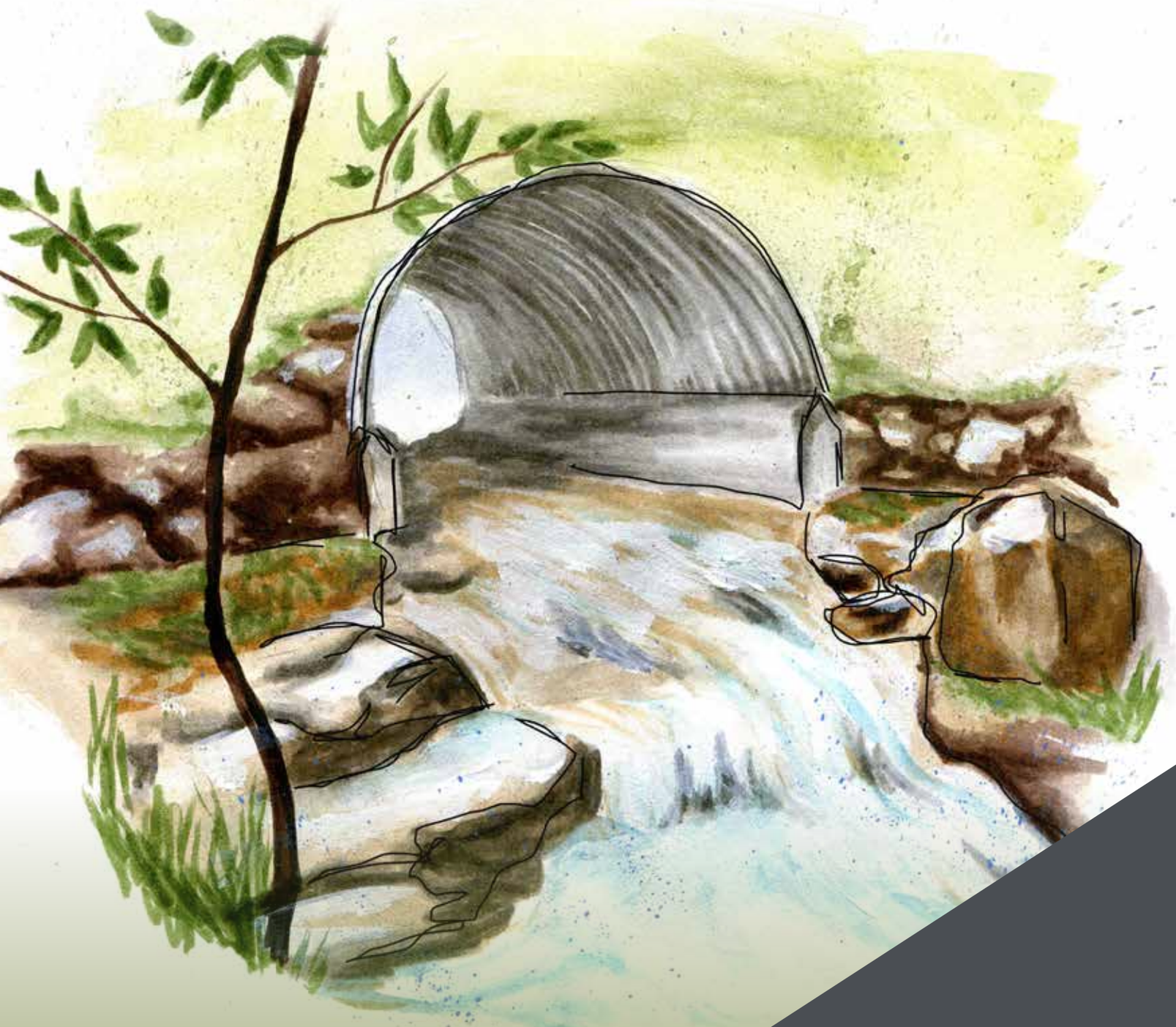
fRI Research

ANNUAL REPORT

2021–2022



fRI Research

Informing Land & Resource Management

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Written by Ben Williamson
Art and design by Penny Snell

PRESIDENT'S MESSAGE
JESSE KIRILLO

When I reflect on all the changes that have taken place in the world this past year, it's remarkable how steady fRI Research has been. The hard-working, dedicated individuals that make up this organization have remained steadfast in their focus on the same mission: doing practical science for a working landscape.

That doesn't mean the programs and projects have stayed the same. fRI Research has always prided itself in staying nimble and working on the most important issues for our partners. In these pages, you can see that each program truly strives to ensure the work they do is relevant and makes a valuable scientific contribution.

Finally, I would like to give my heartfelt thanks all the partners who have seen the value of collaboration and research and have supported these research programs. With your support and direction, we have excelled in our goals as an organization. When the next land or resource management challenge comes, they can be confident that fRI Research will be ready with the knowledge and tools they need.

MESSAGE FROM GENERAL MANAGER
RYAN TEW

In 2017, the Board of Directors approved a five-year strategic plan that serves as a guide for the important decisions that I and the Board of Directors make on behalf of fRI Research. That document sets out five key goals to pursue, and I'm proud to say that we've excelled in all five areas as the fifth year comes to a close.

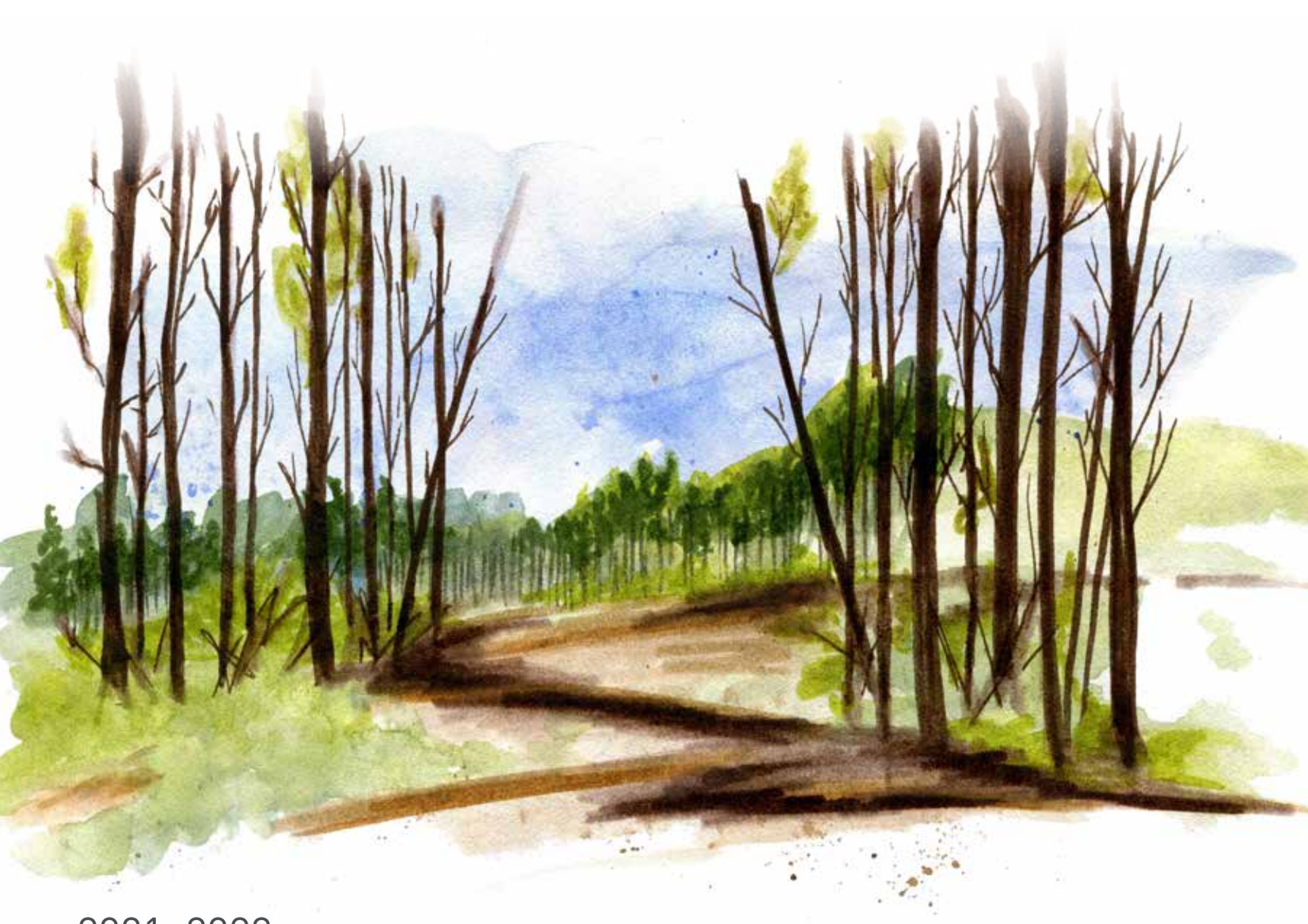
In 2021–2022, we have continued to deal with the challenges of a global pandemic. Our flexibility (strategic goal #1) and strong IT infrastructure allows us to continue fulfilling our commitments to our partners without interruption. We've adjusted to the situation and found ways to continue doing fieldwork and collaborating on research in a safe and efficient manner.

A big part of why we're able to achieve what we do is, of course, the full-hearted backing of our partners. Two years ago, I had the honour of thanking Millar Western for stepping up their commitment to the shareholder level, and now I am delighted to welcome both Tolko Industries and Vanderwell Contractors as our newest shareholders.

These organizations provide stable funding to support fRI Research as a whole. Thanks to this, and updates to our administrative fee structure, our research institute is on a firm financial footing. This is so important because it allows us to provide certainty to our partners that we will be able to deliver on the science and tools that they need (strategic goal #3), and stability for our staff so they can know they are valued and fairly compensated (strategic goal #2).

It's an exciting time for fRI Research, especially for two of our flagship research programs. Our Water Program has relaunched as the Water and Fish Program, which our partners have brought in Dr. Barry White to lead. And the Federal-Provincial MPB Partnership, which has renewed the mandate of the Mountain Pine Beetle Ecology Program to address the ongoing threat from this forest pest.

The core of my job is relationships, and I am tremendously grateful for the people who I work with—the diligent administration team, the brilliant scientists, and the integrity of our partners.



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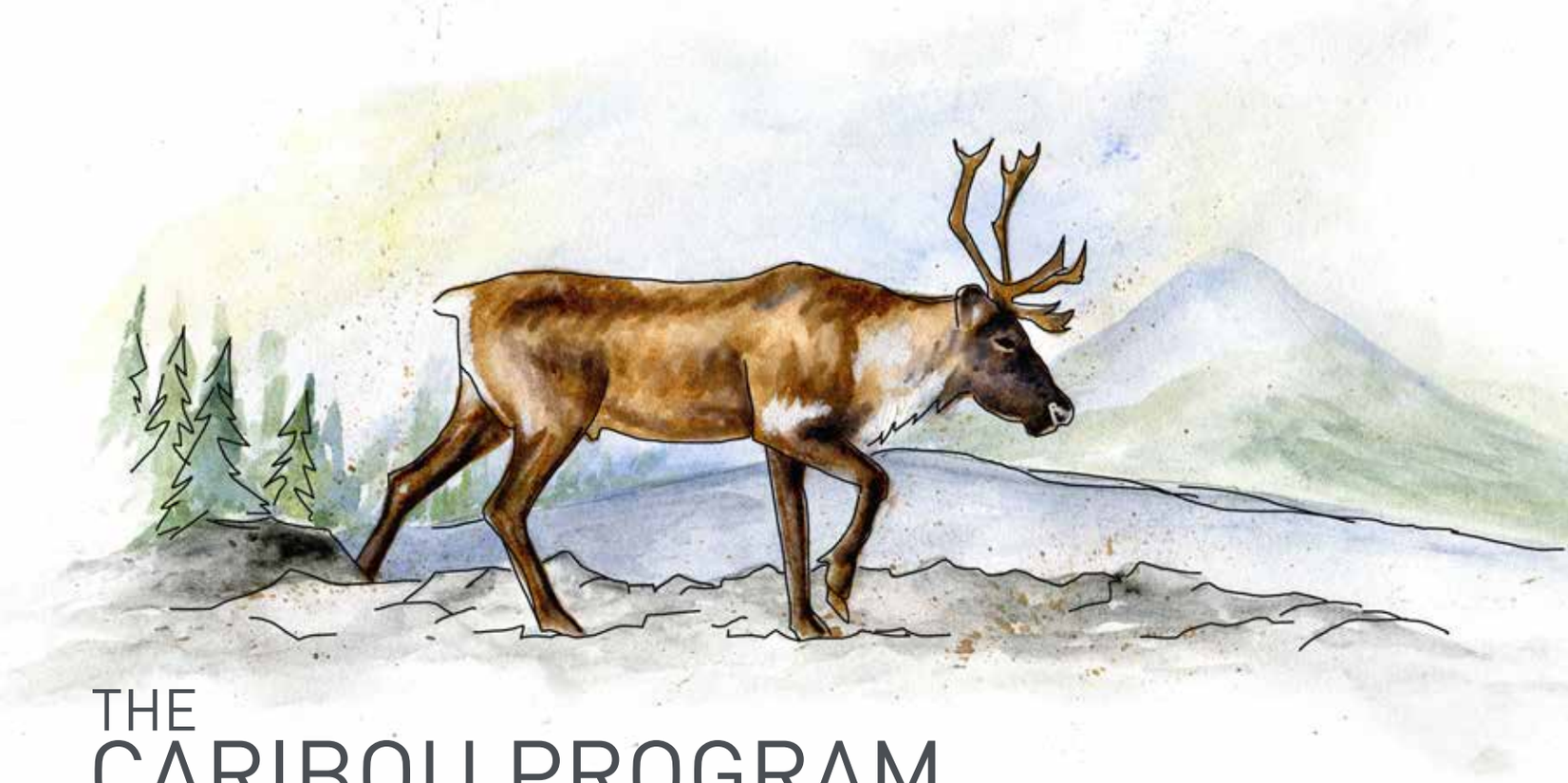


THE CARIBOU PROGRAM

Many of Alberta's caribou herds are in trouble. Unlike their cousins moose, deer, and elk, these ungulates need large, undisturbed areas of mature forest. Unfortunately, decades of human-use has carved up caribou ranges, which invites more competitors and predators that thrive in young forest.

Since its beginning in 2013, this applied research program has discovered how caribou respond to:

- a wide range of human activities such as forestry, oil and gas development, recreational OHV use, and habitat reclamation
- natural landscape change from mountain pine beetle and wildfire
- occurrence of related species such as moose, deer, elk, and their predators: wolves and bears

The goal of the program is to find practical conservation solutions for a working landscape. The Caribou Program has, for example, scientifically evaluated tens of thousands of linear features to prioritize them for restoration. It has worked out the exact landscape features that increase caribou mortality, affect caribou calving rates, and influence their movements while foraging or migrating.

The Caribou Program has been successful because it has worked collaboratively with government, industry, and Canada's leading universities. The Government of Alberta and Weyerhaeuser have provided our researchers with invaluable location data of collared caribou. Many forest industry partners have shared company data and on-the-ground know-how for their forest management areas. Collaborations with scientists at universities in British Columbia, Alberta, and Ontario have ensured our group has been at the cutting edge of ecology research. And funding from many governments and industries have allowed the Caribou Program to make these advances for caribou conservation.

In 2021–2022, the Caribou Program was actively working on three research projects. In addition to publishing in peer-reviewed journals, the program devoted resources to communicating their results through reports and briefing notes for partners, presentations at scientific conferences, and creating infographics to make the science accessible to everyone.

MOOSE RESPONSE TO DISTURBANCE IN WEST-CENTRAL ALBERTA

This project used moose GPS collar data to figure out how moose respond to different re-vegetation trajectories on seismic lines and different silvicultural treatments used by forestry. Because moose draw predators like wolves and bears, treatments that moose avoid may be less of a problem for caribou. This project in the Little Smoky, A la Peche, Redrock-Prairie Creek, and Narraway caribou ranges looks at variables like ecosites, vegetation height, and other habitat and landscape characteristics.

The project wrapped up in 2021 when results were delivered to our partners. We found that the size of cutblocks, replanting density, and vegetation height in the cutblocks affected moose habitat selection. The densities of seismic lines, cutblocks, and burned patches also influenced habitat selection, particularly in winter.

CARIBOU CONSERVATION THROUGH BETTER CUTBLOCK DESIGN

Cutting mature forest for timber, roads, or any other reason, converts caribou habitat into moose, deer, and elk habitat. The resulting influx of predators is driving the decline of Alberta's woodland caribou. This project looks for harvesting regimes and silviculture prescriptions that tilt the balance towards caribou.

To do this, the Caribou Program spent two summers gathering vegetation data and setting up trail cameras in hundreds of cutblocks, and in the winters, capturing and collaring mule and white-tailed deer. The cutblock data allowed us to relate animal use of cutblocks with fine-scale site characteristics, so we could see which forestry practices favour deer, and which favour caribou. The GPS-collared deer let us see which habitat deer choose or avoid.

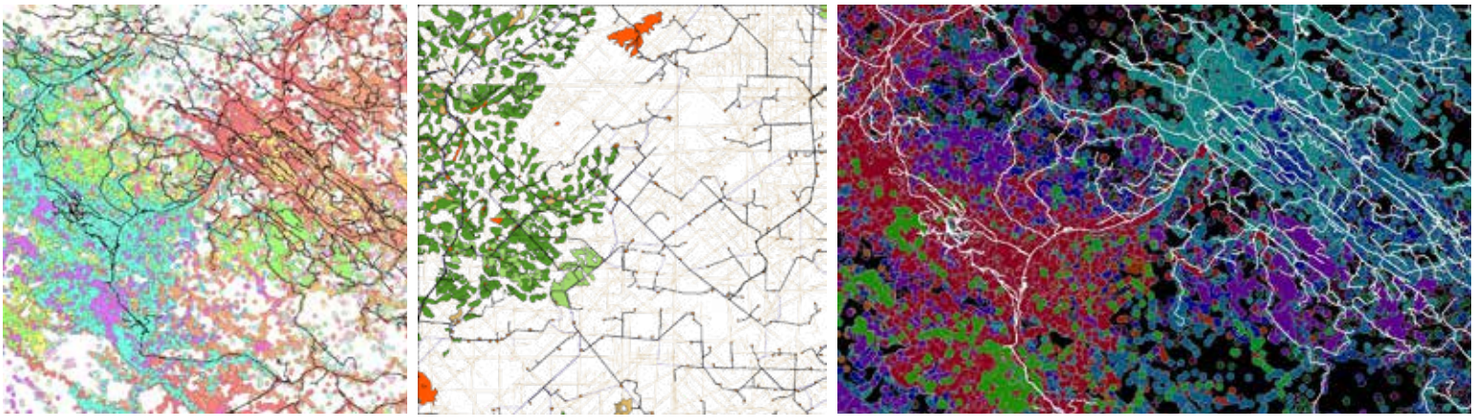
The team finished the analysis for partners in 2021. They found several forestry practices that should help mitigate the impact of harvesting on caribou and the broader boreal ecosystem. These include reducing forage such as dogwood, fireweed, willow, and wild roses, and replanting fewer trees, as high densities seem to attract white-tailed deer, bears, and moose.

ADVANCING HARVEST SYSTEM AND SILVICULTURAL PRACTICES FOR IMPROVED WOODLAND CARIBOU AND FIBRE OUTCOMES

This project builds on "Caribou Conservation through Better Cutblock Design". Once again, we are looking at the effects of different silviculture techniques on characteristics important for caribou, such as the amount of lichen, other vegetation, and lateral cover. What this project adds is a comparison to areas disturbed by fire and areas with documented use by caribou. We will also assess cutblocks for their ability to become caribou habitat in the years ahead.

2021 was the first summer of fieldwork. Crews visited hundreds of sites in west-central Alberta to take vegetation inventories and collect a slew of fine-scale site data. This work is being done with the Alberta Regional Caribou Knowledge Partnership and is expected to finish in 2023 with delivery of results and an interactive GIS tool for land managers. This tool will show which areas are on course to become woodland caribou habitat, and identify silviculture practices that could help with this.

GIS SERVICES



Right from our organization's start in the early 1990s, we have prioritized strong GIS capabilities to power our science. GIS Services works closely with our biologists on many research projects to help organize, process, and manage spatial data, work out data sharing agreements with partners, and create scripts and tools to improve the researchers' efficiency. This essential background work happens so smoothly and routinely that it doesn't always get its due recognition outside the organization.

But there are other times when GIS Services is a lot more visible—the GIS tools for our partners and the public. Our longest-running product is GBTools, a suite of sophisticated models for Grizzly Bear Program partners who use them to help make decisions on the landscape that consider this threatened species and its habitat.

In 2021–2022, one of the tools got an important upgrade. Habitat States is a composite of grizzly bear resources and risk that can reveal population sources and sinks. Now, we've generated annual datasets from 2000 to 2018, so users can run simulations of management actions in an area of interest, starting from any of those years.

A multi-year effort has been underway to standardize datasets for the GBTools, removing the "seams" between areas and years to make results more accurate and reproducible. We are also in the process of updating the GBTools code for it to work with the newest ArcGIS Pro.

GIS Services is also working on the Caribou Webtools, and this year released Version 2, which are fully cloud-based models for where caribou are likely to be, forage and rest, travel more easily, and are at risk of predation from wolves and cougars. Users can create scenarios by adding or restoring features such as roads and wellsites, so they can see how different management activities will affect caribou. The tools come with a disturbance dashboard to see how, under user-defined scenarios, the landscape is in relation to the recovery target of 65% undisturbed habitat within a caribou range.

Finally, the GIS team are also experts at data visualization, and have put their powers to work by creating beautiful, immersive StoryMaps to help bring our science to life. In this way, GIS Services is a science enhancer, making more efficient and effective every step in the process, from data collection to analysis to communication.

THE GRIZZLY BEAR PROGRAM

The Grizzly Bear Program is hibernating. As of April 2021, the Grizzly Bear Program is not currently starting new research projects. Over 24 years, the Program has helped train over 50 graduate students, published hundreds of papers, and pioneered new scientific methods in conservation biology.

We still maintain our long-term database to make sure this invaluable trove of grizzly bear genetic and health data is available for scientists in governments and universities. This includes a searchable digital database as well as our large repository of biological samples, which can supply the basis for future research questions. The Grizzly Bear Program and GIS Services also continues to update and maintain the GBTools and other products for partners so they can understand how their activities, past and future, will impact grizzly bears and their habitats.

We also work to answer partner questions based on data we have previously collected. This past year, Karen Graham pulled together historical den site data, GPS collar data, and decades of experience to create a pamphlet to help foresters avoid human-bear conflicts during winter operations. The pamphlet contained maps of den locations, historical timings for when bears tend to enter and exit hibernation, how to spot dens, and what to do if an active den is found. Karen also presented to industry partners.

We are continuing to publish peer-reviewed papers with our academic partners. In 2021–2022, the Grizzly Bear Program co-authored nine papers and contributed data for two master's theses.

LANDSCAPE ESTIMATES OF CARRYING CAPACITY FOR GRIZZLY BEARS USING NUTRITIONAL ENERGY SUPPLY FOR MANAGEMENT AND CONSERVATION PLANNING

Cameron J.R. McClelland, Catherine K. Denny, Terrence A. Larsen, Gordon B. Stenhouse, Scott E. Nielsen.

Using vegetation and ungulate data, we created maps of digestible energy for grizzly bears. Comparing this to the area with the highest density of bears in Alberta, we estimated the theoretical maximum carrying capacity in 60 watershed units.

UNRAVELLING THE IMPACTS OF DISTURBANCE TYPE AND REGENERATION ON MOVEMENT OF THREATENED SPECIES

Laura Finnegan, Rebecca Viejou, Doug MacNearney, Karine E. Pigeon, Gordon B. Stenhouse.

We used GPS collar data from grizzly bears and caribou, and found that while disturbance does affect the movement of both species the results are nuanced. Each species responds differently to harvest blocks, wellsites, roads, seismic lines, and pipelines, and the effect also depends on the season.

GRIZZLY BEAR RESPONSE TO TRANSLOCATION INTO A NOVEL ENVIRONMENT

Gordon B. Stenhouse, Terrence A. Larsen, Cameron J. R. McClelland, Abbey E. Wilson, Karen Graham, Dan Wismer, Paul Frame, Isobel Phoebus.

The Government of Alberta may try moving a bear involved in human conflict far from population centres. We found that although these recently translocated bears behaved and used habitat differently, they could often survive without further conflict for years, and are not a greater threat to humans than non-translocated bears.

SIMULATING MULTI-SCALE MOVEMENT DECISION-MAKING AND LEARNING IN A LARGE CARNIVORE USING AGENT-BASED MODELLING

Alejandra Zubiria Perez, Christopher Bone, Gordon Stenhouse.

Grizzly bears have vast home ranges. Accurately defining these is essential for informing conservation efforts. We simulated grizzly bear movement decisions based on the bear's learning and memory to predict home ranges. Our predictions compare well with real GPS collar data. This improves our understanding of bear habitat, as well as our understanding of what drives grizzly bear behaviour.

MAPPING RECREATION AND TOURISM USE ACROSS GRIZZLY BEAR RECOVERY AREAS USING SOCIAL NETWORK DATA AND MAXIMUM ENTROPY MODELLING

Tristan R.H. Goodbody, Nicholas C. Coops, Vivek Srivastava, Bethany Parsons, Sean P. Kearney, Gregory J.M. Rickbeil, Gordon B. Stenhouse.

We found that an increasing likelihood of tourism and recreation results in less grizzly bear foraging.

LANDSCAPE CONDITION INFLUENCES ENERGETICS, REPRODUCTION, AND STRESS BIOMARKERS IN GRIZZLY BEARS

Abbey E. Willson, Dan Wismer, Gordon Stenhouse, Nicholas C. Coops, David M. Janz.

We collected skin samples from 86 grizzly bears and extracted proteins related to energetics, reproduction, and stress. We compared protein concentrations with bear locations and found that more food resources affected energetic proteins, wetland and uplands increased and roads decreased reproduction biomarkers, and forest type was related to a stress protein.

CORRECTING FOR ENZYME IMMUNOASSAY CHANGES IN LONG TERM MONITORING STUDIES

Abbey E. Wilson, Agnieszka Sergiel, Nuria Selva, Jon E. Swenson, Andreas Zedrosser, Gordon Stenhouse, David M. Janz.

An important biomarker for stress in animals is cortisol, which can be extracted from hair. Hair can be collected non-invasively, and so is a low-impact way to understand population health. Here we created a method that allows us to compare new results with pre-2014 results, when a commonly used cortisol test kit changed.

PROTEIN BIOMARKERS IN SERUM AS A CONSERVATION TOOL TO ASSESS REPRODUCTION: A CASE STUDY ON BROWN BEARS (URSUS ARCTOS)

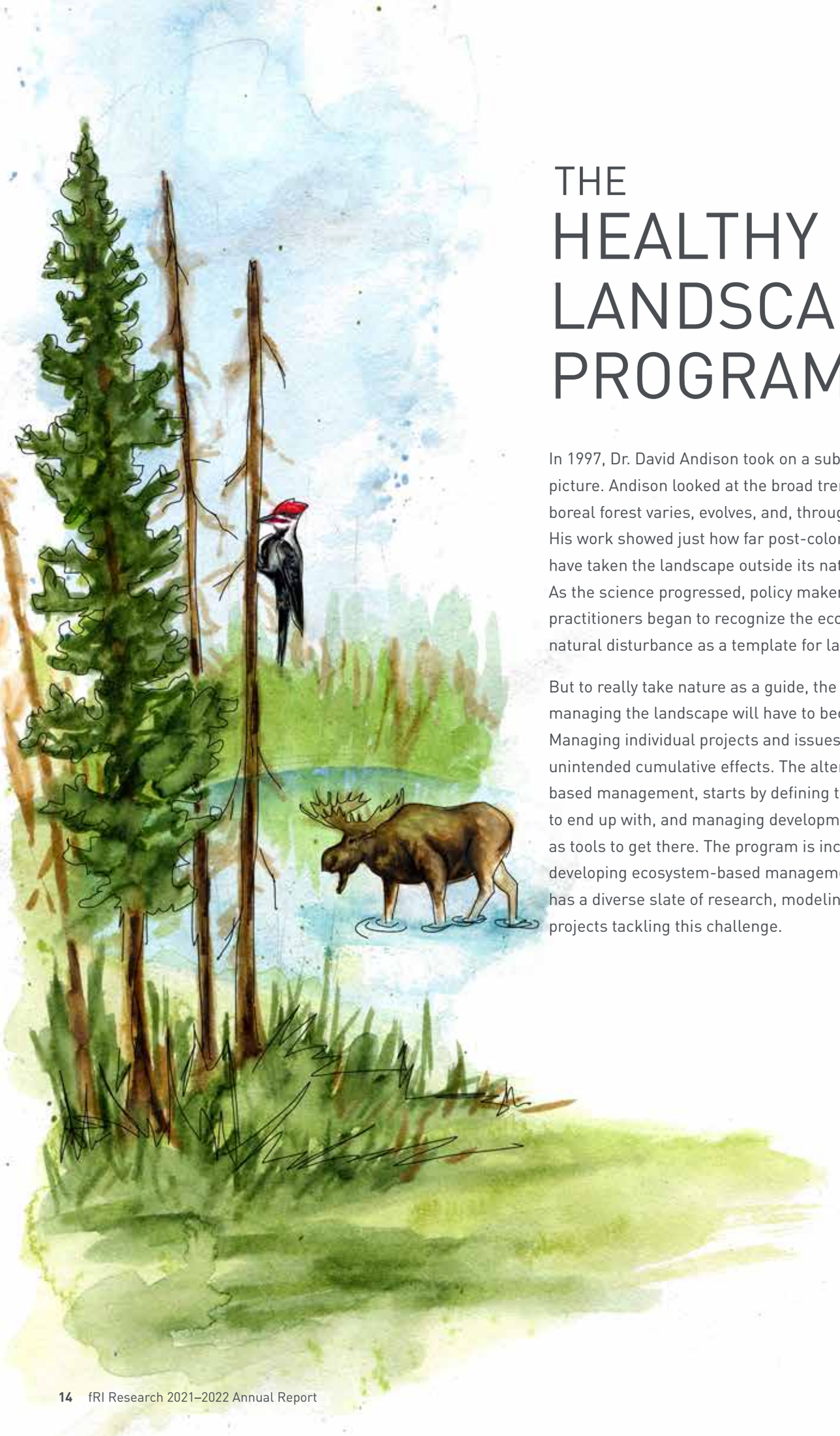
Abbey E Wilson, Sarah A Michaud, Angela M Jackson, Gordon Stenhouse, Cameron J R McClelland, Nicholas C Coops, David M Janz.

We identified protein biomarkers in grizzly bear blood samples that tell us if a bear is pregnant, lactating, or sexually mature. We also found two proteins that relate to a bear's habitat use.

CORTISOL LEVELS IN BLOOD AND HAIR OF UNANESTHETIZED GRIZZLY BEARS (URSUS ARCTOS) FOLLOWING INTRAVENOUS COSYNTROPIN INJECTION

Marc Cattet, David M. Janz, Luciene Kapronczai, Joy A. Erlenbach, Heiko T. Jansen, O Lynne Nelson, Charles T. Robbins, Gordon B. Stenhouse.

Cortisol levels are an important method for understanding the health and stress of wildlife, but we have noticed very high levels in the hair of bears that we dart during live capture. We tried simulating a single stress event with a cortisol-releasing hormone injection, but it didn't affect levels in the bear's hair. We suggest further tests with injections over a few hours, or combined with anaesthesia.



THE HEALTHY LANDSCAPES PROGRAM

In 1997, Dr. David Andison took on a subject focused on the big picture. Andison looked at the broad trends in how the Canadian boreal forest varies, evolves, and, through wildfire, is renewed. His work showed just how far post-colonial human activities have taken the landscape outside its natural range of variation. As the science progressed, policy makers and industry practitioners began to recognize the ecological benefits of using natural disturbance as a template for land management.

But to really take nature as a guide, the current way of managing the landscape will have to become more holistic. Managing individual projects and issues in isolation leads to unintended cumulative effects. The alternative, ecosystem-based management, starts by defining the landscape we want to end up with, and managing development, restoration, and fire as tools to get there. The program is increasingly focused on developing ecosystem-based management, and in 2021–2022, has a diverse slate of research, modeling, and communication projects tackling this challenge.

UNDERSTANDING HISTORICAL LANDSCAPE PATTERNS WITH LANDWEB

Landweb is a suite of models that allowed for land management at a very large scale: much of the boreal forest from Manitoba to BC, and up into the Northwest Territories. After years building the underlying modeling platform SpaDES, plus developing and calibrating the Landweb modules, the program was ready to run. Landweb simulates pre-industrial natural range of variation of a landscape, and then compares that with the current state or any number of future management scenarios.

In 2021, the team provided results for over a dozen forest management areas in Alberta and Saskatchewan, included in reports discussing how partners could interpret and use this information. There is also an online portal at landweb.ca, through which users can run other pre-defined scenarios to explore how different disturbances can take a landscape closer to or further from its natural range of variation.

NEXT STEPS WITH LANDWEB

The team is already thinking about how this technology can be further used and improved.

To that end, we convened a Landweb user group that will help guide development with scientific rigor and practical usefulness at the forefront. The group consists of the model creators, Alex Chubaty and Eliot McIntire, and representatives from the companies and Government of Alberta who use the model.

Government of Alberta scientists are diving into the code and performing their own sensitivity analyses to understand how it can be used. Other potential partners are also interested in extending the model to include new areas in Manitoba.

Brian Carnell

EBM DEMONSTRATION CO-OPERATIVE

Early in 2021, the program launched HealthyLandscapesEBM.ca, a website designed to clarify what ecosystem-based management could look like in Canada's forests and showcase examples of where ecosystem-based management concepts have been implemented.

Throughout the year, the team has curated more case studies exemplifying parts of ecosystem-based management that, together, demonstrate that although there is a long way to go, many jurisdictions and companies have already been taking steps along the road.

EBM CHALLENGES FOR ALBERTA AND SASKATCHEWAN FORESTS

In 2017 and 2018, the Healthy Landscapes Program organized a series of dialogue sessions with government, industry, NGOs, scientists, and Indigenous representatives to try to move ecosystem-based management from theory into practice. These sessions uncovered hidden pitfalls, and the program took some time to assess these challenges.

The result was an extraordinarily comprehensive report that described the social, ecological, scientific, and legal barriers that must be overcome on the ecosystem-based management journey.

LINKING EBM CONCEPTS WITH FINE-FILTER VALUES

In the first phase of this project, Tim Vinge's modeling work demonstrated that using forest harvesting to push the landscape towards its natural range of variation increased overall biodiversity in several species of birds. This second phase is quantitatively measuring the impact of disturbance on different types of bird habitat to put EBM concepts to the test.

EXPLORING AGGREGATED HARVEST IN WOODLAND CARIBOU RANGES

The Healthy Landscapes Program has teamed up with the Alberta Regional Caribou Knowledge Partnership to test whether aggregating forest harvests can benefit caribou habitat compared to business as usual. The project will also look at trade-offs with other ecological and socio-economic values. Finally, the team will investigate practical ways that aggregated harvesting can be part of forest planning. This project will use the Patchworks model on three areas in Alberta and one in Saskatchewan.

ALBERTA LAND-USE KNOWLEDGE NETWORK

About ten years ago, the LuKN began with the mission of bringing together the research and resources useful for land-use planners. Over the course of that decade, nearly 2,000 entries have been carefully curated and catalogued. In recent years, we've also launched the Land-use Planning Hub specifically for resources about regional planning in Alberta.

These valuable records are about to get a broader reach and a long-term home. We have begun migrating our library into the Canadian Conservation and Land Management portal (cclmportal.ca). This portal is a national knowledge network with much the same purpose as LuKn and similar focuses as fRI Research, namely boreal caribou and land management.

By amalgamating our records into one central portal, it will be easier for land managers to find the information they need, thus fulfilling LuKN's mission. Until the migration is complete, we will continue to maintain the landusekn.ca and landusehub.ca websites.

MOUNTAIN PINE BEETLE ECOLOGY PROGRAM

In the 2000's, the mountain pine beetle (MPB) made it over the Rocky Mountains, and helped by warmer winters, began a range expansion that has attacked more than two million hectares of forest in Alberta, and counting. In 2007, fRI Research started the Mountain Pine Beetle Ecology Program to learn about the direct and indirect effects on Alberta's forests and watersheds. Since then, it has played a leading role in identifying knowledge gaps, funding practical research, and ensuring the results are communicated to governments, industry, and communities.

The governments of Canada and Alberta recognized that this issue cannot be ignored, and that more research is needed to get insight into the beetle's biology, predict its dispersal, develop better ways to detect MPB, learn about its ecological and social impacts, and understand how it alters wildfire risk and behaviour. To this end, a federal and provincial partnership has provided funding for a suite of projects to address these topics.

The consortium put out a call for several batches of proposals. And before the end of the 2021–2022 fiscal year, 15 projects were underway with more to come.

MODELLING EASTERN SPREAD RISK OF MPB USING HOST GENETIC ANCESTRY

Led by Dr. Catherine Cullingham, Carleton University

A major concern is to what degree MPB will be able to spread in jack pine. Alberta's boreal pine forest gradually fades from lodgepole pine in the west to jack pine in the east. Along this gradient, there are mixed stands with both species, as well as hybrid pines—some more lodgepole-like and some jack-like. Lodgepole and jack pine have differences in their needles and cones, but it is difficult to distinguish the hybrids without genetic testing.

This project uses landscape genetics, creating predictive maps of the pure and hybrid zones. Having previously identified genetic markers to distinguish pure and hybrid trees, researchers will verify these predictions of pine ancestry by sampling trees in less certain areas. This will allow Dr. Cullingham's group to compare the overlap of MPB with pure and hybrid pine, providing quantitative data for predicting the risk of spread to eastern Alberta and beyond.

THE PHYSIOLOGICAL COSTS AND CONSEQUENCES OF OVERWINTERING IN MPB

Led by Dr. Heath MacMillan, Carleton University

We know, roughly, how severe a cold snap has to be to kill MPB, but temperatures that do not quite get low enough for long enough to cause high beetle mortality probably still reduce their ability to thrive in the next breeding season.

This study will find out to what extent MPB suffer tissue damage, ion regulatory collapse, or simply consume excess energy in different overwintering conditions. This will allow for better predictions about future population growth and spread in new habitats, under a changing climate.

IMPROVING MONITORING TOOLS TO DETECT MPB AT LOW DENSITIES IN NOVEL HABITATS: INCORPORATING HOST-TREE STRESS AND FUNGAL VOLATILES IN BEETLE ATTRACTION

Led by Dr. Nadir Erbilgin, University of Alberta

When MPB are in high densities, they can cause landscape-scale effects that can be easily noticed during aerial surveys. To detect low density MPB populations, the province relies on traps and trap trees, but these are only as good as the chemicals used for bait. Since MPB in low densities typically attack dead or weakened trees, Dr. Erbilgin and his lab will test out the compounds that trees release when stressed, and compounds released by fungal species that infect MPB-attacked trees.

This project will find new chemicals, test them in the field, and use the results to develop a new and more effective bait for detecting MPB at low population densities. This will make provincial control efforts more effective by helping crews find and remove more single trees during the green attack phase, before the populations can explode. The traps can also directly help control populations by luring enough of the beetles away from real trees, causing local MPB extinctions.

ASSESSMENT OF EASTERN SPREAD RISK OF MPB THROUGH STUDIES ON BEETLE DISPERSAL AND HOST COLONIZATION

Led by Dr. Maya L. Evenden, University of Alberta

MPB emerge from their host tree in the summer and fly to a new area. They generally travel few kilometers before they are guided by tree pheromones to a new host tree. Dr. Evenden and colleagues hypothesize that the act of flying and using up their fat stores makes MPB sensitive to those tree pheromones.

The Evenden lab will test whether flight changes the physical response of antennae to those chemicals and whether flight changes the MPB behavioural response to those chemicals. They will also use bait traps to collect beetles and determine whether their body condition and fat content varies across MPB's expanded range.

DYNAMIC SPECIES DISTRIBUTION MODELLING TO PREDICT MPB BOREAL INVASION

Led by Dr. Allan L. Carroll, University of British Columbia

Detecting and acting early when MPB reaches a new area has a better chance of controlling beetle population. Classical species distribution models, especially paired with dynamic species distribution models, can help identify areas at risk of invasion and create a chance for managers to get ahead of MPB.

Dr. Carroll's team will develop both types of models based on data from vegetation inventories, remote sensing, climate, and previous dispersal models. These will project MPB distribution into the future, for Alberta and the rest of the western boreal. The models will be validated by data from MPB monitoring in Alberta and Saskatchewan. These models will predict where MPB currently occurs, and where there is a high risk of spread so that managers can better target their control efforts.

EFFICIENT MONITORING OF MPB OUTBREAK SPOTS USING ARTIFICIAL INTELLIGENCE APPLIED TO DRONE THERMAL IMAGERY

Led by Dr. Nadir Erbilgin, University of Alberta

The Government of Alberta does regular aerial surveys to find red-attack trees, followed by ground surveys to spot pitch tubes on nearby green-attack trees. These can then be cut and burned before the MPB can emerge.

A more efficient method may be possible because living trees transpire, creating an evaporative cooling effect at the end of warm days. Dead trees also emit less longwave radiation during cooler mornings. These signatures are detectable with thermography. Dr. Erbilgin and colleagues will develop an algorithm for differentiating healthy trees from green-attack trees to enable earlier and more efficient detection of MPB spread.

TOWARD PRE-EMPTIVE MANAGEMENT OF FUTURE OUTBREAKS: PREDICTING THE DISTRIBUTION OF POST-EPIDEMIC MPB POPULATIONS IN THE WESTERN BOREAL FOREST

Led by Dr. Allan Carroll, University of British Columbia

During epidemics, MPB can mass attack healthy pines, but during endemic phases, the low-density populations are limited to attacking weak or dead trees. If endemic populations of MPB are left unmanaged, then they may erupt into epidemics if there is an event such as drought that creates a lot of susceptible trees.

Dr. Carroll and colleagues will develop a model that predicts where endemic populations are persisting, by using stand density—more dense stands tend to have more suppressed, low-vigor trees. The researchers will ground-truth the model to see if it is correctly predicting stand structure, endemic suitability, and the actual presence of endemic populations. If this works, the team will use LANDSAT-derived data to model the rest of the boreal without the Alberta Vegetation Inventory data used to calculate stand density.

GENE CONSERVATION TO MITIGATE IMPACTS OF MPB ON ENDANGERED WHITEBARK PINE AT ITS NORTHERN LIMIT IN ALBERTA

Led by Jodie Krakowski, Whitebark Pine Ecosystem Foundation of Canada

In addition to blister rust, MPB is a major threat to whitebark pine, so replenishing the provincial genetic archives with seeds from healthy trees is a conservation priority. Because whitebark pine grow in high elevation areas that are difficult to access and have irregular seed crops, it is hard to plan these efforts.

This project will collect seeds from the northern whitebark pine range. At the same time, the Whitebark Pine Ecosystem Foundation of Canada will collect data on cone crop abundance and seed variability. This will allow the team to correlate the timing and abundance of seeds in these areas with stands in other areas, which can act as an indicator for when to launch future collection efforts.

DEVELOPMENT OF FINE SPATIAL RESOLUTION TREE SPECIES INFORMATION FOR MPB-IMPACTED ECOSYSTEMS FOR SPECIES-AT-RISK HABITAT ASSESSMENT

Led by Dr. Nicholas Coops, University of British Columbia

This project will create maps of overstory tree species covering Alberta, BC, and the Yukon, which are accurate, high resolution, and current. These maps are critical for managing MPB control efforts, particularly in caribou habitat where the impacts of beetle and beetle control can have cascading effects on species at risk.

The GIS layers, code used to create the layers, and published papers based on the layers will all be distributed freely for future research and use by land managers.

USING INNOVATIVE TECHNIQUES TO UNDERSTAND HOW MPB IS SHIFTING ECOSYSTEM COMPOSITION AND CONFIGURATION IN JASPER NATIONAL PARK

Led by Dr. Eric Higgs, University of Victoria

MPB is causing a large change in the landscape of Jasper National Park, but to understand the significance of this disturbance event, we need to know how the landscape has historically varied.

The Mountain Legacy Project team will use 1915 survey photos, 1949 aerial photographs, 2002 LANDSAT imagery, 2020 aerial imagery, and repeat oblique photographs to reconstruct geo-referenced landcover for the area around the Jasper townsite. This will allow the university and Parks reserachers to quantify land cover changes over more than a century.

SOIL CARBON STOCKS IN FORESTS RECOVERING FROM MPB OUTBREAK: A POSSIBLE CARBON SINK?

Led by Dr. Justine Karst, University of Alberta

Living trees add carbon to the soil by dropping litter, but they also prime soil for carbon mining by microbes, which reduces carbon stocks. MPB's large scale effects on forests could therefore have a large effect on the complex carbon balance of forest soil.

This project will compare the soil carbon stocks in undisturbed and MPB-attacked lodgepole pine stands. This will help us understand an important effect of MPB, as well as give insight into boreal soil microbial communities.

GENERATION OF TREE LEVEL FIRE FUEL INFORMATION ACROSS MPB INFESTATION MOSAICS

Led by Dr. Nicholas Coops, University of British Columbia

The next generation of fire modeling uses information about individual trees, rather than relying on stand-level data. Dr. Coops' team will use high-density LiDAR to scan typical green-, red-, and gray-attack stands in a range of forest types and conditions. The team will use both handheld and UAV-based LiDAR to capture individual tree attributes, thus revealing how MPB attack stage changes alters fuels.

Once verified, the researchers will create reference tables so that fire modelers can look up similar stand and environmental characteristics and get representative LiDAR-derived individual tree fuel information. This will allow forest managers to more accurately predict fire behaviour.

ASSESSMENT OF RISK FACTORS INFLUENCING LANDSCAPE LEVEL FIRE IN MPB FORESTS

Led by Dr. Christopher Bone, University of Victoria

Weather conditions during wildfire such as temperature, relative humidity, wind speed, and precipitation can amplify or mask the effect MPB, making it important to consider these risk factors when studying the MPB-wildfire relationship.

This project will determine if the number of wildfire ignitions is different before and after MPB outbreaks, and the degree to which weather, stand characteristics, and time since MPB-attack influences the chances of a large wildfire. Being able to predict large wildfires would be important information that communities at risk could act on.

QUANTIFYING SPATIO-TEMPORAL VARIABILITY IN POST-MPB OUTBREAK FUELS IN JASPER NATIONAL PARK, USING TERRESTRIAL LASER SCANNING, AND BI-TEMPORAL MULTI-SPECTRAL AIRBORNE LIDAR

Led by Dr. Laura Chasmer, University of Lethbridge

Dr. Chasmer and colleagues will use several aerial imaging technologies to measure coarse and fine fuels of unaffected stands and those at different attack stages. They will use this to explore how the local environment, time since attack, and attack severity affect the stand structure and fuel connectivity.

This project will deploy new technology and data analysis methods. Not only will it provide Jasper National Park with maps showing wildfire risk, it will also advance our understanding of the effects of MPB on wildfire risk, and develop new research methods.

HOW DO THE SPATIAL LEGACIES OF MPB OUTBREAKS AFFECT FIRE SEVERITY IN CANADIAN LODGEPOLE PINE FORESTS?

Led by Dr. Patrick M. A. James, University of Toronto

This study will look at stands that were attacked by MPB and subsequently burned by wildfire. It will relate the attack stage with the burn severity. This will be done for both mean burn severity of a fire, and for how MPB-kill affects severity within fires.

These relationships can be used to forecast fire severity throughout Alberta's boreal forest. This work may also reveal conditions where MPB does not affect fire severity.

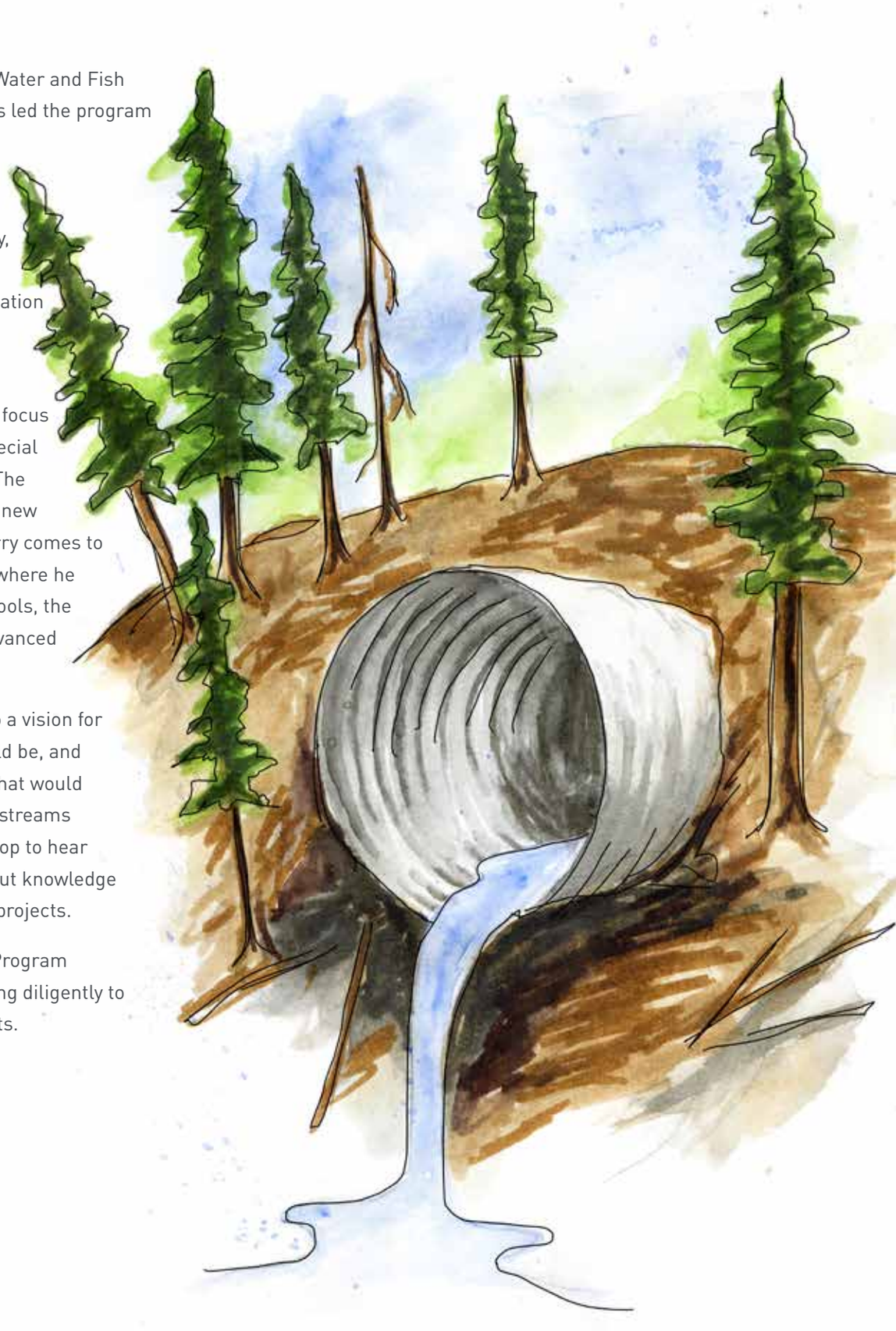
THE WATER AND FISH PROGRAM

This was a year of transition for the Water and Fish Program. Dr. Axel Anderson, who has led the program for a decade, returned to working full time within the Government of Alberta. An experienced hydrologist with a deep understanding of forestry, we already miss his leadership on projects ranging from road sedimentation to flood mitigation.

The program partners took this opportunity to expand the program's focus to include work on fish species of special concern such as trout and grayling. The partnership also funded and found a new Program Lead – Dr. Barry White. Barry comes to us from the Government of Alberta, where he helped develop and champion lidar tools, the Wet Areas Mapping initiative, and advanced watershed models.

His job was to unite the partners into a vision for what the re-launched program should be, and work with them to develop projects that would meet the critical issues on Alberta's streams and fish. The first step was a workshop to hear from Canadian scientific leaders about knowledge gaps, new technology, and potential projects.

Meanwhile, throughout 2021–2022, Program Coordinator Erin Humeny was working diligently to complete several outstanding projects.



CANADIAN BIOMONITORING NETWORK

The network, called CABIN, was already in wide use across Canada by federal and provincial governments. The advantages are a strong, standardized protocol and a large, shared database that maximizes the benefits of doing biomonitoring. The Water and Fish Program selected and worked to establish reference sites along the eastern slopes so that the effects of different activities on aquatic biodiversity can be measured.

The reference sites must be accessible for field measurements, relatively undisturbed to provide a suitable control, and they cover a range of representative streams spanning the eastern slopes. Erin selected 127 watersheds that met all these criteria, including 40 in an FMA to determine the effect of forest practices on aquatic biodiversity in Alberta in future studies.

ROAD SEDIMENTATION RISKS

A big focus of the Water and Fish Program has been identifying and helping to address the erosion of sediment from roads into streams. Especially during heavy rainfall, sand and silt can be carried off unpaved roads. If there aren't well designed and maintained ditches, the sediment will make its way into streams and harm water quality.

The Mighty Peace Watershed Alliance, a grassroots not-for-profit society, reached out to us for help identifying stretches of road that could cause sedimentation problems. We used models, particularly Road Erosion and Sediment Delivery Index, which combines road and stream data with slopes to pinpoint likely trouble spots in the Upper Peace region.

HELPING WITH CITIZEN SCIENCE

Erin worked with Watershed Planning and Advisory Councils and other user groups such as off-highway vehicle associations to deploy citizen scientists to inspect culverts, fords, and bridges. The groups use the Alberta Watercourse Crossing Inventory app, which provides a simple, standardized way to gather data about stream crossings. Erin's role was providing maps identifying high priority crossings for inspection, and training small groups of volunteers.

Associations

In 2021–2022, fRI Research served as the coordinating organization for four independent associations:

- Alberta Regional Caribou Knowledge Partnership,
- Foothills Landscape Management Forum and Caribou Patrol Program,
- Forest Growth Organization of Western Canada, and
- Foothills Stream Crossing Partnership.

We help with common administrative functions such as human resources and information technology to avoid redundancy and reduce everyone's operational overhead. We also serve as a liaison to help connect these groups to our partners in academia, government, industry, and NGOs.
Beyond this assistance, each association conducts their activities independently to fulfill their separate mandates.

ALBERTA REGIONAL CARIBOU KNOWLEDGE PARTNERSHIP

One of the biggest conservation challenges in Alberta is that of the woodland caribou herds, which are classified as a threatened species. To help address this challenge, a dozen forest companies created a $5-million fund to help, which will be administered by the ARCKP, a collaboration between the forestry sector and the Government of Alberta.

The ARCKP has a two-part mission: fund essential caribou research and share tools and strategies for caribou conservation. On the knowledge sharing side, the association creates infographics and summaries of research in a regular publication called The Exchange, hosts webinars presenting important recent findings, and for those that want all the details, full scientific reports for all ARCKP projects.

The suite of projects funded by the ARCKP grew from three in its first year to six in 2021–2022. These projects all address immediate and practical knowledge gaps related to woodland caribou ecology and forestry practices, and seek to inform policy and practices for improved habitat outcomes for woodland caribou.

REVIEW OF ALBERTA'S INTEGRATED LAND MANAGEMENT POLICIES, PRACTICES AND LEGISLATION

Land-use policy must balance many competing user groups and values. Integrated land management is a collaborative approach that brings different users together to strategically plan activity to reduce footprint on the landscape. The Foothills Landscape Management Forum conducted a literature review and interviews to identify integrated land management practices and policy potential in Alberta and other relevant

jurisdictions. They also held a workshop to discuss several recommendations that could help move the concept from analysis to action.

EXPLORING THE IMPLEMENTATION OF AGGREGATED HARVEST IN WOODLAND CARIBOU RANGES COMPARED TO CURRENT AND OTHER POTENTIAL HARVESTING APPROACHES

By harvesting fewer but larger patches of forest, it could be possible to maintain more undisturbed habitat for woodland caribou. In this project, FORCORP modeled many harvesting scenarios to understand the costs and benefits of this approach. Scenarios ranged from small patches to very large patches, and were tested in the northeast, northwest, and west-central regions of Alberta. They found that larger patches did disturb less caribou habitat, however it resulted in lower harvest volume.

UNDERSTANDING ALTERNATIVE HARVESTING AND SILVICULTURAL APPROACHES FOR PROMOTING WOODLAND CARIBOU HABITAT WITHIN CONIFEROUS FORESTS AND DECIDUOUS/MIXEDWOOD FORESTS

This study uses expert interviews and a literature review to identify options and trade-offs of different forestry practices, such as partial harvests, commercial thinning and suppressing deciduous species. Some of these approaches can reduce forage foods for competitors or maintain some old growth stand characteristics needed by caribou. However, these can also be expensive and require more roads for access. FORCORP, who did the study, recommends a large-scale pilot project to quantify the effects and costs of these alternative strategies.

EVALUATION OF THE FEASIBILITY OF TERRESTRIAL LICHEN SEEDING AND/OR TRANSPLANTATIONS

Lichen is a key winter caribou food typically found in old growth forest, and can take up to 100 years to recover after disturbance. Scientists from NAIT first finished a literature review synthesizing lichen transplantation and seeding, and a discussion on how possible and practical this might be. The authors found that there are many difficulties and unknowns, but that transplants can establish lichen growth.

STUDY TO ADVANCE HARVEST SYSTEM AND SILVICULTURE PRACTICES FOR IMPROVED WOODLAND CARIBOU AND FIBRE OUTCOMES

This project by the Caribou Program visited hundreds of cutblocks to relate stand characteristics with wildlife use. The goal is to understand which forestry practices are better for caribou or increase the likelihood of harvested areas becoming woodland caribou habitat. The team is partway through the fieldwork and analysis but has delivered a literature review on the topic.

RECONCILING PRE-INDUSTRIAL PATTERNS, CARIBOU HABITAT AND MANAGEMENT REALITY

A Healthy Landscapes Program project is also exploring aggregated harvest, but through the lens of each area's natural range of variation (NRV) before industry and fire suppression altered the landscape. The goal is to understand how, and to what degree, clustering harvesting disturbance is possible on the landscape, and how it might vary under different conditions and policy scenarios. It also seeks to understand if NRV aligns with proposed aggregating harvesting patterns to improve woodland caribou habitat outcomes, and what the potential trade-offs are for other values of interest.

Three Caribou Conservation Initiatives

The Caribou Program is an fRI Research run program that studies woodland caribou behaviour, habitat, health, and interactions with other wildlife.

The ARCKP is government and industry run, and acts as a forum and funding source for knowledge generation and mobilization.

The Caribou Patrol is an Indigenous run program that reduces caribou mortality on highways through education, signage, and highway patrols.

Caribou Patrol

CARIBOU PATROL: SEASON 10

There are four caribou herds around the mountain town of Grande Cache. All four have declined, some to critically low population levels.

This is the traditional territory of the Aseniwuche Winewak Nation of Canada, and since 2012, the Nation has taken an active role in saving the herds with the Caribou Patrol. Now the successful partnership between the AWN and the Foothills Landscape Management Forum can celebrate a decade of saving caribou.

Canadian caribou herds face many challenges, from industrial development to climate change, but the A La Peche herd has a particular hazard: Highway 40. The busy corridor runs roughly north-south through the middle of the range, splitting the caribou's winter forest habitat from their summer alpine refuge. Every spring and fall, the herd must cross the highway.

The Caribou Patrol, as the name suggests, drives the highway during migration season. When they see caribou near the road, they use stockmanship techniques to either help the caribou safely cross, or, if the location is too dangerous, steer the animals back from the road. Although developed for livestock, these low stress techniques work to some extent on all herding animals.

In the 21–22 season, the Caribou Patrol was out for 255 person-days and took action a record 107 times to safely direct a total of 169 animals. Zero caribou were killed on the highway this year, a testament to the effectiveness of the patrollers.

Education is the other major Caribou Patrol activity. At Edmonton's Deep Freeze festival in January, they talked with 1,675 people, a new best for a single event. But it was the quality of the conversations, more than the number of visitors, that made this an especially rewarding effort. Through highway signs and an alert on Alberta 511 during migration season, the goal is to increase people's awareness of the hazard, so they slow down and watch more carefully for crossing animals; and in classroom materials and presentations, the Caribou Patrol hopes to increase people's appreciation for these animals while they are still with us.

Caribou Patrol

Caribou Patrol

Caribou Patrol

However, the highlight of the season was something closer to home: the premiere of *AWN Elders: Atih Acimowina* (meaning "caribou stories" in Cree) in Grande Cache and Hinton. The short documentary film consists of interviews with AWN elders, where they share their memories of caribou, in their own language. They talk about the hunts of their youth, the herd sizes, and how the land has changed. These images are paired with footage of the local area.

At the showing in Grande Cache, the community rolled out a literal red carpet for the elders. The elders were touched that the next generation listened and cared, and they spoke with enthusiasm of sharing more stories. The Caribou Patrol is working not just to preserve the animals, but also what they mean.

The Foothills Landscape Management Forum

The FLMF is a group of forestry and energy industry companies working together to practice integrated land management. The independent association recently demonstrated the benefits of this collaborative approach in a pilot project and is consulting with the government on next steps. While that process is underway, the FLMF continues to support the Caribou Patrol Program and the Aseniwuche Winewak Nation that runs it.

FOREST GROWTH ORGANIZATION OF WESTERN CANADA

FGrOW is a large collaboration between twenty forestry company divisions, the Government of Alberta, Government of Saskatchewan, the Canadian Forest Service and the University of Alberta. It is an amalgamation of several forestry associations that came together to increase efficiency and collaboration:

- Alberta Forest Growth Organization
- Foothills Growth and Yield Association
- Mixedwood Management Association
- Tree Improvement Alberta
- Western Boreal Growth and Yield Associations

Together, they conduct much of the growth and yield research in western Canada. FGrOW facilitates communication within the industry and with other stakeholders. The association also builds scientific and operational capacity among its members through training and tech transfer. In 2021–2022, FGrOW had 14 active projects worked on by five project teams: Foothills Pine Project Team, Mixedwood Project Team, Policy and Practice Project Team, Western Boreal Growth and Yield Association, and Tree Improvement Alberta.

REGENERATED LODGEPOLE PINE TRIAL

Now in its third decade, this project monitors how lodgepole pine stands develop in western Alberta with a network of over 100 locations. It has and will continue to give results on common treatments such as the impacts of herbicide, pre-commercial thinning, planting density, and their interactions. The Foothills Reforestation Interactive Planning System was developed using data from this study. This tool predicts stand development and links with the provincial Growth and Yield Projection System to forecast growth and yield.

COOPERATIVE MANAGEMENT OF HISTORIC RESEARCH TRIALS

FGrOW members are pitching in with the Canadian Forest Service and the Government of Alberta and to maintain and measure a series of historic lodgepole pine research trial. Some of the sites in this trial were established in the 1950s and had been regularly measured for decades. This broad coalition will ensure that these irreplaceable trials will continue to produce knowledge of forest growth, yield, silviculture, and fibre qualities.

MEASUREMENT OF THE MOUNTAIN PINE BEETLE PERMANENT SAMPLE PLOT NETWORK

After mountain pine beetle came to Alberta, and seeing what it had done in British Columbia, member companies decided to follow stand development on 236 permanent sample plots affected with low to high levels of beetle attack. The members return regularly to quantify how these stands develop, including how the level of competing vegetation effects regeneration.

STRIP CUT UNDERSTORY PROTECTION TRIAL

Here, a strip cut understory protection harvest is the removal of overstory aspen so that the spruce underneath can grow faster. This trial is designed to provide data on the effects of this treatment and fill an important information gap in growth and yield projection of aspen-dominated stands.

DYNAMIC ASPEN DENSITY EXPERIMENT

Aspen provide protection to spruce against frost, winter drying, and weevils, however they also slow their growth by blocking sunlight. This experiment thinned the aspen to different levels in 17- and 22-year-old mixedwood stands of aspen and white spruce. The goal is to determine how aspen density thresholds affect the survival and growth of the spruce. It will also weigh the benefits to white spruce against the cost to the hardwood.

PROVINCIAL GROWTH AND YIELD INITIATIVE

This is a collaborative data collection and management program. By pooling almost all Alberta permanent sample plot measurements, the industry has created a unique long-term dataset. Observations span thousands of locations, some going back to the 1960s. This allows FGrOW members to better develop, calibrate, and validate growth models for forest management.

QUANTIFICATION OF HERBICIDE IMPACTS ON TIMBER AND NON-TIMBER VALUES

This project returned to harvest blocks treated with glyphosate in the 1990s. An earlier study had documented the effects in the first decade after treatment. By measuring plant communities 25 to 40 years after harvest, on treated and non-treated areas, researchers quantified the long-term impacts on biodiversity.

EXCEL TOOLBOX FOR FORESTERS

FGrOW supported the development of a set of tools in Microsoft Excel. This provides easy access to useful models and equations and helps standardize and simplify certain planning and analysis functions in a forester's job.

DEVELOPMENT OF A 64-BIT VERSION OF THE GROWTH AND YIELD PROJECTION SYSTEM

The Province of Alberta's Growth and Yield Projection System currently runs on a 32-bit operating system. However, many organizations are now running modern 64-bit Windows operating systems. This project developed a Dynamic Link Library that will work with the projection system on 64-bit Windows operating systems in addition to the 32-bit systems.

REALIZED GAIN TRIALS

FGrOW members have spent decades selectively breeding trees to produce seeds that should grow better in Alberta. But until these seedlings are tested in real-world conditions, it is difficult to quantify the level of actual improvement. These trials follow stands of improved trees across over 150 locations comparing improved seed to wild sources.

MIXEDWOOD GROWTH MODEL

This model was created by the University of Alberta for pure or mixed stands of white spruce, lodgepole pine, trembling aspen, black spruce and jack pine. Because it is an individual-tree model, it can handle both simple, even-aged stands as well as multi-age, multispecies stands such as those created by partial harvesting. FGrOW is supporting the latest update and documentation of the software.

LONG-TERM STUDY

This study has several installations across western Canada established around 30 years ago. It is testing thinning in mixedwood aspen and white spruce stands in order to provide data for model development such as the Mixedwood Growth Model and is now also measuring impacts of climate change.

EMPIRICAL POST-HARVEST STAND ASSESSMENT

Phase one of this study ran until 2013 and included data from historical surveys from the 1980s and later. The project is now completing its second phase to track how stands develop following harvesting. Specifically, it evaluates stand performance against expectations, and the relationship with planting density and site treatments.

FOOTHILLS STREAM CROSSING PARTNERSHIP

The Foothills Stream Crossing Partnership is a group of companies working with the provincial government and NGOs to inspect and maintain the fords, culverts, and bridges they build across streams. Together, the Partnership has completed tens of thousands of inspections, allowing crossing owners to identify sedimentation and fish passage issues and prioritize maintenance.

In the 2021 season alone, FSCP members fixed 250 crossings, re-opening over 500 kilometers of upstream fish habitat. Since the group began working on the backlog of stream crossings, the total reconnected habitat is over 1,500 kilometers in Alberta's eastern slopes.

2021 had one of the highest priority projects in the FSCP's history. A busy logging road crosses Emmerson Creek, a tributary of the Athabasca near Hinton. Over time, the culvert under the road had become "hanging", one of the most common problems at road crossings. This is where the downstream end of the culvert is no longer low enough, creating a waterfall that fish can't get up.

By pulling out the culvert and replacing it with a bridge, fish can now access another 85 kilometers of critical habitat for


West Fraser

Athabasca Rainbow trout and Bull Trout. Projects like this are significant benefit for those and other listed fish species such as Arctic Grayling.

Since its beginning in 2005, the momentum has steadily built up. The number of partners, inspections, and repairs has increased year on year so that today almost all the members have now inspected almost all their crossings, scheduled re-inspections, prioritized maintenance, and steadily ticked off projects.

Because of the relatively complete inventory of member stream crossings in the foothills, the group is putting more of a focus on high priority watersheds in the boreal. The generally lower slope of streams to the east means that the issues are different: for example, inspectors find fish passage is blocked less often by hanging culverts, but more often by beaver dams.

It must have felt overwhelming when the FSCP started in 2005, up against tens of thousands of crossings, many of unknown status. But first slowly and soon by the thousands, the group has shown with each inspection and repair, the power of partnership for solving big issues.

2021–2022 FSCP

Crossing Owners

Arc Reources
Athabasca Oil Corp
Baytex Energy
Blue Ridge Lumber
Canfor
Cardinal Energy
Canlin
Chevron
Cenovus
Energy Transfer Canada ULC
Hammerhead Resources
Hinton Wood Products
Keyera
Millar Western
NuVista Energy
Outlier Resources
Paramount
Petrus
Peyto
Pieridae Energy
Repsol
Slave Lake Pulp
Shell Canada
Spartan Delta
Strathcona
Tangle Creek
Taqa
Tidewater Midstream
West Fraser
Weyerhaeuser

Advisory Partners

Alberta Environment and Parks
Alberta Energy Regulator
Fisheries and Oceans Canada
Alberta Conservation Association
Trout Unlimited
Aseniwuche Development Corp
Albert Backcountry Hunters and Anglers Assoc

PARTNERS

Partnerships are the foundation of fRI Research. They identify and analyze issues, assemble resources, and integrate research into land and resource management. Without our partners' commitment, we would not be the strong, effective source of knowledge and tools that we are today. fRI Research offers flexible and inclusive ways of partnering that we group into the three broad categories below, though many partners find more than one role for themselves.

Shareholders

fRI Research shareholders provide stable core funding and in-kind contributions to support the overall operation of the entire organization. In 2021–2022 shareholders are: Alberta Agriculture, Forestry, and Rural Economic Development; Canfor; Parks Canada, Jasper National Park; Millar Western Forest Products, Norbord; Repsol Oil & Gas Canada; Tolko Industries, Vanderwell Contractors (1971), Hinton Wood Products, a division of West Fraser Mills; and Weyerhaeuser.

Program and Association Partners

These partners provide funding or in-kind contributions to directly support our programs and associations. Many of these partners are also responsible for land, resource, or forest management, and are interested in using fRI Research knowledge and tools in their operations.

Alberta Indigenous Relations
Alberta Agriculture and Forestry, and Rural Economic Development
Alberta Conservation Association
Alberta Energy Regulator
Alberta Environment and Parks
Alberta Forest Products Association
Alberta Innovates
Alberta Labour
Alberta Newsprint Company
Alberta-Pacific Forest Industries Inc.
Arc Resources
Aseniwuche Winewak Nation of Canada
Athabasca Oil Corporation
Baytex Energy
BC Ministry of Forests
Canadian Food Inspection Agency
Canadian Natural Resources Limited
Canfor Corporation
Canlin Resources Partnership
Cardinal Energy
Cenovus Energy Inc.
Chevron Canada Resources
Environment and Climate Change Canada
FORCORP
Forest Resource Improvement Association of Alberta
Government of Manitoba: Department of Agriculture and Resource Development
Government of Saskatchewan: Ministry of Environment
Habitat Conservation Trust Foundation
Hammerhead Resources

Hawthorne Energy
Keyera Corporation
Louisiana-Pacific Corporation
Mercer Peace River Pulp
Mighty Peace Watershed Alliance
Mistik Management
Natural Sciences and Engineering Council of Canada
Natural Resources Canada, Canadian Forest Service
Northland Forest Products
Nuvista Energy
Outlier Resources
Paramount Resources
Petrus Resources
Peyto Exploration & Development Corporation
Pieridae Energy
Project Learning Tree Canada
Respsol Oil & Gas Canada
Sakâw Askiy Management
Shell Canada
Spray Lake Sawmills
Strath Resources
Suncor Energy
Sustainable Forestry Initiative Inc.
TAQA North
Teck Resources
TerrainWorks
Tidewater Midstream
Tolko Industries
Tourmaline Oil Corporation
University of Alberta
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Vanderwell Contractors (1971) Ltd.
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Weyerhaeuser
XTO Energy Inc.

Alignment Partners

These partners provide informal support for fRI Research.

Alberta Biomonitoring Institute
Alberta Fish and Game Association
Forest Genetic Resources Council
Alberta Innovates
Alberta Professional Planners Institute
Alberta Riparian Habitat Management Society
Alberta Society of Professional Biologists
Association of Alberta Forest Management Professionals
Banff National Park
British Columbia Institute of Technology
Canadian Institute of Forestry
Canadian Wildlife Health Cooperative
Council of Forest Industries
County of Grande Prairie No. 1
Ducks Unlimited Canada
Fisheries and Oceans Canada
Forest History Association of Alberta
Forest Stewardship Council
Forest Protection Ltd.
Forsite Consultants Ltd.
Government of British Columbia: Ministry of Environment; Ministry of Forests, Lands, and Natural Resource Operations
Government of Northwest Territories: Ministry of Environment and Natural Resources
Inside Education
International Model Forest Network
McCarthy Tétrault LLP
Métis Settlements General Council
Mitacs

Municipality of Jasper
NAIT Boreal Research Institute
Nature Conservancy of Canada
Northern Rockies Museum of Culture and Heritage
Norwegian University of Life Sciences
Norwegian Institute of Bioeconomy Research
Saskatoon Forestry Farm Park & Zoo
Scandinavian Brown Bear Research Project
St'at'imc Government Services
Swan River First Nation
Town of Hinton
TRIA-Net
Trout Unlimited Canada
Watershed Alliances and Councils: Athabasca, Beaver River, Bow River, Lesser Slave, Milk River, Mighty Peace, North Saskatchewan, Oldman, Red Deer River, South East Alberta
Wildlife Habitat Canada
Woodland Operations Learning Foundation
Yellowhead County

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Informing Land & Resource Management

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