BCRC
BEEF CATTLE RESEARCH COUNCIL

Research funded by the Sustainable Beef and Forage Science Cluster

under the Canadian Agricultural Partnership
AgriScience Program

2018-2023

July 2018

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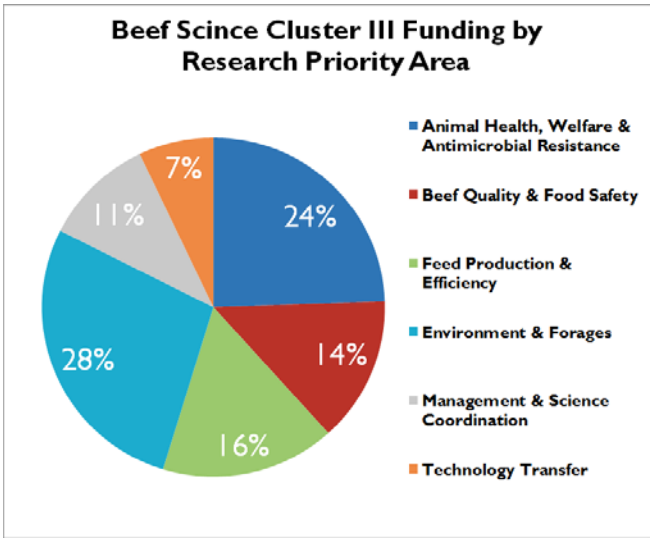
Introduction

The Sustainable Beef and Forage Science Cluster is a partnership between Agriculture and Agri-Food Canada (AAFC) and the Beef Cattle Research Council (BCRC) to ensure that proactive and strategic investments in research are allocated to programs that have the greatest potential to move the Canadian beef cattle sector forward. This Cluster builds on the success of the first (2009-2013) and second (2013-2018) Beef Science Clusters.

Third Cluster projects will advance the science of past Clusters as well as address current and anticipated threats and opportunities for Canadian beef production. Investments are focused on a portfolio of research that contributes to the industry's ability to meet the growing global demand for high quality, safe beef through responsible and profitable production practices that support a sustainable future for the Canadian beef cattle industry.

Joint industry and government commitments to this third Beef Science Cluster total $21 million, including $14 million in funding from AAFC, $5 million in funding from the research allocation of the Canadian Beef Cattle Check-Off and $1.5 million in in-kind industry contributions in the form of cattle, equipment, and materials. Funding has been directed to 26 research projects that will be completed by March 31, 2023.



The establishment of research programs under the third Beef Science Cluster was an extensive process including numerous consultations with stakeholders and experts as well as

economic and practical analyses. Desired research outcomes by the third Cluster are directly aligned with objectives established under the 2018-23 Canadian Beef Research and Technology Transfer Strategy, and address three core objectives:

- to enhance industry sustainability and improve production efficiencies
- to improve consumer confidence and beef demand
- to improve public confidence in Canadian beef

Investments in the third Cluster are expected to lead to several benefits, including:

- maintaining or improving competitiveness
- support for science-based policy, regulation and trade
- informing science-based public education and advocacy
- supporting the Canadian Beef Advantage
- maintaining professional capacity to conduct long-term research and respond to emerging or critical issues in an expedient manner
- improving uptake of research knowledge and technologies by the industry

While considering approval of research projects under the third Cluster, the BCRC's staff and council members sought guidance and expertise from the industry's leading research experts. A Science Advisory Panel appointed by the BCRC offered research expertise from across Canada in a range of research areas. Independent peer reviews were also solicited for each proposal.

The BCRC first developed the Cluster under Growing Forward in 2009 to enhance industry leadership in developing and managing applied science and technology research plans that are aligned with industry priorities. The first Beef Cattle Industry Science Cluster was a four-year initiative with research funding allocated between April 1, 2009 and March 31, 2013. Industry and government funding commitments through the first Cluster totaled approximately $10.5 million directed to 32 research projects. The second Beef Cattle Industry Science Cluster was completed March 31, 2018. Industry and government funding commitments through the second Cluster totaled approximately $20 million directed to 26 research projects.

Results reports are available at http://www.beefresearch.ca/resources/reports.cfm. These reports outline how dollars were invested, and how that research is contributing to advancements in production efficiencies, quality and demand for Canadian beef. In many cases the financial impacts of deliverables to the industry were calculated, while some impacts may not be fully apparent for several years.

Beef Quality research projects:

The quality of Canadian beef products forms the basis of consumer demand and trade, and contribute significantly to competitiveness with other beef exporters and other protein sources in the world markets. Traditionally Canada has successfully produced a youthful, lean, commodity beef product based on a primarily grain-based feedlot production system. The product responds to a grading system which rewards for these characteristics. However, both the consuming public and our competitors continue to change, and the beef industry recognizes the importance of strengthening our competitive advantages through improving product consistency and continuing to enhance carcass and meat quality.

Learn more at http://www.beefresearch.ca/research/beef-quality.cfm

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Developing a tool to better predict carcass yield

Project Title:	
Development of yield prediction tools to optimize carcass cut-out value	

Project Code:	BQU.08.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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Background:

Canada's beef yield grades estimate the percentage of red meat in the overall beef carcass based on fat depth and ribeye size measurements between the 12th and 13th ribs. Periodically updating these yield grade equations to reflect changes in breed types, carcass weight, etc. has been very costly, as it requires detailed carcass dissections on very large numbers of animals. New Dual X-Ray Absorptiometry (DEXA) technology allows carcass composition to be estimated very precisely in a research environment, potentially allowing beef yield equations to be updated more economically and more frequently. At the same time, commercial carcass-based carcass grading technologies collect many more measurements than the simple ribeye size and fat depth measurements used by current yield grades. Beef cattle are generally thought to be reasonably consistent with respect to how lean meat is distributed around the carcass, but small variations may exist. The measurements that these camera-based technologies can record (carcass width, length, shape, etc.) may be able to identify carcasses that have a marginally higher percentage of retail meat in more valuable cuts (e.g. loin) or a slightly lower percentage of meat in less valuable cuts (e.g. chuck) than other carcasses. This, in turn, would impact the relative value of these fabricated carcasses to the packer, and could be provide valuable information back to seedstock breeders and cattle feeders.

Objectives:

Develop improved algorithms to predict lean meat yield and integrate them into existing computer-based technologies. Researchers will also benchmark total lean, USDA 5 yield classes and wholesale boxed beef yield variation within the Canadian cattle populations and establish guidelines for future targets.

What They Will Do:

Initially, carcass lean meat percentage, USDA retail yield, and Canadian (1993) retail percentage will be estimated for commercial beef carcasses using the whole carcass camera (commercial packing plant) and ribeye CVS camera (research abattoir). The carcasses will be fabricated to commercial specifications, and the camera and carcass data will be used to develop a “wholesale boxed beef yield” prediction equation. The prediction will be strengthened with more data from 700 research cattle processed at AAFC Lacombe. The updatedequations will be incorporated into the CCA’s “Carcass Information System” and tested in a commercial packing plant.

Following this, carcasses from a commercial packing plant and AAFC Lacombe will be fabricated in two ways. One carcass side will be subjected to an industry standard cutout. The other side will be fabricated in a manner that optimizes boxed beef cutout value based on the new prediction equations. Following this, each primal, wholesale and retail cut from each carcass side will be scanned with the DEXA machine, then fully dissected into fat, lean and bone. The lean will be DEXA scanned again to determine intramuscular fat (marbling) content.

Implications:

This project will develop cost-effective approaches to individually fabricate beef carcasses to optimize cut-out value and better meet the demands of Canada’s domestic and international beef markets in a commercially practical manner that minimizes unnecessary labor costs.

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2021 National Beef Quality Audit at Retail and Processing

Project Title:

2021 National Beef Quality Audit

Project Code:	BQU.10.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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Background:

Canada has conducted National Beef Quality Audits in 1995, 1999, 2010, and 2015. The Audit measures defects and quality in Canadian beef at the packer, further processor, retail and consumer levels to measure progress towards correcting defects identified in previous audits and identifies opportunities for further improvement.

Objectives:

To benchmark measurable carcass and offal quality attributes during harvest as well as to survey value chain priorities from feedlots, packers, retailers, and food service. Researchers will also survey meat at national retail banners and foodservice to benchmark merchandising trends for Canadian beef.

What They Will Do:

Auditors will visit large packing plants that together process 75% or more of Canadian cattle on three consecutive days in fall, winter and spring. A total of 15,000 grading records will be collected from the days of those visits (yield, marbling, REA, grade fat, quality grade) and defect data (hide color, brands, horns, tag, bruises, grubs, surface injection site lesions, BCS, liver abscesses, condemnations) will be collected from 33,000 head. Computer programs allowing the e+v carcass grading camera to detect bruises will be tested. Feedlots, packers, retailers, and foodservice sectors will be surveyed regarding their priorities for enhancing beef carcasses and beef quality.

Retail beef (300 each of striploin, top sirloin, crossrib and inside round steaks) as well as lean and extra lean ground beef (75 packages each) will be purchased in Calgary, Toronto and Montreal. Fat depth, color, width, length, and thickness will be measured on the steaks. Half of each type of steak will be used for quality analyses. Numbers and types of*E. coli* will be determined. DNA will be extracted for genomic tenderness tests, then cooked and used for mechanical tenderness measurements. The other 150 steaks will be used to assess flavor profiles, tenderness, flavor, and juiciness. Burger samples will be used for proximate analysis (moisture, fat, protein, iron, vitamins, oxidative stability).

Implications:

Canada's National Beef Quality Audit Beef is the industry's report card that documents improvements in carcass and beef quality, identifies opportunities for further improvement along the value chain, and informs industry efforts to satisfy customers with the juiciness, tenderness, flavor and overall quality of Canadian beef.

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Food Safety research projects

In order to maintain consumer demand for beef domestically and internationally, research and innovation focus on improving food safety interventions, methods to quantify their effectiveness, and the development of strategies that counteract multiple pathogens.

Learn more at http://www.beefresearch.ca/research/food-safety.cfm

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Understanding and preventing E.Coli resistance at the abattoirs

Project Title:

If E. coli shed by cattle is becoming resistant to antimicrobial interventions in abattoirs, how best to raise the hurdles

Project Code:	FOS.01.17
Completed:	*In Progress. Results expected in March 2022.*

Researchers:

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Background:

Packing plants have greatly improved their control of *E. coli* (including Shiga toxin-producing *E. coli*, or STEC) on carcasses by implementing steam, hot water and organic acid interventions. They are also focusing increased attention on the proper sanitation of gloves, knives, and both fixed and moving equipment to prevent re-contamination of beef. Limited laboratory-based evidence suggests that *E. coli* may be surviving some of these interventions. If *E. coli* are evolving and adapting to these interventions, the effectiveness of current packing plant interventions may decline over time.

The cleaning agents used to wash and sanitize packing plant equipment are effective while they're in contact with the equipment, but are eventually rinsed off, and are no longer effective. A coating of N-halamine on equipment surfaces may help to prevent this problem. With an N-halamine coating, chloride ions from bleach are attracted to the surface and stay on even after rinsing, so it will remain active until the next shift starts.

Objectives:

To Determine if E. coli from cattle are increasing in resistance to heat, acid, and sanitizers and in biofilm forming potential and the mechanisms by which E. coli persist in beef packing facilities. Researchers will identify genetic elements that confer resistance to E. coli using whole genome sequencing and determine the role and mechanisms of biofilm in the transfer of pathogens from various surfaces to meat. Researchers will also explore novel sanitization technologies to control food-borne pathogens.

What They Will Do:

The research team will characterize Top 7 STEC collected from Western Canadian slaughter plants between 2012 and 2016 (700 isolates) and feedlot cattle between 2002 through 2010 (100 isolates). These isolates will be tested for their ability to survive heat, acid, and the two most common types of sanitizers used in packing plants.

Another 750 E. coli isolates collected from hides and carcasses will be compared between a packing plant that uses complex carcass sanitation interventions and one that doesn't; some of these isolates were also collected from equipment before and after cleaning. These isolates will also be tested for their acid, heat and sanitizer tolerance.

DNA will be compared between generic and Top 7 STEC *E. coli* that are resistant or susceptible to heat, acid or sanitizers, or that are able to produce biofilms. They will identify genes related to stress resistance as well as antimicrobial resistance.

E. coli strains that are known to form weak, moderate or strong biofilms will be cultured on stainless steel disks, then rinsed off and stored (damp or dry) at 4°C, 10°C and 25°C for 2, 4, 6 and 30 days. Beef samples will be placed on the disks for 5 minutes, and *E. coli* from the disks to the beef will be quantified.

Pieces of high density polyethylene (conveyor belt material) and stainless steel (glove material) will be coated with N-halamine. Coated and non-coated pieces will be inoculated with saline, *E. coli* and meat juice at 7°C (meat plant operating temperature) and 15oC (meat plant downtime temperature) and withdrawn after 0, 1, 2, 4 and 6 hours. *E. coli* survival and extent of cell injury will be determined. This will be repeated with pieces that have been pre-exposed to meat juice, to determine if meat juice reduces the effectiveness of the N-halamine coating. The degree of biofilm formation will be assessed. The effect of repeated N-halamine exposure on heat, acid and sanitizer tolerance of generic *E. coli* before and after exposure will be compared to *E. coli* from non-coated surfaces.

Implications:

This research will determine whether microbes are developing resistance to industry-standard heat- and acid-based food safety interventions, which is critical to assess whether additional or alternative in-plant sanitation strategies are needed to ensure the continued safety of Canadian beef for domestic and international customers.

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Identifying cattle that are more likely to be E.Coli 0157 super-shedders

Project Code:	FOS.07.17
Completed:	*In Progress. Results expected in March 2022.*

Project Title:

Identification of genetic and microbial markers for E. coli O157 super-shedders through longitudinal biopsy and monitoring

Researchers:

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Background:

Packing plants have improved their control of *E. coli* O157:H7 and recalls due to *E. coli* O157:H7 in beef are becoming rare, in 2014 Canada had 10 *E. coli* O157 related recalls and only one involved beef. Cattle are thought to be the main reservoir for *E. coli* O157:H7. Fewer than 10% of cattle are thought to be the “supershedders” that contribute the most to the problem. On-farm sampling is of limited value because some supershedders shed longer than others. Previous research has identified genes related to suppressed immunity in the rectum that were related to supershedding in a very small number of animals. This project will validate these genes and study them further.

Objectives:

To determine what causes some cattle to be supershedders and recommend improved techniques to mitigate *E. coli* O157 in beef cattle.

What They Will Do:

1000 cattle will be rectally biopsied and fecal sampled on arrival at AAFC Lethbridge. DNA markers will be screened to identify potential high and low shedders (at least 3% or 30 cattle per group). These will then be sampled weekly to monitor shedding over a four-month period.

Using gene markers identified in an earlier study, the repeated rectal samples will be analyzed to monitor how gene expression changes at different stages of supershedding, and relate these changes to the bacteria found in the fecal sample.

Gene expression of both the host and the bacterial population will be compared between super-and low- shedders to identify possible mechanisms related to colonization and shedding in both the bacteria and the host. The team will look for SNP markers in the genes (DNA) that are differentially expressed between the super- and low-shedders.

The *E. coli* O157:H7 isolates collected will be whole-genome sequenced to look for genes related to the heat, acid and sanitizer tolerance identified in FOS.01.17, differences in pathogenicity (virulence, toxin and adherence genes), or differences in colonization.

Implications:

This project will define the interactions between cattle and bacteria that determine why some animals become supershedders, which is a critical step to developing more effective on-farm and/or in-plant interventions against *E. coli* O157:H7, and further improving the safety of Canadian beef.

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Animal Health and Welfare research projects

Major production limiting diseases can be costly, even devastating for an individual herd, and have the potential to harm the entire beef cattle industry. Applied research works to develop effective and economical management practices, and diagnostic and treatment tools. These reduce costs and losses associated with animal health and production limiting diseases in primary production sectors.

Learn more at http://www.beefresearch.ca/research/animal-health-welfare.cfm

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What are the economic impacts of parasitic roundworms?

Project Title:	
Assessing economic impacts and developing models for evidence-based decision support systems for sustainable parasitic roundworm control in Canadian beef cattle	
Project Code:	ANH.04.17
Completed:	*In Progress. Results expected in March 2022.*

Researchers:

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Background:

Internal parasites steal nutrients away from the animal and can cause production losses but Canadian data on this topic is old and based on feedlot cattle. Ivermectin-based pour-on products are inexpensive so they are sometimes used without first determining whether they are needed. This can lead to resistance, lost efficacy, and wasted money. Most pour-on products are very closely related, meaning that resistance to one encourages resistance to others. Parasite control options are limited if these products lose efficacy.

Cows consume L3 larva and shed parasite eggs. The eggs hatch and develop into L3 larva in the environment, so this stage is very climate dependent. An ability to accurately predict pasture contamination rates based on climactic conditions would help develop more appropriate parasite treatment protocols.

Objectives:

To investigate the production impact of roundworms, and the seasonal patterns of pasture contamination in commercial stocker beef cattle herds in Western Canada. Researchers will parameterize, test, and refine the GLOWORM-FL predictive model.

What They Will Do:

Production impacts of internal parasites will be determined in 20 herds of at least 100 head in both Eastern and Western Canada over two years of grazing the same pasture. In each herd, 25 head will be treated twice with Safeguard and Longrange 90-100 days apart to eliminate parasites. The remaining cattle will not be treated. Average daily gain and fecal egg counts (FEC) will be compared between treated and untreated stocker cattle. L3 larvae will also be collected and DNA sequenced to determine what worm species are present.

Soil level temperature, relative humidity, precipitation, and dewpoint will be continuously measured in six of these herds (three in Western and three in Eastern Canada). Fecal egg counts and DNA sequencing will be conducted using fresh fecal samples collected from each herd every six weeks during the grazing season to identify which species are present. Larvae on pasture will be monitored in spring, mid-summer and fall to assess pasture contamination.

A European computer model (GLOWORM-FL) will be used to predict L3 levels on pasture over time based on egg shedding rates, climate conditions for larval development, survival and migration to grass. Samples from the field studies will be used to infect cattle. Feces will be collected and incubated to produce known numbers of L3 larvae (*Cooperia* and *Ostertagia*). Artificial fecal pats will be made and kept in rainfall and temperature conditions typical of Canada. These will be used to study the migration of L3 from fecal pats under varying rainfall conditions, as well as mortality rates in dry fecal pats at temperatures ranging from -15 to 30oC. The results from these controlled experiments will be used to modify the European model for Canadian conditions, and the modified model will be validated against field data collected in the previous experiments.

Implications:

This project will provide up-to-date information on the prevalence and production impacts of parasitic roundworms, and a tool to reliably identify environmental conditions that warrant treatment. This will help slow the development of resistance and maintain the efficacy of treatments.

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Identifying the best strategies for treating toe tip necrosis and digital dermatitis in feedlot cattle

Project Title:

Identification of treatment strategies for the most common causes of lameness in feedlot cattle

Project Code:	ANH.05.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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Karen Schwartzkopf-Genswein Ph.D. (Agriculture and Agri-Food Canada), Murray Jelinski D.V.M. (Western College of Veterinary Medicine), Sonia Marti Ph.D., Eugene Janzen D.V.M. and Karin Orsel D.V.M. (University of Calgary)

Background:

Lameness is a relatively common and very costly problem in feedlot cattle, with performance, economic, and welfare consequences. However, different forms of lameness are caused by different things, so different approaches are needed for effective treatment. Reliance on antimicrobials may not always be appropriate or effective; and contributes to antimicrobial resistance. This study will evaluate and refine more appropriate and effective treatment options for two relatively common and troublesome types of lameness, toe tip necrosis syndrome (TTNS) and digital dermatitis (DD).

Objectives:

To assess the efficacy of commonly used antimicrobial and non-antimicrobial treatments for the treatment of DD and TTNS.

What They Will Do:

Three experiments will be conducted in commercial feedlots. For each experiment, breed, sex and days on feed will be recorded. Weight, lameness (gait, stride length, speed), and blood parameters will be measured weekly until the animal has healed. Treatment costs and times, retreatment rates, and treatment failure rates will be calculated.

TTNS will be studied in 144 fall-placed calves. Two antibiotics (Tetracycline and florfenicol) and an anti-inflammatory pain relief product (banamine) will be compared (Liquamycin LA + banamine, Nuflor + banamine; Resflor) on their own, or in combination with nipping the toe tips to let the infection drain.

DD will be studied in 144 animals in spring and treated with a ceftiofur antibiotic on its own (Excede in light weight calves or Excenel in heavy weight calves), ceftiofur + copper sulfate footbath, or only a copper sulfate footbath.

Another 144 DD cases will be studied in spring, comparing the effects of walking affected animals through a copper sulfate footbath once, twice 7 days apart, or twice 14 days apart.

Implications:

This project will identify effective treatment strategies for common types of lameness encountered in commercial feedlots to reduce the reliance on antimicrobial treatments, slow the development of antimicrobial resistance, improve animal welfare, improve production efficiencies, improve industry competitiveness and support public confidence in Canada's beef industry.

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Effect of rest stop duration and quality during transport on cattle welfare

Project Title:

Effect of rest stop duration and quality on the behaviour and welfare of cattle transported by road

Project Code:	ANH.06.17
Completed:	*In Progress. Results expected in March 2022.*

Researchers:

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Karen Schwartzkopf-Genswein Ph.D. (Agriculture and Agri-Food Canada Lethbridge), Derek Haley Ph.D. (University of Guelph) and Sonia Marti Ph.D. (University of Calgary)

Background:

Cattle transport is one of the beef industry's practices that is most visible to the public, and is facing increased public and regulatory scrutiny. It is important to have valid Canadian science to ensure that potential regulatory changes will truly benefit the animals they are designed to protect. This research will focus on the benefit of providing a rest stop during long distance transportation of feeder calves.

Objectives:

To determine the effects of varying rest stop (RS) duration, time of RS, condition of RS, and calf source on calf health and welfare;

What They Will Do:

This team will conduct three pairs of experiments, each with detailed data collection in a research facility (Agriculture Agri-Food Lethbridge) with field data collection in a commercial rest stop and feedlot setting (University of Guelph).

Effects of transport and rest stop duration: Four loads of 100 commercial auction mart calves will be purchased, have their weights and temperatures recorded, and sampled for physiological measures related to stress, immunity, dehydration and nutritional status. The calves will be loaded and transported for 12 hours (two loads) or 36 hours (two loads). After 12 or 36 hours, 40 calves

will remain on each truck. The other 60 will be unloaded and rested for 4, 8 or 12 hours at the research facility with access to water and long hay (20 head each). Calves will be weighed, sampled, and have their temperature recorded on arrival and after resting. The calves will then be reloaded, transported for more 5 hours, then all calves will be unloaded, weighed and sampled. Calves will be backgrounded for 30 days to monitor performance, physiological parameters, and health. Feeding, resting and movement behavior will be recorded during the rest and backgrounding periods.

Calves sourced from Western Canadian auction marts will be unloaded and rested in Thunder Bay for either 8 or 12 hours on route to a commercial feedlot in Ontario. Cattle will be video monitored and observed for resting, feeding and drinking behavior during the rest period and on arrival at the feedlot. Animal health and performance will be monitored during the first 30 days on feed.

Effect of calf source and rest stop duration: Four loads of commercial calves (100 head each) will be purchased, two carrying recently-weaned auction mart calves and two carrying ranch-direct calves. After 36 hours of transport, 20 calves will remain on the trailer and 80 calves will be unloaded at the research facility for rest stops of 0, 4, 8 or 12 hours. The calves will then be reloaded, transported for 5 more hours, then backgrounded for 30 days. Weight, physiological, health and behavior measurements will be recorded at each step.

Calves sourced from Western Canada ranches and auction marts will be unloaded and rested at Thunder Bay for either 8 or 12 hours en route to a commercial feedlot in Ontario. Cattle will be video monitored and observed for resting, feeding and drinking behavior during the rest period and on arrival at the feedlot. Animal health and performance will be monitored during the first 30 days on feed.

Effects of rest stop quality: Four loads of 100 commercial auction mart calves will be purchased. After 36 hours of transport, 20 calves will remain on the trailer. The other 80 will be rested (20 calves per treatment) for 8 vs. 20 hours under high quality (ample room, bedding, feed and water access, hay quality) or low quality (half as much room, no bedding, half as much feed and water space, poor hay) rest stop conditions. The calves will then be reloaded, transported for 5 more hours, then backgrounded for 30 days. Weight, physiological, health and behavior measurements will be recorded at each step.

Calves sourced from Western Canadian auction marts will be unloaded and rested at Thunder Bay in pens with or without bedding. Cattle will be video monitored and observed for resting, feeding and drinking behavior during the rest period and on arrival at the feedlot. Animal health and performance will be monitored during the first 30 days on feed.

Implications:

This project will develop science-based recommendations for the duration and management of rest-stops during long-distance transit. This information is valuable to support the refinement of effective and outcome-based Canadian livestock transport regulations as well as improve welfare outcomes for Canadian feeder calves and reinforce public confidence in Canada's beef industry.

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Understanding Mycoplasma bovis pneumonia in beef cattle

Project Title:

Mycoplasma bovis pneumonia in beef cattle

Project Code:	ANH.13.17
Completed:	*In Progress. Results expected in March 2021.*

Researchers:

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Jeff Caswell D.V.M., D.V.Sc. (Ontario Veterinary College), Kent Fenton D.V.M. (Feedlot Health Management Services), Jose Perez-Casal Ph.D. (VIDO-InterVAC), Edouard Timsit D.V.M. (University of Calgary) and Ruud Veldhuizen Ph.D. (Western University)

Background:

Mycoplasma pneumonia and Bronchopneumonia with interstitial pneumonia (BIP) are costly diseases with performance losses, chronic illness and severe animal welfare impacts. Both diseases appear to be caused by *Mycoplasma bovis (M. bovis).* Efforts to prevent and treat mycoplasma pneumonia has significant antimicrobial use and resistance implications. These are challenging diseases to deal with because so little is known about how they develop. Even though calves commonly carry *M. bovis*, very few actually get sick. *M. bovis* may be more likely to cause disease if the calf's lungs have already been damaged by *Mannheimia hemolytica* (shipping fever). *M. bovis* may also cause the calf's immune system to degrade some lipids and proteins that are important for lung function.

Objectives:

To determine specifically how *M. bovis* causes damage to the lung and why *M. bovis* infection leads to pneumonia in some calves but not others. Researchers will also characterize BIP and identify the role of *M. bovis* as a cause of this newly emerged disease of feedlot cattle.

What They Will Do:

To determine how or whether *M. bovis* causes lung damage, lung lesions, lipase, phospholipase and protease levels will be compared between *M. bovis* pneumonia cases and healthy lungs. In addition, the effect of *M. bovis* exposure on lipase, protease,

other proteins, or oxygen and nitrogen radical production by macrophages will be studied. These compounds will be exposed to immune and respiratory tract cells to see if lung surfactant breakdown, cell damage, or cell death occurs.

To determine the role of *M. bovis* infection in BIP, the team will describe the epidemiology and risk factors (prevalence, seasonality, year, feedlot, initial risk category, days on feed, ration, prior treatments, clinical course) by reviewing 500 previously recorded cases of the disease. They will compare samples from 20 BIP cases to 20 controls (other respiratory deaths) to characterize histopathology, immunohistochemistry, and the bacteria (including *M. bovis*) and viruses present. Surfactant samples will also be collected and compared to results obtained in the preceding step.

To determine the conditions for *M. bovis* infection and pneumonia, they will culture macrophages in conditions resembling an infected lung. Some macrophages will be infected with different strains of *M. bovis* and others won't. Protease, lipase, and cytokine production will be compared. Then they will expose healthy *M. bovis* calves to *M. haemolytica* (with or without *M. bovis*). The *M. haemolytica* infections will be treated, and animal health, temperature, serum haptoglobin and fibrinogen, ultrasound, post-mortem lung lesions, bacterial culture, and histopathology will be observed. They will also impose inflammation and lung necrosis treatments on healthy calves and then expose them to *M. bovis* to see whether the severity of disease differs.

Implications:

This project will enhance our understanding of how *M. bovis* interacts with other respiratory pathogens to cause lung infection, damage and associated immune responses. This research will help inform continued efforts to develop an effective *M. bovis* vaccine and integrated disease prevention and treatment strategies, and ultimately support improved animal health and reduced reliance on antimicrobial interventions through reductions in bovine respiratory disease.

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RESEARCH & TECHNOLOGY DEVELOPMENT FOR THE CANADIAN BEEF INDUSTRY

The Canadian Cow-Calf Surveillance Network

Project Title:

The Canadian Cow-Calf Surveillance Network

Project Code:	ANH.21.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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Background:

Animal health surveillance is very limited in Canada's cow-calf sector. The Western Canadian Cow-Calf Surveillance Network (ANH.23.13)(ANH.23.13)project involves 100 herds in Alberta, Saskatchewan and Manitoba. Information has been gathered on animal welfare, marketing and production practices, disease prevalence, antimicrobial use, trace mineral deficiencies and herd productivity. The research team will build on that success and expand the network to include herds in British Columbia, Ontario, Quebec and the Maritimes.

Objectives:

To recruit a group of 175 herds to collect baseline information on herd productivity, welfare practices, health, nutrition and biosecurity will be collected through regular surveys.

What They Will Do:

This project will support the basic infrastructure of the network. Cooperating producers and veterinary clinics will be recruited and retained, regular baseline surveys on production practices will be conducted, and serum and fecal samples will be collected and banked.

Herds in Western (120) and Eastern (55) Canada that have enough cows, are willing to participate and maintain adequate records will be identified. Surveys (e.g. welfare practices and attitudes, biosecurity practices, health management (e.g. vaccination practices, and nutritional and production practices), and some topics identified by participants) will be web- or paper-based; production data will likely be collected through a smartphone app to make sure it's obtained on a timely basis. Economic analyses will determine the industry costs of various production limiting diseases, as well as regional variations.

Implications:

This project will expand the Western Canadian Cow-Calf Surveillance Network to a national scope, generate productivity, management, economic and animal health and disease data from a much broader range of environments and production systems, and identify promising knowledge transfer opportunities and potential research needs.

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Understanding Mycoplasma bovis

Project Code:	ANH.30.17
Completed:	*In Progress. Results expected in March 2022.*

Project Title:

Investigating antimicrobial resistance (AMR) and virulence factors of Mycoplasma bovis

Researchers:

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Murray Jelinski D.V.M. (Western College of Veterinary Medicine); Tim McAllister Ph.D. and Trevor Alexander Ph.D. (Agriculture Agri-Food Canada Lethbridge); Scott Weese D.V.M.(University of Guelph)

Background:

Mycoplasma bovis(*M. bovis*) is associated with respiratory disease, arthritis, mastitis and ear infections in cattle. It's not clear whether the same strains of *M. bovis* are responsible for each of these different manifestations. Developing a vaccine against *M. bovis* is difficult because it can switch which antigens it expresses on the cell surface. *M. bovis*may also becoming more antimicrobial resistant and may be able to transfer its antimicrobial resistance genes to other respiratory disease pathogens.

Objectives:

To gain a better understanding of *M. Bovis* and how it manifests itself in different diseases.

What They Will Do:

The research team will sequence the microbial genomes and characterize the upper and lower respiratory microbiomes (including all *Mycoplasma* species) of 50 cattle dying from mycoplasma pneumonia to those of 50 cattle dying from other respiratory diseases. They will examine which *Mycoplasma* species are present in the upper vs. lower respiratory tract as well as differences between calves infected with mycoplasma vs. other forms of pneumonia.

Whole genome sequencing and phenotypic antimicrobial resistance testing will be conducted on 250 *M. bovis* isolates from 2008 through 2019 to assess how antimicrobial resistance profiles have changed over time. These samples will also be used to

determine whether different *Mycoplasma* strains prefer the lung or the joints.

Since the expression of the surface proteins is so variable, the researchers will use the whole genome sequence data to look for other known virulence factors. These results will be compared to cell culture virulence assays as well as for differences in adhesion to bovine bronchial and nasal cells.

Conjugation assays will be conducted to determine whether *M. bovis* can exchange antimicrobial resistance genes with other bacteria such as *M. haemolytica*, *H. somni*, and *P. multocida*.

Implications:

This project will quantify changes in antimicrobial resistance patterns over time and evaluate whether *M. bovis* exchanges antimicrobial resistance genes with other bovine respiratory disease pathogens. This research will also support the development of more effective treatment regimens, as well as identify more promising vaccine candidates.

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Antimicrobial Use, Resistance, and Alternatives research projects

Antimicrobial resistance concerns and expertise can be found in both livestock and human health, opening more opportunities for collaborative research approaches than ever before. Research in this area provides us with a better understanding of how antibiotics are being used on farm and how fast resistance is happening. With changing consumer expectations and antimicrobial purchasing regulations, prudent use of antimicrobials is more important than ever. Research into antimicrobial alternatives can help prevent animal disease as well as decrease input costs for producers. Learn more at http://www.beefresearch.ca/research-topic.cfm/antimicrobial-resistance-11

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Characterizing the microbiome of beef cattle to identify risk factors that affect respiratory health

Project Code:	AMR.10.17
Completed:	*In Progress. Results expected in March 2023.*

Project Title:

Characterizing the microbiome of beef cattle to identify risk factors that affect respiratory health

Researchers:

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Background:

Some bacteria naturally present in the respiratory tract of beef cattle help to prevent pathogenic bacteria or viruses from invading. Factors like stress and antimicrobials can disrupt the protection that these 'good' bacteria provide. However, we need to know more about which bacteria have protective effects, and how their populations can be maintained or restored.

Objectives:

Characterize the bovine nasopharyngeal microbiota from birth to weaning and define animal, management, and environmental elements that influence the nasopharyngeal microbiota of and how those elements correlate with animal health.

What They Will Do:

Animal, management and environment effects: 4,000 calves entering 10 feedlots will be sampled using deep nasal swabs. Upper respiratory tract microbiota will be compared between groups differing in BRD risk, weight, sex, origin, season, distance travelled and BRD outcome. Treatment, morbidity and mortality data will be collected. Relationships between upper respiratory tract microbiota and health outcomes will be assessed.

Nasopharyngeal microbiota from birth to weaning: 45 cows will have deep nasal swabs collected at calving, and their calves will be sampled within 3 weeks, at 2 months, 3-4 months, and 6 months of age. Calf microbiota will be compared to the dam. Changes in respiratory microbiota and relationships to health outcomes will be compared over time.

Mapping bacterial communities along the respiratory tract: 30 feedlot steers (15 healthy and 15 with BRD) will be sampled at 13 sites along the respiratory tract. The bacteria populating different regions of the respiratory tract will be identified and compared between healthy and sick cattle.

Changes in bacterial communities during BRD development: 50 feeder steers at high risk of developing BRD will be studied in the first 60 days on feed. Deep nasal swabs will be collected on arrival, and a rumen bolus will be given to monitor and identify temperature changes indicative of BRD before visible signs of illness appear. In animals displaying elevated temperatures for 24 hours, repeated blood and respiratory tract samples will be collected until visual signs of illness develop or the animal recovers. Sick calves will be treated and resampled 4 to 8 days later. Microbiota will be assessed and compared between sick and healthy calves, between treated calves and calves that recover on their own, between different time points of sickness and recovery, and between different locations in the respiratory tract.

Effect of on-farm vaccination on feedlot BRD: 50 vaccinated and 50 non-vaccinated calves from AAFC Lacombe will be shipped to AAFC Lethbridge 5 weeks after weaning. Blood samples will be collected on arrival to measure antibody levels. Deep nasal swabs will be collected on arrival, 14 and 30 days on feed. Microbiota and health outcomes will be compared between vaccinated and non-vaccinated calves.

Effect of stress: Preconditioned and non-preconditioned calves from AAFC Lacombe (50 head each) will be shipped to AAFC Lethbridge. The two groups will be kept separate, but commingled with auction mart calves. Deep nasal swabs will be collected pre-shipment and 2, 7, 15 and 30 days after feedlot placement. Stability of the respiratory microbiota, health and treatment outcomes will be compared between groups.

Implications:

This project will help the beef industry to maintain animal health with less reliance on antimicrobials by improving our understanding of what constitutes a healthy respiratory microbiome and how management practices can disrupt or support the respiratory microbiome and affect its ability to resist bovine respiratory disease.

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Feed Grains and Feed Efficiency research projects

The profitability and health of the finishing sector relies in large part on the production of high quality and yielding feed grains, and animals that are highly efficient in converting feed mass into increased body mass. Research in this area provides identification and validation of economical methods of identifying seedstock with improved feed efficiency and the development of new feeds and alternative feeding strategies. Learn more at http://www.beefresearch.ca/research/feed-efficiency.cfm

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Determining the minimum fibre requirement for feedlot cattle

Project Title:	
Determining the minimum fibre requirement for feedlot cattle and improving the empirical prediction of ruminal pH	
Project Code:	FDE.01.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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Greg Penner Ph.D. (University of Saskatchewan); Katie Wood Ph.D. (University of Guelph); John McKinnon Ph.D. (University of Saskatchewan); Wenzhu Yang Ph.D., Tim McAllister Ph.D., Karen Beauchemin Ph.D., Karen Schwartzkopf-Genswein Ph.D., Yuxi Wang Ph.D. (Agriculture Agri-Food Canada Lethbridge); Joyce van Donkersgoed D.V.M. (Alberta Beef Health Solutions); Darryl Gibb Ph.D. (Gowans Feed Consulting)

Background:

High grain diets improve feed conversion efficiency but contribute to abnormal behavior (eating bedding and fences), acidosis and liver abscesses, which are offset with antibiotics. A better understanding of fibre requirements may help find ways to maintain efficiencies while reducing the health, welfare and antibiotic use concerns. Research has not defined whether these issues are related to absolute fibre levels, forage:concentrate ratio, or specific fibre fraction(s). Fibre requirements may also vary with digestibility, fibre particle size, starch source, processing, etc.

Objectives:

To evaluate criteria that may affect the fibre requirement for feedlot cattle, and improve the ability to predict ruminal pH in feedlot cattle using dietary parameters.

What They Will Do:

Phase 1: Effect of undigestible NDF (uNDF) on dietary fibre requirements

Study 1: Six cannulated heifers will be fed low (5%), medium (10%) or high (15%) roughage rations containing either barley silage

(5.9, 6.2 or 6.5% uNDF) or straw. Each diet will be fed for 24 days, and animals will be rotated among all six diets. Intake, rumen pH, rumen motility, chewing, particle size and sorting will be measured, along with rumen SCFA and blood glucose and insulin.

Study 2: Similar to Study 1, except heifers will be fed barley silage (long chop length, short length, short chop length plus straw) or wheat silage (long chop length, short length, short chop length plus straw).

Study 3: 360 steers will be fed one of four finishing diets for 126 days. Based on the studies above, diets will contain uNDF levels ranging from inadequate to excessive using different chop lengths or levels of barley straw. Performance and variability within a pen, behavior, lameness, locomotion, carcass weight, shrink, yield and quality grades, and liver scores will be measured.

Phase 2: Effect of starch fermentability on dietary fibre requirements

Study 4 (AAFC): Similar to Study 1, except heifers will be fed barley grain with a low (65%), medium (75%) or high (85%) processing index and either low or high uNDF.

Study 5 (AAFC): Similar to Study 1, except some barley grain will be replaced with 0, 10 or 20% DDGS, and straw or forage inclusion rates will be varied to achieve low or adequate uNDF.

Study 6 (UofS): 360 steers will be fed finishing diets containing moderately or highly fermentable carbohydrate diets, with low or adequate uNDF. Performance and variability within a pen, behavior, lameness, locomotion, carcass weight, shrink, yield and quality grades, and liver scores will be evaluated.

Phase 3: Integration of the Model

2x2 Latin Square Individual feeding trial comparing moderately (corn) and highly (barley) fermentable carbohydrate source, with adequate or low uNDF. Feed intake, feeding behavior, rumen pH and animal performance will be measured.

Phase 4: Predict rumen pH based on diet variables

Data from these and other published studies will be used to develop and validate a model to improve the empirical prediction of ruminal pH in beef cattle finishing diets.

Implications:

This project will identify fibre fraction(s) and levels that promote and maintain optimal rumen and animal health while facilitating efficient digestion and feed conversion. This will help to reduce in-feed antimicrobial use while ensuring animal welfare and productivity.

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Genetic evaluation of cattle raised under high vs. low input winter feeding systems

Project Code:	FDE.06.17
Completed:	*In Progress. Results expected in March 2023.*

Project Title:

Genetic analyses of feed intake, feed efficiency, female fertility, and cow lifetime productivity in beef cattle raised under two environments

Researchers:

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John Basarab Ph.D. (University of Alberta); Changxi Li Ph.D. (Agriculture and Agri-Food Canada Edmonton); Carolyn Fitzsimmons Ph.D. (University of Alberta); Hushton Block Ph.D., Vern Baron Ph.D., Mohammad Khakbazan (Agriculture Agri-Food Canada); Graham Plastow Ph.D., Ghader Manafiazar Ph.D., John Crowley Ph.D. (Livestock Gentec); David Benfield Ph.D. (Growsafe); Kathy Larson (University of Saskatchewan)

Background:

Feed efficiency in a growing feedlot steer is a different trait than feed efficiency in a mature range cow, so selecting for one won't necessarily improve the other. An animal won't fully express its genetic potential unless it's in a favorable environment. A favorable (high input) wintering environment may compensate for inferior genetics in heifers and cows that have above-average needs or below-average efficiency and allow them to regain condition and rebreed quickly enough to maintain a 365 day calving interval. In a tougher (low input) wintering environment, only the easy keeping, more efficient cows will be able to extract enough nutrition from their feed to maintain body condition, rebreed and maintain a 365-day calving interval.

Objectives:

To estimate genetic and phenotypic correlations of dry matter intake (DMI) and feed efficiency with heifer fertility, longevity and lifetime productivity (LTP) of cows reared under two winter feeding systems: Higher Inputs vs. Lower Inputs.

What They Will Do:

400 Angus-cross cows at AAFC Lacombe will be wintered from November to March in a drylot or on swath grazing. The breeding

season will begin in June for both heifers (45 days) and cows 65 days). The University of Alberta's Angus-based synthetic herd will also be managed in a drylot or fed lower quality hay supplemented with oats on range. Heifers will be bred for 50 days starting a month before the cow's 60 day breeding season. Residual feed intake will be measured in heifers from 8 to 11 months of age, and heifer and cow weights, backfat, pregnancy status, calving dates and calf performance will be recorded.

The research team has previously collected residual feed intake data on 1,700 heifers and 289 cows, as well as 2838 matings in drylot or pasture settings. This project will generate additional data (1,000 heifer and 400 cow residual feed intake records and 2460 additional matings). All heifers and cows will be genotyped. Longevity and lifetime productivity will be determined, and genetic and phenotypic correlations between feed intake and efficiency, reproduction and total lifetime productivity will be calculated. Genetic relationships between cow and heifer performance will be determined. Genetic markers for these traits will be identified, and genetic, hybrid vigor and environmental effects will be calculated. Economic analyses will be conducted, and a multiple trait selection index will be developed. An additional 2,000 commercial heifers will be genotyped and measured for feed efficiency to develop commercial-level genetic evaluation indexes for heifer selection

Implications:

This project will determine whether genetics identified as "efficient" under feedlot conditions will produce cows with superior lifetime productivity when wintered under intensive drylot vs. extensive range conditions.

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Strategies to enhance the use of wheat grain in feedlot diets

Project Code:	FDE.09.17
Completed:	*In Progress. Results expected in March 2023.*

Project Title:

Further strategies to enhance the use of wheat grain in feedlot diets.

Researchers:

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Background:

Diets with a high concentration of wheat are thought to pose a higher risk of acidosis, founder and liver abscesses than barley-based finishing diets. Wheat can be fed safely if it's processed like barley, but its kernel variability makes it harder to process properly. Although most cattle feeders prefer to feed barley, Canada's barley acreage is decreasing and wheat is often cheaper than barley.

Like barley, wheat is susceptible to Fusarium head blight (FHB) or scab, which can produce a mycotoxin called deoxynivalenol (DON), particularly in pink tombstone kernels. FHB also produces fumonisins, trichothecenes (T-2), and zearalenone. Soft wheat generally has higher DON levels than hard wheat. Ruminants are believed to be less susceptible to vomitoxin than monogastrics, but mycotoxin impacts on rumen microbes and feed efficiency of beef cattle really haven't been studied very closely.

Objectives:

To define the impact of processing methods including dry-rolling, tempering and possibly steam flaking on the feed value of wheat. Researchers will also design diets and make recommendations that capture the feed value of wheat without encountering the negative health consequences of clinical and subclinical acidosis and assess if there is any detrimental impact of high levels of doxynivalenol (DON) in wheat fed to feedlot cattle.

What They Will Do:

20 wheat lines (hard and soft, high and low protein, high and low starch, high and low test weight) will be selected from Agriculture Agri-Food Canada and the Crop Development Centre.They will be dry- vs. temper-rolled and used in artificial rumen and cannulated cattle experiments to look for differences in the rate and extent of dry matter and starch breakdown, and to determine whether variety or processing method influences optimal starch utilization or the risk of subclinical or acute acidosis.

High and low protein wheats will be dry- and temper-rolled and fed to 160 steers in an 84d backgrounding (35% wheat grain) and 120d finishing (85% wheat) trial. Cattle will be fed once daily; feed intake and behavior, rumen pH and samples, VFA, NH_3-N, protozoa, lipopolysaccharide (an indicator of rumen microbe death), microbial communities, blood serum, hair cortisol, fecal samples (digestibility), hot carcass weight, dressing percentage, backfat, REA, yield, quality grade, and liver scores will be recorded. Liver and rumen epithelium samples will be collected to study gene expression.

DON-free and high DON wheat will be procured and used to formulate diets containing 0, 5, 10 and 20 ppm DON. These will be fed in a finishing diet (85% wheat). The feeding trial and data collection will otherwise be similar to the one described above. Signs of toxicity (anorexia, diarrhea, ataxia) will also be recorded, and livers will be inspected for tumors, cirrhosis, hyperplasia, and the shape and structure of rumen and intestinal cells in cannulated cattle will be inspected.

Implications:

This project will develop refined recommendations for incorporating wheat into feedlot diets. It will provide cattle feeders with additional feed grain options to improve the economics of cattle feeding while maintaining animal health, welfare, performance and carcass quality.

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Identifying causal mutations associated with bull and cow fertility and how they link to feed efficiency

Project Code:	FDE.13.17
Completed:	*In Progress. Results expected in March 2021.*

Project Title:

Identification of causal mutations located in distortion regions in beef cattle genome associated with bull and cow fertility and its links to feed efficiency

Researchers:

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Background:

Cattle have two copies of each gene, with one coming from each parent. In theory, each parent is equally likely to pass either one of its copies to each one of its offspring, but sometimes one form of the gene is more likely to show up in the offspring than the other form, especially when one form of the gene is associated with embryonic death. This is called transmission ratio distortion (TRD). An earlier study looked for regions of the genome that are affected by TRD, for single nucleotide polymorphisms (SNPs) in those regions. This study will examine whether these SNPs are associated with fertility and feed efficiency in beef cattle.

Objectives:

Develop a new methodology/software to identify TRD regions using haplotypes approach and valedate the results across 9 beef breeds. Researchers will also identify causal mutations associated with fertility and feed efficiency of the most promising genes found from commercial herds and correlate between feed efficiency traits and fertility traits in young bulls.

What They Will Do:

This team will analyze genotypes from Angus (225,984), Beefbooster (997), Charolais (863), Gelbvieh (927), Hereford (1,077), Limousin (717), Simmental (827), and composite cattle from Alberta (747) and Ontario (1596) as well as additional cow genotypes (600) from the University of Guelph. Data includes age at first service, first service to conception interval, calving to first service interval, days open, non-return rate, calving ease, sire conception rate, and semen quality traits. Researchers will key regulator genes and causative mutations related to fertility and its correlation with feed efficiency.

They will also look for groups of linked SNPs (haplotypes), and compare the 75 best and 75 worst phenotypes out of a population of commercial cattle to determine whether the SNPs and haplotypes are in a gene with a function. Functional genes will be mapped to chromosomes.

Implications:

This project will identify genes associated with reproductive failure to ensure that efforts to genetically improve feed efficiency do not cause severely negative unintended economic consequences by impairing fertility in Canadian beef cattle.

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Evidence-based prebiotic and probiotic solutions for improving gut health and feed efficiency in cattle

Project Title:

Evidence-based prebiotic and probiotic solutions for improving gut health and feed efficiency in cattle

Project Code:	FDE.14.17
Completed:	*In Progress. Results expected in March 2022.*

Researchers:

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Background:

Prebiotics are feed ingredients that cattle can't digest but bacteria can. Probiotics are bacteria that have a benefit for cattle. Feeding prebiotics along with probiotics is called synbiotics. Pre- and probiotics have been on the market for years and some have shown promise for monogastrics. There is less research available to show that they provide consistent benefits for cattle. Past Beef Science Cluster funded research has been developing science-based pre-, pro-, and synbiotic strategies.

Objectives:

To isolate and characterize rumen bacteria that metabolize yeast mannan and analyze prebiotic-probiotic interactions in an artificial rumen and an artificial intestine. Researchers will also determine the effects of synbiotics on feed digestibility and production in ruminants

What They Will Do:

Rumen bacteria will be batch cultured with yeast mannan, Bio-Mos and dried distillers' grains with solubles (DDGS) for 3 months to identify those that grow best and metabolize it most effectively. Population growth, gene expression, and bacterial interactions will

be monitored, and genes coding for yeast-mannan degrading enzymes will be identified.

Bacteria that grow best in batch cultures will be fed yeast mannan, Bio-Mos and DDGS in an artificial rumen. Metabolic outputs will be measured, and metagenomics will be used to monitor changes in the microbiome over time. Bacteria that degrade yeast mannan will be isolated, cultured, and sequenced to identify the enzymes responsible. Similar experiments will be conducted in an artificial intestine using bacteria collected from duodenally cannulated cattle.

Ruminally and duodenally cannulated cattle will be fed Bio-Mos, DDGS or a control diet. If yeast mannan degrading bacteria aren't stimulated in the rumen, bacteria identified in previous trials will be added. Rumen and duodenal pH and digestibility measures will be collected. The rumen, duodenum and fecal microbiome will be characterized, and probiotic-prebiotic interactions will be examined.

Performance effects of yeast mannan and yeast-mannan degrading bacteria will be studied in ruminants fed yeast mannan degrading probiotics and DDGS or Bio-Mos. Productivity, rumen function, animal health, and the rumen microbiome will be analyzed.

Implications:

This project will enhance our understanding of the interactions that occur between feed, rumen microbes, and the animal; this will help improve animal performance while minimizing digestive disturbances and diet-related animal welfare concerns and help develop effective alternatives to feed additives and growth promotants.

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Forage and Grasslands Productivity research projects

The health and profitability of the cow-calf sector depend on forage and grassland productivity. Research is focused on the development of strategies that will improve grassland management to increase productivity and sustainability. Research also works to develop annual and perennial forage varieties with increased biomass yield per acre, maintained or improved nutritional value, improved water efficiency, and appropriate economic characteristics. Learn more at http://www.beefresearch.ca/research/forage-grasslands.cfm

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Development of native and tame forage varieties and mixtures for improved forage and environmental productivity and resilience

Project Title:

Development of native and tame forage varieties and mixtures for improved forage and environmental productivity and resilience

Project Code:	FRG.01.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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Background:

The beef industry needs tame and native forage varieties with improved yield, nutritional quality and persistence. However, Canada's forage seed market is small, and economic margins from forage seed sales are not adequate to encourage seed companies to invest in forage breeding and development work. Consequently, the beef industry has been investing in these activities under both the first and second Beef Science clusters. In addition to breeding, long-term mixed plant stands have been established to study changes in plant communities, carbon sequestration, and soil microbiology over time.

Objectives:

To evaluate and develop new varieties of meadow brome, orchardgrass, and tall fescue and continue advancement of native plant breeding. Researchers will also do genomic prediction of alfalfa germplasm for high yield, regrowth, and quality as well as assess the diversification of existing and newly seeded plant mixtures and provide scientific data regarding soil carbon sequestration and soil biodiversity benefits

What They Will Do:

Tame forage breeding will continue (selecting meadow brome for yield, regrowth, plant height and quality) and expand (selecting tall fescue for winter hardiness and leaf palatability, and orchardgrass for increased water-soluble carbohydrate levels to improve animal productivity and plant stress tolerance). A winter hardy orchardgrass cultivar developed in Utah will be evaluated in several locations (Lethbridge, Swift Current, Brandon, Saskatoon, Beaverlodge) to study genotype and environment interactions.

Genomic tools currently being studied in crested wheatgrass will be expanded to alfalfa to look for markers for yield, regrowth, and quality. They'll compare genomic to traditional breeding strategies to compare accuracy and rate of genetic improvement. They'll look at whether adding forbs (meadow yarrow, wild sunflower, cone flower, prairie flax and winterfat) to existing native forage stands (western wheatgrass, side oats grama, nodding brome, blue bunch wheatgrass, little blue stem and purple/white prairie clovers (established in monocultures, 2-, and 7-way mixtures) in Lethbridge, Brandon and Swift Current will improve carbon sequestration, soil microbial and pollinator diversity, and forage production and stand stability. The best mixtures will be established at new sites (Brandon, Swift Current, Beaverlodge and Saskatoon) to look at additional environments.

Work to improve seed production in plains rough fescue will continue, as will improvement of purple and white prairie clovers, side-oats grama, and winterfat. A long-term study of sainfoin persistence on pasture will compare Mountainview and Melrose in mixtures with meadow brome, hybrid brome and crested wheatgrass at two harvest frequencies on self-reseeding, yield, regrowth, quality and soil nutrients in Brandon, Swift Current and Saskatoon.

Implications:

This project will develop higher yielding, nutritious tame and native forage varieties and mixtures for cow-calf producers across Western Canada. It will generate additional data regarding the role of native forage species and rangelands in supporting soil carbon sequestration, soil health and plant and pollinator biodiversity.

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New sainfoin varieties

Project Title:	
Novel sainfoin cultivars for enhancing production efficiencies of pasture and beef cattle and building capacity in forage breeding	
Project Code:	FRG.02.17
Completed:	*In Progress. Results expected in March 2022.*

Researchers:

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Background:

Grassstands are less productive than they could be because bloat fears discourage some producers from seeding alfalfa. Sainfoin is a non-bloating legume. It has lower protein levels than alfalfa, but contains condensed tannins that appear to reduce protein breakdown in the rumen and improve protein digestion and absorption in the intestine. Consequently, gains on sainfoin pasture can be as efficient and rapid as on alfalfa pasture. Sainfoin is resistant to the alfalfa weevil, grows earlier in the spring, later in the fall, and copes with salinity better than alfalfa. Researchers at AAFC Lethbridge have been selecting sainfoin for improved yield, regrowth and survival in alfalfa stands, and have found that sainfoin's survival depends partly on the alfalfa variety it is grown with, as well as where it is grown.

Objectives:

To gain insight into grass, sainfoin interactions and develop new sainfoin germplasm for grass/sainfoin mixed stands. Researchers will also determine nutritional quality of new sainfoin and grass/sainfoin stands and develop integrated crop management practice to optimize growth and longevity of grass/sainfoin pastures.

What They Will Do:

Five sainfoin populations will be seeded (within, between or across rows) with orchard, meadow and hybrid brome in Lethbridge, Saskatoon and Carman. Plants will be counted four weeks after seeding, and yield and grass:sainfoin proportions will be measured twice per year for four years.

Forage quality will be monitored in years 2-4, with laboratory and animal digestibility trials using samples collected at times relevant to grazing and silaging.

The sainfoin plants that flourish the best in grass stands will be identified in years 3 & 4, cloned and screened for disease resistance, seed production and forage quality, and other economically and agronomically relevant traits.

Implications:

This project will generate novel bloat-free sainfoin cultivars that improve the efficiencies of pasture and beef cattle production in Canada.

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Improving abiotic stress tolerance in alfalfa

Project Title:

Improving abiotic stress tolerance in alfalfa through the simultaneous down-regulation and/or genome editing-mediated knockout of multiple genes.

Project Code:	FRG.06.17
Completed:	*In Progress. Results expected in March 2022.*

Researchers:

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Background:

Alfalfa is susceptible to numerous stresses including drought, waterlogging, salinity, frost and/or winterkill. Sometimes stress tolerance improves when certain genes are under-expressed. Transgenic approaches to down-regulate particular genes have worked better than conventional breeding in some cases. However, transgenics also face public acceptance and regulatory hurdles. Genome editing (“fixing” genes that are already there, rather than adding new genes from a different species) may help avoid GMO concerns by down-regulating genes that are naturally present rather than by introducing new genes from a different species.

Objectives:

To assess the efficacy of previously discovered genes in enhancing alfalfa performance under abiotic stress conditions when down-regulated via RNA interference (RNAi). Researchers will attempt to make further improvements in abiotic stress tolerance, and, if technology permits, utilize CRISPR-Cas9 as an alternative approach for gene knockout.

What They Will Do:

In other plants, four genes (called CBF2, ACBP3, FAO and TAC1) have been found that allow those plants to cope with freezing, drought, flooding, and salinity better when those genes are down-regulated. Another gene (MtHB2) has a similar effect when up-regulated. These genes will be cloned into alfalfa. Seven transgenic lines will be developed and grown under non-stressful conditions. The four lines showing the most downregulation for each of these genes will be grown and exposed to salinity, drought,

freezing and flooding stress until the control plants show visible signs of stress. The plants will be allowed to recover, and survival, root and shoot growth will be measured. Lines that differ from the controls will be re-tested, and a larger range of biochemical and physiological measures will be collected. They will also follow the same procedure with all the genes in the same plant at the same time. This will identify whether or which of these genes or gene combinations allow the plant to grow normally under normal conditions but survive better in stressful conditions.

Based on this, and providing suitable technology is available, they will knock-out some of these genes in alfalfa. If so, they may be able to produce a more stress tolerant alfalfa using a non-GMO gene editing approach, faster than they could through conventional breeding.

Implications:

This project will use modern breeding tools to develop alfalfa varieties that survive and flourish in marginal lands characterized by flooding, drought, salinity and temperature extremes, where forage and cattle production often occurs.

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Keeping legumes in pasture stands longer

Project Title:	
Sustaining the legume component of grazed pasture mixtures for summer grazing and stockpiling complex mixtures in Eastern Canada	
Project Code:	FRG.09.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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Background:

Results from previous Beef Science Cluster projects have identified legume-grass mixtures that perform well in Central and Eastern Canada. However, the legumes have quickly dropped out of the mixed stands, leading to a decline in pasture and animal productivity. The potential ability to establish legumes using sod- or frost-seeding has been demonstrated, but results are variable and likely depend on grazing and fertility management. Carbon sequestration in soil organic matter can also be enhanced by adding legumes to grassland. Overcoming challenges related to legume establishment, seedling vigor, acidic soils, and moisture extremes would help keep legumes in pasture stands and benefit pasture health, carbon sequestration and animal productivity.

Objectives:

To increase the amount of herbage yield and quality of complex pasture mixtures through nutrient management strategies, refined grazing management, novel and enhanced stand renovation technologies, and plant genetics. Researchers will also identify cultivars and new germplasm with significant adaptation to grazing, extreme weather events, and/or negative soil attributes. Complex mixtures of legumes and grasses will be stockpiled for extended grazing and a database of soil nutrient changes in response to management as it relates to soil carbon sequestration and impact on pasture productivity will be developed.

What They Will Do:

Alfalfa, trefoil or red clover cultivars will be grown in growth cabinets with and without seaweed extract, oligo-chitin, or oligo-chitosan as growth promotants. Germination rates, emergence, seedling vigor, plant height, regrowth and root morphology will be recorded. Results will be field tested at Nappan, Normandin and Quebec City over 3 years.

To evaluate seeding method and grazing intensity and frequency on forage legume renovation, alfalfa and trefoil (three cultivars each) will be frost- vs. sod-seeded at Nappan, Normandin and Quebec City. Once established, the stands will either be mechanically harvested three times per season or rotationally grazed (high stocking density, low stocking density or fall stockpiled). Legume density, plant composition and yield will be evaluated.

To evaluate the effect of grazing management on legume establishment and persistence, animal performance, and soil carbon dynamics, 12 paddocks will be overseeded with alfalfa or trefoil (three cultivars each), then grazed at high (moved twice daily), medium (moved every 4 days) or low density (moved every 8 days). Growth rate, backfat, grazing days, forage yield, quality and composition will be measured. Soil will be assessed for carbon, nitrogen and over a five-year period.

To identify new breeding lines of alfalfa, trefoil and red clover with adaptation to acidic soil conditions, cultivars of each will be hydroponically grown at acidic or neutral pH. Plants and roots will be sampled after 1, 7 and 14 days. Some plants will be transplanted to a field with acidic soil, and bloom dates,

seedling vigor and yield will be assessed to identify superior cultivars.

To identify new breeding lines of alfalfa, trefoil and red clover with adaptation to waterlogged soil conditions, similar experiments will be conducted in field plots where water levels can be controlled and varied.

To assess fertility management to increase the persistence of forage legumes on marginal soils, alfalfa, birdsfoot trefoil and red clover will be frost- or sod-seeded into acidic or limed soils at Nappan and Normandin and subjected to three fertilizer regimens: 0 vs. 25 vs. 80 kg nitrogen/Ha, 120 kg potassium/Ha vs. soil test recommendations, or 0 vs. supplemental supplemental. Legume density, composition and yield will be assessed.

Researchers will then look at over-seeding legumes into existing complex mixtures for late fall grazing. Timothy or tall fescue pastures at Nappan, New Liskeard and Normandin will be seeded with strips of alfalfa, trefoil or red clover. Pastures will be grazed or cut until mid-summer, then stockpiled until November. Legume persistence, yield, and quality will be evaluated over 3 years.

Finally, legumes will be over-seeded into naturalized pastures for late fall grazing. Naturalized pastures at Agriculture Agri-Food Canada Nappan or the University of Guelph will be sod-seeded with trefoil, tall fescue and timothy or with alfalfa, tall fescue and timothy in spring. Weaned calves will be grazed in late fall. Animal growth, forage yield, quality, establishment and persistence of seeded species will be evaluated over three years.

Implications:

This project will identify legume genetics, seeding practices, and grazing management practices that will enable legumes to become established and maintained in mixed grass pastures on marginal lands to improve the competitiveness of Central and Atlantic Canada's forage and beef sectors.

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IN PROGRESS

Increasing fall productivity in winter-hardy alfalfa

Project Title:	
Increasing fall productivity in winter-hardy alfalfa by selecting for reduced fall dormancy	

Project Code:	FRG.11.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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Background:

Alfalfa with reduced fall dormancy can grow later into the season, so it has higher yields. Alfalfa with higher winter hardiness survives the winter better. Winter hardy alfalfa usually has higher fall dormancy but these traits are genetically independent, so one should be able to select for winter hardy alfalfa with low fall dormancy.

Objectives:

To improve late-season productivity of winter-hardy alfalfa varieties suitable for grazing in northern regions by recurrent selection for reduced dormancy (RD) and evaluate the impact of selection on freezing tolerance.

What They Will Do:

Recurrent selection: The team will select Peace and Yellowhead alfalfa varieties for reduced fall dormancy, and test for freezing tolerance, researchers will then look for genes that respond to these selections. They will grow individual plants at long daylengths and warm temperatures, cut them, shorten the daylength and reduce the temperature, grow them again, and find the tallest plants. After three rounds of this, the tallest plants are crossed, and the cycle starts again.

Impact of recurrent selection: The resulting seed will be planted to evaluate grazing or cutting tolerance. These populations will also be tested for freezing tolerance by slowly freezing them at 4oC per hour to -22 through -36oC, thawing in the dark at -2oC,

regrowing them for 3 weeks, and determining which varieties survive.

Genomic validation: Plots established in Normandin, Quebec City, Swift Current and Lacombe will be evaluated for yields, fall dormancy and winter hardiness and their stability in the different locations. Gene markers for freezing tolerance and fall dormancy that have previously been identified in Quebec will be validated in these western populations.

The new, improved varieties and others will be exposed to intense continuous grazing in Lacombe to see how they tolerate grazing, and tolerance to cutting frequency will be evaluated in Swift Current.

Implications:

This project will identify genes that support late fall growth and winter survival to improve the yields and survival of alfalfa, particularly at more northerly latitudes, and help the forage and beef sector adapt to challenges and opportunities posed by climate change.

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Enhancing forage productivity in silvopasture systems

Project Title:

Evaluating the potential for increased forage productivity in mid-rotation forested rangeland sites through an integrated forage, cattle and timber management approach

Project Code:	FRG.20.17
Completed:	*In Progress. Results expected in March 2021.*

Researchers:

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Lauchlan Fraser Ph.D., David Hill Ph.D., John Church Ph.D. (Thompson Rivers University); Lisa Zabek, (British Columbia Ministry of Agriculture); Harold Hetherington, Kevin Derow (British Columbia Ministry of Natural Resources); Grant Glessing (Tolko Industries Inc); Kevin Boon, (BC Cattlemen's Association)

Background:

Forests are an important grazing resource in many areas, especially where logging occurs. Forage production declines as trees age and block the sunlight the forage crop needs to thrive. This usually happens around 20 or 30 years after an area's been replanted, followed by 40 or 50 years of poor forage production until the trees are large enough to harvest. In silvopasture systems, trees are harvested in strips or rows so that more sunshine can reach the forage in the unforested strips. This allows the forage to grow better, benefitting both the cattle and wild ungulates. More sunshine reaches the sides of the trees that remain standing, so they grow better too.

Objectives:

To assess the potential for silvopasture, created in mid-rotation conifer stands, to enhance forage productivity (yield and quality), timber productivity, and inject additional forage into the forest-grazing landscape. Co-benefits such as carbon sequestration, plant diversity and soil water availability relative to conventional management strategies will also be evaluated.

What They Will Do:

This project will be done at three BC sites dominated by lodgepole pine and pinegrass. The 4 treatments used will be an unlogged control, conventional thinning, 7.5 m wide strips, and 15m wide strips, followed by forage establishment. They will monitor forage

and timber productivity, plant composition, total carbon, above- and below-ground wood density, tree density, and soil moisture availability, forage quality, and timber productivity. Aerial images will be used to assess vegetation cover and composition. Carbon sequestration, soil bulk density, soil moisture, temperature and understory species diversity will also be evaluated.

Implications:

This project will evaluate the potential for integrating strip logging and grazing to realize environmental benefits of reduced soil erosion and faster habitat recovery on logged sites, accelerate tree growth, improve forage yields, and benefit both the ranching and lumber industries across Canada.

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Environmental Sustainability research projects

Research on the interface between beef production and the environment in which it is produced is important to providing producers the tools and knowledge they need to be optimal stewards of their land. Research also demonstrates the environmental benefits of cattle production by measuring its contributions to plant and animal biodiversity, carbon sequestration, reduced soil erosion and watershed protection. Research in this area also supports the advancement of science-based regulations. Advancements in feed efficiency and forage and grassland productivity also contribute to environmental sustainability. Learn more at http://www.beefresearch.ca/research/environmental.cfm

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Quantifying the Canadian beef industry's impact on biodiversity

Project Title:

A regionalized life cycle impact assessment model for the quantification of Canadian Beef production impacts on biodiversity

Project Code:	ENV.07.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

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(University of Alberta); Getahun Legesse (Manitoba Agriculture); Carrie Selin (Alberta Biodiversity Monitoring Institute); Stephen Davis Ph.D. (Canadian Wildlife Service / University of Regina); Tom Harrison M.Sc. (South of the Divide Conservation Action Program) and Kristine Tapley M.Sc.(Ducks Unlimited)

Background:

Research funded under the second Beef Science Cluster has revealed that there is relatively little information about how biodiversity is impacted by Canadian beef production. Solid data is needed to assess whether our industry is having positive or negative impacts, and whether our environmental practices are improving or not. Detailed biodiversity information is available for Alberta, but not for the rest of Canada. Historical data collected through PFRA, provincial or community pastures or other public sources may help fill some of these gaps. However, there is no commonly accepted method of analyzing or presenting biodiversity results. This makes it difficult to compare biodiversity statistics reported by different groups.

Objectives:

To identify the main drivers of changes in biodiversity and compile and build indicators to address biodiversity loss at regional and national scales. Researchers will also propose a life cycle inventory assessment (LCIA) model to address the impacts of beef production on biodiversity.

What They Will Do:

The AAFC project lead is involved in the Livestock Environmental Assessment and Performance partnership initiative of the United Nation's Food and Agriculture Organization (FAO-LEAP), ensuring international credibility and applicability.

Characterization of typical beef farming scenarios: A research project that was funded by a previous Beef Science Cluster will be expanded to look at the effects of grazing management on native and tame pastures using data from AAFC, Canadian Wildlife Service, Ducks Unlimited, and StatsCan. Factors contributing to biodiversity loss, maintenance or improvement will be identified (e.g. beef, crop, and oilfield production, urban development).

Literature review of datasets and indicators of changes in biodiversity: biodiversity indicators that have been established elsewhere will be identified and compared. All available data sets will be used to populate these indicators. The project team will develop a draft guidance document for biodiversity assessment in livestock production, with input from the FAO-LEAP Biodiversity Group. Feedback from the LEAP committee will be incorporated as a biodiversity assessment model is developed for Canada.

Characterization of biodiversity status in Canada and development of biodiversity indicators at regional and national scales: all available data will be used to identify which plants, birds and animals (including threatened species) live throughout Canada. Additional data regarding biodiversity and pasture health will be collected using on the ground pasture surveys.

Proposal of the LCIA model and identification of gaps in the current LCIA framework: A Life Cycle Inventory Assessment model for biodiversity will be developed, tested, and compared with existing models. Remaining biodiversity information data gaps will be identified to inform future biodiversity monitoring and research initiatives.

Implications:

This project will analyze historical information regarding how cattle production practices can reduce, maintain or improve plant, animal and bird biodiversity to support the development of best practices for sustainable beef production in Canada and internationally.

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IN PROGRESS

Do synthetic hormones used in beef production have environmental effects when excreted?

Project Code:	ENV.09.17
Completed:	*In Progress. Results expected in March 2021.*

Project Title:

Assessment of occurrence of synthetic hormones (melengestrol acetate and trenbolone acetate) and beta-agonist (ractopamine) in cattle operations and associated environments

Researchers:

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Background:

Natural growth promotants (estrogen, testosterone, progesterone) and synthetic growth promotants (zeranol, trenbolone acetate TBA, melengesterol acetate MGA, ractopamine RAC) are used to improve the growth rate and efficiency of cattle. They also have environmental benefits due to decreased resource use and greenhouse gas production. However, there are concerns that growth promotant residues excreted in manure or urine may have negative environmental effects, including potential hormone-disrupting effects that impact reproduction and development of fish and amphibians. Very little research has been done in Canada, and data from other countries may not reflect Canadian field conditions. Lab-based studies may use hormone or manure concentrations, temperature and pH conditions that are not representative of production or natural environments.

Objectives:

To quantify concentrations of MGA, TBA, RAC and their metabolites in feces and manure from cattle administered with these growth promoters, in surface runoff from pens, on cropland that has had manure spread on it, and in ground water in areas around feedlots. Researchers will also evaluate effectiveness of windrow composting and manure stockpiling in dissipating MGA, TBA, and RAC residues and evaluate endocrine disrupting effects of these compounds.

What They Will Do:

The researchers will measure MGA, TBA and RAC in fresh feces and manure as well as composted and stockpiled manure, feedlot catch-basins and soil. They will determine whether (and how far) these residues travel in water and soil, and how long it takes for these compounds and their break-down products to disappear.

120 heifers will be split into three groups, Control vs. MGA+TBA vs. MGA+RAC. 80 steers will also be used and divided into two groups; Control vs. TBA+RAC. All animals will be backgrounded (100 days) and finished (120 days). Repeated samples of fresh feces and manure will be collected and analyzed. These samples and analyses will also be carried out at commercial feedlots.

A rainfall simulator will be used to generate runoff and assess transport of compounds from the feedlot environment. Manure will be spread on soil that hasn't received manure before, and the rainfall simulator will be used to assess potential metabolite transport from agricultural soils. Catch basin water from both research (AAFC) and commercial feedlots will be sampled and tested. Groundwater will be tested at the AAFC site to assess infiltration potential.

Repeated sampling and testing will be used to assess the effects of manure stockpiling and composting on the half-lives of these compounds and their breakdown products. Broadcast vs. incorporation of manure on agricultural soils will also be compared.

A human adenocarcinoma (glandular cancer) cell line that is very sensitive to hormones will be used to determine whether these residues or metabolites occur at high enough levels in the environment to impact estrogen or testosterone production.

Implications:

This project will close the knowledge gap about the potential for endocrine disrupting effects from levels of growth promotants or their metabolites typically found in the environment to provide sound science to guide Canada's beef industry in appropriately responding to public concerns about modern beef production.

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BCRC BEEF CATTLE RESEARCH COUNCIL
RESEARCH FACTS
RESEARCH & TECHNOLOGY DEVELOPMENT FOR THE CANADIAN BEEF INDUSTRY

Economic and environmental impacts associated with removal of performance-enhancing technologies in the Canadian beef cattle industry

Project Title:

Economic and environmental impacts associated with removal of productivity- enhancing technologies in the Canadian beef cattle industry

Project Code:	ENV.15.17
Completed:	*In Progress. Results expected in March 2023.*

Researchers:

Tim McAllister, Ph.D. and Kim Ominski, Ph.D.
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Background:

The benefits of performance enhancing technologies (PETs) like implants, beta-agonists and ionophores on weaning weight, growth rate and feed efficiency are well-established. Research funded under the second Beef Science Cluster suggests that growth promotants contributed to the improved resource use efficiency and environmental impact we have seen over the past 30 years.

However, perceived health concerns among consumers are leading retailers and foodservice companies to promote “free-from” beef products. Commercially relevant data is needed to accurately assess the benefits (potential domestic and international market access) and costs (increased environmental footprint, production and product segregation costs) of removing performance enhancing technologies from Canadian beef production.

Objectives:

To examine productivity, environmental sustainability, and economic viability including cost of segregation associated with removal of productivity-enhancing technology from the Canadian beef cattle industry. Researchers will also examine current and future

market demand (retail and export) for beef raised without PETs.

What They Will Do:

The research team will use published and current Canadian research and commercial data (30,000 feedlot records) to estimate nationally relevant production cost, productivity and carcass value impacts of removing production enhancing technologies. Results from the National Beef Quality Audit retail meat case study and consumer purchasing data from Alberta, Saskatchewan, Ontario and Quebec will be used to assess actual consumer behavior with respect to price, quality and production claims.

Implications:

This project will provide in-depth analyses to understand whether market premiums associated with domestic and international beef market opportunities for beef raised without performance enhancing technologies the environmental and economic drawbacks of removing these performance enhancing technologies.

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Knowledge and Technology Transfer projects

Effective knowledge dissemination and technology transfer to influencers of beef production is critical to realize the value of investments in beef research. It enables producers and other industry stakeholders to make informed decisions and adopt innovations to maintain the sustainability and competitiveness of the industry.

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BEEF CATTLE RESEARCH COUNCIL

RESEARCH FACTS

RESEARCH & TECHNOLOGY DEVELOPMENT FOR THE CANADIAN BEEF INDUSTRY

Enhancing Technology Transfer in the Canadian Beef Industry

Project Title:	
Enhancing Technology Transfer in the Canadian Beef Industry	
Researchers:	
Tracy Herbert Herbertt@beefresearch.ca Tracy Herbert and Stacey Domolewski (Beef Cattle Research Council)	

Project Code:	TEC.01.17
Completed:	*In Progress. Results expected in March 2023.*

Background:

The BCRC developed a “Knowledge Dissemination and Technology Transfer Strategy” during the first Beef Science Cluster and implemented it during the second Beef Science Cluster. These technology transfer efforts have greatly increased producer and industry awareness about the importance and relevance of applied beef and forage research and have transformed scientific research results into understandable and useful information and tools that have been delivered into the hands of producers. An important step has been to identify the key “influencers” that producers turn to for advice (e.g. veterinarians). The Beef Cluster’s technology transfer efforts have centered on the www.beefresearch.ca website and the videos, webinars, infographics, production tools and other producer resources that are posted there. This site has seen wide acceptance by the agricultural media as well. An extension workshop in the fall of 2016 brought together technology transfer and extension experts from across Canada, and identified some key technology transfer initiatives with national relevance that everyone could work on together under the third Beef Science Cluster to effect lasting change and adoption of changes deemed to be critically important to Canada’s beef industry.

Objectives:

1. Support and deliver a range of technology transfer mechanisms that effectively accelerate the uptake of research outcomes by industry,
2. Enhance extension initiatives through greater communication, collaboration, and tools that empower technology transfer agents.

What They Will Do:

The BCRC extension team will support and deliver numerous technology transfer mechanisms that speed the uptake of promising research outcomes by industry, and to enhance extension initiatives through greater communication, collaboration, and tools that empower technology transfer agents. They will:

1. regularly communicate with industry (e.g. articles, fact sheets, videos, infographics, radio clips, webinars, USBs),
2. produce new resources (e.g. more of the above, plus interactive decision making and cost analysis tools; multi-media, timed appropriately, aimed at multiple audiences, particularly early adopters)
3. lead innovative efforts to increase the impact of knowledge and technology transfer efforts (e.g. Bov-Innovation, measuring adoption, feedback from producers and extension experts to better understand why things are adopted and adapted or rejected and fail),
4. enhance website functionality (www.beefresearch.ca) the framework for most Beef Cluster extension efforts),
5. engage researchers with industry (e.g. Beef Researcher Mentorship), and
6. evaluate and appropriately modify the Knowledge Dissemination and Technology Transfer Strategy and the Canadian Beef Research and Technology Transfer Strategy (measuring traffic, feedback, adoption, etc. and modifying as indicated).

Implications:

This project will make key research results available to producers, other industry end-users, the public and policy makers via www.beefresearch.ca, webinars, on-farm decision making tools, and other avenues to encourage the rapid adoption of new science and innovations, thereby providing a return on industry and public investments in the Beef Science Cluster.

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