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The **alumni magazine** of the **Faculty of Agricultural, Life & Environmental Sciences**

GREEN HOUSE

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UNIVERSITY OF ALBERTA
FACULTY OF AGRICULTURAL,
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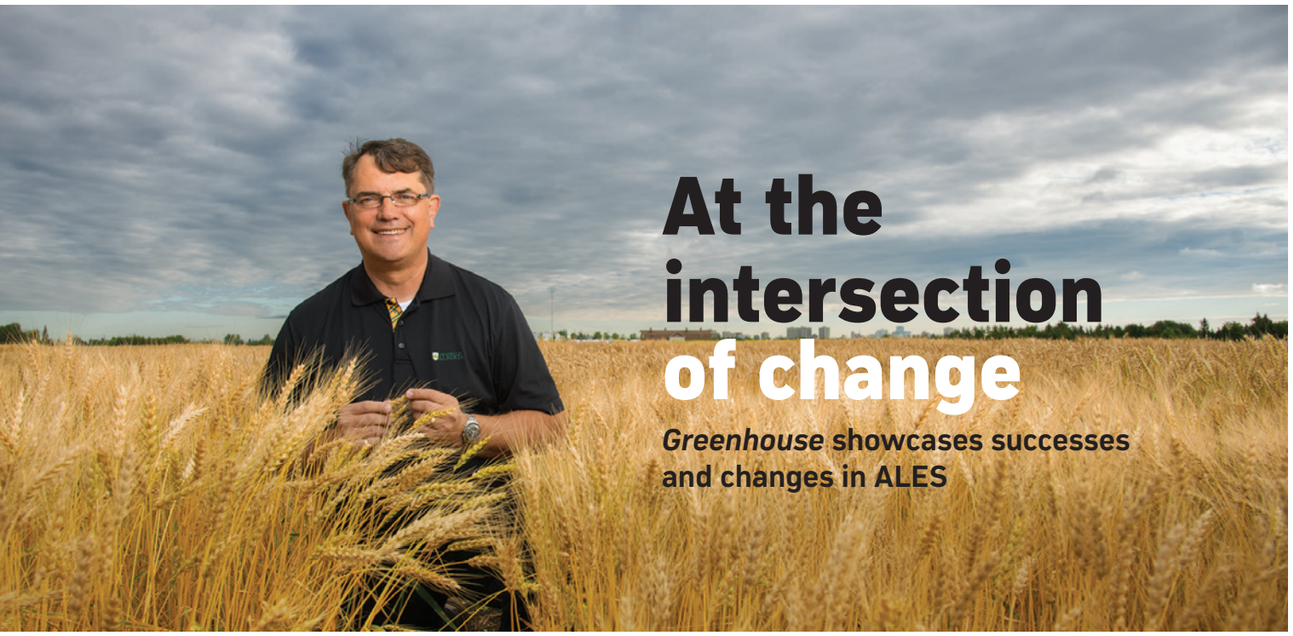

At the intersection of change

Greenhouse showcases successes and changes in ALES

The Faculty of Agricultural, Life and Environmental Sciences (ALES) has evolved from its earliest days as one of the first faculties at the University of Alberta. That evolution has seen many successes, and as we look to the next iteration of how we serve our constituents, we rely on the past to guide us forward.

In 2017 the Faculty of Agricultural, Life and Environmental Sciences underwent a President's Visiting Committee review, which went beyond the familiar but rigorous unit reviews and professional accreditation processes done within our faculty. The work of the PVC was to examine and provide recommendations to the faculty in areas such as strategic priorities, research accomplishments and relationships with the wider community (including alumni, levels of government and the donors). The chair of our faculty's President's Visiting Committee was Robert Easter, who served as president of the University of Illinois before his retirement (the University of Illinois is a significant and respected leader in the U.S. land grant universities with a budget of US$6.5m).

The PVC provided a report that was laudatory of the work of ALES. The one area of specific focus was the integrated nature of the work that we do. The faculty has a wide range of disciplines that run the spectrum of environment, agriculture, food, nutrition, health, gerontology, family studies, economics, forestry and so many more. The committee acknowledged the transdisciplinary nature of much of our teaching and research and recommended that the ALES experience should be seen as a template for integration across the university.

One of the first research sites of the faculty, the Dairy Barn still stands today on what is now South Campus (circa 1923).

The articles in this issue of *Greenhouse* speak not only to the diversity of our work within the faculty, but also the important "collision points" that connect food security, environmental resilience, product innovation, nutrition and health, as well as many other sectors and issues that are important to Alberta, Canada and the world. There is a wealth of opportunities available for our students within this powerful mix of activities and issues. They benefit through classroom experiences and other extracurricular activities, which create a wide range of unique experiences and learnings.

Despite the recent recognition the faculty has received like that of the PVC, we have experienced challenges as well. As you have likely heard, the University of Alberta has been undergoing a rigorous budget analysis, which has an impact on all units within the academy. In an effort to be as efficient as possible, while providing our students, scholars and staff with all the support they need, the faculty has undergone a comprehensive financial review to assess where we are at, and where we need to be in years to come. In short, we need to be exceptionally sensitive to where resources are applied, which means that, for now, the decision has been made to suspend *Greenhouse* magazine as a print publication. In this instance, and will all matters, we welcome your feedback. Please consider taking a moment to jot us a note. The email address is **greenhouse@ales.ualberta.ca**.

The construction of the campus of the University of Alberta officially gets underway with its sod-turning ceremony, circa 1900 (approx).

Our mailing address is

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We live in communities that are connected and complex. The Faculty of ALES is committed to ensuring that our teaching and research mission incorporates expertise and approaches that span the traditional boundaries in which we do in ways that create new insights and innovations.

Sincerely,

Stanford F. Blade, PhD, P.Ag
Dean, Faculty of Agricultural, Life and Environmental Sciences

Spring 2018

GREEN HOUSE

feature

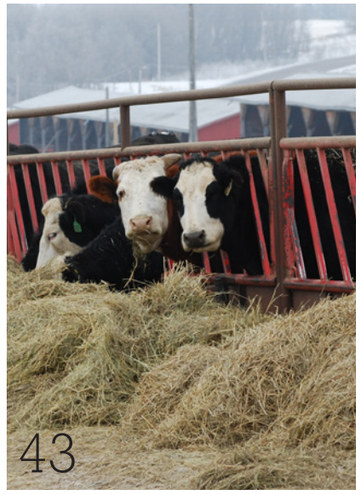
HAPPENINGS

FEATURES

CLARIFICATION: Grain farmer Darren Haarsma grows hemp, not marijuana. A photo and caption in the Table of Contents of the fall 2017 issue of *Greenhouse*, which highlighted our story about two different products derived from the cannabis sativa plant, may have misled readers. We apologize for the confusion.

on the cover
Illustration by Jean-François Podevin

ALUMNI CLUB



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Letters should include the writer's full name, address and home telephone number, and may be edited for purposes of clarity and space.

GREENHOUSE

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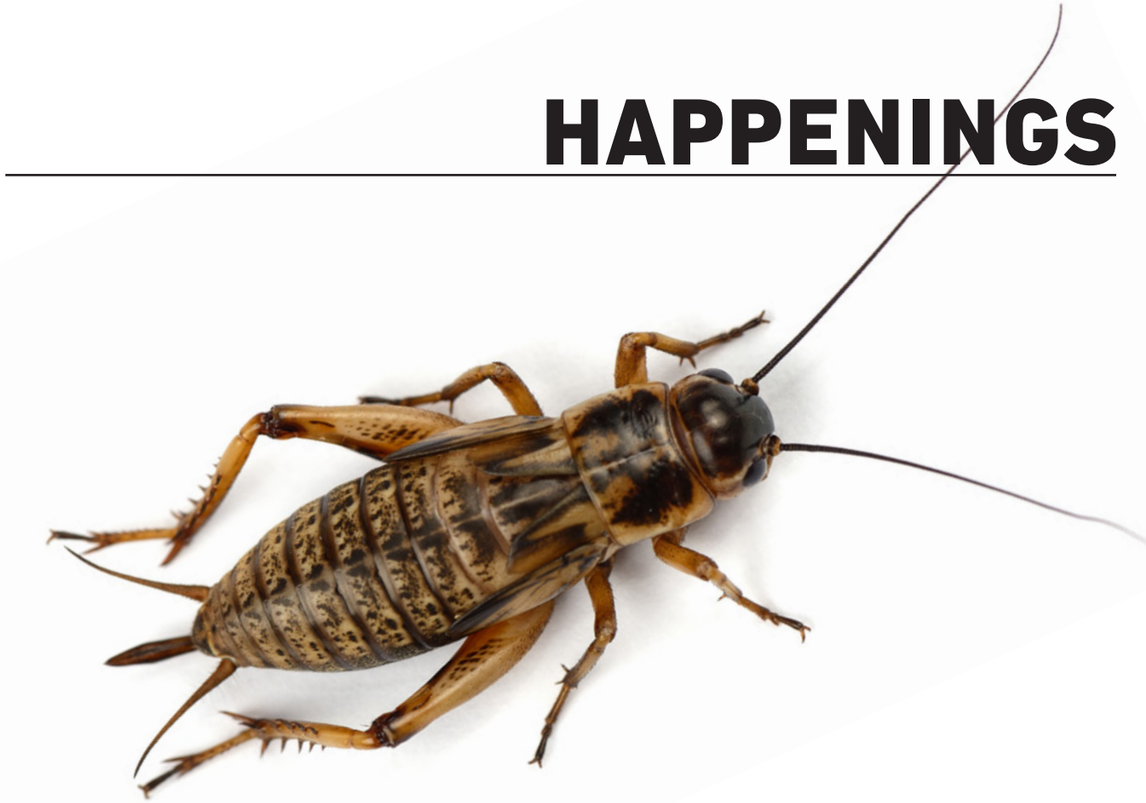
HAPPENINGS



HOW SWEET IT IS(N'T)

ALES-trained scientists launch business selling cricket-flour treats

HELEN METELLA

Would you eat crickets? Willingly? Regularly?

Two young scientists with graduate educations from the Faculty of ALES are betting you will—if not right away, then soon after your first opportunity.

Silvia Ronzani and Claudio La Rocca are co-owners of Camola Sustainable Bakery, a new business that produces numerous tasty treats—including granola bars, cakes, sourdough breads, pizzas and "bugscotti"—all of which are prepared by including some flour made from ground-up crickets.

"(The amount) is less than the regular flour but way more than a spice," says Ronzani, the partner who develops the recipes. While the exact proportion of cricket flour is their trade secret, it's definitely enough for consumers to derive the many benefits of eating bugs, says La Rocca.

"Insects are almost pure protein—crickets specifically are 67 per cent," he says. "There's almost no fat, little water and fewer carbs. They are very rich in micronutrients—iron, calcium, potassium—and are high in vitamin B12. A tablespoon of cricket flour gives you 100 per cent of your B12 for the day."

Additionally, he says, they require far fewer resources to farm than traditional sources of protein. "One kilogram of cricket flour requires a little less than four litres of water. One kilogram of beef, depending on the farming system, is estimated to take 22 to 44 litres of water."

Both La Rocca and Ronzani are insect scholars—each are authors of separate master's theses about the relationship carabid beetles have to the environment. La Rocca earned his graduate degree from the Department of Renewable Resources in 2016 and Ronzani will soon do so from the same department. However, La Rocca learned about edible insects through extracurricular research, which he started after a classmate invited them to eat home-roasted crickets three years ago.

That information, plus skills learned at UAlberta's business incubator eHub, helps them convince reluctant potential customers to taste a cricket-flour product.

"It's a culinary adventure. You are trying new tastes, it's good for the environment and it's also good for your health."

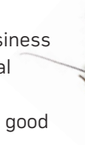


PHOTO BY ROBERT BERDAM

OVERHUNTING NOT THE CAUSE OF CARIBOU DECLINE, FINDS RESEARCH

'No evidence' harvesting is to blame

BY NEWS STAFF

There are several reasons why barren ground caribou populations in Canada have declined more than 70 per cent over the past two decades, but too much hunting by Indigenous people is not one of them, new research says.

"There is little to no evidence that harvesting has had any negative effects on wildlife population dynamics in Canada," says Brenda Parlee, lead researcher on a study that sought to unearth the facts around an issue she sees as poorly understood by governments and the public.

Some people assume that Indigenous people will overhunt natural resources key to their cultures, economies and health unless central governments are involved, says Parlee.

"You can see this kind of storyline in newspaper headlines in various parts of the country; such assumptions have also led to expensive and time-consuming processes of harvest management (restrictions to hunting) in Northern Canada and elsewhere in the country."

Parlee and her colleagues argue that these assumptions are based on anecdote and not evidence.

Barren ground caribou in northern Canada is a very well-studied species and one that is highly valued and harvested by First Nations and Inuit peoples, says Parlee, an associate professor in the Department of Resource Economics and Environmental Sociology.

Their herds tend to dramatically cycle in size every 40 to 70 years, and harvest data and related research shows that Indigenous people adapt to those cycles, she says.

Parlee's team analyzed 13 years of harvest data collected by governments in the Northwest Territories, which showed strong parallels in caribou population and harvest numbers (as caribou populations dropped, communities harvested fewer caribou). As well, the research synthesized 30 years of human health studies, which show similar steep declines in traditional food consumption across Canada, including in the North.

All evidence points to Indigenous people being very good stewards of the resources integral to their food security and economies, says Parlee.

"Most communities in the North are respectfully participating in harvest management planning with the aim of doing their part to protect caribou," she says. "But time, attention and resources could be better spent."

Traditional knowledge and scientific research indicates there are a variety of other factors that drive changes in populations of barren-ground caribou.

"There is a lot of evidence that human disturbance of habitat from mining, and oil and gas activity is a critical problem," says Parlee.

"Indigenous communities living in the Bathurst caribou range will be the first to tell you the Bathurst caribou herd has undergone a dramatic population crash that coincides with a dramatic increase in mining development."

Parlee suggests current government policies that restrict harvesting but allow for increasing mining and oil and gas activity are putting both caribou and northern communities at risk.

"It's a problem that compounds," she says. "Mining exploration and development is increasing stress on caribou, and restricting subsistence harvesting of caribou creates problems of food insecurity.

The problem is not just limited to northern Canada, she says. "Wildlife conservation decisions need to be based on evidence, not anecdote. It is counterproductive to ignore valuable knowledge from Indigenous people who have sustainably managed their natural resources for thousands of years."

Prime farmland continues to be lost to urban expansion

Report recommends neighbouring municipalities work together to co-ordinate better land use planning.

BY BEV BETKOWSKI

Alberta's municipal governments need to be more careful about allowing prime farmland to be gobbled up for residential and industrial use, says a report from the Department of Resource Economics and Environmental Sociology.

"Municipal governments have to come to grips with what they want their communities to look like in the future," says Brent Swallow, one of the report's co-authors. "Just having cheap services financed through extra tax revenue is not enough of a goal. It's short-term gain with long-term costs."

The research, compiled by Swallow and fellow researchers at the U of A-based Alberta Land Institute, shows that between 1984 and 2013, the amount of land with urban or industrial uses in the corridor between Edmonton and Calgary jumped by 52 per cent, increasing by more than 1,600 square kilometres. Between 2000 and 2012, about 35 per cent of the converted land was classified as rich, top-rated cropland, with another 34 per cent rated second highest in quality in Alberta.

The loss of the prime agricultural land was driven by several factors including population growth, rising prices for agricultural land driven by urban demand, expanded road networks to service rural subdivisions, and fragmentation of the rural landscape as more acreages were developed.

That loss will have long-term economic, environmental and visual impacts on the land, Swallow says.

Neighbouring municipalities need to work together to create co-ordinated land-use plans and taxation formulas instead of competing with one another, to avoid the creeping development of unattractive pockets of light industry plopped next to residential estates, Swallow says.

There are rural municipalities in Alberta that want to maintain their rural character, but they're so heavily developed, it doesn't look like it. If they'd worked with their neighbours, it could have been different.

"We forgo opportunities for the landscape to remain beautiful for future generations," he says.

Municipal governments tend to still base their land-use philosophy on policies developed in the 1980s and 1990s, Swallow adds.

"There's been this ethic of growth, that it's good, it means more tax revenue, more services for the population. They see that growth in terms of impacts on public finance," he explains.

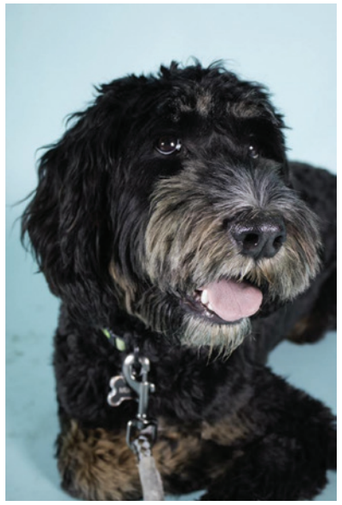
The downside, though, is the costs that come with increased expansion.

"If you have scattered rural residences, that means you need expanded school bus services and more road maintenance. That's a burden for the future taxpayer," says Swallow.

Councils are starting to realize they face these related issues, but the temptation is still there to make rezoning decisions that can be inconsistent with their own growth plans for allowable land uses, Swallow notes. "They want to keep it for these uses, and then a proposal comes along for a use outside that zoning and they'll approve it."

PUTTING HIS BEST PAW FORWARD

ALES welcomes its first certified wellness animal



The Faculty of ALES is proud to welcome one of its newest staff, and likely its furriest. Murphy the labradoodle is certified through the Chimo Animal Assisted Wellness and Learning Society (CAAWLS) as a wellness animal, and his loving owner Jillian Pratt, recruiting specialist for the faculty, couldn't be more proud. "He's always liked people, often more than other dogs, and he really just wants to be your buddy.

My partner and I had been interested in animal wellness before we picked up Murphy and were really excited to watch him grow into the loving family member that he is now."

GH: What made you think Murphy would make a good wellness animal and how was the experience in getting him certified?

JP: Murphy has always had a really sweet nature, right from when we got him at eight weeks old. Seeing how much he enjoyed being around people and all the love he had to give, we knew we wanted to get him wellness certified. Being that I work on campus, I was already familiar with CAAWLS, so they were the natural local choice for certification.

Getting him certified was a really smooth process. The CAAWLS website lays out the different criteria their wellness animals need to meet and regularly host certification sessions that test for obedience and temperament. Rather, it's the criteria the handler and animal need to meet together, as people and animals are certified together as a team. As Murphy had already been through puppy kindergarten, obedience training and a few sports classes (agility and flyball), we were hopeful he would pass his certification. We were nervous because he was still fairly young (just under two at the time) but he did great and we passed.

GH: What's the best thing about Murphy that students should know?

JP: The best thing about Murphy is that he truly loves people and really helps you not to feel lonely or overwhelmed. I'm pretty sure he loves interacting with others as much as they love him. I've talked with students who missed their family pets and were happy to connect with Murphy and others who said it was just nice to have him be so happy to see them. In addition to being here to help with the stress that comes with being a student, Murphy also makes regular rounds to all of our ALES staff spaces to ensure they have the opportunity for engage in animal-assisted wellness.

It really is a win-win for everyone: Murphy helps people destress and relax, and in return Murphy receives an unlimited supply of belly rubs. (*And they are well deserved! – ed*)

Dear Sir, Madame:

Despite that I can send an email, I hope this note arrives to the *Greenhouse* magazine.

I am a 1966 Agriculture graduate and I do like to read the publications of the Faculty of Agricultural, Life and Environmental Sciences.

Sincerely,
Doris Wyllie

PHOTO BY RICHARD SIEMENS

Ahead of the class

HELPING YOUNG PARENTS SUCCEED IS MACKENZIE MARTIN'S GOAL ANDS SHE'S WELL ON HER WAY

BY HELEN METELLA

Mackenzie Martin, an extraordinarily busy undergraduate student in the Department of Human Ecology, can now add being a Rhodes Scholar to her lengthy to-do list.

Martin, who is simultaneously pursuing her bachelor of science and bachelor of education degrees, as well as a certificate from the University of Alberta's Peter Lougheed Leadership College, is the latest recipient in the Faculty of Agricultural, Life and Environmental Science of the prestigious Rhodes Scholarship.

Currently immersed in practicum teaching at a junior high school in Edmonton, the lively and articulate 22-year-old is headed to graduate studies at the University of Oxford this fall, via one of the world's oldest, most prestigious and selective international scholarships.

"There are so many wickedly smart people at Oxford and I look forward to having great conversations with people who challenge me and talk about things I've never heard of before, never even thought of before," said Martin, whose studies in human ecology take place within the Department of Human Ecology.

"It's so exciting to join the Rhodes community, which aspires to develop and support public-spirited leaders around the world."

In addition to her curriculum studies in child and family development, she invested extra effort researching aging, and on creating a program that inspires pregnant teenagers and teen mothers in Edmonton to pursue post-secondary education.

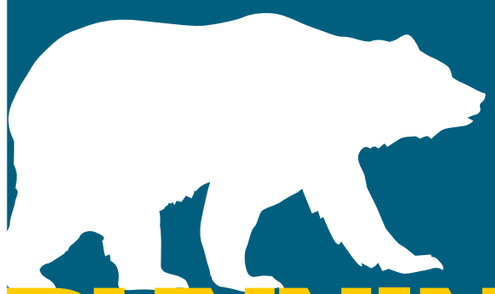
In 2016, she won an undergraduate researcher stipend to conduct an ethnographic study at De Hogeweyk, an internationally renowned village near Amsterdam for people with dementia.

Working alongside faculty researchers Janet Fast and Megan Strickfaden, she is a part-time research assistant with AGE-WELL NCE, a national research network that focuses on aging and technology.

The team is developing a tablet application and associated database that allow family caregivers to choose appropriate technological tools for their needs.

"Mackenzie demonstrates all of the best attributes of an ALES student," said Stan Blade, dean of the Faculty of ALES. "A great education taught by superb faculty members, international perspective through a diversity of experiences, and local leadership in important activities and initiatives to help the community. We are so pleased that she has been selected for this remarkable opportunity at Oxford."

Martin's award marks the second time in three years that a student from the Faculty of ALES has received a Rhodes Scholarship. Each year, a class of 100 scholars is selected from countries around the world and 11 are chosen from Canada.



RUNNING OUT OF ROOM:

THE IMPACT OF ROADS ON GRIZZLY BEARS

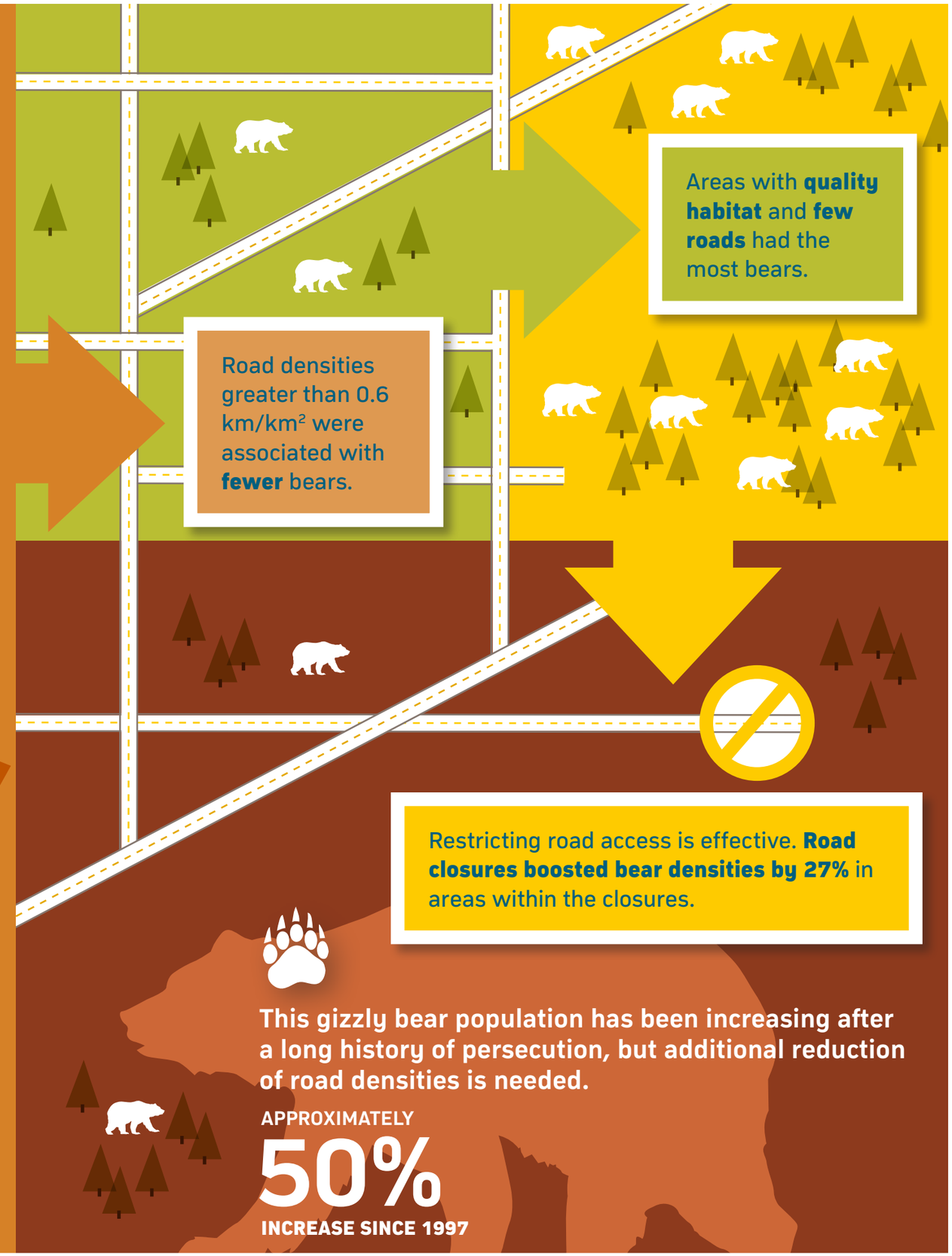
Human activity negatively affects bears. Roads enable human access to bear habitat, but the effect of roads on bear density is rarely assessed.

By Clayton Lamb
Infographic by Paige Weir

Clayton Lamb, who is currently completing his PhD with conservation biologist and co-author Scott Nielsen in the Applied Conservation Ecology Lab, created a beautiful demonstration of the problem with grizzly bears and roadways.

How do roads affect grizzly bear density?

We performed DNA-based, spatially explicit capture-recapture to estimate the density of a threatened grizzly bear population in British Columbia, Canada.



This gizzly bear population has been increasing after a long history of persecution, but additional reduction of road densities is needed.

APPROXIMATELY

50%

INCREASE SINCE 1997

Top: Left to right: Erik Umbach (second-year ENCS student), Nathan Lauer (graduate research assistant), Benoit Boudreau (second-year forestry student and business owner), Hajo Spathe (forestry master's student from Germany) and Austin Kalin (NAIT student). **Bottom:** Hajo Spathe.

EYE ON THE PRIZE

One smart student has turned his class work into a study for success.

BY CAIT WILLS

Benoit Boudreau was in love.

He wanted to marry the love of his life, Denise, but as a second-year forestry student in the Faculty of Agricultural, Life and Environmental Sciences, he knew that handling the financial responsibilities of both an education and a family weren't in the cards. But, instead of giving up, he did what any enterprising young Romeo would do: he started his own company.

"It's amazing that I've found a way to make an income while I was in school," he marvels two years into business ownership. The budding tycoon has taken the skills and knowledge he has learned in school and turned it into the successful arborist company, Tree Ninjas.

"I've been an arborist since I was 18," says the now 22 year old. "I had three solid years of experience and I asked a tonne of questions on the job," he says. Realizing there was a shortage of arborists in Edmonton, and that the skills he was learning in the classroom could translate into the field prior to graduation, Boudreau challenged the arborist certification—and passed with flying colours.

Two seasons later, Boudreau has a young crew of four full-time employees and a seasonal crew that supplement the core group until November each year.

"Most of the staff are forestry students," he says, and that, while their experience might be lean, their knowledge is deep. "We have PhD students who are writing theses on tree species, so they know what they're talking about!"

Like his crew, Boudreau has gained knowledge in the Department of Renewable Resources, thanks to the hands-on learning he says he has acquired as an undergraduate student. "There has been lots of learning in the classroom that I can apply, like hydrology and soil science," he says.

Another significant impact on his success has been the work he's been able to win on campus. "The university has been very supportive," says Boudreau, and that "having contracts with the University of Alberta has given us a huge opportunity."

Now that Boudreau is a well-established businessman and husband, he's ready to take on his next greatest challenge: in December 2017 he and his wife welcomed their first son days after their first wedding anniversary. To him, Boudreau hopes to pass on the same guidance he has received.

"My dad always says that entrepreneurship is when someone has a goal, and multiple people help him get there," says Boudreau. "We have a community of people helping us; we have young fire, and we have determination."

AWARDS

Innovation Awards shine spotlight on two ALES researchers

BY HELEN METELLA

Two researchers and the groundbreaking technologies they invented while working in the Faculty of ALES have been recognized for the patents those innovations received in 2016.

Clover Bench, an animal behavioural-ist, and Feral Temelli, a food engineer renowned for her work in supercritical fluid technology, are scientists in the Department of Agricultural, Food and Nutritional Science. Each received an Innovation Award from TEC Edmonton, which honours University of Alberta researchers, their ingenious technologies and the commercialization community that helps transfer those innovations from the lab to the world.

Bench created, along with adjunct professor Al Schaefer, a method and an apparatus that automatically collects and interprets non-invasive infrared images from one or more animals at a time, to predict their health, growth or reproductive state using both thermal and behavioural biometrics. The technology simultaneously enables scientists to gather large amounts of radiated heat and behaviour information from animals in short periods of time, for a variety of applications that can be customized for the species and the setting, says Bench.

"From a behaviour science standpoint it has opened up a whole new way of approaching animal behaviour, by using the unique attributes of the infrared camera to capture the subtle movements of an animal that cannot be observed easily using standard visual-based methods," she says.

Temelli's patent is for generating micro- and nano-sized particles and fibres from biopolymers (biodegradable molecular structures) so that they can be used to impregnate a bioactive component and/or encapsulate a bioactive component with biopolymers.

"Our new technology overcomes the challenges associated with conventional techniques for drying of high molecular weight biopolymers," she says. "We can now create new opportunities for ingredients to deliver bioactive components, targeting a variety of applications."

Getting to the root of aspen survival

SIMON LANDHÄUSSER HAS A PASSION FOR NURTURING ASPEN SEEDLINGS—EVEN THOUGH HE'LL NEVER SEE THE FORESTS THEY'LL BECOME.

BY MICHAEL BROWN

After nearly 30 years, Simon Landhäusser still talks about the aspen tree with a devotion that would make even the most strident lawn-care fanatic think twice before mowing down one of the tree's fledgling sprouts.

"You just have to look at the river valley in the fall, they're gorgeous," says the new Killam Professor and tenured University of Alberta forest restoration researcher of the green-to-bright-yellow vistas that aspens in autumn bring. "If you look at art of the boreal forest, most artists draw aspens. Because of its smooth bark, crown shape and colours in the fall, it's stunning on big landscapes."

But like any relationship that survives the test of time, Landhäusser says, a tree's beauty is only bark deep—and it's what's underground that counts.

"It is such an interesting species—it does things very differently than many other trees, which makes it an intriguing species to work with."

LOTS OF SEXTING CAN WRECK A ROMANCE

Tech-communication shortcut undermines features of strong relationships

BY HELEN METELLA

Sexting—sharing sexual messages and images by cellphone or other web-connected devices—can spice up your sex life, but it may be at the expense of other important aspects of your relationship, says a new study led by the University of Alberta.

People who sext their romantic partner frequently (several times a week, sending both sexual words and nude or mostly nude images) or hyper-frequently (daily or more often) report greater sexual satisfaction than non-sexters and those who send words only.

However, the frequent and hyper-sexters are far less satisfied with many other aspects of their relationship, said Adam Galovan, lead author of the study and a family scientist in the Department of Human Ecology.

They have a higher degree of couple conflict and are more ambivalent about the relationship continuing than non-sexters, and also report feeling less secure attachment in their relationships and lower levels of commitment. In addition, they are more likely to view pornography and show more infidelity-related behaviours on social media.

"Sexting doesn't seem to be a feature of a healthy relationship," said Galovan. "My interpretation is that the sexters are focusing more on the sexual part of their relationship and may be neglecting other areas."

This seems to be borne out by another finding in the study, he says. The frequent and hyper-sexters reported a high degree of "technology interference" in their relationship, which is a term for when a partner texts or emails during face-to-face conversations, meals or leisure time with their partner.

Evidence of letting technology take precedence over personal interaction may explain what is contributing to the poor scores in other aspects of their romance, said Galovan.

"These folks want to get to the end goal—a good relationship—without doing the hard work of talking, listening and spending quality time together," he said.

"It's the instant gratification culture—we want it now. But it's what you do to get to that goal that actually defines a good relationship. They need to put the phone down and have a good old fashioned conversation—spend some time together nurturing the relationship—instead of shortcutting with sexting to try to get a quality relationship."

FUNDING

Three scientists in the Faculty of ALES have received a financial boost to support their ongoing human health research. **Rene Jacobs, Catherine Field** and **Rhonda Bell** are sharing approximately

$1.5 MILLION

in funding from the Canadian Institutes of Health Research (CIHR).

SHUTTERSTOCK.COM

First ENCS students study northern systems in Yukon

UNIQUE MAJOR OFFERED TO THIRD- AND FOURTH-YEAR STUDENTS NOW A REALITY

BY HELEN METELLA

Two environmental and conservation sciences students are the first to move their studies to Whitehorse for an entire winter semester, as part of a new element in a unique program of study.

The program is a major in northern systems, delivered jointly by the Environmental and Conservation Sciences program (ENCS) in the Faculty of ALES and Yukon College. The major is for students seeking an education in the distinct culture of Canada's Far North, as well as a bachelor of science degree focused on its environment.

"It's basically all the things that I'm passionate about in one spot—an abundance of wildlife, beautiful landscapes and a culture that is very connected to the land," says Taylor Lund, a third-year conservation biology student.

Both Lund and fourth-year student Jessica Hayes became the inaugural participants of the winter 2018 semester, because they wanted a closer perspective on life in Canada's Far North.

"A huge part of conservation biology is being able to convey science to the rest of the public," says Lund. "So if you can understand people and the way they live, it makes it easier to speak their language—it creates a personal connection."

The program was created eight years ago for northern residents to earn a science degree without leaving their community. Since then, it has also attracted students enrolled in Edmonton, and from other programs and places.

The specialized study for the major occurs in years three and four of the ENCS program and includes such pertinent topics as Northern land-use planning and climate change.

Many of its Edmonton-based students participate in its winter field school, or in the river-based summer field school. Whether students go North for a semester, take their courses in Edmonton, or attend full-time in the Yukon, the program is eye-opening and timely, says Fiona Schmiegelow, director of the Northern ENCS Program.

"A major strength of the program is that we make sure that Indigenous perspective is woven throughout the fabric of the curriculum," she says. "[That perspective is] an absolutely fascinating point in the history of the North; there is a real opportunity to experience what's happening, firsthand."

"My future opportunities have greatly expanded through the BSc program being offered here," says David Silas, fourth-year student and citizen of the Selkirk First Nation in Yukon. "Plus, it is a huge advantage to be able to apply what I learn in the classroom to the immediate real world around me."

GOING GREEN WITH HIGH TECH

Thanks to a $1.5 million investment by Western Economic Diversification Canada, small businesses will be scaling up with more opportunities for commercialization of their products at Agri-food Discovery Place on South Campus.

Led by agrifood researcher Heather Bruce, projects will now be able to access at 1,500-litre fermenter on site, which will help the development of biodegradable plastics, probiotics and fertilizer.

CLEAN, GREEN AND READY FOR ACTION

New sustainable technology is emerging as the route to success for Albertans, thanks to ALES research

BY CAIT WILLS

ILLUSTRATIONS BY JEAN-FRANÇOIS PODEVIN

The *Ingenious Knight of La Mancha*, AKA Don Quixote, is often seen as the epitome of heroism after the literary figure appeared in 1604 as a fighter of injustice. More than 400 years later, scientists in the Faculty of Agricultural, Life and Environmental Sciences are quixotic, positioning themselves to arm society with the tools needed to develop clean and green technology.

In 2016 the University of Alberta received $75 million in federal funding to support the development of the Future Energy Systems initiative, which pulls expertise from faculties across campus to work collaboratively to solve the energy challenges of society.

Here in Alberta, whose place in the world has traditionally been known as a carbon-based energy supplier, those challenges are legion.

David Bressler is changing that perception one molecule at a time.

Bressler, a professor in the Department of Agricultural, Food and Nutritional Science, is adept at lopping off atoms – he did it when he figured out a way to break off the extra acid group at the end of a molecule, which helped him develop hydrocarbon fuels, and he's doing it again by restructuring cellulose nanocrystals (CNC) to create ethanol.

Fermentation is a magical metabolic process that creates, among other things, ethanol from sugar. This series of chemical reactions take the glucose that exists in a plant and turns that biomass into ethanol and carbon dioxide. That ethanol is further distilled and turned into fuel, which is widely considered to be a "clean" fuel source alternative to fossil fuels.

The way Bressler is building this pure form of fuel makes it renewable and potentially an answer to many of the issues that arise with the extraction and processing required in the manufacturing of fossil fuels. By taking cellulose from waste pulp, Bressler then soaks the cellulose nanocrystals in a high level of acid to rid them of sugars. The CNC then breaks down further and ferments, thus creating cellulosic ethanol.

The result: Bressler says this new fermentation process could achieve a 40-per-cent increase in efficiency in developing ethanol.

"This is huge," says Bressler. "This industry sees a 0.1 per cent improvement produce tens of millions of gallons of ethanol." This new fermentation process, which has been developed by Bressler and his colleague, Dominic Sauvageau in the Faculty of Science, will therefore have global implications for fuel production.

The economic implications for this type of interdisciplinary research is why the Canada First Research Excellence Fund developed the program of scholarly activity at the University of Alberta, says the Future Energy Systems director Larry Kostiuk.

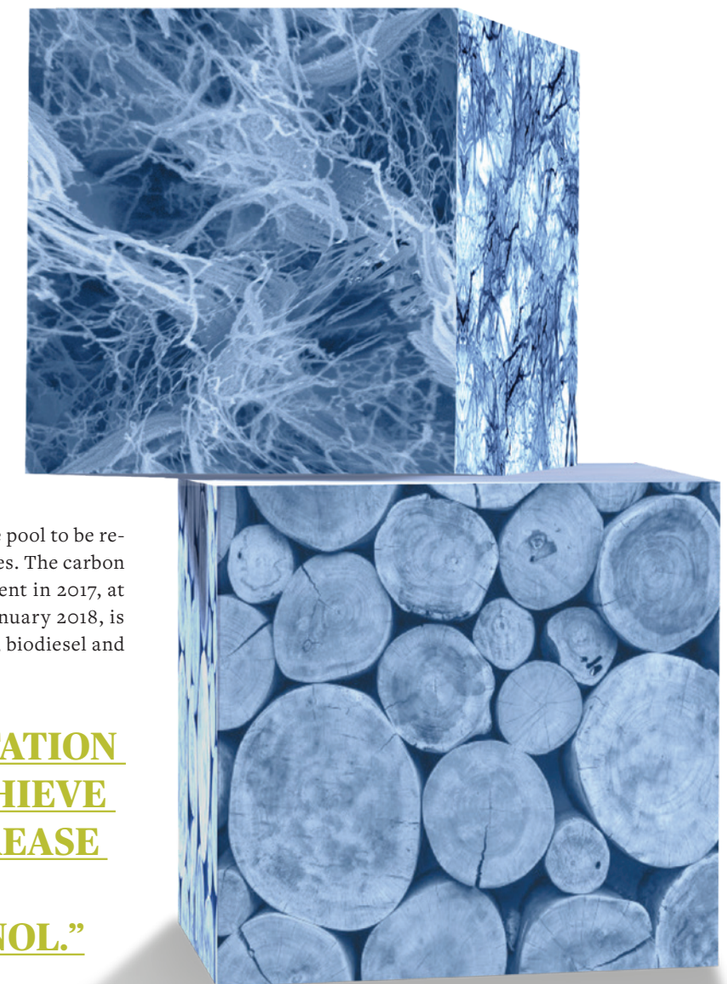
"The work that is being done across faculties within the Future Energy Systems initiative can have a significant and profound economic impact on the lives of Albertans, and, in time, around the world," says Kostiuk.

For Bressler, taking an existing technology—in this instance, the fermentation process, which has been used since ancient Egypt—and creating new solutions to global problems is at the heart of his work. "This work is about developing a new strategy, not a new technology," he says, in order to create a better way of doing something. His work is, at its very essence, disruptive technology, which he defines as entering the market place and creating new opportunities for investment.

Currently Alberta has a provincial mandate requiring five per cent of the national gasoline pool to be renewable ethanol in line with the federal policies. The carbon levy implemented by the provincial government in 2017, at $20 per ton, and increased to $30 a ton in January 2018, is not applied to biofuels, including biomethane, biodiesel and ethanol. Further, in November 2017 the Alberta government released a document that included eligible sources of biomass—they include both agricultural crop residue, agricultural processing residue, forest mill residue and standing trees killed by mountain pine beetle or wildfire on Crown land.

This means that Bressler's development of cellulosic ethanol, produced from cellulose, the stringy fibre of a plant, will take the biomass from fibre produced by the forestry industry and turn it into fuel.

That's a pretty simple equation for success.



> "THIS NEW FERMENTATION PROCESS COULD ACHIEVE A 40-PER-CENT INCREASE IN EFFICIENCY IN DEVELOPING ETHANOL."

> **"WHAT IS THE RELATIONSHIP BETWEEN RENEWABLE DEVELOPMENT AND COMMUNITY DEVELOPMENT?"**

The costs of new technology weigh heavily on **JOHN PARKINS**. A sociologist in the Department of Resource Economics and Environmental Sociology, he seeks answers to questions about how the process of implementing new technologies impacts society, and how those systems need to work in order to not only be embraced, but also enthusiastically encouraged—especially by those who could be negatively impacted.

"As a researcher we're always asking more questions," he says; "we want to talk to communities about different scenarios and what those may look like for communities."

A subject at the forefront for Parkins and his team at Future Energy Systems is the concept of wind power as a renewable resource.

According to the Wind Energy Association of Alberta, wind is the lowest-cost source of new energy in the province. With more than 900 wind turbines, approximately eight per cent of Alberta's energy needs are currently met by wind power. Alberta is Canada's third-largest wind market, and the provincial Climate Leadership Plan has mandated that 30 per cent of the province's power will come from renewable resources like wind, hydro and solar by 2030. In addition, the association lists $3.6 billion in local spending on project development and construction, an estimated $137 million in operations and maintenance spending and $13.5 million in land lease payments to homeowners in 2017.

So how does that translate for everyday Albertans—many of whom are in rural areas?

That's where Parkins comes in.

"One of the first and most key questions we ask is 'what is the relationship between renewable development and community development' and, from that, 'who owns the technology and who is responsible for the community engagement'.

"With wind power especially, [success] is determined by the community and their concerns about the development of the infrascture."

This systems analysis is embedded in the work being done at the community level, says Parkins, as well as with his colleagues at Future Energy Systems. While most people think of Pincher Creek as the area most impacted by wind turbines, Parkins says, "it's the east side of the province that's the most windy.

"Those communities are at ground zero. With the phase out of coal and the implementation of the carbon tax, there is an expectation that wind power will be built out by 2030," and, in his experience, those communities are deeply conservative and suspicious of the NDP government and its Climate Leadership Plan.

"It's a perfect storm of opposition," he says. "The wind turbines represent a deep ideological divide.

"I call them socialist towers," he says ruefully.

> **"EVEN AS WE MOVE AWAY FROM FOSSIL FUELS, CHANGE WON'T HAPPEN OVERNIGHT."**

The skepticism Parkins notes, synthesizes and develops into effective policies for renewable resources is key to the implementation of work being developed by Bressler and others in the Future Energy Systems initiative.

Because society's current energy systems are based on the extraction and burning of carbon-based fuels, a nonrenewable resource, some say time is running out, so scientists are accelerating the pace under which they develop and deploy new technologies that focus on renewable resources, and their applicability and impact in society today and in days to come.

For **ANNE NAETH**, co-lead of the Future Energy Systems theme "Resilient Reclaimed Land and Water Systems", community engagement is the intersection of her research expertise in renewable resources, her dedication to teaching students and her passion for developing new ways to share information.

"Often the focus of renewable resources is bio-physical based," she says, "but another important aspect is the societal impact of the work we do."

Like Parkins and Bressler, Naeth looks at the systems determination of each and every research project, including the diversity of components of an ecosystem, when determining the process of how to effectively develop, integrate and initiate projects.

"Regardless of energy and where it comes from there's always going to be a need for reclamation because we are always going to make disturbances," she says. "Even as we move away from fossil fuels, change won't happen overnight. In the meantime, we have all these legacy sites as well as current sites [that need to be managed] as we move to renewable resources."

One of the ways Naeth says taking the concept of developing reclamation as part of the plant-soil-water interrelationship—the way these factors interact, are disturbed and can be restored after disturbance—and achieving measurable and applicable outcomes is by focusing on reclamation at the beginning of a project, not the end.

"What we want is more forward thinking with partners, having us—the land reclamation people—as part of the planning, which saves money and time.

"What we can then instil in students is that 'what we should be doing is not what necessarily has been done to this point."

Naeth is a professor of land reclamation and restoration ecology in the Department of Renewable Resources and teaches a fourth-year capstone course annually. These mandatory, practical projects entail students working directly with communities on a reclamation project. If it can't be applied, it's not helpful. If it's not helpful, it's not to be used, says Naeth.

"It's a new world and a new role in land reclamation."

GOING THE DISTANCE

HOW TWO WOMEN ARE SEIZING CONTROL OF CANCER THROUGH SCIENCE

by **Cait Wills**

photograpy by **Jessica Fern-Facette**

Julie Rohr's life is like a game of numbers.

Smart, articulate and curious, the 35-year-old was diagnosed in November 2015 was a "one-in-a-million diagnosis" of leiomyosarcoma, or LMS. The cancer of the soft-muscle tissue was found in her abdomen and, since having surgery to remove tumours on the large vein that travels from her heart to her lower extremities and her liver, the cancer has now metastasized in both lungs.

"This cancer is extremely aggressive and doctors usually consider LMS a terminal diagnosis," she says matter-of-factly. "But I know people with it who have been alive for 25 years, which show it's also the most unpredictable diagnosis.

"A lot of people look at fighting cancer as a battle, but I'm not a fighter, so this feels more like a high-stakes chess game."

Carla Prado is also one in a million, so the chances of them meeting, let alone collaborating, were tiny. Yet meet they did, which changed both their lives forever.

Prado, who moved to Edmonton in 2004 not on whim but on impulse, is the director of the Human Nutrition Research Unit. There, she leads a team of registered dieticians and researchers on analysis and evaluation of the critical and individualized needs of patients with cancer.

The work being done at HNRU is important, she says, because food preferences affect everyone and, for people who have cancer, they often don't have the luxury of being picky with their caloric intake. For instance, Prado's PRIMe study, which looks at the diets of people suffering from colorectal cancer and their protein intake, could result in specialized care that helps these patients fight the disease.

Those tools are exactly what Julie Rohr was missing when she began her journey with cancer.

"Upon diagnosis I was terrified of food; I didn't know what to eat or what to put in my body," she says. "The literature on cancer nutrition is so varied and you have no idea what is the right answer; I was really worried that what I put in my body was really going to affect my outcome.

"I went to see many different people, whose expertise wasn't in cancer nutrition, but I didn't feel like I had the answers I needed.

"At Christmas 2017 I had tickets to a banquet. I wasn't feeling well and I wasn't in the mood to go. My husband, who is very intuitive, said that he thought I might meet someone there who needed to hear about what I was going through, or someone who I needed in my life. And Carla Prado was sitting at my table.

"We got to talking about what we do for a living and when she told me that she studies cancer nutrition at the University of Alberta, I said to her, 'You're the person I've been looking for, for the last two-and-a-half years.'

For Prado, helping patients like Rohr is a priority.

"Julie has so much going on, so if we can help her develop nutritional strategies, that would a success," she says. "It's our responsibility to understand how her body has changed through

"Julie has so much going on, so if we can help her develop her nutritional strategies, that would be a success."

- Carla Prado

CARLA'S STORY

"I arrived in Edmonton in March 2004 wearing a sweater. It as -20C when we landed, but there were no winter clothing shops where I'm from in Brazil," says Carla Prado. "I had first heard about the University of Alberta after visiting an English-as-a-second language (ESL) fair. There was a booth there from the university and, after looking up more information online, I fell in love with the nutrition program.

"I emailed nutrition professor (emerita) Linda McCargar, who was very kind and replied to say that she was grateful I had contacted her, but there were no positions in her lab and no funding available."

Undeterred, Prado and her husband, Leandro, came up with a plan: they would sell all their worldly goods and move almost 10,000 kilometres to Edmonton so Prado could convince McCargar to take her on as a grad student. Upon arrival, Prado contacted the professor and asked for a tour of the lab. Upon meeting, and asked why she was in Edmonton—was it a business trip, or perhaps a holiday?—Prado announced that she and her husband had moved specifically so she could learn from McCargar.

"She almost fainted," laughs Prado at the memory.

This determination is emblematic of how Prado has reached the level of success she has achieved as a young scientist. After completing doctoral studies and traveling to two different North American research institutions to increase her specialized knowledge, she returned to the University of Alberta as assistant professor. In 2014 Prado was awarded the Campus Alberta Innovates Program Chair in Nutrition, Food and Health and now heads the HNRU on the University of Alberta's North Campus.

cancer treatment and then give her the best tools she needs."

Luckily for Rohr, the HNRU has one of only two devices in Canada—and 20 in the world—that gets down to the cellular level when weighing body composition.

The whole body calorimetry unit serves as a one-stop shop to analyze the entirety of a person's caloric needs, both what they need to subsist, as well as what is expended at rest, during sleep and activity and while food is being digested. "All of these factors are critical in determining the optimal caloric needs of a patient," says Prado.

While it looks like a small hotel room, the unit is entirely air tight (with a dedicated intake and ventilation system) where patients are assessed over a predetermined timeframe that can be up to 48 hours. By measuring carbon dioxide and oxygen levels in the room, an extremely accurate measure of energy metabolism can be calculated while the body is at rest. And for Rohr, the location in Edmonton means she can access this world-class equipment only a few minutes from home.

"The whole body calorimetry unit is the showpiece of the HNRU," says Stephanie Ramage ((BSc 2008, MSc 2011), human nutrition research coorindator. "It allows us to complete assessments of the energy needs of the clients not only at rest, but also through a whole range of daily activities.

"Within the unit we also have the metabolic cart, which uses respiration to measure oxygen intake and carbon dioxide output to calculate the calories the client is using." This is important, says Ramage, because about 60 to 70 percent of the total calories a body requires is to maintain baseline function, including respiration, cognition and digestion. For example, "If you need 2000 calories a day, then you need 1400 calories just to maintain breathing, brain function and digestion," she says. Because dietitians rarely have access to this level of specificity in analyzing a client's needs, having this unit available is critical. "This is a powerful way to show people who may be struggling with what is required to fuel their bodies," says Ramage.

The whole body calorimetry unit works by assessing oxygen and carbon dioxide levels, and starts as soon as the client is in the room. While Rohr used the unit for one hour to determine her needed baseline calories, the unit can be used for up to 24 hours at a time for a test, which presents new challenges for staff. Patients need to be supervised and fed, and ironically, Ramage says their most often complaint is that patients feel their getting too much food.

"After 45 minutes we have our first reading, and we then make the first meal for the client," says Ramage.

Basing their meals on the adage of "50-30-20" (50 per cent carbs, 30 per cent fat and 20 per cent protein), the meals patients get on site are structured around lean meat, whole grains and fruits and vegetables. The test kitchen on site is used for meal preparation and for building meal plans for clients who, once their testing and assessments with a dietician are complete, the development of meal plans for at-home care.

Above: Stephanie Ramage demonstrates how blood is drawn from patients who are enclosed within the Whole Body Calorimetry Unit. **Right:** visiting student Camila Pinto shows how the metabolic cart works.

"The thing that's so great about this unit is that we can address so many issues."

"We have the capacity to analyze food down to the vitamins and minerals," says Ramage and that ability, coupled with food surveys, handouts and food recall sheets, means the unit's staff are able to determine exactly what the optimal health benefits are for an individual.

"The thing that's so great about this unit is that we can address so many issues," says Ramage. Body composition assessment, analysis of energy metabolism, food and dietary analysis and recommendations and supporting clinical services are all available under roof.

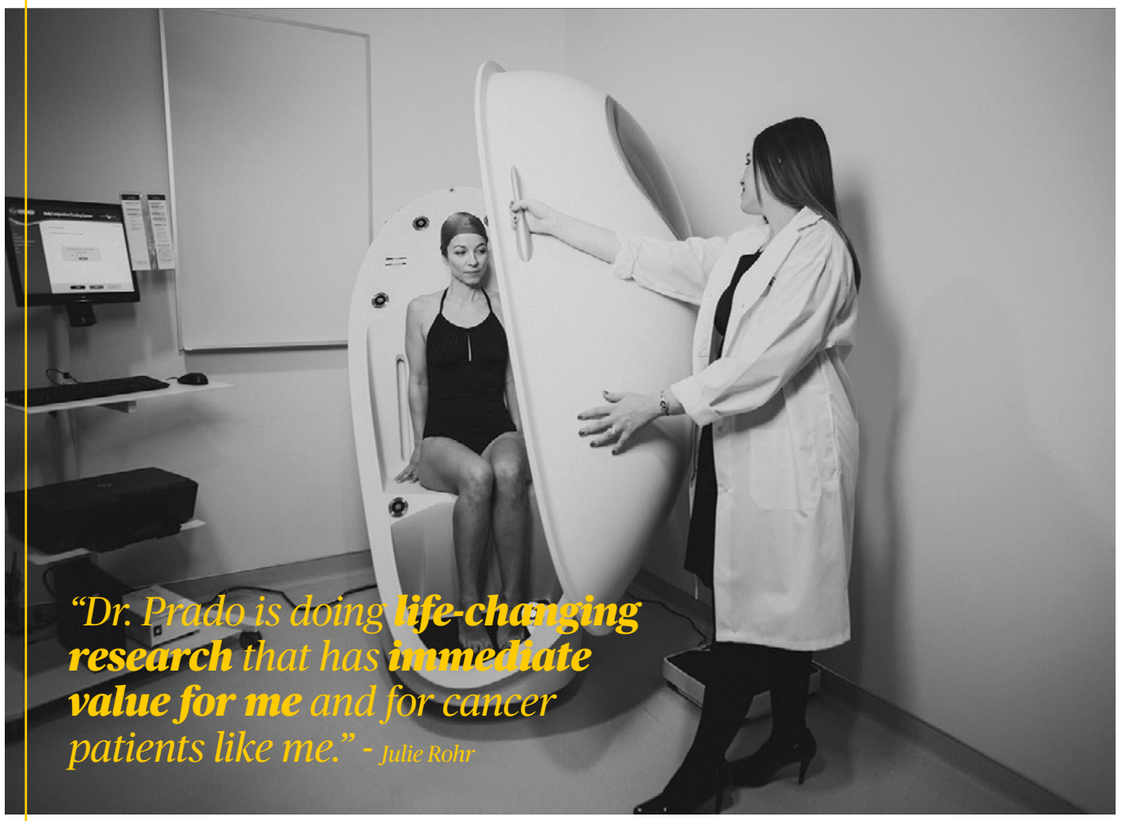
Taking an X-ray to the next level is the DXA, or Dual X-Ray Absorptiometry testing device. It is the gold standard of body composition assessment and measures bone density, lean tissue mass and total regional body fat, all within 15 minutes using a very low does X-ray (think the same amount as a cross-country flight).

The "Bod Pod" looks like Mork From Ork's eggship, but the air displacement plethysmography device is serious business. It measures the amount of air a patient displaces while sitting inside the unit. This displacement measures two things: fat mass and fat free mass, which is the combination of muscle and bone in the body.

"The Bod Pod unit is very specialized," says Prado. "It helps the HNRU provide the types of information for analyzing health that helps us understand and show how people are different from each other.

Bioelectrical analysis is also used, which measures resistance to the electrical signal through the water present in

The Dual X-Ray Absorptiometry testing device, or DXA, provides a precise measurement of body density, lean tissue mass and total regional body fat.



Julie Rohr in the Airdisplacement Plethysmography (BodPod).

muscle, versus that which is present in fat.

These four tools provide a whole-body analysis from the cellular level to determine energy metabolism, body composition and optimal nutrition—the weapons of choice for Rohr in addressing her body's needs as she lives with cancer.

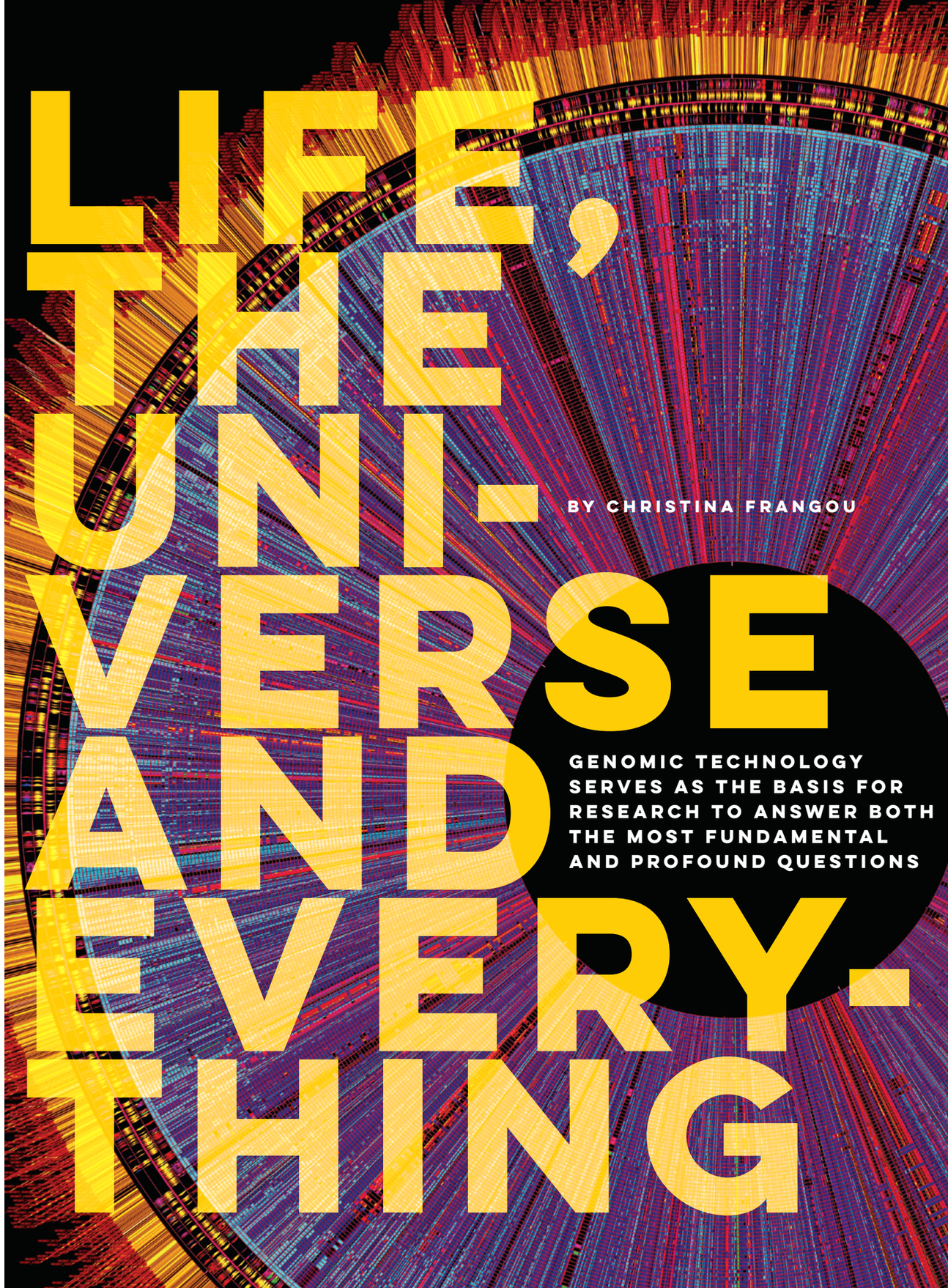
"It's so critical to know this information when you're fighting this disease," she says. "We are very lost when it comes to finding this type of information.

"Some cancer diets are very nutrient deficient, and some are very dense. Every cancer is different so there has to be different treatment for each patient."

The next step in Rohr's treatment is a clinical trial in Seattle, where she hopes to join the 18 other patients who are part of a group under the care of one of the only LMS oncology specialists in North America. "It's a shot in the dark," she says, but, like in a chess game, Rohr deftly maneuvers forward, even as the cancer pushes her back.

"Diet in the cancer world is more of a lifestyle and meal planning opportunity that will give you the most power you can, and I look forward to feeling safe and not anxious with what I'm putting in my body," she says.

"I'm so glad that this research and Dr. Prado are available to me—it gives me peace of mind that I have the answer. Dr. Prado is doing life-changing research that has immediate value for me and for cancer patients like me."



LIFE, THE UNIVERSE AND EVERYTHING

BY CHRISTINA FRANGOU

GENOMIC TECHNOLOGY SERVES AS THE BASIS FOR RESEARCH TO ANSWER BOTH THE MOST FUNDAMENTAL AND PROFOUND QUESTIONS

Over the next four days, the world's population will grow by the equivalent of the city of Edmonton—and it will continue to do so every four days if current trends maintain.

At this pace, by 2050 the Earth will be home to more than 9.2 billion people. To meet the food needs of such a sizeable population, global food production must double in the next 32 years, a challenge made even more daunting as the climate changes.

In the Faculty of Agricultural, Life and Environmental Sciences, researchers have set out to address the shortfalls in food production by applying innovative genomic technologies to some of Canada's largest agricultural industries.

Improvements to food production in these industries—including both crops and livestock—could impact billions of people around the world for generations to come, says scientists who are leading the charge.

"I believe passionately that agriculture is one of the grand challenges for the world at the moment. We're still growing the world's population. Access to sufficient food, and the right food, is an important part of maintaining society," says Graham Plastow, professor in the Department of Agricultural, Food and Nutritional Science.

He is also CEO of the Livestock Gentec Centre, an international collaboration based at the University of Alberta that brings together scientists in genomics, genetics and bioinformatics to address the need for better breeding and management technologies. Among its successes, Livestock Gentec has pioneered the development of tests for genome-wide association studies in cattle, which will help breed cattle that are more resilient against disease.

"Genomics has already delivered tangible results but the greatest gains have yet to be realized," says Plastow.

He and colleagues throughout the faculty have focused their efforts on genomics' promise in industries with an enormous impact on federal and provincial economies, as well as the national and international food supply. In beef cattle, Plastow's team is targeting the DNA sequencing of animals by looking at ways to improve their health and welfare. For cattle and pigs, a goal of genomic research is to find ways to select animals that will produce more resilient offspring and that are more hearty against illness. At the same time, they are looking for ways to reduce the amount of methane produced by beef cattle without decreasing the amount of beef produced.

"TO DO GENOMICS RESEARCH, YOU NEED A LOT OF DATA ON YOUR ANIMALS."

Alberta is an ideal place to study genomics and beef cattle, says Plastow. The province is home to the largest beef cattle herds in Canada, accounting for just over two-fifths of the national total, and Alberta's beef production contributes $15 billion to Canada's GDP annually. With more than two million beef cattle in Alberta today, the animals that can be studied here outnumber anywhere else in the country.

"To do genomics research, you need a lot of data on your animals. It's usually not sufficient to study 10 animals," he says. "Alberta is a fantastic place to do cattle research. It means we can attract people who are interested in working with animals and use this opportunity to drive research forward."

Genomic research is also targeting ways to shorten the breeding cycle for cereal crops like barley, says Rong-Cai Yang, who is a professor with a specialization in statistical genomics and quantitive genetics, also in the Department of Agricultural, Food and Nutritional Science.

In Western Canada, it currently takes 12 years to create a new variety of barley. Once a new variety is produced, breeders rely on the breed's phenotypes, the observable characteristics like height and yield, to see how it interacts with the environment.

Information gleaned from genomics could reduce that process, says Yang.

In the past, barley breeders relied on data collected in the field to improve crops. By combining field data with lab data from geneticists, breeders receive valuable information that can help select crops with higher yields, are less disease prone, and of higher quality.

DNA:
THE MOLECULES THAT MAKE UP THE GENES FOUND INSIDE THE CELLS OF AN ORGANISM

GENOME:
AN ORGANISM'S TOTAL SET OF GENES

GENOME SEQUENCING:
READING THE ORDER OF THE DNA'S BUILDING BLOCKS (CALLED NUCLEOTIDES) IN ORDER TO LEARN ABOUT THE SPECIFIC FUNCTIONS OF INDIVIDUAL GENES, OR TO IDENTIFY FAULTY GENES

AT THE FOREFRONT OF NEW SCIENCE

MAKING SENSE OF DNA SEQUENCING, ALES ANIMAL BIOLOGIST SPECIALIZES IN BIOINFORMATICS

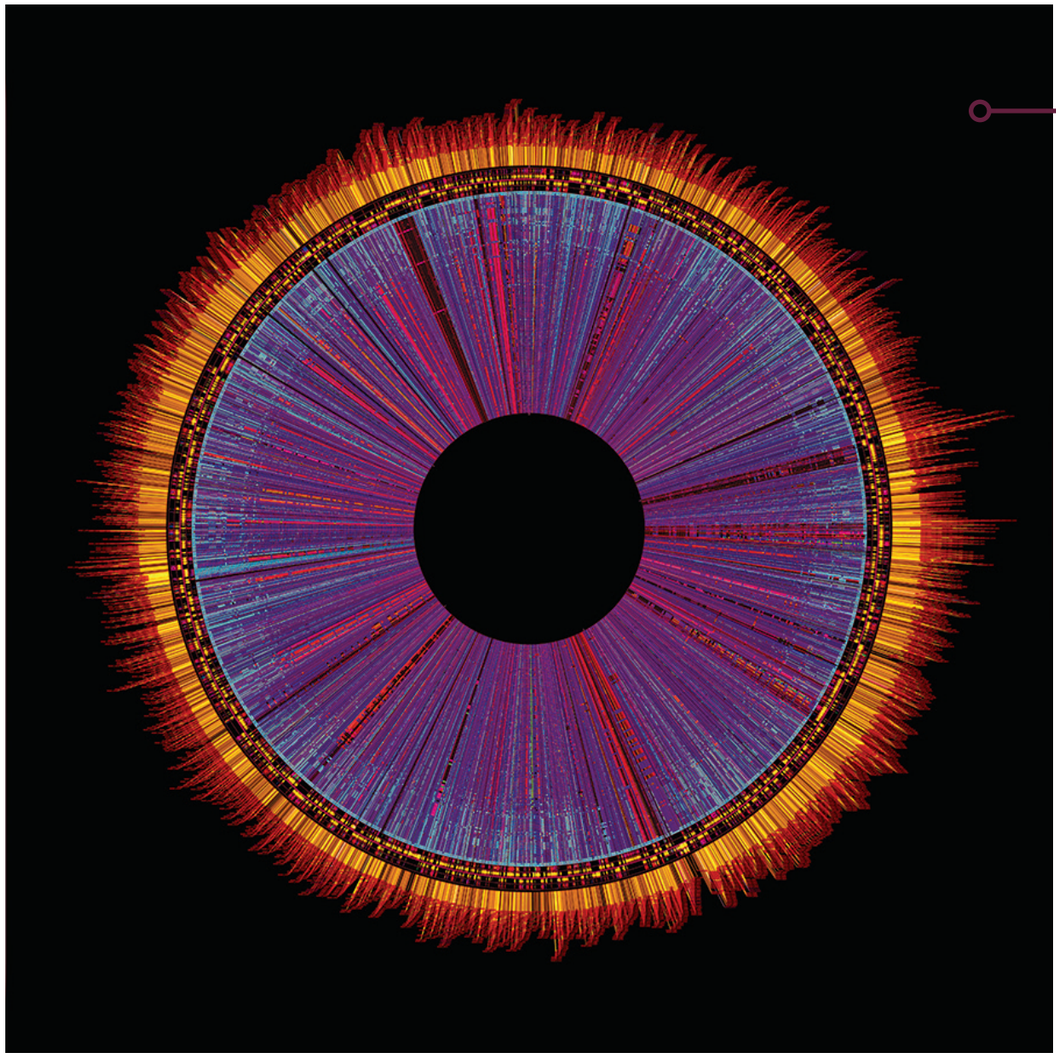
HELEN METELLA

Information overload is a growing problem in animal science, so researchers are inventing tools to manage it—and a significant portion of that problem solving in Canada is happening in the Department of Agricultural, Food and Nutritional Science (AFNS).

Thanks to recent advances in chemistry and molecular biology, scientists can now characterize the entire genome of an animal (its total DNA) in mere hours instead of years. Obtaining this sequence information is a key step towards understanding the hereditary instructions that control what cells do, and contributes to differences between individuals.

However, when the genomes of many animals are sequenced—for example, a thousand head of cattle—the amount of data generated is overwhelming.

To organize and digest it, a relatively new science called bioinformatics has become hugely important in the past decade.



An image created in Paul Stothard's research group, using software they created to visualize bacterial genomes. Here more than 100 E. coli genomes are compared to a single reference genome to identify shared and unique genetic features. Each ring in the figure depicts the genome of a different E. coli isolate. Segments are coloured to indicate their similarity to the reference genome.

Yang's team developed software called the Barley Breeding Platform, which brings phenotypic and genomic data together. They are now working on an updated version with more information, allowing breeders to select varieties based on multiple genomic traits.

"This will be very important to the agriculture industry in Canada. We need to produce high-quality, disease-free wheat and barley crops to be competitive globally," he says.

To increase yield in field peas, crop scientist Jocelyn Ozga is studying how the plant "partitions" nutrients and sugars to either its seeds or its roots. Her goal is to get more food to the seeds to increase their size and yield.

She already knows that when the levels of the hormone gibberellin are higher in the developing seed, more of the sugar does indeed get partitioned to the seed. But too much of the hormone makes the plant itself longer and thinner, and that makes it harder to harvest because they lodge (fall over).

Through transcriptomics (the study of RNA molecules in cells), she is comparing plant lines that overproduce gibberellin, and those that don't, to see exactly what the hormone is doing to stimulate more starch and bigger seeds.

"By understanding that, we can cherry-pick aspects that increase the key aspect of partitioning just in the seeds and not have it affect the stature of the plant," she says.

With several key pathways now identified, next she wants to "very logically look at each pathway to see how you can modify them by traditional genetics or modern techniques."

The answers have great potential to be applicable in other crops, too, says Ozga. Plants such as wheat also have genes that reduce sensitivity to gibberellin, and lodging in wheat is an undesirable trait it would be beneficial to avoid when increasing yield.

These researchers emphasize that their work requires close collaboration with partners outside the university.

Genome Canada, a not-for-profit organization funded by the Government of Canada, places high priority on agriculture research, and has granted nearly $40 million in funding to faculty members at the University of Alberta over the last few years.

Genome Canada, in turn, asks researchers to co-fund from other sources, both government-related like Agriculture and AgriFood Canada and Alberta Agriculture and Food, and industry.

This broad collaboration allows for a pooling of ideas and funds, resulting in large-scale and practical projects, says Michael Dyck, a professor and animal physiologist in the Department of Agricultural, Food and Nutritional Science who conducts genome research in pigs.

"Part of Genome Canada's mandate is to develop and implement genomic research that benefits Canadians and sectors of agriculture and various sectors. We'll have a local impact but there's potential to have an international impact as well."

"We use computers and software to make genomic comparisons, to tell us where the differences exist, so we can relate that to other characteristics, such as milk production and feed efficiency," says Paul Stothard, a biologist specializing in bioinformatics and genomics in the Department of AFNS.

Knowing the connections between genomic traits and animal characteristics then allows scientists to develop specific DNA tests that allow producers to breed efficiently and inexpensively, he says.

"Before the use of DNA testing, selective breeding was done on the basis of the observable characteristics of an animal or its close relatives," says Stothard.

"But sometimes the physical characteristics of an animal can't tell you everything you want to know, or it's a trait that's difficult to observe, such as milk production—dairy bulls carry those genes but they are only expressed in their daughters."

The development of a DNA test begins with tracking down DNA samples from enough animals with information recorded on the trait of interest. Genome sequencing is then performed, and the resulting data analyzed to first find the differences in the DNA sequences, and then to correlate those differences with the trait. Additional work can then be done to verify the influence of specific DNA sites on phenotype (observable characteristics).

Livestock production creates tremendous opportunities for identifying the genes and DNA differences that affect traits because a great deal of information on animal phenotypes has been collected, says Stothard.

"A lot of other researchers in AFNS have embarked on large-scale projects involving the use of DNA sequencing. Bioinformatics is an important part of all of these studies, and we contribute in any way we can."

Already, in collaboration with Stothard, the department's researchers have created genetic tests to increase hybrid vigour in cattle, and have identified new genes that govern immune response and feed processing.

Stothard's skills in bioinformatics are also in demand elsewhere. Collaborating with a UAlberta researcher in biological sciences, he is characterizing the genomes of bacteriophages (viruses that infect bacteria). With researchers in the School of Public Health, he is identifying microorganisms present in treated waste water, to understand the risks associated with waste water reuse.

The software tools he and his team create are also shared with the world's research community.

"They are used by hundreds of people daily and have been cited in thousands of studies. So that's another impact of our work. DNA is the common thread across all these studies and it applies to everything, from viruses to bacteria, invertebrates to mammals to plants."

An orthomosiac of the Roy Berg Kinsella Ranch, located about 150 kilometres east of Edmonton.

EYE IN THE SKY

Drone technology research helps precision ranching develop new tools for success

BY CAIT WILLS

As a boy, John Church idolized Colonel Steve Austin. One of his most fascinating bionic enhancements was his eye, which allowed him to see with a 20x optical zoom.

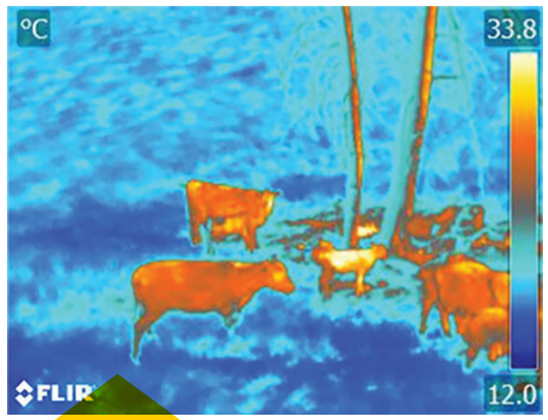
Today, Church (BSC, Ag '91) uses drone technology to develop new tools for ranchers—but his zoom capabilities are 180 times better than the Six Million Dollar Man.

The technology he uses is an RBG camera of orthomosiacs of pastures, which can be used to assess plant volume. There are also multispectral, hyperspectral and LiDAR (light detecting and ranging) sensing methods. Through building a map of land using a non-distorted image to create a mosaic, farmers are able to see their land down to the last inch, says Church. "Each pixel captured by the drone is representative of approximately 2.5 centimetres," he says.

"This is price effective technology that has never before been available at this level."

PRACTICAL APPLICATIONS

At its most basic level, the rangeland and pasture management that can be developed through this technology will allow farmers to find individual weeds for treatment instead of having to commit to broadcast application. Church, who is the



Top: John Church. **Bottom:** A thermal reading of the heat emanating from cattle that are not under heat stress.

TOP IMAGE COURTESY OF THOMPSON RIVERS UNIVERSITY

B.C. regional innovation chair in cattle industry sustainability and associate professor of cattle research at Thompson Rivers University, says drone technology will also help with estimating underground carbon sequestration by plants, the location and measurement of biomass and optimal times for moving cattle to the next pasture.

"I'll be compiling data using drones, which have an advantage over satellites because satellite data is often compromised because of cloud cover," he says. "With drones, you can fly low and slow.

"We regularly fly as low as 40 metres," says Church, which means that the cattle that are being monitored are far enough away not be panicked by the noise of sight of the drone, but are close enough to be monitored with the sophisticated imagery available through the on-board cameras.

"Farmers have a saying, 'Take calf, leave half,'" says Church. "This type of pasture management will be more precise and, therefore, more cost effective."

But there are bigger implications, of course ...

In the summer of 2017 a heatwave struck California. In June, media reports said that California was seeing some of the highest temperatures ever recorded; three weeks later, Los Angeles had the dubious distinction of breaking a 131-year heat record. Across the parched state, plants and animals felt the impact of this unprecedented meteorological occurrence.

On July 8, the *Porterville Recorder* in the San Joaquin Valley reported that the June 30 state of emergency would be extended by the Tulare County Board of Supervisors. The reason: an estimated 4,000 to 6,000 cattle had died in the last month of heat exhaustion and rendering facilities were over capacity.

Tulare County, nestled west of Sequoia National Forest, is known as the most productive county in the United States in terms of agricultural revenue, at $3.5 billion USD annually. The dairy industry typically generates revenue of about $1 billion USD a year, and farmers in Tulare County often say there are nearly more cows than people—200 dairy farmers and 380,000 cows were the count in 2017. This was before the heat wave.

By using drone technology, Church plans to assess heat stress in cattle at both the Kinsella Ranch and the Mattheis Ranch, both important research sites for the faculty. "The thermal camera that provides 30x optical zoom will provide us with important information in these hotter summers," he says. One of the reasons why the cattle at these ranch sites are so integral to this work, he says, is because the faculty uses primarily Angus, which have black coats, over Charolais, which are light coloured.

"No one is really asking the question about how heat stress will impact cattle long term," he says. Given the increase of temperatures globally—"we may see temperatures go up two, five or even 10 degrees over the next decade"—assessing heat stress is important work now, which will have long-term implications.

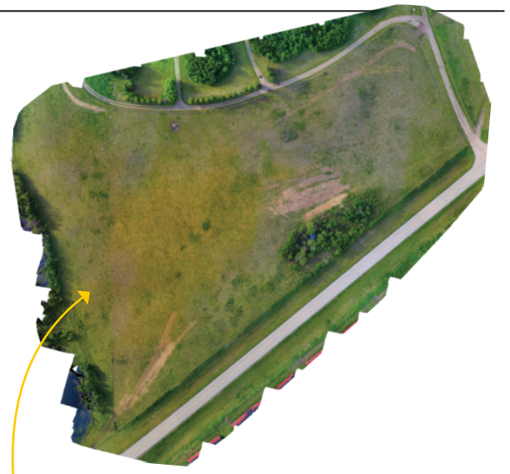
And it all started right here.

John Church earned his undergraduate degree from the Faculty of ALES in 1991. He then went to Delhousie University—"it's important to spread out your education," he says—before returning to the Department of Agricultural, Food and Nutritional Sciences (AFNS) to study under Bob Hudson who, according to Church is the "father of precision ranching".

"Dr. Bob knew we didn't have the tools to be precise, but he knew they were coming," says Church. "It's exciting for me to come back to the University of Alberta and realize his vision 20 years later."

The idea of precision ranching was coined in the early '00s by a number of researchers in the Department of AFNS,

"It is the right analysis at the right time, which helps advance our work."



WHAT THE NEW FARMER NEEDS TO KNOW

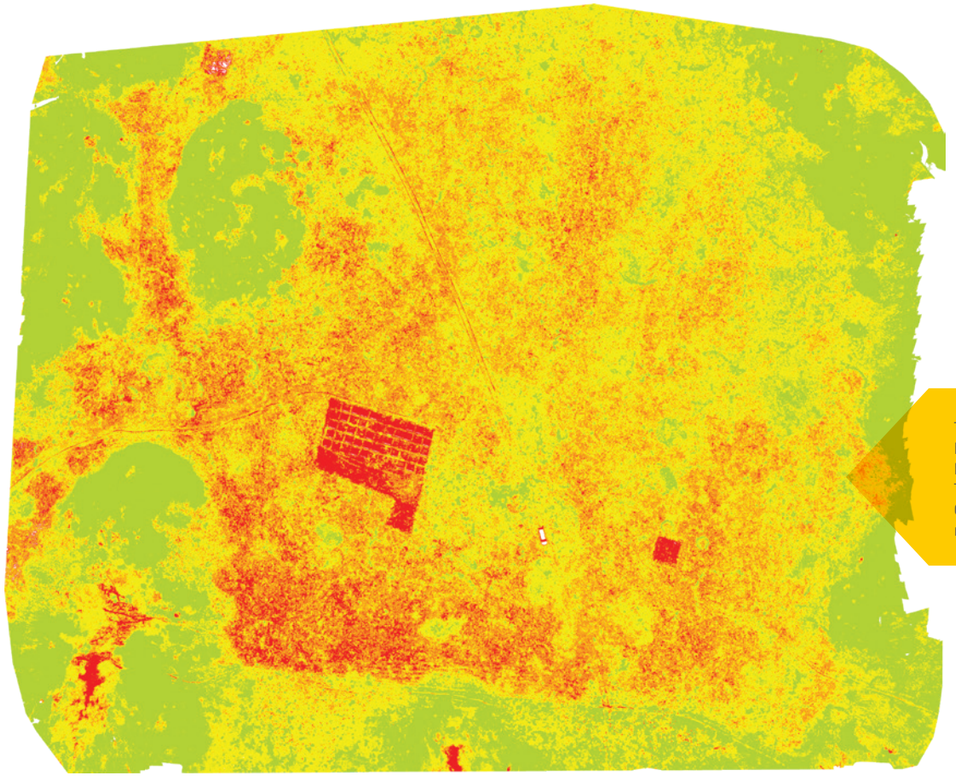
(a glossary of terms)

ORTHOMOSIAC:

An aerial photograph geometrically corrected so that the scale is uniform; the photo has the same lack of distortion as a map. It is used to measure true distance because of that lack of distortion. And, Church says, because each pixel of an orthomosiac is geotagged, plant identification can be managed through GPS entry. "You can walk right up to the plant, using orthomosiac technology."

LiDAR REMOTE SENSING:

Uses light in the form of pulsed light to measure ranges of variable distances through reflected energy. Multispectral LiDAR sensors acquire data at different wavelengths and the hyperspectral LiDAR systems provide greater possibilities for remote sensing of [plants]. According to research conducted by the Finnish Geodetic Institute, hyperspectral LiDAR has a significant impact on remote sensing and other fields where target(ed) 3D detection and identification is crucial.



This image is the NDVI map of the Kinsella Ranch. The red spots are Cameron Carlyle's research sites .

"We can monitor forage production as well as carbon in the soil."

including Bob Hudson and Edward Bork, who is now the director of the Rangeland Research Institute.

"The concept is quite simple," says Bork. "It was a spin off of 'precision farming'; the latter of which generally tries to optimize the application of costly inputs into cropland—including fertilizer, water and pesticides—across complex landscapes at just the right timing and rate of application in order to maximize crop production.

"Precision ranching, in turn, was conceived as the process of optimizing the timing and spatial distribution of livestock—potentially containing multiple species like bison, cattle, elk and deer that have complementary diets—in order to simultaneously organize both animal production and long-term sustainability of rangeland resources."

A lofty endeavour, but one the Rangeland Research Institute handles adeptly by supporting research projects led by Church and Cam Carlyle, who is an assistant professor of rangeland ecology in the Department of Agricultural, Food and Nutritional Science .

"Analogous to precision agriculture, which is all about doing the best land management possible, is the work we are doing," says Carlyle. "It is the right analysis at the right time, which helps advance our work so much."

"What may take a human a week in a pasture to review and analyze can be completed by a drone tour in about 20 minutes," he says.

By looking specifically at heat stress in cattle, and at vegetation, to determine the frequency of drought due to climate change, the research Church and Carlyle will conduct while Church is on sabbatical with the faculty should have significant impacts for landowners.

"We can monitor forage production as well as carbon in the soil," says Carlyle. "Ranchlands are such a large ecosystem they can be used to sequester carbon," and this research could have financial implications for rangeland management, he says. "Could producers be paid a carbon offset to sequester carbon?"

WHAT'S NEXT

Like all good scientific inquiry, this high-end technology raises as many questions as it answers. With these high-tech drones at his fingertips, Church will be using his sabbatical year in ALES to develop precision ranching for use by farmers around the globe. Thanks to his ability to stay above the ground, but get down to the dirt, he is confident these tools will help hone precision ranching in the 21st century.

PHOTO BY CAIT WILLS

HISTORIC BEEF CATTLE HERD MOVES INTO FACULTY OF ALES

HAYS CONVERTERS DONATED TO LIVESTOCK GENOMICS PROGRAM BY FAMILY THAT DEVELOPED BREED

BY HELEN METELLA

An entire herd of the famed Hays Converter beef cattle breed now has a new home within the Faculty of Agricultural, Life and Environmental Sciences.

The herd was donated to the faculty's livestock genomics program by retired senator Dan Hays, the son of the late senator Harry Hays, who developed the breed in southern Alberta in the 1950s.

Eighty breeding females and five bulls are now housed at the Roy Berg Kinsella Research Station, 150 kilometres east of Edmonton, where the faculty researchers and students study beef cattle breeding with its existing head of 850 cattle. This fall, a final 20 females will complete the transfer.

The move happened in December 2017, after the Hays family announced its intention to donate in 2015. Unlike donating money, donating animals or land involves an emotional attachment, says Barry Irving, manager of the research ranch.

"Especially a named herd like this one that's named after a family. It's like giving away a little of yourself," he says.

The Hays Converter represents a significant part of Canada's agricultural history. It was the first beef breed developed by a Canadian livestock producer, which was recognized as a

In my view, this is a fantastic opportunity for our genetics students.

SENATOR DAN HAYS PHOTOGRAPHED BY JOHN ULAN

pure breed and registered under the provisions of the Animal Pedigree Act in Canada.

Harry Hays' decision to crossbreed cattle was also controversial for the time, when purebred selection was the common practice. However, Hays wanted to develop a breed that would convert feed to lean meat as efficiently as possible in the harsh conditions of Western Canada's rangelands. At the time (1940s to 1960s), cattle could not be imported from Europe to Canada because of fears of spreading foot and mouth disease.

By combining the genetics of the Hereford, Holstein and Brown Swiss breeds, Hays selected not just for hardiness, but for fast growth, sound feet, easy calving and good milk production and fertility.

Although the popularity of the Hays Converter breed was usurped by the eventual importation of European breeds in the 1960s, and is now used for commercial beef production by just three breeders (in Quebec and Manitoba), it is helpful in genetic research.

"It's a crossbreed between two very well-known genomes, the Hereford and Holstein," says Irving. "The value of that herd is that it unlocks the complexity of those crosses."

Researchers at Livestock Gentec, the UAlberta-based centre that researches the commercial benefits of genomics in the livestock industry, are keen to get started working with the Hays Converters.

"In my view, this is also a fantastic opportunity for our genetics students to gain firsthand experience of managing genetic improvement for a breed," says Graham Plastow, CEO of Livestock Gentec.

In addition to his remarkable career as a lawyer, humanitarian and senator, Dan Hays became involved in the livestock business as a breeder, exhibitor and marketer. He and his father operated a large mixed farm and ranch near Pekisko in the Foothills southwest of Calgary.

Harry Hays died in 1982, but his son continued to operate the ranch for another 18 years. In 2000, Dan Hays sold the bulk of his ranch lands, but maintained his herd of Hays Converters.

Through the work being done by Livestock Gentec, led by Graham Plastow, a research relationship formed between Dan Hays and Plastow. That research, in the case of the Hays Converters, looks at the traits of the cows, including carcass weight, marbling and milk production, as well as feed efficiency, which are the results of optimal genetics.

The hope is that research done on the Kinsella ranch through Livestock Gentec will result in transnational outcomes for Alberta beef producers, says Plastow.

TRAINING PEOPLE HOW TO TRANSFORM THEIR WORLD

ESTABLISHED TO SHARE AGRICULTURAL EXPERTISE OVERSEAS, AGRITEAM NOW IMPROVES LIVES ON MULTIPLE FRONTS

BY HELEN METELLA

As a student at the University of Alberta, Bob Francis famously did not let a significant opportunity slip by him just because it involved several unfamiliar tasks—and by nurturing that trait ever since he has built a remarkable career.

Francis, '80 B.Sc. (Ag) is the founder, president and CEO of Agriteam, which delivers management and technical expertise to 26 countries in a dizzying array of sectors. Its current projects range from designing an HIV-AIDs surveillance system in Pakistan to developing a computer system for land titles in Columbia to training the new police force in Ukraine.

"The thread that connects all of this? We do capacity building," says Francis from his company's headquarters in Calgary. "We help governments and institutions build the capacity to perform the functions they need to do."

Francis' zest for solving multifaceted problems featuring many moving parts surfaced early.

In 1979, he was completing two bachelors of science (he also has one from the University of Calgary) and doing coursework for a master's in agricultural economics. While also working part time for Canada's Department of Agriculture, he learned that local sheep producers wanted Alberta to help them import a planeload of bargain-priced breeding stock from New Zealand.

Realizing the provincial government wasn't interested in the rigmarole of transferring sheep to individual producers in small batches, Francis created a business plan, found a venture capitalist and chartered a DC-8 stretch jet to fly 806 purebred sheep to Alberta. At the time, it was the largest importation of livestock by air into North America and, not surprisingly, the Canadian government did not have a big enough quarantine location.

"So we turned our family ranch (in Priddis) into a private quarantine facility," says Francis. "I dropped out of grad school, sold enough sheep to pay off the Alberta investors and went (into) farming."

Several years later, when Canadian agriculture officials were approached by Saudi Arabian royalty who wanted someone to build a domestic sheep industry for them, they remembered Francis and recommended him.

Despite negotiating with the Saudis for several years, Francis never finalized a contract. "But it gave me the idea to set up a consulting company to do large-scale agricultural projects overseas," he says.

His first contract was with an Asian development bank guiding the marketing of livestock in Indonesia. That led to other overseas projects in agricultural policy and extension training, such as exporting Uruguayan meat to North America. This experience, like the ones before, helped create Agriteam, which was founded in 1986.

While the company's roots were in agriculture, Francis responded to new opportunities by rapidly diversifying, a decision that set him apart from his competition, he says. The company now works in projects concerning agriculture, the environment, education,

Agriteam has programs around the world that help address issues of social injustice and inequality.

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"**We are moving societies** to a better state and are having impact on government policy making."

Agriteam works on projects involving agriculture, education, government restructuring and public health.

government restructuring and public health.

"The core aspects of business development and management of activities were common among all the sectors," says Francis. "We just needed to hire specialists for different projects—so we hired lawyers, health specialists, people with master's and PhDs in education."

Today, Agriteam employs almost 100 full-time Canadians, another 300 to 400 on contract, and approximately 1,000 local staff in field offices around the world. It is hired by development banks, governments and non-governmental organizations, and also works in partnership with universities, such as it's doing on a maternal and child health project in Tanzania with the University of Calgary.

At first glance, the projects seem wildly diverse, but in fact, "we are moving societies to a better state and are having impact on government policy-making that, in turn, has an impact on people's livelihoods," says Francis.

"A lot of the problems we have in the world—radicalization and migration—are a result of people who don't have hope. A lot of those problems are avoidable if we help those countries develop and prosper," he says. "We need to develop countries so companies are prepared to invest there, to generate opportunities and a tax base. We need better skills; a better rule of law. Our aid program in Canada is one of the vehicles that can help those countries develop."

Francis points to concrete examples of how development aid has already transformed countries in the 32 years since he began working in this field. Both Thailand and South Korea were eligible for foreign aid back then, he says. Both are now robust trading partners with Canada.

Equally satisfying to Francis are the changes he sees in individual Canadians he employs.

"We live in a nice, secure, well-managed part of the world. I take someone from Canada to South Sudan to work and they come back another person—more enlightened, more global."

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IN MEMORIAM

The Faculty of ALES notes with regret the passing of its following alumni:

DOROTHY MURIEL ROSS
'36 BSc(HEc), of Edmonton, AB, in September 2017

HELEN MAUD GIBSON
'40 BSc(HEc), of Victoria, BC, in February 2008

ARDYCE MARGUERITE SYME (REYNOLDS)
'40 BSc(HEc), of Victoria, BC, in October 2014

RENA ELVES (WISHART)
'41 BSc(HEc), of Calgary, AB, in February 2016

CHARLOTTE MARIAN RATTRAY
'41 BSc(HEc), of Edmonton, AB, in April 2015

AMELIA C. AYRE (CHABAN)
'42 BSc(HEc), of BC, in December 2016

GERDINE MCPHEE
'42 BSc(HEc), of Gibsons, BC, in March 2015

SIDNEY BERNARD SLEN
'42 BA, '43 BSc(Ag), of Lethbridge, AB, in December 2017

KATHLEEN DORIS IRVING
'43 BSc(HEc), of Calgary, AB, in September 2016

FRANCES ELEANOR LELAH KOHN
'44 BSc(HEc) of Delta, BC, in December 2017

LESLIE R. WETTER
'44 BSc(Ag), '46 MSc, '50 PhD, of Saskatoon, SK, in December 2010

JOHN STUART BLACKIE
'47 BSc(Ag), of St. Albert, AB, in November 2017

NORMA ADELAIDE ROBERTSON (SMITH)
'48 BSc(HEc), of Edmonton, AB, in December 2017

WILLIAM PHILIP CAMPBELL
'49 BSc(Ag), of Nepean, ON, in December 2017

CONNOR L. EDWARDS
'49 BSc(Ag), of Three Hills, AB, in April 2015

NANCY-JEAN CORNELL HEUTHER (YORK)
'49 BSc(HEc), of New Westminster, BC, in February 2017

PATRICIA SCHLOSSER
'50 BSc (HEc), of Edmonton, AB, in February 2018

ROY LEONARD MILLAR
'50 BSc(Ag), '52 MSc, of Prairie Village, KS, in August 2017

WALTER LEROY MCNARY
'51 BSc(Ag), of Camrose, AB, in September 2017

ALEXANDER BAILLIE MORRISON
'51 BSc(Ag), '52 MSc, of Bountiful, UT, in February 2018

MARGARET ANNE BELL (HANSEN)
'52 BSc(HEc), of Chandler, AZ, in October 2017

JOHN K. CHURCH
'52 BSc(Ag), of Calgary, AB, in October 2017

PATRICIA JEAN DUGGAN
'53 BSc(HEc), of Atlanta, GA, in April 2017

JOHN MARKOVICH
'53 BSc(Ag), of Edmonton, AB, in November 2017

JAMES ANDREW LORE
'54 BSc(Ag), of Carstairs, AB, in December 2017

About Jim Lore
Jim liked to quote the artist Charlie Russell who said that if you can make your living doing what you like, you are one of God's truly blessed. He always said that he was one of those.

CALVIN CECIL CIBART
'55 BSc(Ag), of Regina, SK, in August 2017

EILEEN ETHNE QUINN (BRETT)
'56 BSc(HEc), of North Vancouver, BC, in September 2016

ROBERT WILLIAM CROMARTY
'57 BSc(Ag), '60 MSc, of Richland, WA, in October 2017

MARYETTA HARPER (THORNTON)
'60 BSc(HEc), of Edmonton, AB, in October 2017

About Pat Schlosser
A prairie girl at heart, Pat had a love of nature, which was reflected in her beautiful gardens and her reverence for the changing seasons. Believing in giving back to one's community, Pat was part of a group of families who donated a special parcel of land near Devon Alberta for future generations to enjoy.

GUENTER WILHELM RIEDEL
'62 BSc(Ag), '67 PhD, of Ottawa, ON, in February 2018

RONALD CLYDE KRAUSE
'67 BSc(Ag), of Calgary, AB, in October 2017

DOUGLAS BRUCE PATTERSON
'70 BSc(Ag), of Calgary, AB, in January 2018

KAREN DALE LOUIE (MIMURA)
'77, BSc(HEc), of Calgary, AB, in November 2017

THERESE GERMAINE BEAUDOIN (LAPLANTE)
'78 BSc(HEc), of Edmonton, AB, in September 2017

BERTHA SOLVEIG EGGERTSON (ANDREASSEN)
'82 MSc, of Calgary, AB, in December 2017

ANNE MARY HODGSON (HUTCHINSON)
'87 MSc, of Maple Bay, BC, in November 2017

DARLENE BARTKOWSKI, BSC(HEC)
'92 of Edmonton, AB, in January 2018

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