# Rangeland Research Institute

## 2023-2024 Annual Report

UNIVERSITY OF ALBERTA

Rangeland Research Institute

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**Cover photo:** Smooth blue beardtongue (*Penstemon nitidus*) and a stunning view overlooking the Red Deer River at the Mattheis Research Ranch in the Mixedgrass Prairie of southern Alberta. The 2023-2024 RRI Annual Report is dedicated to our generous land donors, Edwin Mattheis and Ruth Mattheis, who sadly passed away in September 2023 and May 2024, respectively.

**Photo by Lisa Raatz**

## 1. Introduction

The Rangeland Research Institute (RRI) was created as part of the historic and generous donation of the Mattheis Ranch to the University of Alberta by alumni, Edwin and Ruth Mattheis in 2010. Their vision was to create a legacy research location that is also used for teaching and outreach in the Mixedgrass prairie. The 12,300-acre Mattheis Research Ranch is central to supporting that vision. The ranch consists of 80% unbroken native grassland and represents an ecosystem that is rapidly declining on the western Canadian Prairies, but also globally as intact grasslands are lost through land conversion, disturbance, or degradation.

In 2015, Dr. Edward Bork, Mattheis Chair in Rangeland Ecology and Management and Director of the RRI, ensured that a conservation easement was placed on the Mattheis Ranch in partnership with Western Sky Land Trust in order to protect it from future development, conversion, or land fragmentation. Edwin and Ruth also recognized the vulnerability of these grasslands to fragmentation and chose to donate their entire ranch in order to keep it as a contiguous, unbroken landscape that provides important forage for grazing livestock, wildlife habitat, water purification, pollinators, soil carbon sequestration and greenhouse gas mitigation, as well as many other environmental goods and services.


Edwin and Ruth Mattheis at the University of Alberta-Western Sky Land Trust conservation easement announcement in Calgary, March 10, 2015

Among these benefits was the provision of critical habitat for grassland songbirds, which were near-and-dear to Edwin and Ruth's hearts. Also notable was that the vision for Mattheis Ranch was to highlight the key role that sustainable livestock grazing has in grassland conservation, thereby emphasizing the compatibility of this agricultural land use with environmental stewardship.

Sadly, Edwin Mattheis passed away in September 2023 and Ruth passed away in May 2024. The RRI honours their lives and the legacy that they have created. We are so grateful for Edwin and Ruth's vision, generosity, and passion for the land. There are many students, staff, researchers, and visitors who have been inspired by and benefit from being at, working on, and learning about the Mattheis Research Ranch. This landscape has become a focal area for researchers investigating a broad range of questions that relate to grasslands and sustainable grazing management practices. Undoubtedly, in the coming decades there will be many more who will visit the Mattheis Ranch and be inspired to dedicate their time and energy to work in, study, and commit themselves to conserving our remaining rangelands.

In keeping with Edwin and Ruth's vision, the RRI continues to focus on its mandate to facilitate critical research, teaching, and outreach, with the Mattheis Research Ranch as a key location, along with the Roy Berg Kinsella Research Ranch, private and public lands, and more recently, the Stavely and Onefour Research Stations. This report summarizes key activities undertaken by the RRI from April 1, 2023 through March 31, 2024, and includes a summary of research activities, including three research profiles of recently completed projects; a summary of communication and outreach activities; capacity building; as well as a financial summary of the previous year.

## 2. Research

Research is the primary mandate of the RRI. Research activities that take place at the Mattheis and Kinsella Research Ranches are both a result of direct funding from the Competitive Grants program offered by the RRI, as well as researchers who use the land bases, facilities, and in-kind support provided by the RRI to attract external funding. For directly supported RRI projects, the funding comes from the interest generated by the Rangeland Ecology and Management Fund. The RRI puts out a call for Competitive Grant proposals approximately every second year to encourage researchers to conduct research specifically at the Mattheis Ranch and address novel and relevant research questions that relate to some aspect of rangeland ecology and management.

In early 2024, the RRI solicited research proposals, with four projects receiving funding over a period of two years; these projects are listed in Table 2.1. Most of these new projects investigate aspects of plant and soil microbial communities, greenhouse gas emissions, carbon sequestration, and nutrient cycling on grazed rangelands, wherein differences will be evaluated between season-long and rotational grazing systems as part of the large multi-disciplinary Genome Canada supported project entitled "Climate Action Through Grazing" (or CAT-G) taking place at Mattheis and Kinsella Research Ranches. Research being conducted at the ranches improves our fundamental understanding of rangelands, including on a wide diversity of topics, many of which relate to the environmental goods and services provided by rangelands. 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 in March 2024.**

| Researcher(s) | Project title | Location(s) |
|---|---|---|
| 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 |

Staff use of the housing facilities in support of research and teaching at the Mattheis and Kinsella Research Ranches in 2023-2024 is summarized in Table 2.2. Mattheis Ranch had 400 person-days of use, mostly by those from the University of Alberta (Department of Agricultural, Food and Nutritional Sciences; Dept of Renewable Resources), but also by external collaborators: Agriculture and Agri-Food Canada, Alberta Biodiversity Monitoring Institute, and Tannas Conservation Services. Because the Mattheis Ranch is approximately 400 km southeast of Edmonton, most of this use involved overnight stays. Kinsella Ranch had 349 person-days of use, again, mostly by faculty and staff at the University of Alberta (Department of Agricultural, Food and Nutritional Sciences; Dept of Renewable Resources; Dept of Biological Sciences), but also external organizations: York University (Toronto, Ontario) and Alberta Biodiversity Monitoring Institute. Much of the use at Kinsella involved day-trips to the ranch.

**Table 2.2.** Research facility use at the U of Alberta Ranches (number of researchers) from Jan 1, 2023 – Dec 31, 2023.

| Category of Researchers | Mattheis Research Ranch | Kinsella Research Ranch |
|---|---|---|
| Research Leads (Primary Investigator, Post-doctoral fellow) | 15 | 8 |
| PhD students | 2 | 5 |
| MSc students | 9 | 9 |
| Undergraduate students | 12 | 7 |
| PL SCI 220 field trip, led by Dr. Linda Gorim | 18 | - |
| ENCS 471 field trip, led by Dr. Edward Bork | 7 | 7 |
| Other staff (technicians, support, contractors) | 14 | 4 |
| **Total number of people** | **77** | **40** |
| **Total number of person-days** | **400** | **349** |

## 3. Research Profiles

# Plant growth regulators reduce lodging in forage seed crops

*Prepared by: Dr. Edward Bork, Bishnu Pandey and Dr. Nityananda Khanal*

Select regions of western Canada are renowned for their role in providing a reliable global supply of grass seed used in both forage establishment and land reclamation. The Peace River region of Alberta and British Columbia is particularly well known for the production of grass seed, producing 30% of Canada's forage and turf seed. This includes important agronomic grasses such as meadow bromegrass (*Bromus biebersteinii*), creeping red fescue (*Festuca rubra*), and timothy (*Phleum pratense*). Producers harvesting seed from these swards face many challenges, such as maximizing their annual seed yields while minimizing costs, and increasing the harvestability of the seed produced. A common problem with these grass stands is their tendency to experience lodging, where grass stems collapse under their own weight and become prone on the ground (Fig. 1). Lodging is particularly common during favorable growing conditions (wet years) or when fertilization is used to increase seed yields. Lodging may not only impact plant growth and associated seed production, but also the ability of seed to be harvested with the use of commercial equipment, leading to a significant economic loss of harvestable seed.

Figure 1. Creeping Red Fescue exhibiting lodging in Beaverlodge, Alberta. Photos from Bishnu Pandey.

To avoid lodging and attain increased seed yields, the use of plant growth regulators (PGRs) has become more common, both within forage swards and annual cropland. PGRs are either natural or synthetic compounds capable of changing plant growth by altering plant metabolic, physiologic, and associated morphological attributes. In an effort to improve grass seed yields and harvestability, many producers are applying PGRs to their forage swards, including trinexapac-ethyl (TE), chlormequat chloride (CC), or ethylene (ETH). Working with Drs. Nitya

Khanal, forage scientist at Agriculture and Agri-Food Canada in Beaverlodge, and Edward Bork (University of Alberta), Bishnu Pandey conducted his MSc studies on the impact of these PGRs on several forage grasses. This work was conducted at the AAFC Beaverlodge Research Station in NW Alberta between 2020 and 2022, and included a combination of field trials, mesocosm studies and greenhouse investigations.

MSc student, Bishnu Pandey, measures internode length in the greenhouse.

The initial greenhouse study was used to isolate the effects of PGRs on the morpho-physiology of grass crops while in a juvenile growth stage (first year of growth). Distinct interspecific differences were found in grass responses to the PGRs. For example, TE applied at 0.2 kg/ha reduced the root, shoot and total biomass of timothy and creeping red fescue for up to 40 and 55 days, respectively, post-treatment (Figs. 2A, 2B), but did not alter the biomass of meadow bromegrass. Importantly, both TE and CC (1.12 kg/ha) reduced the height of all three forage grasses, and led to a lower severity of lodging, while the same was not observed with ETH (0.6 ka/ha). Additionally, TE and CC increased the concentration of chlorophyll and carotenoids within timothy. Many grass attributes, however, were non-responsive to the PGRs, such as individual tiller counts, specific leaf area, root area and length, as well as plant relative growth rates.

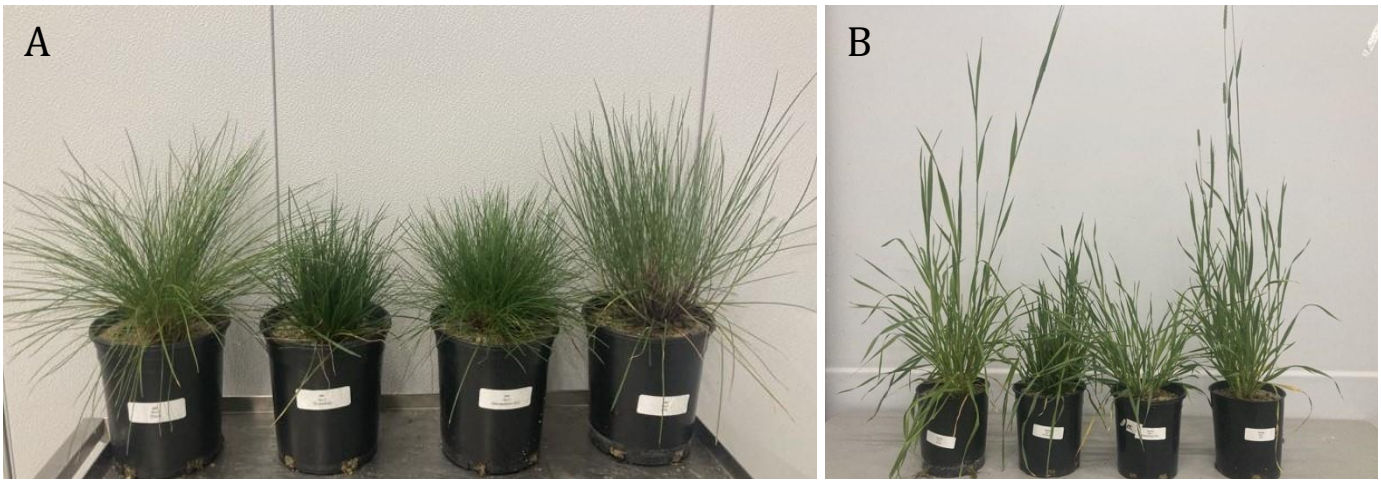



Figure 2. Biomass comparison of A. Creeping Red Fescue and B. Timothy treated with plant growth regulators in the greenhouse L-R: Untreated control, TE, CC, and ETH, respectively.

Microcosm field trials in Beaverlodge, Alberta.

Parallel field studies examining all three PGRs on the three forage grasses during 2021 and 2022 showed similar results, with the application of TE leading to the greatest reduction in stem internode length, and therefore, the largest decline in plant height and associated lodging (Figs. 3A, 3B). Application of TE was also more effective in the taller statured grasses of timothy and meadow bromegrass, rather than creeping red fescue. Notably, while the PGRs were found to alter the morphology of several forage seed grasses, no changes were observed in those attributes responsible for seed yield. The latter included seed-head size (length), individual seed weight and number, and total seed yield. The absence of seed yield changes due to PGRs highlights the ability of these compounds to alter plant morpho-physiology without negatively impacting seed production. Finally, the beneficial role of PGRs in reducing plant height and lodging severity was more apparent during growing seasons with above-normal precipitation, reinforcing the key role of environment in dictating when and where PGR application may be beneficial for commercial seed production.

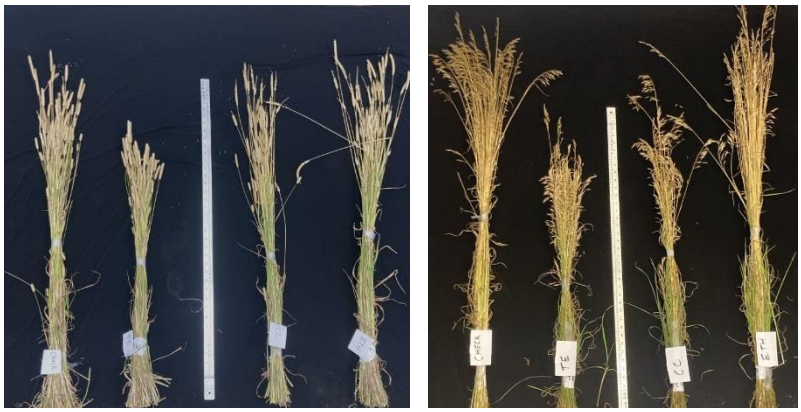


Figure 3. Biomass comparison of A. Timothy and B. Meadow bromegrass treated with plant growth regulators L-R: Untreated control, TE, CC, and ETH, respectively.

Overall, these results indicate that among the PGRs tested, TE was the most effective in reducing plant height, and in the process reducing the risk of lodging. While this change did not alter the total amount of seed produced, the lower risk of lodging, particularly during favorable growing conditions, is likely to maximize grass seed harvestability, thereby indirectly benefiting commercial grass seed growers. Further studies are recommended to address the role of long-term PGR application to grass swards under field conditions, as well as the impact of environmental variability in regulating grass morpho-physiologic and seed yield responses.

# Combating annual brome grass invasion in Mixedgrass Prairies

*Prepared by Dr. Edward Bork, Anabel Dombro and Lisa Raatz*

Non-native annual brome grasses are well known across the western United States for their propensity to invade and dominate rangeland ecosystems, where they increase wildfire frequency and sharply reduce the provision of ecosystem services, including grazing opportunities, native biodiversity, and wildlife habitat quality. While rangelands of the Canadian Prairies have been mostly immune to annual brome invasion, this has changed in recent years, with the Mixedgrass Prairie of southern Alberta near the Montana border experiencing marked increases in brome abundance. High levels of seed production, together with an early growth pattern that usurps resources from native plants, can sharply reduce range health and grazing opportunities in affected grasslands.

MSc student, Anabel Dombro (foreground), and others assess annual brome and native plant cover in the first year post-treatment (2020) when annual brome density was at its peak.

Annual brome biomass in 2020

In areas where annual brome invasion has occurred, various strategies are employed to attempt brome control and restore degraded rangeland. One promising new tool that has emerged is the use of indaziflam, a cellulose-biosynthesis inhibiting herbicide that is applied to the soil surface, and following entry into the topsoil, affects the development of establishing seedlings. As most native grassland species are perennials, their roots reside well below the treated surface layer, rendering them less impacted by indaziflam, while annual bromegrasses, which rely on annual seed production to maintain the seedbank, are prone to decline as they germinate on or just below the soil surface. Indaziflam efficacy has been tested in the central plains of the United States, but not in northern temperate grasslands, where more fertile soils,

cooler climates, and vegetation dominated by cool season species, may alter annual brome control with indaziflam.

Annual brome (*Bromus squarrosus*) surrounding a scarlet mallow (*Sphaeralcea coccinea*). Even small brome plants occurring at high density add large amounts of seed to the seedbank.

In 2019, the Rangeland Research Institute partnered with Bayer Crop Science (now Envu), and Alberta Environment and Parks, to evaluate indaziflam as a control strategy in affected native Mixedgrass Prairie grasslands. Anabel Dombro, a summer student initially hired to help sample the study sites, eventually became an MSc student in the project working with Dr. Edward Bork, and RRI Program Coordinator Lisa Raatz, and recently completed her summary of findings in January 2024. Anabel's work provided several interesting findings.

One of the earliest was that the most abundant annual brome species within the affected region was corn brome (*Bromus squarrosus*), a species that has been less reported, and not as intensively examined in other regions, much less for control. While an unfamiliar plant to most, it strongly resembles Japanese brome (*B. japonicus*) which is on the Noxious weeds list in Alberta.

In the second year after herbicides were applied (2021), there were reductions in brome biomass and density.

Following indaziflam application at different rates and seasons at two experimental field sites, Anabel examined the duration of annual brome control. Reductions in annual brome density and biomass peaked in the second growing season after application, but continued to be suppressed through four consecutive years, highlighting the long-term efficacy potential of indaziflam in northern temperate grasslands. Indaziflam requires some rainfall to wash into the soil and become active and annual brome also requires soil moisture to germinate. Brome control could be achieved using rates as low as 37.5 g ai $ha^{-1}$ of indaziflam, although higher rates (75 and 150 g ai $ha^{-1}$) generally led to the greatest control, findings further supported by studies of the surviving germinable seedbank from treated plots. In addition,

reduced brome led to an increase in the biomass of native plant species in the field, highlighting the potential to restore livestock grazing opportunities.

Overall, few negative changes in native grassland composition were observed, although in the fourth year of the study indaziflam caused slight reductions in diversity and a shift in perennial grass composition, with increases in Western Wheatgrass and reductions in Needle and Thread and Blue grama. However, one cautionary note was found, in that greenhouse trials conducted using young (establishing) native grass seedlings treated with indaziflam demonstrated negative root and shoot growth responses, thereby reinforcing the non-selective nature of indaziflam in affecting establishing plants. Thus, while indaziflam holds significant promise for helping to contain annual brome invasions into Alberta's native grasslands, some caution in warranted in its application, particularly if done frequently and at high rates, as this could alter the long-term recruitment and retention of important native plant species within these ecosystems. Additionally, indaziflam has a relatively long persistence in the soil which is how it depletes the annual weed seedbank in native grasslands, but this also means that indaziflam is not a viable option for brome control within a seeded cropping system. Registration of indaziflam for use in Canadian rangelands in still pending but is anticipated to be available within the next year or so.

Four years after herbicide was applied (2023), brome biomass and density in all treatments receiving indaziflam were very low.

Native grass cover and litter dominated instead of annual brome in treated plots by 2023.

**Dr. Edward Bork**
University of Alberta
edward.bork@ualberta.ca

# Grassland Recovery from Wildfire

*Prepared by Dr. Cameron Carlyle and Brendan Bischoff*

In October 2017 two wildfires burned across grasslands and croplands of southern Alberta and Saskatchewan. These fires were devastating to the local ranching community because of the loss of livestock and forage. The general recommendation for managing cattle on grasslands following fire is to avoid grazing for at least 1 year or longer if possible. However, recently there has been advocacy in the United States to allow grazing in the year following wildfire as some studies have shown no detrimental impacts. While several studies have been done following wildfire in Alberta they have all been opportunistic taking advantage of wildfires whenever and wherever they occur. Thus, following the recovery of additional large-scale fires is beneficial as it adds to our understanding of grassland recovery.

A burned fence post and evidence of erosion from a pasture in the spring following wildfire.

MSc student, Brendan Bischoff (right), and undergraduate field assistant eating lunch and discussing plant identification.

Brendan Bischoff, an MSc student at the University of Alberta supervised by Cameron Carlyle, undertook a project to follow the recovery of grasslands after the 2017 wildfires. Brendan examined the quantity and quality of forage in burned and non-burned areas in the years following the fire along with collaborators Edward Bork (University of Alberta), and Eric Lamb, Sarah Grover and Roy Vera-Velez (University of Saskatchewan).
In a small plot study, Brendan tested whether the timing of defoliation in the year immediately following the wildfire affected plant recovery. He clipped plants at three different times during the growing season after the fire occurred from burned and non-burned areas, then measured their biomass. The

results showed that late season defoliation had the largest effect, which is likely because this timing of defoliation removed the most biomass.

In comparisons of burned and non-burned areas, where cattle grazing was excluded, Brendan found that burned areas had less biomass for at least 4 years following the fire. Importantly, the amount of litter in burned areas didn't return to pre-burn amounts. This is important because litter insulates soils, helps keep moisture in the ground and supports plant growth. The prolonged loss of litter could have long-term consequences on forage production, especially in years with reduced rainfall. Roy Vera-Velez examined the quality of plant regrowth and found that burned areas had higher quality forage, which is an expected result because low quality, standing dead plant material was burned away and fire can add nutrients into the soil. Areas that scored higher for range health metrics (measured in unburned areas immediately adjacent to the burned areas) had more biomass sooner following fire, supporting the need for good range management.

A weather station sitting on the boundary between burned (left) and non-burned grassland (right), in the year following the wildfire.

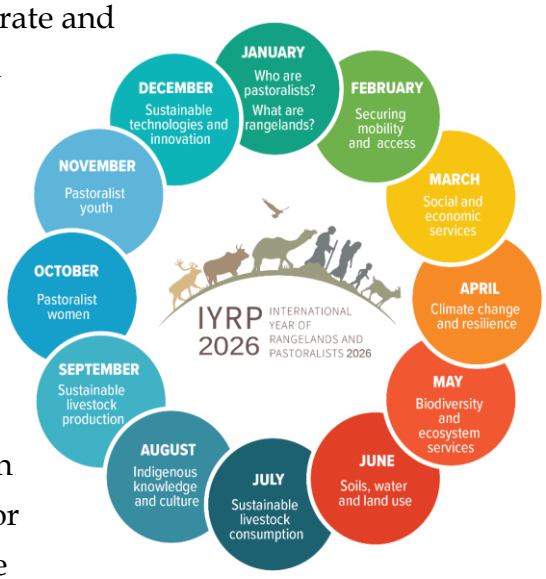
Overall, the investigators saw limited prolonged effects of the burn on forage production, but rainfall levels were only slightly below normal during the sampling period, and litter levels were much reduced which could have lasting effects. In other studies examining grasslands after wildfire, the amount of post-fire rainfall was an important predictor of forage recovery, and post-fire management should take weather into account. Future work on this project will examine producer management effects on grassland recovery and remote sensing analyses of forage recovery (led by Sarah Grover at the U of S). We thank the producers whose lands were affected by the fire for allowing us to conduct our research and the Government of Alberta for funding support.

**Detailed results of this study can be found in:**

Bischoff, B.K., Bork, E.W., Carlyle, C.N. 2022. Forage productivity is resilient to timing of post-wildfire defoliation in mixed-grass Prairie. Can J of Plant Sci. 102(4): 926-30.

## 4. Capacity Building

The Rangeland Research Institute continues to collaborate and partner with other organizations to build research and outreach capacity. The RRI will celebrate the 2026 International Year of Rangelands and Pastoralists along with hundreds of other organizations globally. Leading up to 2026, RRI has been and will continue meeting with IYRP focus groups, Society for Range Management (SRM parent society, SRM International Mountain Section, and SRM Prairie Parkland Chapter), Saskatchewan Prairie Conservation Action Plan and University of Saskatchewan to plan for outreach events, webinars, and tours that highlight the importance of rangelands and focus on aspects of the twelve IYRP themes.



Global framework for monthly IYRP themes.

In 2024, Dr. Erick da Silva Santos joined the faculty of ALES as a Forages, Pasture, and Grassland researcher and has already assumed a full teaching load, teaching the undergraduate Forage Crops course (PL SC 354) in the Jan to Apr 2024 term. Erick joined the U of A as a post-doctoral fellow with Dr. Edward Bork and has a strong history of collaboration. He will continue working on the large multi-disciplinary Alberta Agri-Systems Living Labs project while also building his own program at Breton, Kinsella and Mattheis Ranches, as well as on public and private land.

In addition to the Living Lab projects, which have already been initated on many private ranches in Alberta and Saskatchewan, the large Genome Canada project Climate Action Through Grazing (CAT-G) will be initiated in 2024 at the Kinsella and Mattheis Research Ranches as primary research hubs. These research projects directly impact ranchers and inform policy makers by addressing research questions related to greenhouse gas emissions under rotationally and continuously grazed systems, with the overall goal of providing deliverables that include the creation of best management practices to achieve greenhouse gas mitigation. As such, both ranches will have more activity and research in the coming years that directly impacts those in the ranching industry.

## 5. Communications & Teaching

The Rangeland Research Institute collaborates with affiliated researchers who communicate research findings to stakeholders through a variety of methods including tours, seminars, webinars, conferences, workshops, podcasts, radio interviews, peer-reviewed research journal manuscripts, and extension articles and bulletins. Using multiple methods to communicate enables research to be disseminated to a wide audience of other researchers and academics, ranchers and producers, land managers, government policy makers, non-government organizations, collaborators, interested members of the public, students, beef and forage industry, and others.

One of the most effective methods of communicating research to ranchers and producers is publishing extension articles in local newspapers (often also available online). These can have a large impact on people who face challenges related to their operations and grazing systems such as weed management and drought by communicating research highlights that apply to ranch-level decision making.

Table 5.1 lists a subset of peer-reviewed and range-related journal publications authored by affiliated


Dr. Cameron Carlyle contributed to the Rocky Mountain Outlook article: Short-term drought harder on grasslands than previously thought. (Mar 2024).




Dr. Edward Bork contributed to extension articles in the Canadian Cattlemen: Cows can control Canada thistle and brush (May 2023); Saskatchewan Today: Grazing Study: Should you let your cattle decide where to eat? (May 2023); and Lakeland Today: Fence-less pastures could be the new landscape (Apr 2023).

researchers. Projects that have taken place at Kinsella or Mattheis Research Ranches and research projects that have received RRI funding are noted. Additionally, oral and poster presentations by RRI affiliated researchers in 2023-24 are listed in Appendix II, with select highlights described below.

The RRI hosted two extension events with international guests in 2023-24, which raises awareness of the International Year of Rangelands and Pastoralists (IYRP 2026) initiative with some advanced events and early participation. In November 2023, a group of approximately 20 undergraduate students and instructors from Universidad Chapingo, Mexico toured Alberta with a stopover at the University of Alberta that included a day spent with rangeland researchers and graduate students to learn about beef cattle, grazing and forage production systems in Alberta, as well as current research projects taking place at the U of A. The RRI and the Faculty of Science co-hosted a presentation by Dr. Barbara Zimmermann, from Inland Norway University of Applied Sciences, who talked about her research using virtual fences for grazing in Norway's forests, which showed significant potential for cross-collaboration with current U of A virtual fencing projects.


MSc student, Anabel Dombro, talks about her research Annual bromegrass control using indaziflam on Alberta rangelands for SRM-IMS webinar series in Apr 2023.

The University of Alberta (U of A) RRI, Society for Range Management – International Mountain Section (SRM – IMS Alberta and Montana), and Montana State University (MSU) collaborated to host several webinars in winter 2024 that highlighted research projects taking place at MSU and U of A. Three webinars featured projects at the U of A including one by MSc student, Anabel Dombro, who has been investigating the management of annual bromes using indaziflam in southern Alberta rangelands. The webinars were attended by ranchers, producers, and land managers as well as government and non-government groups. All the webinars are available on the SRM – IMS YouTube channel: https://www.youtube.com/@srm-ims.

In addition to extending research through a variety of media, RRI staff and affiliated researchers spend much of their time teaching undergraduate and graduate students who are interested in pursuing a career in agriculture and environmental related fields. The Kinsella and Mattheis Research Ranches hosted two undergraduate classes in late summer 2023: Dr. Linda Gorim used the Mattheis Ranch to teach a group of ~20 students about southern Alberta annual cropping and irrigated production systems, and Dr. Edward Bork used both ranches for the Wildlife and Range Capstone course, which helps senior students synthesize their undergraduate course knowledge into real-world issues and challenges facing ranchers, rangeland stewards and the agricultural industry. Students value hands-on learning experiences and both ranches are valuable teaching resources at the U of A, as well as access to instructors who are experts in rangeland and ecology management.

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 2023 and March 2024**


*Murillo, R.D., Pätsch, R., Wagner, V. Mar 2024. Agronomic non-native species are overrepresented across habitat types in central Canada. J of Applied Ecology. DOI10.1111/1365-2664.14631

Mapfumo, E., Baron, V.S., Lemke, R., Naeth, M.A., Chanasyk, D.S., Dick, C. Mar 2024. Management impacts on organic carbon under continuous perennial grass, perennial grass-legume mixture, and annual cereals on a thick Black Chernozemic soil. Can J of Soil Science. 104(1): 108-123. DOI10.1139/cjss-2023-0041

Villasor, C., Robertson, K., Becker, T., Cahill, J.F., Deak, B., Hensen, I., Otfinowski, R., Rosche, C., Borovyk, D., Vakhlamova, T., Valko, O., Wagner, V. Mar 2024. Invasion success of three cool-season grasses in the northern prairie: a test of three hypotheses. Oikos. 2024(3). DOI10.1111/oik.10266

*Khatri-Chhetri, U., Banerjee, S., Thompson, K.A., Quideau, S.A., Boyce, M.S., Bork, E.W., Carlyle, C.N. Feb 2024. Cattle grazing management affects soil microbial diversity and community network complexity in the Northern Great Plains. Science of the Total Environment. 912: 169353. DOI10.1016/j.scitotenv.2023.169353

Dollete, D., Lumactud, R.A., Carlyle, C.N., Szczyglowski, K., Hill, B., Thilakarathna, M.S. Feb 2024. Effect of drought stress on symbiotic nitrogen fixation, soil nitrogen availability and soil microbial diversity in forage legumes. Plant and Soil. 495(1-2): 445-467. DOI10.1007/s11104-023-06348-1

Arychuk, C.E., Dhar, A., Wilkinson, S.R., Naeth, M.A. Feb 2024. Seeding and transplanting native forbs on reclamation sites in Alberta, Canada. Restoration Ecology. DOI10.1111/rec.14122

Luo, W.Q., Valverde-Barrantes, O.J., Weemstra, M., Cahill, J.F. Jr., Wang, Z., He, D., Chen, Y.F., Chu, C.J., Wang, Y.S. Feb 2024. Leaf and root traits are partially coordinated but they show contrasting multi-trait-based community trait dispersion patterns in a subtropical forest. J of Plant Ecology. 17(1). DOI10.1093/jpe/rtad045

Iheshiulo, E.M.A., Larney, F.J., Hernandez-Ramirez, G., St Luce, M., Chau, H.W., Liu, K. Feb 2024. Crop rotations influence soil hydraulic and physical quality under no-till on the Canadian prairies. Agriculture Ecosystems & Environment. 361: 108820. DOI10.1016/j.agee.2023.108820

Daly, E.J., Hernandez-Ramirez, G., Congreves, K.A., Clough, T., Voigt, C., Harris, E., Ruser, R. Feb 2024. Soil organic nitrogen priming to nitrous oxide: A synthesis. Soil Biology and Biochemistry. 189: 109254. DOI10.1016/j.soilbio.2023.109254

Smith, M.D., Wilkins, K.D., Holdrege, M.C., Wilfahrt, P., Collins, S.L., Knapp, A.K., Sala, O.E., Dukes, J.S., Phillips, R.P., Yahdjian, L., Gherardi, L.A., Ohlert, T., Beier, C., Fraser, L.H., Jentsch, A., Loik, M.E., Maestre, F.T., Power, S.A., Yu, Q., Felton, A.J., Munson, S.M., Luo, Y.Q.,… Batbaatar, A., Bork, E.W., Cahill, J.F., Carlyle, C.N., Chang, S.X., Lamb, E.G., Otfinowski, R..et al. Jan 2024. Extreme drought impacts have been underestimated in grasslands and shrublands globally. Proceedings of the National Academy of Sciences of the USA. 121(4). DOI10.1073/pnas.2309881120

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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 Rangeland Research Institute continues to be active in fulfilling its mandate to conduct research, engage in outreach, and participate in teaching activities. While the Strategic Advisory Council (SAC) has not formally gathered in recent times, many members participate by providing feedback on research proposals that are submitted to the RRI and assisting with making decisions on how to award research funding. Additionally, they promote RRI events and outreach within their networks. The current composition of the SAC as of May 15, 2024, is provided in Table 6.1.

Of note, in July 2024, Dr. Stan Blade will no longer serve as the Dean of ALES as his term expires. Most recently, he has been appointed as Deputy Director General for the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Due to this role change, Dean Blade will no longer serve on the RRI SAC. The RRI is grateful to Stan for his input and interest in the RRI over the years. We welcome Dr. Rickey Yada as the new Dean of ALES commencing October 2024.

Sadly, Edwin Mattheis passed away in fall 2023 and Ruth passed away in spring 2024. Their absence will be felt on the SAC. Edwin and Ruth continued to visit the Mattheis Ranch while they were able to travel and often stopped in for a visit and to receive an update about the research and activities at the ranch. Equally, they shared valuable producer and natural resources industry perspectives with the RRI and members of the SAC.

Edwin and Ruth were proud of the Mattheis Ranch and generously hosted several University of Alberta Presidents including, Dr. Indira V. Samarasekera, Dr. David Turpin, and current President, Mr. Bill Flanagan. Edwin and Ruth communicated the importance of the land and land stewardship, the critical importance of the agricultural industry in Alberta, and shared their vision with these leaders. In doing so they have left a lasting impression on many people, from students starting their careers in rangeland management to those in the highest leadership positions. Edwin and Ruth will be missed.

**Table 6.1. Members of the RRI Strategic Advisory Council, May 2024.**

| Name | Position, *Agency* | Location |
|---|---|---|
| Barry Adams* | Head, Rangeland Resource Management Program (Retired)<br>*Alberta Environment and Sustainable Resource Development* | Lethbridge, AB |
| Dr. Stan Blade | Dean, Faculty of Agricultural, Life & Environmental Sciences, *University of Alberta* | Edmonton, 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) 2023-24 financial statement is shown in Appendix III and summarizes revenue and expenses. The RRI operational revenue is generated from ongoing 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. In 2023-24, the RRI recapitalized $520,000, which is more than in previous years, but 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, 2024, was $ 11,575,990.25 and the annual spending allocation generated by this fund is also listed (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 2023-2024. * 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 |
| Central Plains 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 |
| *Differentiating and understanding the roles of soil nutrient and soil community heterogeneity on plant growth, carbon storage and biodiversity | Cahill |
| 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, & Gamon |
| Use of plant growth regulators for enhancing forage grass seed production in NW Alberta | Khanal & Bork |

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| Precision ranching of cattle: Integrating cattle genomics, grazing behavior, and production | Bork, Fitzsimmons, Carlyle, Plastow, Cahill, Lamb, Church, Basarab, Guan & Li |
| 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 |
| *Using plant traits to assist conservation and management of Alberta's rangelands | Cahill |
| *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 |
| *Using network analyses to better predict ecosystem goods and services in Alberta rangelands | Holden & Cahill |
| *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 2023-2024

**Outreach and promotional activities undertaken in support of the RRI during 2023-2024**

| Abbreviated title | Presenter(s) | Venue | Audience(s) | Date |
|---|---|---|---|---|
| On ranch participatory research: Testing rotational grazing using co-development in the living labs | Bork, Santos, Carlyle, Asante-Badu, Battr, Chowdhury, Novais, Wade, Schmid | CALL-Net Labinar: AAFC | Researchers, academics, producers | 24-Mar, 2024 |
| Grazing boosts grassland carbon storage: An undervalued ecosystem service<br>Watch it on YouTube:<br>https://youtu.be/9Mj19buPEhs?si=aXgjXKamIDPJ2b9d | Bork, Alexander, Boyce, Cahill, Carlyle, Chang, Döbert, Grenke, Hewins, Kaliaskar, Khatri-Chhetri, Ma, Shreshtha, Sobrinho, Thompson | SK PCAP - Prairie's got the goods week; webinar | Public, gov't, NGO, ranchers, producers, policy makers | 21-Mar |
| Effects of soil texture and light availability on *Caragana arborescens* performance | Lacza | R.E. Peter Biology Conference, U of Alberta | Academics, students | 19-Mar |
| Plant social networks: a tool for understanding community assembly and coexistence | Holden | | | |
| The effects of soil microbiome under prior resource conditions on the plant community | Innes | | | |

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| Effects of grazing management on soil carbon storage, size fractions, microbial communities and necromass in northern temperate pastures | *Chowdhury, Bork, Carlyle | ALES Research Symposium | Academics, students | 19-Mar |
| Bovine-derived Lactobacillus mixture as a strategy to minimize beef calf stress at weaning | *Ramirez, Lasso, Mendez, Guan, Ceballos, McAllister, Schwartzkopf-Genswein, Malmuthuge, Silva | | | |
| Effect of grazing management on vegetation diversity and composition | *Wade, Batbaatar, Bork, Chang, Bedard-Haughn, Sorenson, Carlyle | | | |
| Activity behavior and growth performance during summer of grazing beef heifers with divergent residual feed intake | *Lasso, Londono, Fitzsimmons, Plastow, Bork, Basarab, Silva | | | |
| Evaluation of blood parameters associated with environmental stress in grazing beef heifers with divergent residual feed intake | *Londono-Mendez, Lasso-Ramirez, Fitzsimmons, Plastow, Bork, Basarab, Silva | | | |
| Sod-seeding perennial legumes into beef cattle pastures in central Alberta | *Yordanov, Asante-Badu, Santos, Carlyle, Bork | ALES Research Symposium & R.E. Peter Biology Conference, U of Alberta | Academics, students | 19-Mar |
| Effects of non-native cicer milkvetch (*Astragalus cicer* L.) on vegetation and soil ecology on the Canadian dry mixedgrass prairie | *Tran, Lumactud, Amgaa, Carlyle, Thilakarathna | | | |
| Enhancing carbon sequestration and microbial activity through native plant restoration in Saskatchewan grasslands | *Kaliaskar, Carlyle | | | |
| Principles and practices of cattle grazing management: Why AMP grazing? | Bork | CAT-G Ruminations Interdisciplinary Seminar | Academics, students | 14-Mar |

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| Can cow-calf production efficiency be explained by maternal habitat selection and dietary composition in diverse pasture?: 'Precision Ranching' | Bork*, Fitzsimmons, deNovais, Basarab, Cahill, Carlyle, Church, Guan, Lamb, Li, Plastow, Behrouzi, Harland, Lopes, Oloyede, Udeh | Alberta Beef Producers; Beef Research Showcase; Olds, AB | Industry, ranchers | 11-Mar |
| Long-term soil carbon stock in contrasting forage-crop rotation systems | Santos*, Achtymichuk, Dyck, Puurveen, Quideau, Jeffrey, Bork | | | |
| Can virtual fencing be used to rotationally graze beef cattle in western Canada? | Harland*, deNovais, Durunna, Fitzsimmons, Church, Bork | | | |
| Grazing in Norway's carnivore forests: Research on cattle grazing with virtual fencing technology | Zimmermann | RRI, U of A Faculty of Science, INNU, IYRP cohosted seminar | Academics, industry, policy makers, gov't and NGO, students | 27-Feb |
| Sod-seeding perennial legumes into beef cattle pastures in central Alberta | Yordanov, Asante-Badu, Santos, Carlyle, Bork | Bentley Lecture in Sustainable Agriculture; Edmonton, AB | Academics, students, industry, gov't | 13-Feb |
| Effect of grazing management on vegetation diversity and composition | Wade, Batbaatar, Bork, Chang, Bedard-Haughn, Sorenson, Carlyle | | | |
| Grassland carbon and livestock grazing: An undervalued ecosystem service? | Bork, Alexander, Boyce, Cahill, Carlyle, Chang, Döbert, Grenke, Hewins, Kaliaskar, Khatri-Chhetri, Ma, Shrestha, Sobrinho, Thompson | Office of the Chief Scientist of Alberta: Invited presentation, Edmonton, AB | Gov't | 13-Feb |
| Rangeland biological soil crusts: Their ecological functions in the Northern Great Plains and industrial disturbance response | Pyle*, Bork | 10th Native Prairie Restoration/Reclamation Workshop; Saskatoon, SK | Industry, Gov't, NGO, academics, students | 7-Feb |

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| Can virtual fencing be used to rotationally graze beef cattle in western Canada? | *Harland, DeNovais, Durunna, Fitzsimmons, Church, Bork | Society for Range Management Annual Meeting: Change on the Range; Sparks, Nevada | Academics, ranchers, producers, industry, policy makers, gov't and NGO, students | 30-Jan |
| Pedometer-based metrics of animal behaviour in relation to summer heat stress | *Oloyede, Bork, Fitzsimmons, Li, deNovais | | | |
| Management of annual brome invasion within northern mixed grassland using indaziflam | Dombro | MSc thesis defense, University of Alberta, Edmonton | Students, academics | 12-Jan, 2024 |
| Efficacy of virtual fencing to rotationally graze beef cattle in Western Canada | Harland, deNovais, Durunna, Fitzsimmons, Church, Bork | Chinook Applied Research Association: webinar | Producers, industry, gov't | 7-Dec |
| Characterizing grassland carbon storage and responses to grazing in western Canada | Bork, Carlyle, Dobert, Hewins, Shrestha, Ma, Cahill, Chang, Thompson, Quideau, Grenke, Khatri-Chhetri, Kaliaskar, Sobrinho, Lamb, Boyce | 5th Annual World Regenerative Agriculture: webinar | Producers, public, industry | 11-Nov |

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| A brief tour of Canada's rangeland and pasture resources | Bork | Universidad Chapingo, Mexico visit to U of Alberta Range researchers | Students, academics | 8-Nov |
| Grassland and soil carbon storage | Bork, Boyce, Cahill, Carlyle, Chang, Dobert, Grenke, Hewins, Kaliaskar, Khatri-Chhetri, Ma, Shrestha, Sobrinho, Thompson | | | |
| Introduction to the beef industry, Kinsella herds, Genome Canada project | Fitzsimmons | | | |
| Greenhouse gas emissions and feed efficiency in beef cattle | *Behrouzi, Bork, deNovais, Fitzsimmons | | | |
| Annual brome management with indaziflam | *Dombro, Raatz, Bork | | | |
| Forage production in W Canada | Santos | | | |
| An introduction to precision ranching | *deNovais, Oloyede, Udeh, Fitzsimmons, Bork | | | |
| Efficacy of virtual fencing to rotationally graze beef cattle in western Canada | *Harland, deNovais, Fitzsimmons, Bork | | | |
| Harnessing adaptive, multi-paddock (AMP) grazing to boost soil health | Bork, Achtymichuk, Boyce, Cahill, Carlyle, Chang, Döbert, Dyck, Grenke, Hewins, Jeffrey, Kaliaskar, Khatri-Chhetri, Ma, Puurveen, Quideau, Santos, Shrestha, Sobrinho, Thompson | Organic Alberta Conference, Sherwood Park, AB | Producers, public | 3-Nov |
| Precision ranching technology for cattle production | Church*, Bork, Harland | CanWest Veterinary Annual Meeting, Banff, AB | Industry, academics, gov't | 8-Oct |

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| Unique opportunities for sustainable agriculture in Alberta through the Alberta AgriSystems Living Lab | Karisa, Schmid, Herron, Flaim, Flaig, Bork, Chau, Baron | 1st International Forum on Agroecosystem Living Labs, Montreal, QC | Industry, producers, researchers | 4-Oct |
| Evaluation of hematology parameters in beef heifers with divergent residual feed intake during the winter season | Londono-Mendez, Lasso-Ramirez, Fitzsimmons, Plastow, Bork, Basarab, Silva | Canadian Beef Industry Conference, Calgary, AB | Producers, industry, researchers, students | 14-Aug |
| Field tour: Breton plots – including forages in rotation; Review AALL project on rotational grazing impacts on pasture ecosystem function | Bork | Field tour: Alberta Agrisystems Living Labs | Producers, industry, research collaborators | 10-Aug |
| Carbon cycle and beef cattle | Bork | Manitoba Beef and Forage Initiative, Podcast with Chantel McRae; Winnipeg, MB | Ranchers, public, academics, Gov't and NGO | 19-Jul |
| PSVIII-A-3 activity behavior and growth performance during summer of grazing beef heifers with divergent residual feed intake | *Lasso, Londono-Mendez, Fitzsimmons, Bork, Plastow, Basarab, da Silva | Canadian Society of Animal Science. Albuquerque, NM, USA | Academics, students, Gov't and NGO | 17-Jul |
| Methane and carbon dioxide emissions from crossbred beef cattle fall-grazed on native Aspen Parkland pastures | *Behrouzi, Ewasiuk, Bork, Basarab, Fitzsimmons | | | |
| Nutritional epigenetic modifications in beef cattle | *Gibril, Behrouzi, Fitzsimmons | | | |
| Evaluation of blood parameters associated to environmental stress in grazing beef heifers with divergent residual feed intake | *Londono - Mendez, Lasso-Ramirez, Fitzsimmons, Plastow, Bork, Basarab, da Silva | | | |
| Assessment of the rumen bacterial community in beef cows differing in feed efficiency across four feeding and grazing scenarios | *Na, Zhou, Chen, Bork, Fitzsimmons, Guan | | | |
| Emerging precision ranching technology is enabling the development of a “smart” biome | *Church, Bork | | | |

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| Rotational grazing: Practical approaches | Busz | Practical Approaches: Alberta Agrisystems Living Lab | Ranchers, research collaborators | 5-Jul |
| Grazing systems: A brief introduction | Bork | | | |
| Long-term soil C stock in an 8-yr forage-crop rotation within a Gray Luvisol | Santos, Achtymichuk, Dyck, Puurveen, Quideau, Jeffrey, Bork | Canadian Society of Soil Science annual meeting: Truro, NS | Academics, students, Gov't and NGO | 26-Jun |
| Activity behavior and growth performance during summer of grazing beef heifers with divergent residual feed intake | *Lasso-Ramirez, Londono-Mendez, Fitzsimmons, Plastow, Bork, Basarab, Silva | Canadian Society for Animal Science annual meeting: Halifax NS | Academics, students, Gov't and NGO | 12-Jun |
| Evaluation of blood parameters associated to environmental stress in grazing beef heifers with divergent residual feed intake | *Londono-Mendez, Lasso-Ramirez, Fitzsimmons, Plastow, Bork, Basarab, Silva | | | |
| Assessment of the rumen bacterial community in beef cows differing in feed efficiency across four feeding and grazing scenarios | *Na, Zhou, Chen, Bork, Fitzsimmons, Guan | | | |
| Methane and carbon dioxide emissions from crossbred beef cattle fall-grazed on native aspen Parkland pastures | *Behrouzi, Ewasiuk, Fitzsimmons, Basarab, Bork | | | |
| Soil microbial, physical, and chemical response to cattle grazing management in the Northern Great Plains | Khatri-Chhetri | PhD seminar, U of Alberta, Edmonton | Students, academics | 10-May |
| Integrating herbicides, fertilization and rotational grazing for weed management in pastures. | Bork | Alberta Forage Industry Network, invited webinar | Ranchers, producers, land managers, industry | 9-May |
| Annual-bromegrass control using indaziflam on AB rangeland: Results from 3 years post-treatment<br>Watch it on YouTube: https://youtu.be/V4zJ1WFnv4g | *Dombro, Bork, Raatz | SRM IMS, MSU & RRI winter webinar series; online | Rancher, producers, land managers, Gov't and NGO | 14-Apr |

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| Recognizing the ecological value of grazing livestock. | Bork, Carlyle, Dobert, Hewins, Shrestha, Ma, Cahill, Chang, Thompson, Quideau, Grenke, Khatri-Chhetri, Kaliaskar, Sobrinho, Boyce | Agricultural Producers Association of Saskatchewan | Ranchers, producers, industry | 5-Apr, 2023 |

* indicates the primary presenter where projects have multiple authors credited, but a single speaker.

## Appendix III. RRI Financial Statement of Actuals, April 1, 2023 to March 31, 2024

| | Actuals |
|---|---|
| ***Opening Balance on April 1, 2023** | **$0.00** |
| **Revenue** | |
| Lease/Utility (Powerline & O/G) | $ 524,815.99 |
| **Total Revenue** | **$ 524,815.99** |
| **Expenditures** | |
| Transfer to Endowment | $520,000.00 |
| Property Taxes | $ 1,057.98 |
| Supplies, Services | $ 8,961.04 |
| Communications (telephone) | $624.96 |
| **Total Expenditures** | **($530,984.59)** |
| ****Net Balance** | **($6,168.60)** |

** In 2022-2023, the closing balance for the RRI Operating Budget was $3,140.11. Due to the Government of Alberta's directive that funds can not be carried forward, the opening balance is shown as $0.00. While these funds are not lost, they remain unavailable to the RRI and are absorbed by the Faculty of ALES.*

***While the RRI attempts to keep the annual operating net balance near zero, it is not always possible. In 2023-24, a net loss is reported that will be reconciled through the Faculty of ALES budget.*

*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, 2023 to March 31, 2024

| | Actuals |
|---|---|
| **Principal** | |
| Opening Balance (April 1, 2023) | $8,912,843.85 |
| Current Year Contributions | $520,000.00 |
| Capitalized Investment Earnings | $2,143,146.40 |
| **Closing Balance/Market Value (March 31, 2024)** | **$11,575,990.25** |
| **Spending Allocation (Revenue)** | |
| Opening Balance (April 1, 2023) | $222,322.40 |
| Current Year Endowment Spending Allocation | $379,338.54 |
| Total Revenue | **$601,660.94** |
| **Current Year Expenditures** | |
| Faculty Salary[1] | $154,115.19 |
| Support Staff | $97,189.87 |
| Rental Expenses | $13,274.17 |
| Transfers to Research Grants | $60,000.00 |
| Supplies, Services & Sundries | $10,077.45 |
| Total Expenditures | **($336,340.09)** |
| **Closing Balance After Encumbrances (March 31, 2024)** | **$265,320.85** |

[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 has increased in subsequent years and will continue to increase over time.*


**Rangeland Research Institute**

**www.rri@ualberta.ca**