultural, Life and Environmental Sciences: Department of Agricultural, Food and Nutritional Sciences and Dept. of Renewable Resources; Faculty of Science: Dept. of Biology and Dept. of Earth and Atmospheric Science), but also by external collaborators: Government of Alberta: Forestry and Parks, Alberta Biodiversity Monitoring Institute, Agriculture and Agri-Food Canada, and a brief visit by bird researchers from the University of Colorado.

Kinsella Ranch had 688 person-days of use, most of which was day-use. Most activity came from faculty and staff at the University of Alberta (Department of Agricultural, Food and Nutritional Sciences; Dept. of Renewable Resources; Dept of Biological Sciences), the Alberta Biodiversity Monitoring Institute, as well as visiting students from China and Australia as part of field schools.

Table 2.2. Research facility use at the U of Alberta Ranches (number of researchers) from Jan 1, 2024 – Dec 31, 2024.

Category of Researchers	Mattheis Research Ranch	Kinsella Research Ranch
Research Leads (Primary Investigator, Post-doctoral fellow)	14	12
PhD students	7	10
MSc students	10	15
Undergraduate students (research assistants)	23	17
Other staff (technicians, support, contractors; excludes ranch staff)	14	7
Courses		
Dr. Gleise Silva – ALES Summer School Program	-	35
Dr. Linda Gorim - PL SC 210 field trip (undergraduate and graduate students)	21	21
Total number of people	**89**	**117**
Total number of person-days	**695**	**688**

3. Research Profiles

Residual feed intake selection as a strategy to improve thermotolerance in beef cattle

Prepared by Dr. Gleise Medeiros da Silva and Maria Camila Londono-Mendez

Beef cattle producers may see their efficiency, and ultimately profitability, threatened by ongoing global warming. Extreme weather conditions can cause cattle to redirect energy normally allocated for growth, muscle development, and fat deposition toward maintaining body temperature. In summer, this challenge is intensified by a reduced capacity to dissipate body heat, increasing the risk of heat stress. Conversely, winter conditions can induce stress by lowering body temperature and increasing the energy required to maintain thermal balance. When cattle are unable to effectively adapt to these environmental challenges, it can lead to discomfort, impaired performance, and reduced production efficiency.

Crossbred beef cattle in pasture during the summer months at the Roy Berg Kinsella Research Ranch. Photo from Gleise Silva.

To assess the risk generated by weather conditions, Dr. Gleise M. da Silva's research team used the mathematical model known as Comprehensive Climate Index (CCI). The CCI categorizes risk into six levels based on how much animals are affected by climatic conditions: absent, mild, moderate, severe, extreme, and extreme danger. The CCI equation incorporates important factors such as solar radiation and wind speed. These variables significantly influence the risk of environmental stress beyond temperature and humidity, making the CCI a valuable tool for both summer and winter conditions. At the University of Alberta Kinsella Research Ranch, weather conditions during the summer of 2022 ranged from mild to extreme levels of heat stress risk. However, the winter of 2023 posed even greater challenges, with conditions reaching the 'extreme danger' threshold for cattle kept outdoors.

Crossbred beef cattle experiencing winter conditions at the Roy Berg Kinsella Research Ranch. Photo from Gleise Silva.

Classifying cattle for feed efficiency based on residual feed intake (RFI) enables the identification of animals that consume less feed than expected for their growth and maintenance needs. This supports more sustainable and cost-effective production systems. Cattle classified as more feed-efficient may have superior digestive function, metabolic efficiency, and thermoregulatory capacity. Crossbred beef heifers at 11 months of age were evaluated for RFI using the GrowSafe feed system and monitored across both summer and winter seasons. During this period, we assessed cattle activity behavior, blood biomarkers, and rumen temperature.

During the summer, more feed-efficient cattle spent more time standing in the early morning (3:00 to 4:00 AM) and around 6:00 PM. They also rested more during mid-morning, likely for rumination. These animals walked less overall, indicating they used less energy for activity and were more efficient in their energy expenditure.

Bolus devices recorded rumen temperature every 10 minutes, offering valuable insight into the animals' body temperature. The research team found that more feed-efficient cattle had lower body temperatures in the summer and higher temperatures in the winter, indicating enhanced thermoregulation across both seasons. Blood samples further revealed that these efficient animals exhibited hormone, protein, and neurotransmitter profiles linked to reduced stress and improved thermoregulation. Additionally, growth performance was assessed during the summer, and pregnancy weights were adjusted from winter body weights to better understand how energy was utilized during both seasons. However, no significant differences were found between the different RFI groups. Overall, the results suggest that more efficient cattle are better equipped to cope with temperature extremes even though growth performance was not impacted.

In conclusion, this study found that cattle classified as more feed-efficient also exhibited greater thermotolerance during both summer and winter seasons. This ability makes them a valuable option for managing extreme weather fluctuations, supporting more sustainable and

resilient production systems for producers. Ongoing research continues to explore weather resilience in cattle with divergent RFI.

This study was supported by Alberta Beef Producers (ABP). We appreciate the contributions from the research collaborators at the University of Alberta and the Kinsella Research Ranch staff.

For more information, contact Dr. Gleise M. Silva (gleise.silva@ualberta.ca) or Maria Camila Londono-Mendez, PhD candidate (londonom@ualberta.ca).

Kinsella Ranch in fall 2024. Photo by Lisa Raatz.

Grassland soil responses to adaptative, multi-paddock (AMP) cattle grazing in Western Canada

Prepared by Dr. Edward Bork

Grasslands across western Canada form a cornerstone for the cow-calf industry, with more than 25 M ha of land supporting more than 5 M beef cattle throughout the grazing season from May through October. Along with livestock production, these grasslands provide a wide variety of ecosystem services, including wildlife habitat, biodiversity, flood mitigation, water storage and purification, carbon (C) storage and the mitigation of atmospheric greenhouse gases (GHGs). Recent research in Alberta has highlighted the key role of grasslands, including light to moderate levels of livestock grazing, in enhancing C storage.

Cattle at the Mattheis Research Ranch, which was one of the AMP rotationally grazed locations. Photo by Lisa Raatz.

Despite marked progress in recent years quantifying the role of grasslands and grazing in mitigating climate change, including across Alberta grasslands, our understanding of the specific role of management-intensive rotational grazing, in altering soil function, is less clear. This gap was further addressed between 2018 and 2023 by Dr. Mark Boyce, Wildlife Ecologist at the University of Alberta, along with a large team of researchers from the Depts. of Biology (Cahill, Döbert), Renewable Resources (Chang, Ma, Quideau, Shrestha, Thompson), and Agricultural, Food and Nutritional Sciences (Bork, Carlyle, Khatri-Chhettri). They explored differences in soil properties, including water infiltration, GHG dynamics and soil microbial communities, across a network of 30 paired ranches distributed across the Prairie Provinces. Within each pair, one operation utilized adaptive, multi-paddock (AMP) rotational grazing, a form of intermittent use using high herd densities and small pastures to tightly control the distribution, timing and length of grazing, with frequent movement of animals among pastures used to closely regulate the amount of

defoliation and length of recovery periods. Comparisons of grassland soil with neighboring (conventional) operations were used to understand differences in GHG dynamics, hydrologic function, and microbial responses to long-term exposure to AMP grazing.

Researchers take 1 m deep soil cores using a quad-mounted hydraulic soil sampler as part of the AMP project. Photo by Ry Thompson.

Measured across plots at the pasture level, GHG fluxes of carbon dioxide, methane and nitrous oxide did not directly differ in relation to the grazing treatments examined. However, carbon dioxide fluxes increased with cattle stocking rates (i.e., grazing intensities), and methane emissions were greater in soils having a prior history of cultivation (and hence, were no longer comprised of native vegetation). Concurrent lab incubation studies using soil collected from the study pastures to better understand GHG dynamics revealed that while nitrous oxide fluxes did not differ between the two treatment soils, methane fluxes did; soils developed under AMP grazing had 1.5 times greater methanotrophy (i.e., methane uptake, or net removal from the atmosphere) than soils not associated with AMP grazing. As methane is a potent GHG and widely associated with beef cattle production due to enteric fermentation, the greater uptake of methane from AMP soils suggests that this grazing practice may reduce the overall GHG footprint of cattle production while on pasture. Additionally, grazing system impacts on GHG fluxes from incubated soils further depended on soil temperature, with AMP soils having greater carbon dioxide release at cooler temperatures (5^{o}C), but lower emissions of carbon

dioxide at higher temperatures (25°C), indicating AMP grazed soils may have a lower potential to alter GHG-climate forcing as our climate warms.

Measuring water infiltration rates under continuous and adaptively managed rotational grazing systems. Photo from Timm Döbert.

Measured across pastures, water infiltration rates were 42% greater within soils subject to long-term AMP grazing, and most responsive in grasslands having longer recovery periods after grazing events during the growing season. As water capture and retention is a critical factor regulating grassland forge growth, including drought tolerance, this increase is a significant benefit in ensuring continued grassland productivity and pasture ability to sustain cattle grazing, especially in the face of ongoing climate change and extremes in weather events.

When soil carbon stocks and microbial properties were examined, soils of the AMP-grazed soils had greater soil C stock and concentration, as well as a greater proportion of C stored in more stable, protected form via the fine, mineral-associated fraction, thereby providing increased potential to offset rising atmospheric C levels and retain this C over time. Evaluation of the microbial communities from these grassland soils showed that AMP grazing led to an increase in fungal diversity and species evenness and led to more complex soil microbial communities with intricate associations (connectivity) among taxonomic groups. Cattle stocking rates and rest periods were key attributes of cattle grazing that could be linked to microbial diversity. In addition, rotational grazing, and particularly high stock densities associated with AMP practices, altered several microbial indicators, such as the carbon:nitrogen ratio of microbial biomass, the total fungi:bacteria ratio, and the ratio of Gram positive:Gram negative bacteria. These results illustrate that AMP grazing can enhance grassland soil C storage and stability, as well as improve the ecosystem by enhancing fungal diversity and microbial network complexity, with further work warranted to link these changes to other grassland functions.

Collectively, these results highlight the significant impacts of rotational grazing, and specifically AMP grazing, on soil properties and functional responses, including benefits to soil water capture, methane uptake, soil C storage, and microbial community complexity.

More information is available in the following publications:

Döbert et al. (2021) Adaptive multi-paddock grazing improves water infiltration in Canadian grassland soils. Geoderma, doi.org.10.1016/j.geoderma.2021.115314

Khatri-Chhetri et al. (2021) Adaptive multi-paddock grazing increases mineral associated soil carbon in Northern grasslands. Agriculture, Ecosystems and Environment, doi.org/10.1016/j.agee.2024.109000

Khatri-Chhetri et al. (2022) Adaptive multi-paddock grazing increases soil nutrient availability and bacteria to fungi ratio in grassland soils. Applied Soil Ecology, doi.org/10.1016/j.apsoil.2022.104590

Khatri-Chhetri et al. (2024) Cattle grazing management affects soil microbial diversity and community network complexity in the Northern Great Plains. Science of the Total Environment, doi.org/10.1016/j.scitotenv.2023.169353

Ma et al. (2021) Soil greenhouse gas emissions and grazing management in northern temperate grasslands. Science of the Total Environment, doi.org/ 10.1016/j.scitotenv.2021.148975

Shrestha et al. (2020) Adaptive multi-paddock grazing lowers soil greenhouse gas emission potential by altering extracellular enzyme activity. Agronomy, doi.org/10.3390/agronomy10111781.

Needle-and-thread grass (*Hesperostipa comata*), a dominant grass species at Mattheis Ranch. Photo by Lisa Raatz.

Adaptative, multi-paddock grazing: Impacts on pasture vegetation across the Prairie Provinces

Prepared by Dr. Edward Bork

Adaptive, multi-paddock (AMP) grazing entails the use of many smaller pastures to confine animals to a localized area, with cattle frequently moved to a new pasture throughout the grazing season. The use of small pastures enables grazing to occur in a short period of time by animals at high density, which helps ensure more uniform use of all the vegetation (habitats and plants), that is then followed by a lengthy rest period to maximize plant recovery and maintain range health. While AMP grazing, or facsimile's thereof, are growing as a tool to manage beef cattle while grazing, both globally and across Canada, the broader impacts of this practice on grassland vegetation have been less understood, including in grasslands of Western Canada.

Cattle at the Mattheis Research Ranch. The ranch was one of the AMP rotationally grazed locations in the study. Photo by Lisa Raatz.

An on-ranch study led by Dr. Mark Boyce from the Dept. of Biological Sciences, in concert with other investigators from across the University of Alberta, compared grassland in AMP-grazed grasslands to neighboring grasslands exposed to conventional (often continuous, or slow rotation grazing) at more than 30 locations across Alberta, Saskatchewan and Manitoba, from 2018 through 2023. One element of the study, led by post-doctoral fellow Dr. Timm Döbert, found that AMP grazed pastures were associated with a greater presence of non-native plant species, while conventionally grazed pastures had plants that exhibited a greater variety of functional traits among species. Native grasslands that lacked prior cultivation generally had greater total plant species richness, phylogenetically more divergent (i.e., ancestrally distinct) communities, and fewer non-native (introduced) species. While grasslands within AMP grazed ranches did not differ in plant

richness or diversity from conventionally grazed areas, the use of high cattle densities and extended rest between grazing events were both found to contribute to increases in non-native plant species and reduce functional (trait) diversity. Consistent with prior work done in Alberta grasslands, increased non-native plant presence, together with lower species richness and greater phylogenetic divergence, were associated with greater soil organic carbon levels.

PhD student, Jessica Grenke, assesses plant cover and biomass while attracting curiosity from the local herd. Photo from Jessica Grenke.

In another study across these same pastures, Dr. Jessica Grenke, working with Dr. James Cahill in Biological Sciences, found that grasslands subject to AMP grazing had fewer plant species overall, an effect evident at both the landscape and plot (patch) scale. While the comparative grazing treatments (AMP vs neighbors) did not differ in community composition or evenness, native species were reduced under AMP grazing, particularly at the coarse landscape level. Grasslands subject to AMP grazing were also associated with greater biomass production, and this occurred despite greater levels of forage utilization by cattle during summer.

Overall, these results highlight that although AMP grazing itself may not have large impacts on plant community composition, and is not conducive to maintaining native plant species, the specific pasture management practices associated with implementing AMP grazing, including high cattle densities and extended rest, are capable of altering grassland composition and function. More importantly perhaps, large effects were evident of disturbance history, including previous cultivation, which led to strong legacy effects in regulating grassland attributes and function. Finally, the observed increases in soil carbon levels, an important outcome in combating global climate change, including in relation to an elevated abundance of introduced plant species, highlights the challenge associated with simultaneously managing for a variety of ecosystem services in grasslands, including carbon storage and native plant diversity conservation.

More information is available in the following publications:

Grenke et al. (2022) Limited impacts of adaptive multi-paddock grazing systems on plant diversity in the Northern Great Plains. Journal of Applied Ecology, doi.org/10.1111/1365-2664.14181

Döbert et al. (2025) Contrasting grazing practices alter plant community trajectories across western Canada's grasslands with implications for ecosystem function. Agriculture, Ecosystems and Environment, doi.org/10.1016/j.agee.2025.109591

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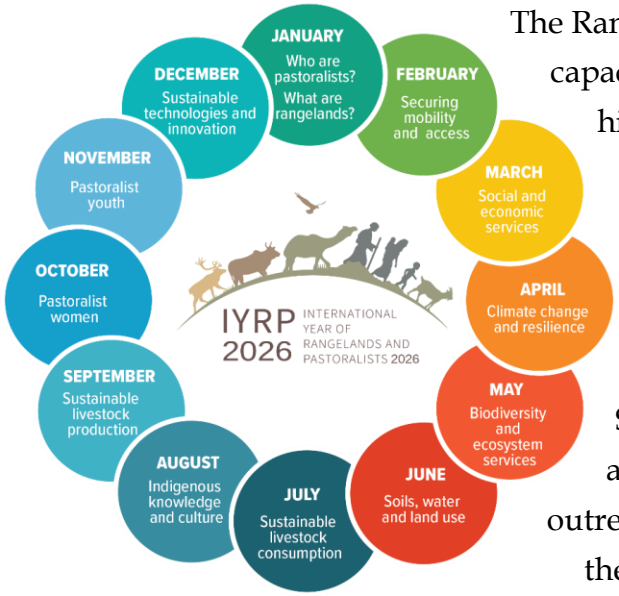
A commonly found native grassland species, harebell (*Campanula rotundifolia*). Photo by Lisa Raatz.

4. Capacity Building



Global framework for monthly IYRP themes.

The Rangeland Research Institute will expand the capacity to communicate and engage in extension by hiring a Knowledge and Technical Transfer person to lead communication and event efforts for promoting the 2026 International Year of Rangelands and Pastoralists (IYRP). The RRI has already been meeting with IYRP focus groups, Society for Range Management, Saskatchewan Prairie Conservation Action Plan and University of Saskatchewan to plan for outreach events, webinars, and tours that highlight the importance of rangelands. Two extension workshops are already being planned for fall 2025 and summer 2026 to celebrate the legacy of the Stavely and Onefour Research Stations and their long history of rangeland research in Canada. The RRI will partner with other organizations to host tours at the Mattheis and Kinsella Research Ranches.

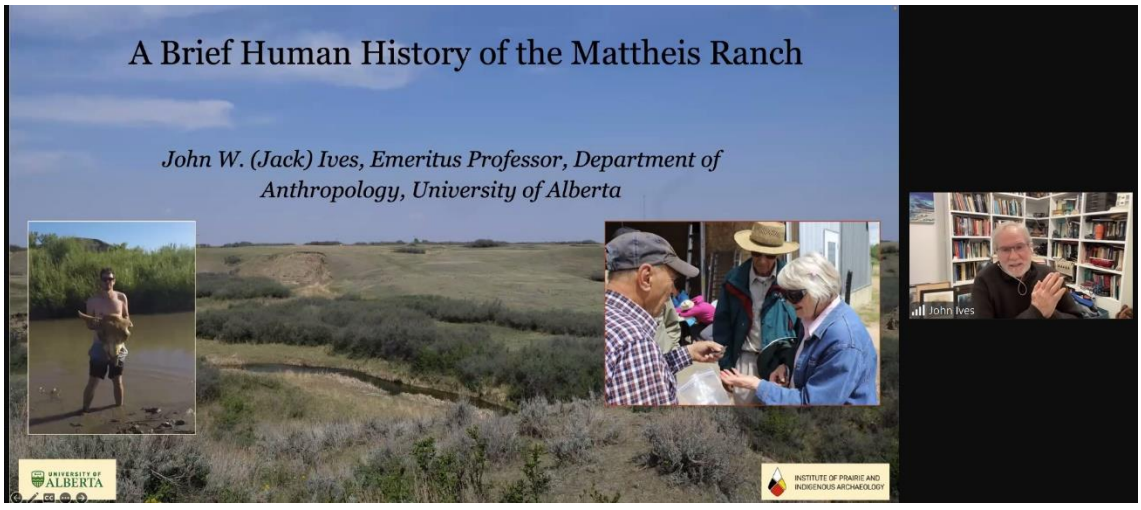
The Climate Action Through Grazing (CAT-G) project continues to raise the profile of the research ranches and the RRI by generating increased research activity last year and in the coming years. The collaboration between researchers at the University of Alberta, and outside organziations (e.g., Agriculture and Agri-Food Canada and Environment and Climate Change Canada) are investigating grazing impacts on birds, greenhouse gas uptake and production, plant community shifts and seedbank distribution, lichens, among other environmental impacts.

Undergraduate student, C. Cameron assesses Biological Soil Crusts (BSC) as part of the CAT-G project at Mattheis Ranch. Photo by Emilie Porter.

5. Communications & Teaching

Communicating and extending research are core priorities for the Rangeland Research Institute. Extending research as well as training students is a condition for receiving funding from the RRI through the Competitive Grants Program. Those who receive funding as well as researchers affiliated with the RRI communicate using a variety of methods: publishing research in peer-reviewed journals, popular press articles such as Alberta Beef Producers online newsletters, webinars, field tour talks, podcasts and radio interviews, guest lectures, posters or presentations at conferences and workshops, websites, among many other methods. In doing so, research findings are effectively and appropriately communicated to a wide range of audiences, including to members of the public, ranchers and producers, land managers and government policy makers, students and other researchers. Peer-reviewed publications authored by research affiliates this past year are listed in Table 5.1 at the end of this section, and select outreach and extension activities are listed in Appendix II.

Popular press articles reach a wide rancher and producer audience by linking research to on-ranch management. Access the full Alberta Beef Producers article.



Emeritus professor, Dr. John Ives, gave a hybrid online and in-person webinar to the Southeastern Alberta Archaeological Society Annual meeting held in Medicine Hat sharing some research and fascinating stories about ancient bison bones and early human artifacts found on and around the Mattheis Ranch.

RRI staff and affiliated researchers also prioritize teaching. They teach courses at the U of A (both in classrooms and hands on learning in the field), train undergraduate and graduate students, host international students and scientists and teach the next generation of range and grassland ecologists and agriculturalists.

The ALES Summer School Program was reignited in 2024! Dr. Gleise da Silva, and her graduate students, toured a group of international undergraduate students from China and Australia at the Kinsella Research Ranch in July 2024. Students learned about Canadian beef production systems and some technological advancements in the industry. Photo by Sergio Lasso.

Mattheis Ranch hosted a field tour in July 2024. Ranch lead, Marcel Busz, talks about water development at the ranch funded by the Canadian Forage and Grazing Association. A key piece of infrastructure for the CAT-G rotational grazing research project, but also for cattle to access quality water from an intersection of multiple paddocks. Photo by Lisa Raatz.

Post-doctoral researcher, Dr. Arturo Macias Franco, speaks at the Kinsella Ranch field tour about the CAT-G rotational and continuous grazing system study and measuring cattle performance metrics. Photo by Carolyn Fitzsimmons.

The RRI continues to fulfill its mandate to communicate research and engage in teaching to diverse audiences as well as raise awareness about rangelands, all of which raises the profile of the RRI.

Table 5.1. Select peer-reviewed publications authored by RRI affiliated researchers between April 2024 and March 2025

*Döbert, T.F., Pyle, L.A., Case, C., Bork, E.W., Carlyle, C.N., Chang, S.X. Sobrinho, L.S., Iravani, M., Boyce, M.S. Mar 2025. Contrasting grazing practices alter plant community trajectories across western Canada's grasslands with implications for ecosystem function. Agriculture, Ecosystems & Environment. Doi.org/10.1016/j.agee.2025.109591

*Harland, A.J., Novais, F.J., Durunna, O.N., Fitzsimmons, C.J., Church, J.S., Bork, E.W. Mar 2025. Evaluation of the technical performance of the Nofence virtual fencing system in Alberta, Canada. Smart Agricultural Technology, 10. Doi.org/10.1016/j.atech.2024.100713

*Oloyede, T.O., Novais, F.J., Fitzsimmons, C.J., Church, J.S., Carlyle, C.N., Li, C., Bork, E.W. Feb 2025. Effects of heat load on beef cattle activity budgets in a northern temperate grazing system. International J Biometeorology. Doi.org/10.1007/s00484-025-02882-y

Cai, L.R., Kreft, H., Denelle, P., Taylor, A., Craven, D., Dawson, W., Essl, F., van Kleunen, M., Pergl, J., Pysek, P., Winter, M., Cabezas, F.J., Wagner, V., Pelser, P.B., Wieringa, J.J., Weigelt, P. Feb 2025. Environmental filtering, not dispersal history, explains global patterns of phylogenetic turnover in seed plants at deep evolutionary timescales. Nature, Ecology & Evolution, 9(2). Doi.org/10.1038/s41559-024-02599-y

§Dombro, A., Raatz, L., Bork, E.W. Feb 2025. Nontarget plant community and biomass responses in Northern Mixed Grassland treated with indaziflam for invasive annual brome control. Applied Vegetation Science, 28:e70019. Doi.org/10.1111/avsc.70019

Sheppard, A.C., Hollik, E.Z., Hecker, L.J., Jung, T.S., Edwards, M.A., Nielsen, S.E. Feb 2025. Beat the heat: Movements of a cold-adapted ungulate during a record-breaking heat wave. Ecosphere, 16(2): e70202. Doi.org/10.1002/ecs2.70202

Chytry, M., Pillar, V.D., Price, J.N., Wagner, V. Jan 2025. On the use of taxon names in community ecology. Applied Vegetation Science, 28(1): e70009. Doi.org/10.1111/avsc.70009

Yang, Y., Gunina, A., Cheng, H., Liu, L.X., Wang, B.R., Dou, Y.X., Wang, Y.Q., Liang, C., An, S.S., Chang, S.X. Jan 2025. Unlocking mechanisms for soil organic matter accumulation: Carbon use efficiency and microbial necromass as the keys. Global Change Biology, 31(1): e70033. Doi.org/10.1111/gcb.70033

§Dombro, A., Raatz, L., Bork, E.W. Jan 2025. Indaziflam provides long-term reduction of annual brome grass (*Bromus* spp.) in Canada's Mixedgrass prairie. Rangeland Ecol. & Management, 98: 73-82. Doi.org/10.1016/j.rama.2024.07.011

*Stotz, G.C., Cahill, J.F. Jr., Gianoli, E. Jan 2025. Selection-mediated adaptive responses of native species to an invasive grass: Shade tolerance vs. shade avoidance. Functional Ecology. Doi.org/10.1111/1365-2435.14740

Pierrat, Z.A., Magney, T.S., Richardson, W.P.,… Gamon, J.A., Cawse-Nicholson, K. Jan 2025. Proximal remote sensing: an essential tool for bridging the gap between high-resolution ecosystem monitoring and global ecology. New Phytologist. Doi.org/10.1111/nph.20405

*Virtuoso, M.C.S., Aalhus, J.L., Juárez, M., López-Campos, O., Bruce, H.L., Li, C.X., Basarab, J.A., Plastow, G., Valente, T.S. Jan 2025. Genetic parameters and genomic insights for meat colour traits of Canadian crossbred beef cattle. Canadian J of Animal Science, 105: 0074. Doi.org/ 10.1139/cjas-2024-0074

*Khakbazan, M., Olson, C.A., Block, H.C., Li, C.X., Basarab, J.A. Jan 2025. Effects of cow feed efficiency, longevity, heterosis, and lifetime productivity on profitability of heifer selection and cow-calf operations. Canadian J of Animal Science, 105. Doi.org/10.1139/cjas-2024-0058

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* Research that includes U of A research ranches for at least one location

§ Project funded by the RRI

6. Strategic Advisory Council

The current composition of the Strategic Advisory Council (SAC) as of March 31, 2025, is provided in Table 6.1. Members of the SAC have not formally met in the past few years while the Faculty of ALES and the Department of AFNS have been in a time of uncertainty (e.g., amidst ongoing budget spending re-allocations, and reductions to available resources to support the full RRI mandate). This includes the recent University transition to a College model, and the Faculty of ALES transition into the College of Natural and Applied Sciences. However, in the meantime, the RRI has engaged the SAC to provide critical reviews and feedback of research proposals when grant funding decisions are made. Additionally, members of the SAC promote RRI events and outreach within their networks. The RRI is grateful for the support of the SAC in these activities.

Table 6.1. Members of the RRI Strategic Advisory Council, March 2025.

Name	Position, *Agency*	Location
Barry Adams*	Head, Rangeland Resource Management Program (Retired) *Alberta Environment and Sustainable Resource Development*	Lethbridge, AB
Dr. Edward Bork	RRI Director; Professor and Mattheis Chair in Rangeland Ecology & Management, *University of Alberta*	Edmonton, AB
Dr. Cameron Carlyle	Associate Professor, *University of Alberta*	Edmonton, AB
Karin Schmid	Research and Production Manager, *Alberta Beef Producers*	Calgary, AB
Josie Van Lent	Producer, *Staden Farms*	Manville, AB
Dr. Walter Willms	Researcher (Emeritus), *Agriculture & Agri-Food Canada*	Lethbridge, AB
Dave Zehnder	Producer; Program Lead, *Farmland Advantage*	Invermere, BC

* Chair of RRI Strategic Advisory Council

7. Financial Overview

The Rangeland Research Institute (RRI) 2024-25 financial statement is shown in Appendix III and summarizes revenue and expenses. The RRI operational revenue is generated from oil and gas extraction surface leases and utility (powerline) activity at the Mattheis Research Ranch. The RRI expenses include costs associated with outreach and extension, and RRI operating as well as administration costs. As in prior years, most of the research costs have been transferred to the Rangeland Ecology and Management Fund (REMF) spending allocation to maximize the funds that can be recapitalized back into the endowment principal (listed as Transfer to Endowment in Appendix III or Current Year Contributions in Appendix IV).

The REMF endowment was created in 2015. Most of the principal comes from revenue received upon construction of the major powerline that runs parallel to Hwy 36 on the Mattheis Ranch, a generous donation from the Alberta Beef Producers, and a large contribution from the conservation easement placed on the Mattheis Research Ranch in partnership with Western Sky Land Trust. As in previous years, the RRI recapitalized $520,000 in 2024-25 with the same goal of building the endowment principal as quickly as possible. Because the Faculty of Agricultural, Life and Environmental Science is taking a proportion of the endowment spending allocation to offset ongoing budget constraints starting annually in 2018 (i.e., using the fund to increasingly pay for staff salaries), the RRI began to recapitalize funds into the endowment. This strategy will build the endowment so that the annual spending allocation will cover salaries as well as provide long-term access to research funding, the latter of which was the original intent. The market value of the REMF as of March 31, 2025, was $ 12,527,673.62 and the annual spending allocation generated by this fund is also provided (Appendix IV).

Appendix I. Summary of ongoing research projects led by RRI affiliates

All projects listed are being undertaken by various research affiliates associated with the RRI during 2024-2025. * Indicates projects that have received support from the RRI Competitive Grants Program.

Project Title	Principle Investigators
Alberta Agrisystems Living Lab	Bork, Santos, Carlyle, da Silva, Fitzsimmons, Cahill, Basarab, Plastow, Dyck, Quideau, Chang, and others
Prescribed Fire and Herbicide Interactions	Bork, Johnson, Tidemann, Raatz, Tannas,
Central Prairies Living Lab	Carlyle, Bork, and others
Climate Action Through Grazing (CAT-G)	Fitzsimmons, Cahill, Bork, Carlyle, Santos, Coates, others
Mapping of carbon stocks in forage lands of Saskatchewan	Carlyle, Bedard-Haughn, Bork, and others
*Long-term monitoring of rangeland ecosystem functions on the Mattheis and Kinsella Research Ranches	Carlyle
Economic and C-capture benefits of including forages in long-term crop rotations at Breton	Bork, Santos, Dyck, Quideau, Jeffrey, & Puurveen
Site specific control of Canada thistle by drone	Webber, Bork, Church, Pettyjohn, & others
Assessment of altered precipitation and defoliation on rangeland EG & S	Carlyle, Chang, Cahill, Willing & Bork
*Quantifying the carbon balance and associated ecosystem properties at the Mattheis Ranch	Puurveen, Raatz, Coates, Wang & Gamon
Agronomic innovations in forage seed cropping systems in Western Canada	Khanal, Bork and Santos

Precision ranching of cattle: Integrating cattle genomics, grazing behavior, and production	Bork, Fitzsimmons, Carlyle, Plastow, Cahill, Lamb, Church, Basarab, Guan & Li
Conservation of lentic riparian areas using virtual fencing	Bork, Church, deNovais, Fitzsimmons, Francis
Quantifying the effects of adaptive multi-paddock grazing on soil carbon sequestration and soil organic matter quality	Schneider, Mandell, Longstaffe, Bork, Byrne & Voroney
Survey of cattle rumen microbiome under different grazing systems: Linkage to grazing behavior and productivity	Guan, Plastow, Bork & Basarab
*Evaluating the contribution of lichens to Alberta's grassland biological soil crusts through baseline taxonomic research and manipulative grazing and drought experiments	Carlyle, Haughland, & Pino-Podas
Evaluating the efficacy of herbicide indaziflam applied in fall and spring to control invasive annual brome in southern Alberta rangeland	Bork, Dombro, Raatz, & Adams
*The resilience of Alberta's grasslands to the combined effects of drought and defoliation	Batbaatar, Carlyle, & Cahill
*Do defoliation intensity and time since defoliation affect plant carbon transfer and soil carbon accumulation?	Chang & Chen
**In Vitro* ruminal fermentation characteristics of different pasture types found at the Dry Mixedgrass natural subregion of Alberta	Da Silva
*Effect of Cicer Milkvetch on soil carbon, nutrient availability, and soil microbiome in mixed prairie grassland	Thilakarathna & Carlyle

Appendix II. Select presentations by RRI affiliates in 2024-2025

Outreach and promotional activities undertaken in support of the RRI during 2024-2025

Abbreviated title	Presenter(s)	Venue	Audience(s)	Date
Identification in a snap: accuracy of mobile apps for vascular plants and lichens in vegetation plots	Wanigasinghe, Haughland, Pyle, Nielsen, Porter	R.E. Peter Biology 16th Annual Biology Conference, U of Alberta; Edmonton, AB	Students, researchers, industry, gov't	20-Mar, 2025
Soil greenhouse gas dynamics on pastures subjected to legume sod-seeding in central Alberta	Asante-Badu, Carlyle, Santos, Bork			
Enhancing soil carbon storage through restoration of native Dry Mixedgrass grasslands	Kaliaskar, Carlyle, Batbaatar, Wade			
Building a lichen barcode library for species-specific identification in southern Alberta	Porter, Nielsen, Haughland			
Factors in the distribution and composition of biological soil crusts in northern grasslands	Cameron, Porter, Haughland, Cahill			
Characterizing plant communities in grassland ecosystems	Anderson, Peetoom Heida, Cahill			
Soil microbial necromass responses to grazing management in northern temperate grasslands	Chowdhury, Wade, Amgaa, Cahill, Fitzsimmons, Bork, Carlyle			
Evaluating the efficacy of sweep net sampling as a method for measuring grasshopper species abundance	Kahveci, Anderson, Peetoom Heida, Cahill			
The evolving use of herbicides for grassland management in western Canada	Johnson	Range group seminar; Edmonton, AB	Academics, students, gov't	18-Mar
Soil carbon storage in Saskatchewan's grasslands	Carlyle	SK PCAP: Prairie's got the goods week; online	Public, researchers, students, gov't, NGO, policy makers	14-Mar
Genomic tools to improve profit, reduce methane emissions, and adapt to a changing environment	Basarab	UofA Researcher spotlight webinar series	Public, alumni, academics, gov't, industry	13-Mar
Conservation Biology Seminar: Monitoring our lichen species	Porter	The King's University Conservation Biology Seminar		13-Mar

Introducing the Climate Action Through Grazing project	Fitzsimmons	Chinook Applied Research Assn: Consort Grazing Club	Ranchers, producers	11-Mar
The function of plant-plant interactions in community dynamics of a native grassland	Holden, E.	PhD thesis defense seminar; Edmonton, AB	Academics, students	6-Mar
Caragana arborescens in the Prairie Provinces: An assessment of invasiveness	Hinojosa, Wagner	Alberta Invasive Species Council annual meeting; Olds, AB	Gov't, NGO, land managers, policy makers, industry, researchers, students	5-Mar
Introducing the Climate Action Through Grazing project	Cahill	Organic Alberta Annual Conference	Producers, public	2-Mar
Developing an NIRS calibration curve for predicting mixed forage quality in Alberta Rangelands	Bhattarai, Carlyle	61st Annual Alberta Soil Science Workshop; Edmonton, AB	Researchers, policy makers, gov't, NGO, students, land managers	20-Feb
Impact of drought stress on carbon and nitrogen dynamics and soil microbial diversity in red clover-timothy grass mixed stands compared to grass monocultures	De Silva, C., Lumactud, Poudel, Thilakarathna			
Modelling the temporal hydro-climatological sensitivity of particulate organic carbon and mineral associated organic carbon in northern temperate grassland watersheds	Modi, Faramarzi, Carlyle			
Effect of grazing management on soil carbon and vegetation diversity and composition in Northern temperate grasslands	Wade, Amgaa, Kaliaskar, Bork, Bedard-Haughn, Sorenson, Carlyle			
Soil microbial necromass responses to grazing management in northern temperate grasslands	Chowdhury, Wade, Amgaa, Cahill, Fitzsimmons, Bork, Carlyle			
Modelling differential responses of C3 and C4 crops to changing atmospheric CO2, temperature, and precipitation in Alberta	Achtymichuk, Faramarzi, Dyck			
Enhancing soil carbon storage through restoration of native dry mixedgrass grasslands	Kaliaskar, Wade, Amgaa, Carlyle			
Legume sod-seeding impacts on soil greenhouse gas dynamics within Central Alberta pastures	Asante-Badu, Yordanov, Battur, Santos, Carlyle, Bork			

A brief human history of the Mattheis Ranch near Duchess	Ives	Southeastern Alberta Archaeological Society Annual Meeting; online and Lethbridge, AB	Public, researchers, academics, policy makers, gov't, NGO	19-Feb
Testing a shortcut: Assessing the Interactions of a Biocrust Index and Plant Richness	Porter, Nielsen, Haughland	Bentley Lectures – poster presentations; Edmonton, AB	Researchers, students, gov't, NGO	19-Feb
Effectiveness of sod-seeding legumes in central Alberta pastures	Yordanov, Santos, Bork	Society for Range Management 78th Annual meeting: Healthy Rangelands, Sustainable World; Spokane, WA	Ranchers, gov't, policy makers, NGO, academics, students, land managers	10-Feb, 2025
Effect of grazing management on soil carbon and vegetation diversity and composition in northern temperate grasslands	Wade, Carlyle, Amgaa			
Soil and plant cover responses to mechanical sod-seeding of legumes in pastures across central Alberta	Yordanov, Santos, Bork			
Promotion of CAT-G Project: Tradeshow booth	Iravani, Fitzsimmons, Fan, Bolen, Peetoom Heida	Western Canadian Soil Health & Grazing Conference; Edmonton, AB	Ranchers, producers, land managers	12-Dec
Increasing soil organic carbon	Achtymichuk, Dyck, Puurveen, Quideau, Santos, Jeffrey, Bork	Alberta Agri-Systems Living Labs webinar series	Ranchers, producers, land managers	5-Dec
eDNA in the grasslands	Porter, Harrison	Grassland Restoration Forum	Gov't, NGO, land managers, producers, researchers	14-Nov
Showcasing the CAT-G Project: Tradeshow booth	Iravani, Fitzsimmons, Bolen	Farmfair International, Edmonton, AB	Ranchers, producers, land managers	5-Nov
Cattle activity budget and production dynamics in grazing beef cattle	Oloyede	MSc thesis defense seminar; Edmonton, AB	Researchers, students	21-Aug
Perennial forage polycultures and organic amendments drive soil carbon sequestration and organic matter stabilization: Results after 90 years of management at the Breton plots	Achtymichuk	MSc thesis defense seminar; Edmonton, AB	Researchers, students	19-Aug

Living Labs approaches and progress	Carlyle			
Applications of virtual fencing for cattle and pasture management	Bork, Harland, Francis	*Field Tour*: CFGA/ARECA Kinsella Research Ranch – rangeland projects	Ranchers, producers, funders, gov't, NGO, researchers	6-Aug
Grazing management, stocking rate and methane emissions	da Silva, G.			
Grazing management and soil Nitrogen cycling, fixation and transfer	Thilakarathna			
Watering, grazing, and cattle management practices at Kinsella Research Ranch	Fitzsimmons, Irving			
CAT-G project's sampling plots, establishment and details	Peetoom-Heida, Anderson			
Past AMP/Rotational grazing research	Bork			
Climate action through grazing goals and approaches	Fitzsimmons			
ALES Summer school program - Visiting students learning about Canadian agriculture & beef industry	da Silva, G., Lasso-Ramirez	*Field Tour*: Kinsella Ranch – Cattle production	Visiting scientists and students from China & Australia	31-Jul
An introduction to precision ranching using beef cattle	Harland, Bork	*Field Tour*: CFGA/ARECA Mattheis Research Ranch – on ranch infrastructure demo and rangeland projects	Ranchers, producers, funders, gov't, NGO, researchers	24-Jul
Strategies to control invasive annual grasses	Raatz, Dombro, Bork			
Watering, fencing, polycrops, and grazing practices at the Mattheis Research ranch	Busz			
The role of cattle as endozoochorous seed dispersers	Wagner			
Past adaptive multi-paddock and rotational grazing research	Bork			
Climate Action Through Grazing projects goals and approaches	Fitzsimmons			

Discovery of key functional SNP markers associated with feed efficiency in beef cattle	Lam, Guan, Plastow, Cánovas	Canadian Society of Animal Science joint annual meeting (ASAS-CSAS-WSASAS): Advancements in Animal Science and Ruminant Research; Calgary, AB	Researchers, industry, gov't, ranchers, policy makers, students	21-Jul
Assessing methane and carbon dioxide production in beef cows across diverse foraging conditions	Behrouzi, Bolen, de Novais, Basarab, Bork, Fitzsimmons			
Residual feed intake and thermotolerance in grazing lactating first-calf beef heifers: Effects on metabolism, performance, rumen temperature, and activity behaviour	Londono-Mendez, Lasso-Ramirez, Fitzsimmons, Plastow, Bork, Basarab, da Silva			
Impacts of residual feed intake measured as a heifer in drylot on mature cows and calves grazing native pasture	de Novais, Bolen, Udeh, Lopes, Oloyede, Guan, Li, Basarab, Fitzsimmons, Bork			
Using growth implants in suckling beef calves enhanced vaccine response against Infectious Bovine Rhinotracheitis	Lasso-Ramirez, da Silva, G., Moya, Lardner, Londono-Mendez, Nielsen, Tanchak			
Backgrounding carryover nutritional effects on nitrogen metabolism and water requirements onto grain or forage-fed finished cattle	da Silva, A., Franco, da Silva, G., Fonseca			
Long term implanting of finished Angus Hereford steers: examining the relationship between feed and water efficiency	Franco, da Silva, A., Fonseca, da Silva, G.			
Use of polyclonal antibodies to improve the efficiency of rumen function	da Silva, G.			
Inoculating suckling beef calves with a bovine-derived blend of Lactobacillus spp. exhibited psychobiotic potential for stress mitigation	Ramirez-Sepulveda, Lasso-Ramirez, Londono-Mendez, McAllister, Schwartzkopf-Genswein, Ceballos, Malmuthuge, Guan, da Silva, G.			
Cold stress responses in beef heifers with divergent residual feed intake	Londono-Mendez, Lasso-Ramirez, Fitzsimmons, Plastow, Bork, Basarab, and Silva, G.			
An examination of virtual fencing as a tool to manage beef heifers and cow-calf pairs in western Canada	Harland	MSc thesis defense seminar; Edmonton, AB	Academics, students	24-Jun

Soil carbon stocks increase with manuring and perennial forage inclusion in a Gray Luvisol	Achtymichuk, Quideau, Dyck, Santos, Puurveen, Bork	Annual Meeting of the Canadian Society for Soil Science; Vancouver, BC	Researchers, Gov't, NGO, students	11-Jun
Annual brome control project in Mixedgrass Prairie	Dombro, Raatz, Bork	SK PCAP – Native Prairie Speaker Series; online	Public, Gov't and NGO, policy makers, researchers	23-May
A cross-habitat comparison of nutrient availability and levels of invasion in central Alberta, Canada	Holden, K.	MSc thesis defense seminar; Edmonton, AB	Academics, students	14-May
Cows, Carbon, and Grasslands	Carlyle	Educated Luncheon, U of A Alumni Association	Alumni, public	30-Apr
Grassland carbon and livestock grazing: An undervalued ecosystem service	Bork, Alexander, Boyce, Cahill, Carlyle, Chang, Dobert, Grenke, Hewins, Kaliaskar, Khatri-Chhetri, Ma, Shrestha, Sobrinho, Thompson	Invited presentation to the Swedish University of Agricultural Sciences (online)	Researchers, students	16-Apr
The critical role of grasslands, grazing & perennial forages in agricultural carbon storage	Bork, Achtymichuk, Boyce, Cahill, Carlyle, Chang, Dobert, Dyck, Grenke, Hewins, Jeffrey, Kaliaskar, Khatri-Chhetri, Ma, Puurveen, Quideau, Santos, Shrestha, Sobrinho, Thompson	Farmers for Climate Solutions, Certified Crop Advisors, Webinar Series; Sponsored by the American Society of Agronomy and the Soil Science Society of America	Ranchers, producers, gov't, NGO, researchers, students	4-Apr, 2024

Appendix III. RRI Financial Statement of Actuals, April 1, 2024 to March 31, 2025

	Actuals
***Opening Balance on April 1, 2024**	**$0.00**
Revenue	
Lease/Utility (Powerline & O/G)	$ 532,167.10
Total Revenue	**$ 532,167.10**
Expenditures	
Transfer to Endowment	$ 520,000.00
Property Taxes	$ 2,017.54
Supplies, Services	$ 8,561.17
Communications (telephone)	$ 639.13
Travel	$ 750.00
Rentals	$ 199.26
Total Expenditures	**($ 532,167.10)**
****Net Balance**	**$ 0**

** Under the Government of Alberta's directive, funds cannot be carried forward. Any remaining funds are no longer available to the RRI, but are absorbed by the Faculty of ALES creating a net balance of $0 annually.*

*** In 2024-25, the RRI intentionally recapitalized funds to the endowment to ensure that the net balance is $0. While the RRI attempts to keep the annual operating net balance near zero, it is not always possible every year.*

Note: This summary excludes U of A (in-kind) support to the RRI through academic staffing, which is currently valued at over $250,000 annually

Appendix IV. Rangeland Ecology and Management Fund Financial Statement of Actuals, April 1, 2024 to March 31, 2025

	Actuals
Principal	
Opening Balance (April 1, 2024)	$ 9,432,843.85
Current Year Contributions	$ 520,000.00
Capitalized Investment Earnings	$ 2,574,829.77
Closing Balance/Market Value (March 31, 2025)	**$ 12,527,673.62**
Spending Allocation (Revenue)	
Opening Balance (April 1, 2024)	$ 265,320.85
Current Year Endowment Spending Allocation	$ 406,166.77
Total Revenue	**$ 671,487.62**
Current Year Expenditures	
Faculty Salary[1]	$ 170,686.44
Support Staff	$ 115,000.31
Rental Expenses	$ 22,115.65
Transfers to Research Grants	$ 116,000.00
Supplies, Services & Sundries	$ 10,023.23
Total Expenditures	**($ 433,825.63)**
Closing Balance After Encumbrances (March 31, 2025)	**$ 237,661.99**

[1] A proportion of faculty staff salary was taken out of the endowment in order to remove it from the Department of AFNS operational budget (starting in 2018/19), and from the Faculty of ALES operating budget (since 2020/21) and account for budget shortfalls. As expected, the proportion of the RRI budget dedicated to faculty and staff salaries (previously part of the Faculty of ALES operating budget) has increased in subsequent years and will continue to increase over time.

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