



20 YEARS
GenomePrairie

CLARITY OF VISION

2019-2020 ANNUAL REPORT

Introduction

Clarity of Vision

Twenty years of Genome Prairie, the year 2020 and 20/20 vision. It all seemed so clear-cut. Then the COVID-19 pandemic happened, our lives changed and global priorities shifted.

However, Genome Prairie's central role in aligning partners and resources to develop and manage genomics, and related biosciences, projects in Manitoba and Saskatchewan remains intact and relevant.

Researchers supported by Genome Prairie address key regional priorities including agriculture and food security, healthcare and personalized medicine, environmental remediation, and natural resources. Together we strive to build the Prairie region's reputation as a location of choice for academic research, innovation, and commercialization.

This Annual Report profiles Genome Prairie's current work in livestock, crops, freshwater fish, wildlife conservation in Canada's North, consumer preferences and community-level genomics. Additionally, our organization is part of rapid response research into COVID-19 on both national and regional levels.

Genome Prairie's mission and vision remain clear and our ongoing support for vaccine development and food security are significant contributions helping to address current and future societal needs.

Our Mission

To accelerate and leverage knowledge translation of genomic discoveries to provide social and economic benefits for the people of Manitoba, Saskatchewan and beyond.

Our Vision

Genomics will change what we know today and how we live tomorrow.

Our Pathway

Project Development

Genome Prairie serves as an engine for economic development. With offices in Saskatoon and Winnipeg, Genome Prairie identifies and refines new project opportunities, facilitates national and international collaboration, and aligns partners and resources to ensure the success of selected research projects.

- Over 20 years, Genome Prairie has invested \$362 million in 35 genomics projects

Research Management

Our projects are at the forefront of research and development in genomics and related biosciences.

Genome Prairie's team strives to bring together significant expertise and resources from different academic institutions and industries across Canada. The scale and complexity of these initiatives requires strong project management to optimize successful completion of goals and objectives.

- Cumulative economic impact of \$290,907,826 in GDP since 2005
- Funding leverage of 7:1. According to independent analysis, for every \$1 invested in Genome Prairie by the provinces, another \$7 of near-term economic impact is generated.

Community Engagement

Success in any scientific field often depends on factors beyond the lab bench. Relationship building and information sharing are critical activities that can lead to unexpected connections and innovation. Through communications and outreach activities, Genome Prairie helps strengthen the Prairie research community and the talent it attracts.

OUR IMPACT

Through collaboration, Genome Prairie's operational activities and investments in projects create economic and social contributions in Manitoba and Saskatchewan.

Genome Canada's business model is based on partnerships with each Canadian region. Genome Canada mandates that every program launched has co-funding partners and every project or initiative has support.

Some of the ways Genome Prairie has an impact include:

- Addressing regional and national issues
- Advancing local talent
- Building public and private sector partnerships
- Contributing to training and employment opportunities
- Developing new technologies
- Establishing expertise, capabilities and capacity
- Facilitating industry solutions
- Leveraging funding

As each day passes, I am reminded of the Chinese expression “May you live in interesting times.” There is no doubt that these have been interesting times at Genome Prairie. During the first quarter of 2020, changes in the organization’s leadership were coupled with the COVID-19 pandemic and the challenges of staff working primarily from home in two different cities.

That said, these are exciting times to be in genomics research in Canada. COVID-19 and the global desire to understand the virus and how it spreads have elevated the research work that we do. For example, in April Genome Canada was able to launch the Canadian COVID Genomics Network (CanCOGeN) – a new initiative backed by \$40 million in federal funding. Prairie-based researchers were also quick to respond to a call for COVID-19 regional genomics initiative projects.

We are indebted to Gerry Brown for stepping in as Genome Prairie’s Interim President and CEO. To have an interim leader, with an accomplished science background, able to fulfill this full-time role was fortunate. I don’t think that having a Board Chair who can manage complex day-to-day operations of an organization at a moment’s notice is the norm, so thank you Gerry.

To Genome Prairie’s staff, your dedication, engagement and work ethic are as strong as ever and we appreciate that. The team’s ability to concentrate on the tasks at hand and get down to business has been great to watch.

I would like to welcome Kendra Mueller to the Board of Directors and we look forward to the agricultural and financial knowledge that she brings to the table. I would also like to thank our current Board members for providing stability and support through these tumultuous times.

Speaking on behalf of the Board – with a keen focus on growth and innovation – we look forward to the next generation of leadership at Genome Prairie.

Bill Johnson
Interim Chair

OUR BOARD OF DIRECTORS

Genome Prairie’s leadership and strategic direction are provided in partnership with our Board of Directors.

Representing an array of industry and research professionals, our Board volunteers their time and expertise to ensure the continued success of our organization.

Bill Johnson (Interim Chair)

Mitchell Abrahamsen

Gerald Brown

Digvir Jayas

Mike Lesiuk

David Migadel

Kendra Mueller

Jenisa Naidoo

Curtis Rempel

Patty Rosher (Vice Chair)

Message from the CEO



Gerald Brown with **Karen Churchill**,
President and CEO, Ag-West Bio

The year 2019-2020 is certainly one for the history books.

As an organization, Genome Prairie saw successes with Genome Canada's recent Large-Scale Applied Research Project (LSARP) competition in agriculture with three new projects in crops and livestock established and running efficiently. Plus, we received additional Western Economic Diversification (WED) support for our Genome³⁶⁰ community outreach initiative, this time in Saskatchewan. Organizational challenges included difficulties in our management structure and its functions early in 2020, and then COVID-19, which surfaced at a critical time in the development of proposals for the Genomic Applications Partnership Program (GAPP) and LSARP competitions.

The team pulled together, overcame the limitations of working from home, and developed numerous project proposals for 2020 competitions. During the same time period, we solicited and awarded one of four Rapid Regional Response (COV3R) projects to address COVID-19, involving principal researchers from both provinces. Relationships have been established with the provincial health labs in both Saskatchewan and Manitoba to participate in the \$40 million Canadian COVID Genomics Network (CanCOGeN) to sequence both COVID-19 and host genomes. Our team continued to work hard – developing innovative solutions and making significant contributions – during a very demanding time personally, professionally and globally.

The COVID-19 pandemic brings immense challenges, as well as highlights past and present contributions to genomics and related research in the Prairies. Genome Prairie is particularly proud of our 15-year history of support and partnership with VIDO-InterVac in the area of vaccines and advancing the understanding of mechanisms of immunity. Our investments have helped establish the necessary infrastructure, expertise and capacity to immediately address COVID-19, testing drug and vaccine candidates, and developing VIDO-InterVac's own series of vaccine candidates. These investments help to make a noteworthy contribution to the global disease challenge, while potentially offering domestic safety and security of vaccine supply.

COVID-19 induced restrictions on social interactions, travel, trade, and food safety and security all benefit from studies and applications in genomics. Genome Prairie's leadership in agriculture has helped to enable the development of crop varieties capable of tolerating climate extremes, and disease and pest problems – helping to provide food safety and security. Similarly, animal vaccines protect the livestock industry for both domestic supply and export markets. We also support leaders in environmental applications, toxicology and oil spill remediation on land and in freshwater and saltwater. The future is exciting, offering extended genomics applications in all these areas, and practically unimaginable advances in healthcare and personalized medicine.

Genome Prairie will continue to ensure that Manitoba and Saskatchewan realize the benefits of, and make significant contributions to, genomics for local, domestic and global applications. As a result, we can be positioned to manage the next crisis – whether it is in health, disease, climate or the environment.

Finally, I want to thank the Board for their considered involvement, their guidance, their support of Genome Prairie's vision, and Bill Johnson in particular for stepping up as Interim Board Chair during this time of management transition.

Gerald Brown
Interim President & CEO

Message from the CSO

2020 Vision – Seeing Differently

As the New Year dawned, 2020 was supposed to be the year of clear vision – and Genome Prairie was working on delivering exactly that with our focus on maintaining the strength of our agricultural genomics base whilst using our growing networks to expand into new arenas such as human healthcare and the environment.

Instead 2020 has become a year where lenses have changed and the world along with it. How we interact in diverse communities, as people and scientists, how we view global and local responses to crises, and how we can prepare for the inevitable next set of challenges have all come under renewed scrutiny.

COVID-19 and recent social upheavals have demanded that we show how genomics as a discipline and how we at Genome Prairie can be a force for unity and reconciliation. This is possibly the most interesting phase of our evolution to date. The ability to pivot our Genome³⁶⁰ program in Saskatoon to provide support to the effort to understand and mitigate the effects of the current pandemic is one concrete example.

However, in the next year our main game will be to further develop our community outreach programs to deliver real benefits, both in our region and beyond. In addition to Genome Canada competitions, particularly the 2020 Large-Scale Applied Research Project competition in Natural Resources and the Environment, we will continue to build on the success of our Genome³⁶⁰ initiative, now active across both provinces with federal and provincial support. In its next phases, this initiative will begin to build a community of shared resources and practice in genomics across the region and to develop a unique concept for delivery of tangible benefits at the municipal level.

It is our contention that the next leap in the evolution of genomics will not be a shiny new piece of technology, but it will be the meaningful and socially inclusive integration of the science into the everyday lives of the communities we serve.

2020 may not be the year we expected, but it is a year of unique challenge and opportunity and Genome Prairie is singularly well-positioned to take on both. The next phase of genomics begins. Here.

Simon Potter
Chief Scientific Officer

OUR STAFF

Genome Prairie's team engages and aligns our partners with the resources necessary to develop and manage bioscience research projects that address regional and national priorities.

Shadman Alam – Lab & Outreach Technician (term)
Mercedes Alcock – Lab Manager, Genome³⁶⁰
Jayne Alexander – Project Officer & Bioinformatician
Shawna Bieber – Programs & Business Development Manager
Gerald Brown – Interim President & Chief Executive Officer
Tammy Hildebrand – Project Portfolio Manager

Beth Ireland – Director of Communications & Corporate Secretary
Faye Pagdonsolan – New Programs, Administration & Human Resources
Patrick Pitka – Chief Financial Officer
Simon Potter – Chief Scientific Officer
Virginia Tomas – Accountant



Ekosi Health's **Karen Debroni** and **Shelley Turner** with **Simon Potter**

20 YEARS GenomePrairie

COLLABORATING ON THE FUTURE

Genome Prairie is founded.

2000



2003

Genomics and infectious disease: Functional Pathogenomics of Mucosal Immunity is one of the first major projects to advance understanding of innate immune responses to infectious disease.



15 YEARS GenomeAlberta

Alberta spins off to form Genome Alberta.

2005



2006

Of knockout mice and men: North American Conditional Mouse Mutagenesis (NorCOMM) launches under Geoff Hicks, University of Manitoba.

Removing roadblocks to innovation: Value Addition Through Genomics and GE³LS (VALGEN) is led by Peter Phillips, University of Saskatchewan.

2008



2009

Future of flax and biofuels: the Province of Manitoba invests heavily in Genome Prairie's Total Utilization of Flax Genomics (TUFGEN) and the Microbial Genomics for Biofuels and Co-Products from Biorefining Processes (MGCB2) projects.





prairiegold

Prairie Gold: managed by Genome Prairie, an innovative \$4.5 million project to develop the emerging industrial oilseed market, including biofuels, in our region.

2010

Genomics in Canada's Arctic: the Microbial Genomics for Oil Spill Preparedness in the Canadian Arctic (GENICE) project is launched with Genome Alberta.



Lentils, livestock and wheat: announcement of a \$24.2-million investment over four years by Genome Canada and its partners in three Genome Prairie-led LSARPs.

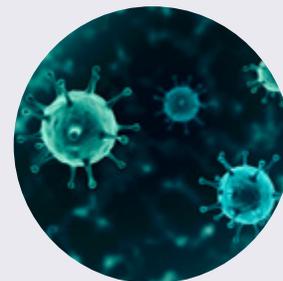
2019

2015

Wheat genome is sequenced: University of Saskatchewan's Curtis Pozniak and his team are part of the International Wheat Genome Sequencing Consortium.



2020



CanCOGeN 

Fighting COVID-19: the CanCOGeN national initiative is launched, emphasizing preparedness for the future and playing a role in Canada's economic recovery.



Genomic ASSETS for Livestock – Protecting Animal Health

In Saskatchewan, there are one million people but two million beef cattle. As a result, the economic footprint of the beef industry is huge.

The 2018 Large-Scale Applied Research Project (LSARP) program is supporting a multi-disciplinary team of researchers and industry partners to advance livestock health diagnostics.

Led by researcher Cheryl Waldner in collaboration with Simon Otto, Genomic ASSETS (Antimicrobial Stewardship Systems from Evidence-based Treatment Strategies) for Livestock connects partners across the Prairies to harness genomic tools to support practical disease management. Waldner is an epidemiologist, a veterinarian, a cow-calf producer and a professor at the Western College of Veterinary Medicine, University of Saskatchewan. Otto is a veterinary

epidemiologist and assistant professor with the University of Alberta's School of Public Health.

Focusing on bovine respiratory disease in the feedlot – the most costly animal health problem in the beef industry – Waldner's team will develop a framework for routine clinical application of rapid metagenomic sequencing.

Genomic ASSETS for Livestock will support precision use of antibiotics to protect animal health and welfare by providing quick and accessible information for veterinarians to guide therapy for individual pens of calves. The same tools used to identify pathogens present in calves arriving at feedlots could also be optimized to identify viral and bacterial vaccine gaps for beef producers.





Calves in the Beef Cattle Teaching & Research Unit at the Livestock and Forage Centre of Excellence

Economies of scale in livestock agriculture demand sophistication in animal health management to continue to meet the demands of the global market. In addition to a number of technological innovations, this project will pioneer the concept of pen-level (or management group-level) precision medicine.

Genome Prairie manages Genome Canada's \$2.5 million contribution, for a total of \$5.6 million in project funding. Recognizing the importance of this work, the governments of Saskatchewan and Alberta (through Genome Alberta), Agriculture and Agri-Food Canada, and the Canadian beef industry are contributing \$3.1 million. Researchers leveraged project funding by expanding industry partnerships and building on aspects of Waldner's NSERC/Beef Cattle Research Council Industrial Research Chair in One Health and Production-Limiting Diseases.

Saskatoon-based Prairie Diagnostic Services Inc. (PDS) is also a project partner. PDS is the largest Western Canadian, full-service animal health diagnostic lab, which is also the first certified nanopore sequencing service provider in Canada. PDS will provide lab research support and will be the first to adopt innovations from this project.

Proof-of-concept research conducted by PDS and the Agriculture and Agri-Food Canada Lethbridge Research Centre demonstrate

feasibility of rapid diagnostics for evidence-informed therapy through application of metagenomic nanopore sequencing and recombinase polymerase amplification. This will be a big improvement compared to the traditional five to seven-day diagnostic turnaround time for culture-based testing.

Expertise on the research team ranges from classical and molecular clinical microbiology to sequencing, metagenomics, bioinformatics, dynamic modelling, epidemiology, economics, and feedlot health management. Genomics & its Ethical, Environmental, Economic, Legal and Social Aspects (GE³LS) activities, led by Otto, are integrated at all stages of the project using industry feedback and economics to maximize uptake.

Key to the research is the newly commissioned University of Saskatchewan Livestock and Forage Centre of Excellence (LFCE), located by Clavet. The LFCE replicates a commercial feedlot setting while allowing repeated access to calves and satisfying required scientific rigor.

Genomic ASSETS for Livestock will provide direct benefits for beef health management and significantly advance genomic applications for infectious disease management across all animal health sectors.



EVOLVES – Accelerating the Inner and Outer Beauty of Lentils

Canada, especially Saskatchewan, is a leader in lentil innovation but it's not geographically close to the markets that consume the most lentils. Given this reality, how can Canadian lentil producers gain an advantage and capture market opportunities on the world stage? With Enhancing the Value of Lentil Variation for Ecosystem Survival (EVOLVES), researcher Kirstin Bett and her team are addressing this very issue.

Announced in summer 2019, EVOLVES is one of eight projects to emerge from Genome Canada's 2018 Large-Scale Applied Research Project (LSARP) competition: Genomics Solutions for Agriculture, Agri-food, Fisheries and Aquaculture.

EVOLVES strives to accelerate the deployment of specific quality traits in lentils through the strategic use of genetic variability. As a result, Bett aims to improve the capability

and agility of Canada's lentil breeding program in order to gain a global competitive advantage.

Bett is a professor at the College of Agriculture & Bioresources in the department of Plant Sciences at the University of Saskatchewan. Her research is focused on pulse crop genomics and dry bean breeding. Bett earned her PhD from the University of Saskatchewan and both her BSc and MSc from the University of Guelph.

"In Saskatchewan, we have a global epicentre of lentil genomics and we work with collaborators around the world," says Bett. For example, Bett and her team currently work with AGT Food and Ingredients – the Regina-based pulse processor and a Prairie success story. Bett is also collaborating with the Italian food giant Barilla (the world's largest pasta producer) on alternatives to durum wheat in pasta for gluten-free diets.

Pulses are the dried, edible seeds of legume plants and are both high in protein and fibre, and low in fat. The most common pulse varieties are dried peas, beans, lentils and chickpeas. By volume, India, China and Brazil are the countries that consume the most pulses.

After four years of intensive research in lentil genetic diversity, Bett's previous LSARP entitled the Application of Genomics to Innovation in the Lentil Economy (AGILE) recently wrapped up. The goal of AGILE was to provide Canadian farmers with faster access to better lentil varieties that excel under Canada-specific growing conditions.

Bett's co-lead researcher on AGILE was Albert Vandenberg, also from the University of Saskatchewan and her co-lead on the EVOLVES project. At the heart of both projects are the sustainability benefits of lentils. "Pulses are fun to work with and a nice package for nutritional attributes," explains Bett.

Total funding for EVOLVES is \$7.4 million. This includes co-funding from the Western Grains Research Foundation, Saskatchewan Pulse Growers, BASF, the University of Saskatchewan, the Global Institute for Food Security, Marche Polytechnic University (Italy), Palacky University Olomouc (Czech Republic), and AGT Food and Ingredients.

Lentil producers from central Asia (the region that consists of former Soviet republics such as Kazakhstan and Uzbekistan) still have the benefit of proximity to India and China where millions of people eat lentils daily.

"Through EVOLVES we can respond to a competitive global market – in terms of lentil size, colour and other specific quality traits – Canadian producers can have an advantage. EVOLVES can help the Canadian pulse industry's goal of diversifying market outlets and creating price stability. We can't compete on volume and low pricing, but we can tailor make what people want in their lentils."



In Saskatchewan, we have a global epicentre of lentil genomics and we work with collaborators around the world.

– Kirstin Bett

Professor, College of Agriculture and Bioresources, University of Saskatchewan



TACSI – Studying Polar Bears and Grizzly Bears in the Canadian North

With support from Genome Canada and Genome Prairie, the Transforming Arctic Conservation through Social Innovation (TACSI) project conducts fieldwork in northern Manitoba, Nunavut and the Northwest Territories. The project is led by Douglas Clark, an associate professor at the University of Saskatchewan's School of Environment and Sustainability.

TACSI received three years of funding through Genome Canada's special call of the 2017 SSHRC Partnership Development Grant competition. The Social Sciences and Humanities Research Council (SSHRC) is also a federal research funding agency.

How did Clark become so interested in bears as a species? After he earned his undergraduate and graduate degrees in biology, Clark worked as chief warden at Wapusk National Park in northern Manitoba for three years (he lived in nearby Churchill). Interestingly, Wapusk actually means "white bear" in Cree.

Encompassing 11,475 square kilometres, Wapusk National Park is located where the boreal forest transitions into Arctic tundra. The park protects approximately two-thirds of the world's polar bear maternity denning areas. Clark's specialty in bear management – which includes all three species that live in Canada – was further solidified by his park warden experience.

Clark describes TACSI as foremost a Genomics & its Ethical, Environmental, Economic, Legal and Social Aspects (GE³LS) project as the researchers co-manage tasks with Inuit community members, such as setting up remote cameras to observe the bears. Relationship-building and mutual respect – of both the human and bear populations involved – is essential for the project's success.

TACSI has broadened to look at grizzly bears, as well as polar bears, since grizzlies are new to both TACSI study areas and local community members are concerned about this new arrival.





Grizzly bears were not known to be in Manitoba but now they are regulars... Genomics is a tool we can use to help find out what's going on.

- Douglas Clark

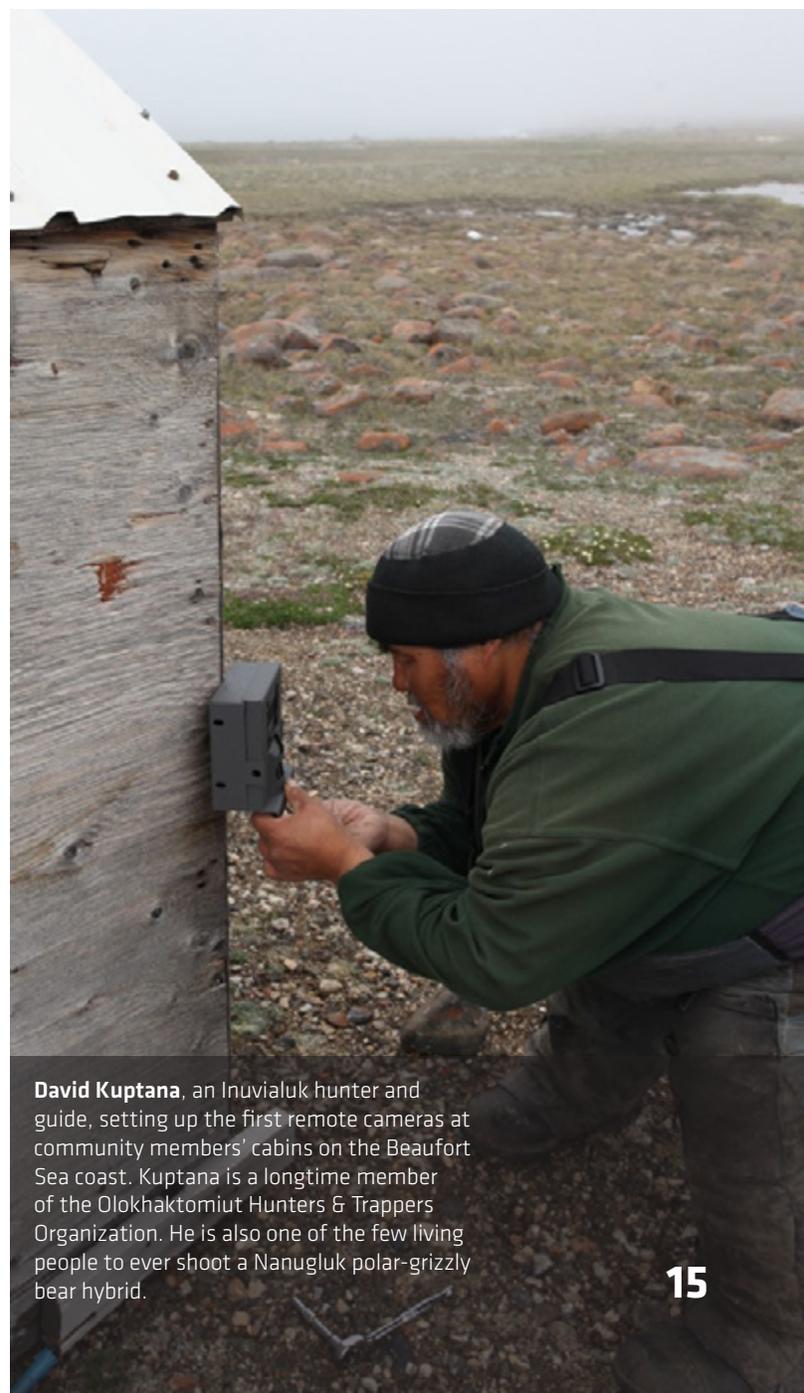
Associate Professor, School of Environment and Sustainability,
University of Saskatchewan

"Grizzly bears were not known to be in Manitoba but now they are regulars. Over the past decade grizzlies have been recolonizing the north, but the reason is not known. Grizzlies are a generalist bear and for some reason they are adapting to living farther north and west. It's like a regime shift and genomics is a tool we can use to help find out what's going on," says Clark.

What the general public might not know is that polar bears and grizzly bears can crossbreed, or hybridize, creating offspring that are also fertile. Nanugluk is the Inuvialuktun for this hybrid bear. Interestingly, black bears are not able to crossbreed with either polar bears or grizzlies. The total polar bear population is divided into 19 subpopulations, of which 12 subpopulations are in Canada.

Other areas of focus include Indigenous co-management of resources and ecosystems and an increase in reported polar bear-human conflicts. Local community members show respect for the animal by not talking about polar bears directly. The Inuit polar bear hunt is tightly regulated, sustainable and central to community life. "Not speaking about polar bears is an avoidance of hubris," explains Clark.

Going forward, more Inuit communities are interested in studying both grizzly and polar bear populations. "We would potentially have access to genomic samples from hunter-killed animals of both species in multiple locations."



David Kuptana, an Inuvialuk hunter and guide, setting up the first remote cameras at community members' cabins on the Beaufort Sea coast. Kuptana is a longtime member of the Olokhaktomiut Hunters & Trappers Organization. He is also one of the few living people to ever shoot a Nanugluk polar-grizzly bear hybrid.

GEN-FISH – Harnessing eDNA to Manage Canada’s Freshwater Fish



What I see as being really key is making sure it's not just a research project, but that there are tools that will be available to all Canadians, particularly fisheries managers, by the end of the four years.

– Margaret Docker
Biologist, University of Manitoba

Canada is home to almost 200 species of freshwater fish spread out over more than two million lakes covering about 7.6 percent of Canada's nearly 10 million square kilometres. Margaret Docker and her colleagues want to catalogue them all (the fish, that is).

"We are certainly not the only ones doing this, but we are likely the first ones doing it on this scale," she says.

Docker is a University of Manitoba fish biologist with particular interest in lampreys and salmonids. It is this and her expertise in environmental DNA (eDNA) that she brings to the table as co-lead of the 25-member Genomic Network for Fish Identification, Stress and Health (GEN-FISH) team. Genome Canada is providing \$4 million to the \$9.1 million, four-year project, with the balance coming through Ontario Genomics, Genome Québec, plus university and industry partners.

Co-led by Daniel Heath from the University of Windsor and Steven Cooke from Carleton University, GEN-FISH aims to produce accurate, easy-to-use toolkits that can determine which fish species are present in a given water body and to estimate how many fish are there. This includes commercial species such as walleye (pickerel), trout, pike, perch, and bass; species at risk such as lake sturgeon and American eel; and invasive species such as sea lamprey in the Great Lakes.

Docker explains this type of wide-ranging, cross-Canada work is where public research such as that funded by Genome Canada can really shine.

"What I see as being really key is making sure it's not just a research project, but that there are tools that will be available to all Canadians, particularly fisheries managers, by the end of the four years," says Docker.

The team has engaged with some Indigenous communities and the researchers hope to expand this facet of the project. "This seems to be something that would lend itself very well to some of these community monitoring programs."

As its name implies, the eDNA approach involves taking samples from the environment such as bodies of water and then testing them for traces of DNA that living things naturally shed. Genetic material, or markers, unique to each species need to be identified.

The GEN-FISH team plans to identify these markers from fish species across Canada so they can be incorporated into DNA microarrays, also called "gene chips."

These devices, about the size of a postage stamp, contain microscopic samples of DNA that react when specific DNA markers are present.

eDNA offers a way to gather information that is difficult to otherwise obtain. Traditional methods such as netting are time consuming, expensive and limited. They must be tailored for individual species (such as using different mesh sizes) and require crews with specialized training. eDNA can scan for multiple species within a single water sample, detecting fish that other methods could miss.

"An example might be larval lampreys that spend most of their lives burrowed in the sediment in rivers and streams," says Docker. Nocturnal species might also get missed if sampling is done only during the day.

GEN-FISH researchers will also gather data on how the DNA markers perform in the field. "Management actions to deal with invasive species can be extremely costly, so we have to be sure the test isn't cross-reacting with a native species or picking up traces of contamination."

The Business of Marketing GMOs to Consumers

“What’s in it for me?” It’s the first question consumers ask, says David Zhang. In the case of first-generation genetically modified organisms (GMOs), the answer is “not much.”

It’s an elementary marketing mistake, explains Zhang, a professor with the Edwards School of Business, University of Saskatchewan.

“I develop this crop because it is pest-resistant, so I don’t have to put more pesticides on the field. It’s good for the environment,” he says. “Does the customer care? That’s a different story.”

Zhang says consumer reluctance to buy GMOs is usually perceived as outright rejection, but analysis of the literature reveals a more subtle point from the consumer perspective.

“Farmers have more yield, are using less inputs, pesticides, whatever. I just don’t think it’s fair that as a consumer I am bearing all the risk – minimal risk, but I’m paying a premium for it. We want a discount,” he says.

“I think this is a very different interpretation.”

Backed with funds from Genome Prairie’s Societal Implications of Genomics Research program, Zhang works to shed light on how communications and advertising can influence attitudes and purchasing decisions.

He gives the example of non-browning apples. The pitch is better shelf life, easier processing, no bruising if they get bumped, all of which makes it easier for busy parents to

add fresh apple slices to their children’s lunches. All good, but... “Do I want to buy apples that have been sitting there for a long time? And are they already bruised, but I can’t tell? It’s not what I wanted!”

Zhang suggests refocusing to fit the perspective of busy parents. For example, non-browning apples stay pretty without preservatives. These apples are all-natural, ready-to-eat, right off the tree. Product developers should also avoid defensive messaging such as insisting GMOs are nothing to worry about; they are not unnatural. This only invites counterarguments. Instead, focus on consumer benefits – even indirect benefits that speak to customer values.

Herbicide-resistant and pest-resistant crops help farmers, yes. But they are also gentle on the environment and spare species such as bees and monarch butterflies.

Zhang argues that it takes a great deal of time and millions of dollars to develop a product. A modest portion should be assigned to answer: will the consumer buy it? “Before you actually do this, maybe let’s see if the consumers will be open to the idea. It’s only going to cost you a small amount to find out.”



Genomics Offers Opportunities for Northern Research

Industrial contamination, monitoring wildlife and fish populations, assessing water quality and the effects of climate change are examples of areas where Northern researchers must take the lead, says Andrew Applejohn, a senior science advisor with the government of the Northwest Territories.

“We needed to change the perspective of researchers and research funders and clearly state, as a government, we are a funder, a practitioner, a generator, a communicator and a regulator of the results of research in our own territory,” says Applejohn.

Applejohn explained his government has a much broader role than is typical of other jurisdictions. This is reflected in its Knowledge Agenda, which addresses science questions relevant to the North as well as who should be included in discussions and what should be considered. Community needs and traditional knowledge figure prominently.

Rob Annan, President and CEO of Genome Canada, says the organization’s mandate fits well with the Knowledge Agenda.

“From the very beginning, we have had a focus on putting genomics into the hands of those that can use it. Embedded in all we do is a real interdisciplinarity of science and social science and other ways of knowing,” says Annan.

Annan explains that Genome Canada uses a co-funding model – its contributions must be matched or exceeded. One aim of this model is to encourage research relevant to all partners. Genome Canada, through its six Genome centres across the country, develops partnerships with academic institutions, industry, public sector institutions, and provincial governments. One piece that has been missing, Annan says, is territorial governments.

It is something Genome Canada hopes to change with the most recent round of its flagship Large-Scale

Applied Research Project (LSARP) competition. Themed ‘Genomic Solutions for Natural Resources and the Environment,’ it offers \$25 million, to be distributed in grants of \$1 million to \$3 million.

Another goal for the North is to help develop homegrown genomics talent. An example is the partnership with Mitacs (another national organization) and the Genomic Applications Partnership Program (GAPP), to link academia and industry to provide opportunities for graduate students.

Applejohn and Annan were among the speakers at a workshop for researchers from across Canada drawn from academia, government and industry gathered in Yellowknife on November 28 and 29, 2019. Expertise included areas such as wildlife biology, water quality, ecotoxicology, genomics and bioinformatics. Organized by Genome Prairie, the event’s purpose was to brainstorm ideas, make professional connections and encourage teams to submit LSARP proposals.



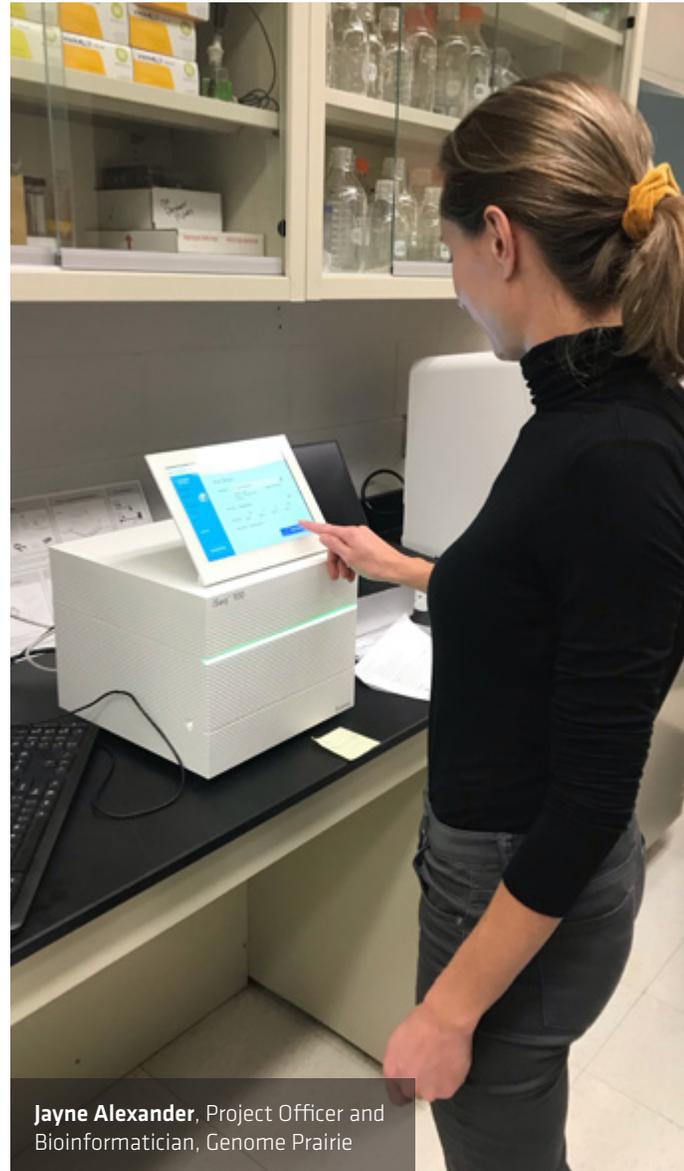
Rob Annan, President and CEO, Genome Canada;
View of Yellowknife, Northwest Territories

Genome³⁶⁰ – Strengthening Genomics Capacity Across the Prairies

Genome Prairie's Genome³⁶⁰ initiative provides specialized training and experience in advanced sequencing technologies, introductory programs at the high school level, repatriates cancer testing currently sent out-of-province, and sets the stage for applications in personalized medicine.

The latter includes a partnership with Ekosi Health, an Indigenous-owned healthcare provider in Manitoba focused on therapeutic applications of cannabinoids to displace opioids and other drugs.

Western Economic Diversification Canada (WED) provides Genome Prairie, through its Genome³⁶⁰ initiative, with support in Manitoba and Saskatchewan to work with partners including Red River College, Université de Saint-Boniface and Saskatchewan Polytechnic, as well as a major Manitoba healthcare provider. The aim is to provide access to, and training on, state-of-the-art sequencing equipment. Genome³⁶⁰ develops homegrown talent and provides hands-on experience to students and partners using next generation sequencing equipment.



Jayne Alexander, Project Officer and Bioinformatician, Genome Prairie



Saskatchewan expansion focuses on industry with genomics tools and knowledge

In addition to training, Genome³⁶⁰ aims to help Western Canadian industries develop and adopt genomics technologies to apply genomics for Prairie-based innovations in healthcare, agriculture, food, pest control and environmental monitoring. Saskatchewan Polytechnic is heavily involved in the initiative's Saskatchewan rollout and serves as both its institutional partner and its sequencing hub.

Matching tools with talent to build a network

All DNA sequencing equipment is state-of-the-art and versatile, ranging from ultra-compact handheld portable units to high-throughput desktop sequencers. SeekNet, with funding support from the Canadian Agriculture Partnership, is placing five desktop sequencers across Manitoba – strategically located to strengthen genomics networks for agriculture, agri-food and agri-based products.

Bringing it home: repatriating cancer testing in Manitoba

Genome³⁶⁰ is working with Manitoba's leading provincial healthcare provider to bring cancer testing back to the province, eliminating the need to send samples out-of-province and creating more than a dozen local jobs. This work lays the foundation to advance genomics-based testing, and to meet future demands in precision medicine, ensuring Manitobans continue to receive high-quality care as the field advances.

Investing in healthy communities: an approach to addictions treatment

Ekosi Health uses innovative cannabinoid therapies to treat addictions and help reduce reliance on opioids and other potentially harmful drugs used to manage pain and mental health. An Indigenous-owned healthcare provider based in Gimli, Manitoba, it has offices in Thunder Bay

and Winnipeg, with plans to expand to Saskatchewan. Genome Prairie, through Genome³⁶⁰, is partnering with Ekosi Health to further develop their informatics division by distilling data and generating knowledge and insight as research delves further into the therapeutic properties of cannabinoids.

Receiving recognition and providing value

Genome Prairie and Genome³⁶⁰ were thrilled to be considered and nominated in the Technology category at the Winnipeg Chamber of Commerce's Spirit of Winnipeg Awards. The nomination "recognizes the application of technology to improve the delivery of products and services to build a smarter city." Genome Prairie's nominee video is available on YouTube.



Amber Bass at the Science Teachers' Association of Manitoba's professional development day



COV3R – Genome Capture Detects COVID-19 Virus (and Everything Else)

The COV3R research team at the University of Regina: Keith MacKenzie, Kara Loos, Andrew Cameron and Danae Suchan

You’ve got a cough, you’re short of breath, you’re weak, feverish, beset with chills, and to top it off, you’ve got a splitting headache. Is it COVID-19, something else, or perhaps several somethings?

“Coinfection is a problem because any time your body has to fight multiple infectious diseases, that can compromise the ability of your immune system to protect you,” says Andrew Cameron.

Cameron, a microbial geneticist at the University of Regina, together with molecular epidemiologist David Alexander at Manitoba’s Cadham Provincial Laboratory and virologist Amanda Lang at Saskatchewan’s Roy Romanow Provincial Laboratory, lead Genome Prairie’s COVID-19 Rapid Regional Response (COV3R)

project. The COV3R team also includes members of the Institute for Microbial Systems and Society at the University of Regina (Cameron is co-director) and the British Columbia Centre for Disease Control.

The COV3R initiative aims to tackle the problem of detecting co-infections, and in the process provide powerful new tools for public health.

Coinfections can allow several pathogens to “gang up” and become deadly. A well-known example is HIV, which isn’t lethal by itself. Rather, it weakens the immune system, leaving the body vulnerable to other potentially fatal infections. Little is known about coinfections with COVID-19.



We're missing big pieces of the picture for other diseases in Canada at the moment because COVID-19 is the priority.

– Andrew Cameron

Microbial Geneticist, University of Regina

Cameron explains that current tests for COVID-19 and other diseases are based on polymerase chain reaction (PCR). These look for genetic markers that are representative pieces of DNA or RNA from a virus or bacterium. The technology is excellent at finding disease-causing pathogens – but only if scientists have found the best markers. “You can’t detect what you don’t test for,” says Cameron.

An added problem is what the pandemic is doing to testing capacity. Laboratories (and the experts to run them) are flooded with COVID-19 testing, forcing them to reduce testing for other respiratory pathogens. “We’re missing big pieces of the picture for other diseases in Canada at the moment because COVID-19 is the priority.”

Cameron and Alexander, with a team of virologists and microbial geneticists, are working to develop testing based on genome capture. The technique enriches the DNA and RNA from all possible viral pathogens, even those scientists don’t yet know about. Cameron explains this will directly complement genetic sequencing of 150,000 coronaviruses as part of Genome Canada’s Canadian COVID-19 Genomics Network (CanCOGeN) initiative.

Genome capture would add a powerful tool to the capabilities of provincial public health testing labs. “Through the design of this

technology, we’re able to detect and then sequence part or even the whole genome of pretty much every virus type that’s known to infect the human lung, which can help guide doctors to prescribe the appropriate treatment for their patients,” says Cameron.

He explains that provincial testing labs are slowly coming off their “all COVID, all the time” situation by adding multiplex testing that can look at usual priorities such as influenza A, B, and respiratory syncytial virus (RSV, which chiefly affects infants but is also a serious problem for the elderly). There are unknowns.

Cameron relates how, in fall 2019, the US military used the genome capture technique in West Africa in their efforts to help combat Ebola and other hemorrhagic fevers. What they found was a whole host of infections of completely different viral groups, all causing similar symptoms.

The COV3R team is also developing a unique tool that efficiently captures genetic material and compares it against all coronaviruses known to infect animals. It will be a valuable asset both in the current pandemic and for early detection of coronavirus pathogens in the future.

“Whole genome sequencing is revolutionizing epidemiology. No other technology comes close,” concludes Cameron.

Genome Prairie Active Projects Funded 2019-2020

CENTRE(S)	SECTOR	LEADER(S)	ORGANIZATION	PROJECT TITLE	TOTAL FUNDING
LARGE-SCALE APPLIED RESEARCH PROJECTS					
Genome Alberta Genome Prairie	Agriculture	Dyck, Michael Harding, John Kemp, Bob	University of Alberta University of Saskatchewan PigGen Canada Inc.	Application of Genomics to Improve Disease Resilience and Sustainability in Pork Production (SWINE2)	\$9,801,714
Genome Prairie	Agriculture	Bett, Kirstin Vandenberg, Albert	University of Saskatchewan	Enhancing the Value of Lentil Variation for Ecosystem Survival (EVOLVES)	\$7,432,398
Genome Prairie	Agriculture	Pozniak, Curtis Sharpe, Andrew	University of Saskatchewan National Research Council of Canada	Canadian Triticum Applied Genomics (CTAG2)	\$8,809,640
Genome Prairie Genome Alberta	Agriculture / Health	Waldner, Cheryl Otto, Simon	University of Saskatchewan University of Alberta	Genomic ASSETS (Antimicrobial Stewardship Systems from Evidence-based Treatment Strategies) for Livestock	\$5,678,154
Genome Prairie Genome British Columbia	Agriculture / Health	Potter, Andrew Hancock, Robert	VIDO-InterVac University of Saskatchewan	Reverse vaccinology approach for the prevention of mycobacterial disease in cattle (ReVAMP)	\$7,358,606
Genome Prairie Ontario Genomics	Agriculture	Pozniak, Curtis Cloutier, Sylvie	University of Saskatchewan Agriculture and Agri-Food Canada	4DWheat: Diversity, Discovery, Design and Delivery	\$11,166,747
Genome Alberta Genome Prairie	Environment	Hubert, Casey Stern, Gary	University of Calgary University of Manitoba	GENICE: Microbial Genomics for Oil Spill Preparedness in Canada's Arctic Marine Environment	\$10,612,988
Genome Québec Genome Prairie	Environment	Basu, Niladri Hecker, Markus Crump, Doug	McGill University University of Saskatchewan Environment and Climate Change Canada	EcoToxChip: A toxicogenomics tool for chemical prioritization and environmental management	\$9,786,922
EMERGING ISSUES					
Genome Prairie	Agriculture	Murphy, Lee Anne Navabi, Katayoon	University of Saskatchewan Global Institute for Food Security	DivSEEK International Network Preserving crop diversity	\$742,073
Genome Prairie	Health	Karniychuk, Uladzimir	VIDO-InterVac University of Saskatchewan	In vivo and Ex vivo models for Zika virus infection	\$713,062
NATIONAL AND INTERNATIONAL INITIATIVES					
Genome Prairie	Agriculture	Pozniak, Curtis	University of Saskatchewan	An integrated approach for enhancing Fusarium head blight resistance in durum (RP3/SK)	\$1,475,000
Genome Prairie	Health	Slater, Jim Banerji, Shantanu	University of Manitoba Provincial Health Services Authority	Genome360 Phase II: Manitoba's Provincial Applied Genomics Enterprise Platform (RP3/MB)	\$2,027,496
GENOMIC APPLICATIONS PARTNERSHIP PROGRAM					
Genome Prairie	Agriculture	Yost, Christopher Whiting, Mike	University of Regina Lallemand Plant Care	Improving on-seed survival and performance of legume inoculants using genome shuffling (YOST)	\$427,491
Genome Prairie Genome Québec	Environment	Palace, Vince Smyth, Patrick	IISD - Experimental Lakes Area Canadian Association of Petroleum Producers	Floating Wetland Treatments to Enhance Remediation (FLOWTER)	\$3,905,267
GENOMIC CANADA AND SSHRC FUNDED PROJECTS					
Genome Prairie	Agri-Business	Zhang, David Di	University of Saskatchewan	Creating consumer-oriented value in genetically modified foods (GMOs)	\$24,294
Genome Prairie	Environment	Clark, Douglas	University of Saskatchewan's School of Environment and Sustainability	Transforming Arctic Conservation through Social Innovation (TACSI)	\$99,925

BIOFUELS & MATERIALS

AGILE

CUC

Prairie Gold

MAVEN

EVOLVES

FPMI

MGB

BIOREMEDIATION

EcoToxChip

TUFGEN

CTAG & CTAG2

MEOR

CROP ADAPTATION

Genomic ASSETS for Livestock

4D Wheat

ZIKA Virus

CAG

VALGEN

EDUCATION & APPLICATION

MGCB2 GENICE

GE³LS

TPGII ReVAMP

FLOWTTER

HEALTH & VACCINES

Genome³⁶⁰

OSS

FiCoGEN

PLM

NorCOMM

MICROBIAL INOCULATES



GenomePrairie

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