CARIBOU PROGRAM | GIS PROGRAM
FOOTHILLS STREAM CROSSING PARTNERSHIP
HISTORY | HEALTHY LANDSCAPES PROGRAM
GRIZZLY BEAR PROGRAM

2018–2019 ANNUAL REPORT

MOUNTAIN PINE BEETLE ECOLOGY PROGRAM
LAND-USE KNOWLEDGE NETWORK
FOOTHILLS LANDSCAPE MANAGEMENT FORUM
WATER PROGRAM | FOREST GROWTH ORGANIZATION
OF WESTERN CANADA

fRI Research
Informing Land & Resource Management

Sean Murray

Words by Ben Williamson

Design by BubbleUP Marketing

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PRESIDENT'S MESSAGE

Jesse Kirillo

It's been another incredible year. Our dedicated program leads and researchers have delivered an outstanding number of papers and tools for our program partners, and it has been all done safely. fRI Research administration under the direction of the board has also begun to tackle some of the hard issues that were outlined in our 5-year strategic plan: addressing the needs of employees and our alternative funding strategy are paramount. This will ensure fRI Research is viable and nimble enough to adapt and serve the programs under our umbrella for years to come.

We have also listened to our partners and have begun to scope out new research opportunities with regards to migratory birds and we are looking closely at how some of our programs will evolve going forward. I'm proud to say this year has been a great success once again is due in large part to our hardworking researchers, program leads and with the support of our partners we at the board are excited to see what 2019–2020 will bring.

GENERAL MANAGER'S MESSAGE

Ryan Tew

Thank you to the fRI Research partners for supporting applied science. They challenge us to carry out our work toward practical land management solutions for governments, as well as the forestry, oil and gas, mining, and oil sands industries. We're proud to provide research and tools, and an invaluable arena for government, industry, and academia to collaborate. Our Board of Directors is focused on making our non-profit business model ever more sustainable, which ultimately ensures that fRI Research remains a responsive and flexible organization. Because of their leadership, we continue to achieve this in changing economic and environmental conditions.

Congratulations to the Grizzly Bear program for being an Emerald Award finalist in 2019 and thank you to Alberta Environment and Parks and the Canadian Association of Petroleum Producers for supporting this nomination. The grizzly bear researchers have delivered an unprecedented volume of results over the past 22 years. This external recognition is a great honour, but the entire fRI Research staff should also be acknowledged for their dedication to finding answers for our partners. Their efforts make my job possible and make me proud to be involved in this foundational organization.

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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 2018–2019 shareholders are: Alberta Agriculture and Forestry; Parks Canada, Jasper National Park; Norbord Inc.; Repsol Oil & Gas Canada Inc.*; Suncor Energy Inc.*; Hinton Wood Products, a division of West Fraser Mills Ltd.; Canfor Corporation; and Weyerhaeuser Company.

*Companies are shareholders through the Foothills Energy Partners

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
Alberta Biodiversity Monitoring Institute
Alberta Conservation Association
Alberta Energy Regulator
Alberta Environment and Parks
Alberta Fish and Game Association
Alberta Forest Products Association
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BC Oil and Gas Research and Innovation Society
Bighorn Wildlife
Borealis Ecology Wildlife Research
Canadian Association of Petroleum Producers
Canadian Institute of Forestry
Canadian Natural Resources Limited
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Woodland Operations Learning Foundation
XTO Energy Inc.
Yellowhead County

Alignment Partners

These partners provide informal support for fRI Research, and align with our vision and goals.

Alberta Chamber of Resources
Alberta Forest Genetic Resources Council
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
Brock University
Carleton University
Council of Forest Industries
Ember Research Services Ltd.
Forest History Association of Alberta
Forest Products Association of Canada
FP Innovations
Hinton and District Chamber of Commerce
Hinton Fish and Game Association
Inside Education
International Model Forest Network
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University of New Brunswick
University of Waterloo
Vilhelmina Model Forest
Watershed Alliances and Councils: Athabasca, Beaver River, Bow River, Lesser Slave, Milk River, Mighty Peace, North Saskatchewan, Oldman, Red Deer River, South East Alberta
Western University
Wildlife Habitat Canada
Wilfrid Laurier University

NOW IS THE TIME TO WRESTLE LIVE DEER

The winters were too cold to safely wrestle deer, and the summers stank like rotten skunk, and it was a fantastic field season.

Let's start with the summers. The Caribou Program set up 67 trail cameras in 67 cutblocks throughout the west-central caribou ranges. The rotten skunk smell is a scent lure we set in front of the cameras. It still doesn't make a lot of sense to us that herbivores would be so curious about a dead skunk, but it does seem to be working: if animals are already in the cutblock, then the lure just gets them to walk in front of the camera so we can count them.

The idea was to see which animals were making use of cutblocks. Particularly predators and the main caribou competitors, moose, deer, and elk. Any pictures of cute rabbits and foxes are strictly a bonus.

It isn't that deer and the like are directly competing with caribou for food and territory. But good deer habitat brings in so many deer that the bears and wolves are soon to follow, which is pretty unfortunate if there happens to be a declining caribou herd in the vicinity.

There are some things about cutblocks that are just going to attract deer because deer like young, regrowing forest. But cutblocks aren't all made the same and they certainly don't stay the same, so we put our cameras in brand new cutblocks and cutblocks that were so old you could hardly tell it wasn't just regular boreal forest. All had been harvested one way or another and there were different preparations and planting.

Forestry companies wanted us to find out whether there are characteristics of cutblocks that deer and their ilk (including elk) seem to really like. Then when they harvest, the companies can try to leave cutblocks that are relatively

worse for deer, and therefore less of a problem for caribou.

Next year we'll do it all over again in more than 50 different cutblocks to really get a good comparison between different cutblock characteristics. But after we figure out which characteristics are bad, we anticipated the next question: how much of a difference those factors make.

The size of any potential effect on deer (and therefore caribou) of different cutblock designs depends on how important cutblocks are for deer in the first place. If deer rarely visit cutblocks, then even if forestry companies totally change how they harvest and replant, it probably won't make much of a difference for caribou. This brings us to the wrestling.

Somewhat unexpectedly, it's the safest way (for the deer) to get a GPS collar on them. It turns out that the stress of chasing deer around in a helicopter to netgun or dart them can lead to "capture myopathy" and them dying within a few hours. So, we put out cages called Clover traps (named for a person, not the plant), and when deer trigger the door to lock, we drive out, pin the deer down, stick it with a tranquilizer, and put the collar on. Wildlife biologist Tracy Mackay explains:

"The whole process is pretty crazy because you have to jump in the trap with them. One person was in charge of opening the door, one counted down. We'd talk about it before, but once inside, we just kind of did our best. We wore hockey helmets. Hoofs were flying. Once I was in there, it wasn't as scary as I thought it would be because they're not that big, so with two people you can get it pinned down. And it's a really common technique. We were following previous research and worked with vets and people who have done a lot of ungulate capture in the past."

For a few weeks we got a brutal cold snap and had to shut down the traps. Below -30°C it's too risky for the deer to drug them and leave them lying on the ground for an hour.

But in the end, we captured 13, collared nine (young males grow too fast so we couldn't get a good fit and had to let them go). None died of capture myopathy, but three were eaten after about a month, so six are still out there, giving us data on what habitat deer use.

Our hope is that we can figure out important characteristics of cutblocks for deer, so that forestry companies can choose harvesting and silvicultural practices that are least harmful for caribou.

THE TREES THAT SURVIVED THE BEETLE

They traveled the ice roads in the Northwest Territories, the standing dead forests of central BC valleys, and the vast leading edge of mountain pine beetle advancing through Alberta. The scientists walked beneath a creaking canopy collecting pine cones that they believe hold answers for how to deal with the beetle's invasion.

The cones contain the tree's genes. These genes, which guided the tree's growth from seed to towering giant over decades, also shepherded the tree through every challenge it might have faced in its life: competition, drought, fire, and perhaps mountain pine beetle. Some genes were successful. Their trees were still green when scientists gathered their cones. The cones of others, by ill luck or insufficient defense, were plucked from the dead.

The scientists, led by Janice Cooke, Rhiannon Peery, Catherine Cullingham, David Coltman, Dezene Huber, Kate St. Onge, and Jakub Olesinsky want to learn which genes tend to survive beetle attack. This is why they are sequencing the genes of lodgepole pine cones from all those different areas.

The question goes back to where the epidemic began in central BC. Near the epicenter of the population explosion, an astonishing amount of the forest was wiped out. But even there, some lodgepole pine trees survived attack.

The main defense against an insect burrowing through the tree's bark is to flood the area with sap to physically push the invader back out. Failing that, the tree can produce some chemicals that are toxic to beetles. Against a couple beetles, any healthy tree stands a good chance of fighting them off. But if a large number of beetles "mass attack" the tree, it would take an extraordinary effort to be able to make enough sap and keep the defense chemical concentrations high enough.

The researchers hope that by comparing the genes of survivors with those that fell to the first wave of beetles, they will be able to identify the seeds of trees

that are significantly better at defending against mountain pine beetle. So far, they have found 20 candidate genes that are extremely likely to be related to surviving beetle attack.

The other way to survive is to not be attacked at all. At the leading edge in Alberta, the mountain pine beetle does not systematically attack every tree. Rather, female beetles fly around sniffing trees until they settle on a target and release a scent that draws in cruising males for a mass attack. Other research groups are starting to get a handle on which aromatic molecules the beetles are drawn to; this team is interrogating the genetic basis. From an initial search, Dr. Cullingham found a gene that helps predicts whether beetles choose a particular tree. The team has since expanded their search by an order of magnitude to try to find even more genes that beetles attack or avoid.

The team is interested in one more area. Above the 60th parallel, the forests have probably never encountered mountain pine beetle. They are as evolutionarily naïve to the threat as can possibly be found in Canada. For this reason, they make an ideal comparison to see the differences with, say lodgepole pine from central BC that have evolved alongside endemic mountain pine beetle for thousands of years. These trees represent the most susceptible variants of the species, and together with all the other cones from around Canada, establish a baseline for genetic diversity of lodgepole pine.

When good defenders and avoiders can be identified by a genetic test, government and industry will have a powerful tool to control the epidemic. Managers can choose to replant varieties with good defense genes. They can verify the susceptibility of seedlings at seedlots before they go in the ground. And they can test existing forests to predict which stands are most vulnerable, and perhaps a higher priority for harvesting.

"We have a little bit of time after the cold winter where a lot of beetles died," says Dr. Peery. "So there is a chance to use this info before they ramp back up."

BOREAL SALAD BARS


Adam Sprot


Adam Sprot

Pipelines get a lot of attention across Canada from protesters and proponents. But out in the boreal forest of west-central Alberta, there's interest from a very different demographic. A study led by Anja Sorensen found that grizzly bears seem to approve. When she took our long-term dataset of grizzly bear movements and compared them to a map of all the pipelines in the region, there was a clear pattern. The bears were favouring areas with high pipeline density, and when they were near pipelines, they dawdled around for hours.

Pipelines are one type of linear feature along with roads and seismic lines that form long gaps through the forest. Because pipelines aren't as shaded by trees, the landscape is criss-crossed by corridors of grasses, forbs, and small shrubs. It's those plants, including clover and dandelion, which Sorensen thinks the bears are interested in.

"These are important bear foods," says Sorensen, "and now we know that when they aren't in their winter dens, grizzly bears are selecting for pipelines, where these plants are abundant."

The research is possible because the Grizzly Bear Program has been fitting bears with GPS collars for over 13 years, which send back hourly locations. Sorensen and the team then used a measure called tortuosity—basically how winding a bear's path is—to spot when it is foraging. A bear that hunkers down in one spot for days is probably binge eating a big animal like a moose, but around pipelines, Sorensen was more often seeing a slow meandering path more reminiscent of a cow making its way through pasture.

During all seasons (except winter when they hibernate), both male and female bears sauntered in areas with lots of pipelines that offer plenty of dandelion and clover to munch. But during the spring, the bears that were most likely to forage near those long salad bars were adult females.

"For grizzly bear populations, adult females are the most important," said Sorensen, "because they either have cubs with them or have the potential to have some next year."

Pipelines, like most other things people leave behind in grizzly bear habitat, are somewhat double edged. On one hand, cutting down swaths of old growth forest generally increases food for bears, as things like forbs and berry bushes suddenly get a lot more light. But there's

a dark side. People tend to pass through these features by foot, truck, or ATV and the evidence is clear: more access leads to more encounters and too often this leads to a bad outcome for the bear, the person, or both.

Past work by the Grizzly Bear Program in Alberta has found a clear link between road density and grizzly bear mortality. This research points to some things pipeline operators could do to reduce the risk. First, their employees who go out to pipelines should be aware that grizzly bears—and potentially protective mother bears with cubs—are selecting for these areas. Staying alert and bear-aware is the best way to prevent a surprise encounter. Second, there may be some things companies can do to discourage the public from using pipelines for recreation, such as building berms or encouraging regrowth at junctions with roads.

While debate rages on building new pipelines, one thing everyone can agree on is the need to keep people and wildlife safe around the ones already out there.

Adam Sprot

STREAMLINING STREAM CROSSINGS

2019:

3,469 crossing inspections

Total:

21,641 crossing inspections

343 crossings repaired

500km of reconnected fish habitat

From fords to culverts to bridges, there are tens of thousands of places where roads cross Alberta's streams. Built right, these crossings let fish get upstream and prevent too much sediment from finding its way off the road and into the water. Unfortunately, past practice was not always up to today's standards, so a group of companies banded together to start dealing with the problem through regular inspections of their stream crossings and fixes for trouble spots.

Since the Foothills Stream Crossing Partnership began 14 years ago, new members keep joining because they can see its strong track record and the value in cooperation.

The association provides the full stack of services that crossing owners need. It starts by training its membership on how to inspect their crossings. This year's training added another 100 employees and contractors who can now visit crossings and efficiently record a panoply of pertinent data. This is possible because the Partnership has developed a custom-built tablet app to streamline and standardize data collection, and automatically send it to an online database. The database is the last key service in the stack, and it was just upgraded to be even more useful.

Each company can log in and see their own crossing data, neatly searchable and

summarized. The new enhancements go further to help members prioritize deficient crossings for repair. The first is integrating the province's Fish and Wildlife Information Management System, which streamlines inspection and repair planning by showing which fish are present, and when there would be work restrictions because certain species are spawning. There is also a new tool that automatically calculates the right size of a crossing structure based on the inspector's measurements of the watercourse.

With more companies and inspectors today than ever before, the work is still accelerating. When the Foothills Stream Crossing Partnership started, it wasn't even clear what the scale of the problem was. But by working with the regulator and sharing the cost of the program, the members have already made tremendous progress on reconnecting fish habitat throughout the foothills. It's bridge building in more than one sense.

Members of the Foothills Stream Crossing Partnership

Baytex Energy
Canfor
Cardinal Energy
Canlin
Chevron
Cenovus
Devon
Hammerhead Resources
Husky Energy
Jupiter Resources
Millar Western
Modern Resources
Outlier Resources
Paramount
Peyto
Repsol
Seven Generations Energy
Shell Canada
Strath Resources
Tangle Creek
Taqa
Tidewater Midstream
Torc Oil
West Fraser
Weyerhaeuser

ROADMAP FOR ECOSYSTEM-BASED MANAGEMENT

Ecosystem-based management: often cited, variously defined. Whatever the precise meaning of the term, it will certainly require an understanding of the natural forest patterns and natural ranges of variation in the area of interest. For the Healthy Landscapes Program, that area is nothing less than western Canada, and it has undertaken an ambitious research program accordingly.

Over the years, stakeholders such as industry and environmental non-governmental organizations have indicated their interest in many of the ideas in ecosystem-based management. But the fuzziness of the concept and the groups' different priorities have hampered progress towards putting the research into practice. To help everyone get on the same page, establish more clarity around the concept, and build trust between stakeholders, the Healthy Landscapes Program hosted a series of four dialogue sessions around Alberta.

"We found broad support for the concept of EBM [ecosystem-based management]," says Dr. Dave Andison, the Program Lead. "Yet stakeholders have different interpretations of what EBM looks like when implemented."

The team was encouraged by the enthusiasm of stakeholders and the trust that dialogue had built between them. They decided that the next step in the discussion about ecosystem-based management in the western boreal was to bring everyone together, this time into a single, two-day workshop. This took place in June 2018 and was attended by 65 engaged representatives from a range of groups. Seven presenters kick-started the discussion with talks about their experiences implementing the concept. Periodically, the participants and presenters self-organized into groups to explore the barriers and propose action plans to implement a concept that was taking on an increasingly solid shape.

One type of action plan was focussed on improving communication and collaboration between stakeholders and communities, particularly Indigenous. There was broad agreement that community engagement should happen early and never stop, rather than waiting until the end of the process.

Another key part of the roadmap were plans for future pilot projects, as well as case studies of past and ongoing projects. In addition, the attendees and presenters suggested gathering and mapping all the examples of ecosystem-based management policies across

Alberta, and finding gaps between what's already in place.

There were calls for more research, particularly meta-analyses where the results of multiple studies are combined to draw deeper conclusions. Another suggestion was to create an advisory board to help guide implementation. And ultimately, there will need to be a full experiment of the concept where land managers operationalize the principles and monitor how the ecosystem responds.

THE PERFECT COMPLEMENT

It was 2016, and Dr. Dick Dempster was analyzing data from the first 15 years of the long-running Regenerated Lodgepole Pine Trial (RLP). The study in the foothills had tested how lodgepole pine stands regrow under several important conditions: what the site is like, how densely they are planted, and if they got weeding or thinning. The results strongly hinted that the site preparation methods of mounding and drag scarification were also important, but that was one variable too many for the study. What the researchers needed was another study that kept all those other things constant, and only varied site preparation. But the trouble with studying trees is that if they started a new trial, they'd have to wait until 2029 to get the results.

That's why Dempster's discovery was so opportune. He heard of another study, this one southwest of Edson. Sundance Forest Industries (now part of West Fraser Mills) had worked with Simon Landhäusser at the University of Alberta to see, among other things, which site preparation was good for seedlings. Amazingly, they had started their trial basically at the same time as the RLP, and had kept the RLP's key variables constant: they were all on the same kind of site, they had the same planting densities, and they had no herbicide or thinning treatments. The study varied only the site preparation methods; because it was only designed to study seedlings, it had been left alone since its last measurements, in 2006. The Sundance trial was the RLP's ideal complement, and it had been running in parallel the whole time.

When forestry companies prepare to regrow lodgepole pine stands, they might try to give the pine seedlings a better chance at outcompeting other plants. For this study, there are two relevant methods. Mounding allows them to plant the seedling on a mound of soil, maybe to keep it from drowning in a very wet site. Drag scarification, or dragging, is when they score the ground before planting,which helps expose the mineral soil. Almost as if it was planned, those - plus planting without either method - are exactly what the Sundance trial tested.

Seizing the opportunity to collaborate with Landhäusser, the team took August and September of 2017 to remeasure a bevy of effects at the old Sundance site. They found that dragging led to the highest density, followed by mounding, and way in last place was no site prep. Any site prep at all increased the basal area, a measure of how much wood fiber had grown. They also found that either preparation led to more trees surviving. Without prep, there were few pine seedlings that grew naturally—80% of the trees growing there had been planted. But on sites that had preparation, it was the opposite. Most of the trees (though a bit further behind the planted trees in size) were natural regeneration.

This research makes a strong case for the benefits of dragging and mounding. Of course, site prep costs more for companies, but Dempster notes that benefit is not just in a higher timber yield. It can also save money because companies aren't likely to have to come back later to fill-in plant. Combined with the RLP, this site preparation trial delivers hard numbers to extremely relevant questions for the industry. And even more than that, it's an example of how the right studies meeting at the right time can lead to great things. "This was a brilliant example of fruitful cooperation between FGrOW, industry, the Canadian Forest Service, and the University of Alberta," says Dempster

BETTER, BIGGER, FASTER

Our researchers can keep pushing forward on the toughest questions, confident that the GIS Program has their back.

"In our country," said Alice, still panting a little, "you'd generally get to somewhere else—if you ran very fast for a long time, as we've been doing."

"A slow sort of country!" said the Queen. "Now here, you see, it takes all the running you can do, to keep in the same place." – Lewis Carroll, Through the Looking Glass

The GIS Program must sympathise.

As our researchers build on their findings, year on year, the questions they take on have tended to become more complex: they consider more interactions, use less simplified models, and work at ever-increasing scale and resolution. Managing spatial data, the lifeblood of their science, has to evolve just to keep up.

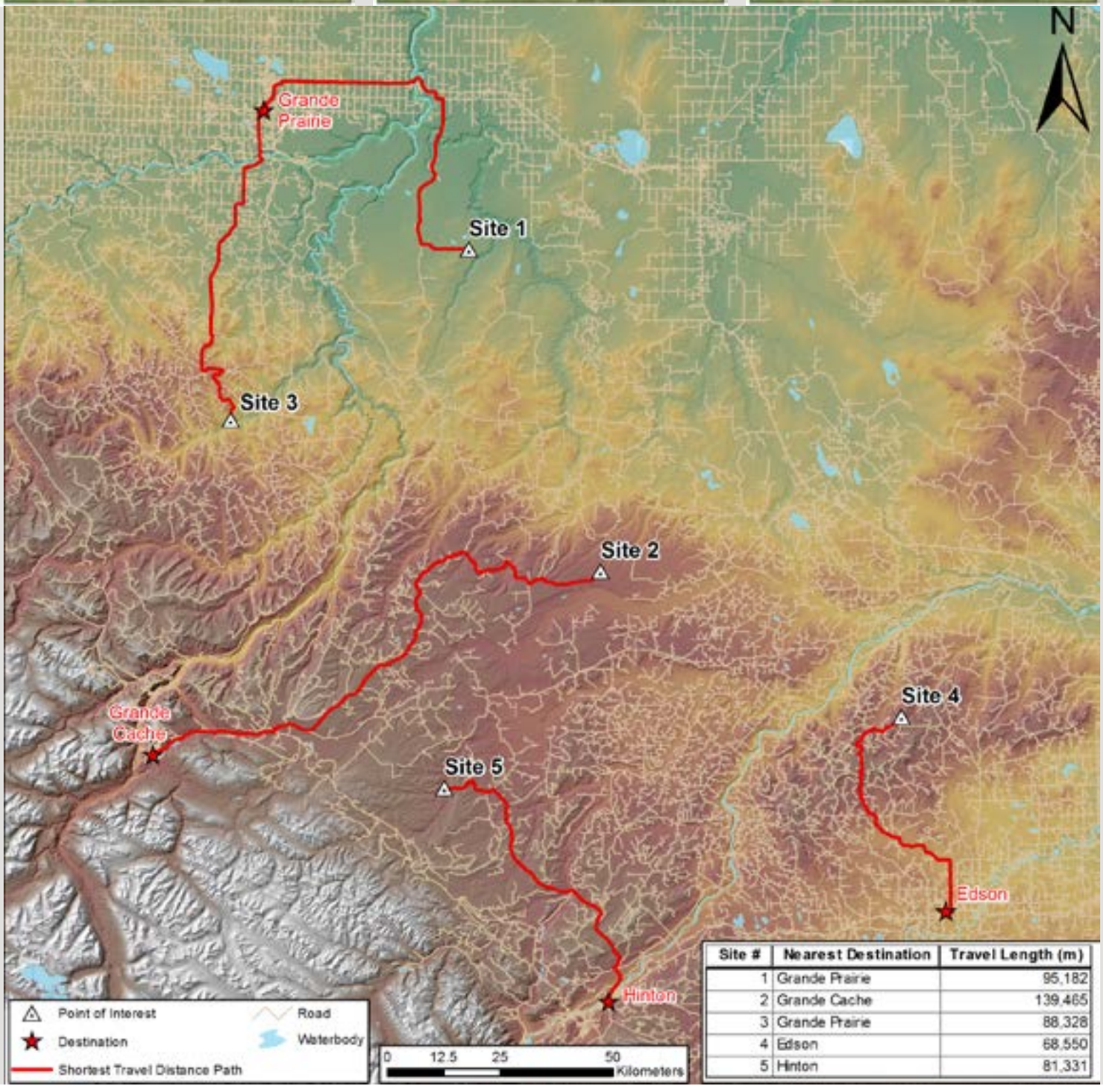
A major challenge is how study areas have grown: spanning data sets, provincial boundaries, and decades. It isn't trivial to find the best way of integrating satellite imagery, LiDAR, aerial photography, and boots-on-the-ground measurements. Some caribou herds, for example, migrate between Alberta and BC every year, almost as if they aren't fussed that each side was surveyed differently, which complicates our work.

Study areas are also expanding their time spans as we tackle long-term questions. Our wildlife biologists want to be able to model scenarios both forward and backward by as much as 20 years. Forecasting and backcasting in the most realistic way is critical, and so is documenting the assumptions that go into that particular wizardry, so that everyone understands how the data can be used. The GIS team's efforts to break out datasets by year found a ready application in this year's Grizzly Bear Tools release for that program's partners. There's a new feature called Change Detection, which shows how grizzly bear habitat quality and mortality risk change over time under different scenarios.

Another project that is only possible because of the dataset enhancements is the collaboration between Caribou, Grizzly Bear, and Mountain Pine Beetle Ecology Programs to understand how the first two species will respond to the third (see page 32). Because the beetle is only changing pine stands, the researchers need a GIS layer of pine in caribou and grizzly bear ranges for every year of the study. No such layer has ever existed, to our knowledge, so the GIS Program created one by finding a way to merge the Government of Alberta's vegetation map with a series of annual maps showing where forest was appearing and disappearing (created by long-time Grizzly Bear Program collaborator Nicholas Coops).

The other way that the GIS Program has expanded our researchers' capacity, is by making their workflows and data-related tasks far more efficient. Before they can do any modeling or mapping, they have to filter and process the variables in the database, which can involve a lot of steps and repetition. This is time consuming, of course, but trying to do it all manually also provides innumerable opportunities to make a mistake which will then take even longer to track down and fix. The GIS Program's solution is to write scripts that automatically perform these routine tasks. So far, they've developed seven tools for the most common—and onerous—data management tasks, with more in the pipeline.

All this means that our researchers can keep pushing forward on the toughest questions, confident that the GIS Program has their back.



Site #	Nearest Destination	Travel Length (m)
1	Grande Prairie	95,182
2	Grande Cache	139,465
3	Grande Prairie	88,328
4	Edson	68,550
5	Hinton	81,331

THE GREAT GRIZZLY COUNT

We hired a crew of 23 biologists to gather grizzly bear hair samples for DNA, to get an estimate of the population size.

They were trained on how to build scent lures with barbed wire for snagging hair tufts off curious bears. They had to build, check, and pack up 200 of them that summer.


Isobel Phoebus


Anja Sorensen


Isobel Phoebus

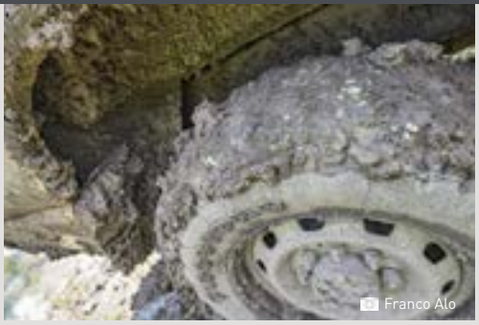

Anja Sorensen

The province has seven "bear management areas" and in 2018 we worked on 3 of them: the area south of lesser slave lake, the area east of Banff National Park, and a smaller study in the area east of Jasper National Park.


Isobel Phoebus

The areas are remote and challenging. Some are helicopter-access only. We're enormously proud of the crew for how hard everyone worked to safely gather the data.


Franco Alo


Franco Alo


Isobel Phoebus

The next step is to sequence the DNA and run the statistics to estimate the populations.


Isobel Phoebus


Monica Dhal

THROUGH THE ELDERS' EYES

The Elders of the Aseniwuche Winewak Nation of Canada can still walk through their traditional lands and find the graves, the abandoned camps, and where the moments of their history, great and small, took place. But time erodes everything, so something must be done before the remnants fade back into the forest.

The Forest Management Area south of Grande Prairie that Weyerhaeuser is responsible for overlaps this traditional territory, giving the company a duty to consult with the Nation to ensure that its operations don't disturb important places. But Weyerhaeuser will go the extra mile with a new project. By working together with the Aseniwuche Winewak Nation, they will create a database of cultural sites. Chantelle Bambrick was the natural choice to organize the project. She works for the Foothills Landscape Management Forum (of which both parties are members), giving her a good understanding of what the two organizations' needs are and how each can contribute to success.

By truck, helicopter, and foot, Bambrick, the Aseniwuche Winewak Elders, Traditional Knowledge Holders and Consultation staff traveled the wilderness north of Grande Cache. As the group reached each site, they used an app on a tablet to record the location, take notes and photographs about what kind of site it is and its historical value to the community. Back in Grande Cache, the data synced to a database. Because the app automatically tags photos to each site, it made it very easy for the community to view everything without having in-depth technical skills. The AWN, while retaining ownership of these records of their past, shares the information that Weyerhaeuser needs for its planning.

Nice as this is for the company, the value of safe guarding the Aseniwuche Winewak Nation's cultural heritage is incalculable. "It is difficult to find the words to describe how meaningful the project has been to our community," says Vivian McDonald, the Nation's Traditional Knowledge and Community Engagement Coordinator.

About the Foothills Land Management Forum

The Forum is a group of forestry and energy companies committed to integrated land management. Using scientific solutions and government collaboration, they create an integrated industrial access plan that will have less environmental impact.

2019 Members

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Strath Resources
Tourmaline Oil
West Fraser
Weyerhaeuser
XTO Energy

"From the Aseniwuche Winewak Nation perspective, the project has bolstered our database not only with new sites and ensuring our data had the accurate locations of sites, but also has given us more details as well as photos. The extensive knowledge our Elders have of the area has been passed down to staff as well as Traditional Knowledge Holders, thus securing the historical information and its transfer to future generations.

"The Elders' perspective is the one that pulls the heart strings. So many times the Elders have thanked the staff over and over again. With tears in their eyes, they have said that they never dreamed that they would return to the areas that they had lived, played, trapped, hunted, fished, guided, and lived with their families as children, youth, young men, and adults. They would sit and tell of what they did, who they were with, the games they played, and general daily activities with such clarity that it takes the people listening back in time to see the land through their eyes. There were times that the Elders had such an attachment to a place that they would sing a song in Cree. These were the times that really affirmed how important and precious the land is to our Elders and ultimately to our people."

CARIBOU PATROL: SEASON 7

As winter begins to dust the alpine with snow, a woodland caribou herd must descend from their mountain refuge and cross the Highway 40 industrial corridor to reach food and shelter in the forest to the east. Not all of them will successfully slip through a gap in traffic. Six months later, as the northern hemisphere again leans toward the sun, the herd must make the return crossing.

The Caribou Patrol, now in its seventh season, is tasked with making this journey a little less perilous. The actual patrol - driving the highway to collect sighting data and frighten caribou back from the road at dangerous moments - is a small part of the program's impact. The team can only cover so much ground, after all. The bigger job is to alert the tens of thousands of drivers during migration seasons. This is done through billboards along the route, Alberta 511 alerts, notifications to local radio stations, and educational outreach. The latter received a big boost thanks to a new tranche of grant funding from Imperial Oil and XTO Energy.


Jill Thorburn

This year, half of that educational grant money went toward "Atih", a startlingly realistic (but entirely synthetic) caribou, a trailer to get it to events around the province, and a fully branded event kit. Atih is a big draw at, for example, the Deep Freeze Festival in Edmonton, where nearly 1,000 people stopped to hear about caribou in Alberta, or at National Indigenous Peoples Day in Jasper, where hundreds of families checked out the Caribou Patrol's booth in under four hours one afternoon.

The other outreach arm is aimed at schools by supplying teachers with the Caribou Edukit, which helps kids learn about the species' status as a threatened species, its biology and how it lives. This year, thanks to the efforts of an incredibly engaged Patrol staff, they can now offer the Edukit en française.

The last main activity of the Caribou Patrol this season was engaging people on Facebook, Twitter, Instagram, and SnapChat. Following on social media and sharing information and sightings is a simple but valuable way for anyone to get involved and help protect an iconic Canadian species.

THE GRIZZLY BEAR FOOD GUIDE

We pushed past the dripping branches of one last willow and found ourselves in a low, soggy meadow. The arrow on the GPS flipped randomly around like a compass needle at the North Pole, telling us that we'd arrived. Our task was to figure out why a grizzly bear had been so interested in this particular spot.

We generally have GPS collars on about a dozen bears roaming the forests of western Alberta. That has let us learn a lot about the population, like how big their home ranges are, and what kinds of plants and terrain make good habitat. But since 2016, we've been trying to do something more ambitious—we want to know what bears are actually doing, and that means following in their paw prints and searching for clues.

It would be impossible to check out every GPS location. And besides, most of them—when the bear was just walking by—aren't likely to offer any information. Instead, the team chose spots where bears hung around for hours. Even narrowed down, there were still thousands and thousands of these location clusters, but over the next two years, we visited over 1,100 of them.

The bones were under a black spruce on the edge of the meadow. Two deer legs, and the jawbone. Scavengers had picked them mostly clean and presumably made off with the rest. Nearby, an earth depression still clearly marked where the grizzly bear had bedded down over a month ago.

Deer remains were a relative rarity for the sites the team visited. To start with, just 8% had any kind of prey remains, although we found bear scat containing hair from prey at another 5%. There were more sites with elk than deer remains, but moose were far and away the most common—more than all other prey combined. That includes small animals like hares, sheep, and even other predators; we found one unidentified canid (perhaps a wolf), two black bear cubs, and one grizzly cub that was visited by two of the males we were monitoring. (Male grizzly bears may kill another's cubs in order to be able to mate with the mother.)

Samples bagged and pictures taken, we bushwhacked back to the truck and set off for the next site. We got a pretty good idea about what this bear was after before we reached the centre of the GPS cluster. All the way through the forest the bushes were loaded with ripe bearberries, bunchberries, and delicious blueberries. About a third of the clusters we visited were foraging sites like this. We found bear scat a few metres further up hill. Large handful-sized plops embedded with berries. It's fairly typical to see bits of the bear's last meal like that. Veg like clover and dandelion often

Amy Stenhouse

pass through partially digested as well. As for what "meat splats" look like, the name should give you an idea.

A grizzly bear's diet varies even more than can be seen in their scat. They'll mow down a ditch lined with clover, they'll hunt moose calves, they'll dig up rotten stumps for ants—whatever is in season. But they don't all eat the same mix of food, and it's becoming clearer that the difference comes down to more than just opportunity. Adult males are most likely to successfully hunt for prey large and small. But even among individual bears of the same age and sex class, some just seem to be killers. When we visited location clusters for one adult male, more than one in five sites had prey remains (quite an outlier compared to the one in twelve average).

After pouring over the data from 1,128 sites, we figured out how to predict with, good accuracy, the chance of there being ungulate remains at any cluster based on the date and time that the bear was there, combined with how many locations there were in close proximity. With this discovery in hand, suddenly all those thousands and thousands of location clusters that we couldn't visit across the whole landscape were windows into what grizzly bears did. Grizzly bears choose places with lots of moose, and they kill and eat more moose there.

But does this source of energy and protein make a difference, or will bears do just fine getting more of it from plants? It would make a lot of sense that digestible protein is a valuable resource because Alberta has fairly low amounts compared to south of the border. So we turned to the trove of body condition measurements we collect whenever we catch and collar a bear. Basically, a bigger, heavier bear can have more, healthier cubs. What we saw was that the bears that eat more meat, especially females, were in better condition.

We had connected the dots: abundance of prey correlates to the amount of prey grizzly bears eat, and how fit the bears are to have more cubs and support population growth.

We have learned a lot about grizzly bear survival from other projects. This research tells us the other half of the story—the diet that will help populations thrive. To get here, we just had to walk more than a thousand times in their tracks.

MORE CONNECTIONS FOR AN INFORMATION HUB

Land use will always be evolving and the Land-use Knowledge Network will keep growing alongside to continue fulfilling its role of connecting people to the information they need.

2018–2019 was a year of steady growth and improvements for the Alberta Land-use Knowledge Network and its companion site, the Land-use Hub. Combined with social media and a relaunched monthly newsletter, the network helped thousands of Albertans find the information they need.

The main landusekn.ca site continues to grow its vast, carefully catalogued library of resources, this year with a particular focus on events around the province. From urban agriculture to watershed management to green building codes, there's probably a local workshop or conference for anyone with an interest in land-use. Every month, the Knowledge Network's newsletter distributes a curated selection of resources on a land-use topic that will be relevant and interesting to practitioners.

The Land Use Planning Hub takes another approach to facilitating land-use planning by providing a space for people to share their experiences and get answers as they prepare for their area's regional plan, or work on implementing it. Landusehub.ca's administrator, Jeff Wiehler, has added 17 articles that synthesize information

on timely topics for land-use planners. For example, there are articles on how to manage conflict areas, how high profile government initiatives may affect land use planning at the local level, and how land management has evolved in over the province's history.

Another addition to landusehub.ca is a compendium of 75 datasets that planners need to use to do their jobs. The government and NGO datasets are publicly available, but through conversation with planners, Wiehler recognized the need to bring them all together in one, easy to find place. Planners can use the portal to find maps for almost any kind of resource, information on invasive species, renewable power forecasts, natural disaster risks, watershed data, climate models, air pollution statistics, and more.

Because the library of articles, events and datasets is drawing in curious eyes beyond the core audience of municipal planners and land managers, the Land Use Planning Hub has also built an interactive tool to give a quick and clear overview of Alberta's seven regions and what the regional plans actually are.

Land use will always be evolving and the Land-use Knowledge Network will keep growing alongside to continue fulfilling its role of connecting people to the information they need. Ultimately, better land-use plans will benefit all Albertans.

THE BEETLE, THE BEAR, AND THE 'BOU

There is still a lot left to learn. For example, will other prey species like moose, deer, and elk thrive in the beetle's wake, drawing in grizzly bear and other hazards for caribou?

We've done lots of research on the impacts of industry and recreation on caribou and grizzly bear, two threatened species in Alberta. Forestry, pipelines, well sites, roads, quads, seismic lines, you name it. But little is known about how they might respond to mountain pine beetle. This is an important question because the beetle has already chewed its way through more than 72,000 hectares of lodgepole pine forest along the western side of the province, and is showing a worrying appetite for jack pine further north and east.

The provincial government and industry, meanwhile, are spending millions of dollars trying to slow the spread and prevent the untimely deaths of a vast number of trees. One way they do this by cutting down recently infected trees and burning them before beetles can fly to the next tree. If infestations or management are going to affect caribou or grizzly bear, land managers need to know how, so they can factor it into their planning.

We suspected that since southern mountain caribou are in their element when they are in mature, intact pine forest with all its tasty lichen, they might not be so keen on MPB or control efforts changing the forest conditions. Grizzly bears, on the other hand, might appreciate those kill-or-control stands because the open canopy would let their preferred foods flourish. To find out, we'd need to actually see if they are more or less likely to visit stands that are attacked by mountain pine beetle and either killed by the insect or by the people trying to slow the spread.

We know where grizzly bears go. We have been fitting them with GPS collars for almost 14 years in areas where MPB occur. The Government of Alberta and fRI Research partners generously supplied the caribou location data from 1998 to 2018. The idea of looking at whether they selected or avoided mountain pine

beetle sounds simple enough, but in the foothills and boreal forest, there are lots of potentially important and related things to account for, like nearby industrial disturbance or forest structure and composition.

Those last two did turn out to be significant. We were able to confirm that caribou do indeed pick mature pine forest to hang out in, preferring stands with a more open canopy (which we know tend to have more lichen on the forest floor). And as expected, grizzly bears do basically the opposite: sticking to forests with open canopies, their edges, and features like roads and pipelines.

But for the core question of whether mountain pine beetle attack or spread control efforts are having an impact on caribou or grizzly bear, we found that there isn't such a clear pattern. Caribou herds did not find MPB killed or controlled pine attractive at the scales we tested, but were not repelled by it either. Other habitat characteristics like food availability seemed to be more important. Likewise for grizzly bears. It will be worth checking to see if there is a more straightforward effect at smaller scales, but even these unpredicted results are worth careful consideration by forest managers.


Laura Finnegan


B O Sweeney

For one thing, it's fairly safe to rule out the conclusion that their beetle control efforts to date are having a big influence—either positive or negative—on caribou or grizzly bear. While this doesn't suggest that government and industry should ignore effects on caribou or grizzly bear habitat when planning where to do control activities, it does provide some assurance that there is room for other priorities, like reducing fire risk and of course, slowing the beetle's spread.

There is still a lot left to learn. For example, will other prey species like moose, deer, and elk thrive in the beetle's wake, drawing in grizzly bear and other hazards for caribou? The boreal is a rich and beautifully complex landscape, home to many species and resources. One thing it doesn't seem to have is easy answers.

FUTURE FORESTRY TECH

Remote sensing is a hot topic in the forest industry. Companies must monitor their Forest Management Areas to check on growth, see which areas need extra planting, weeding, or thinning, and perhaps even detect disease and insect outbreaks. It's not merely expensive—there's also a shortage of skilled workers to get all the field measurements done in such vast, remote areas. As well, governments are concerned with keeping tabs on the fuel loads in forests to prepare for wildfire, and monitoring animal populations. Remote sensing technology could be transformative for many of these tasks and more besides.

So In October 2018, the Forest Growth Organization of Western Canada, Alberta Agriculture and Forestry, the Forest Resource Improvement Association of Alberta, Alberta Innovates, and fRI Research teamed up to bring together forestry practitioners and leading Remote Sensing experts for a two-day conference. The first goal was to get government and industry up to speed on what the state-of-the-art is for these technologies. Namely, how they can help measure the growth, mortality, hydrology, biodiversity, and fire risk of a company's forests. The conference was also helpful as a forum for sharing the needs of the forest industry with the remote sensing research groups, so that those groups' future work can find ready application.

Experts from around the world presented on data collected at a variety of scales, including airborne imagery and photogrammetric point clouds (from both manned and unmanned platforms), airborne light detection and ranging (lidar), and imagery collected by a number of satellites, as well as software tools and methods to turn the data into information. As these components—the vehicle, the sensors, and the image interpretation software—mature, it will be a real improvement to cost, efficiency, and capability from the older, less automated methods.

The appetite for using remote sensing grew during the conference. But even as better technology is adopted over the next decade and helps alleviate the shortage of forest practitioners, companies will still need to send out boots on the ground to calibrate and validate the remote sensing data. Ultimately anything that is helpful in monitoring the forest, is helpful in managing the forest, and it feels like the industry is ready to stop talking about remote sensing, and start doing.


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ALBERTA INNOVATES
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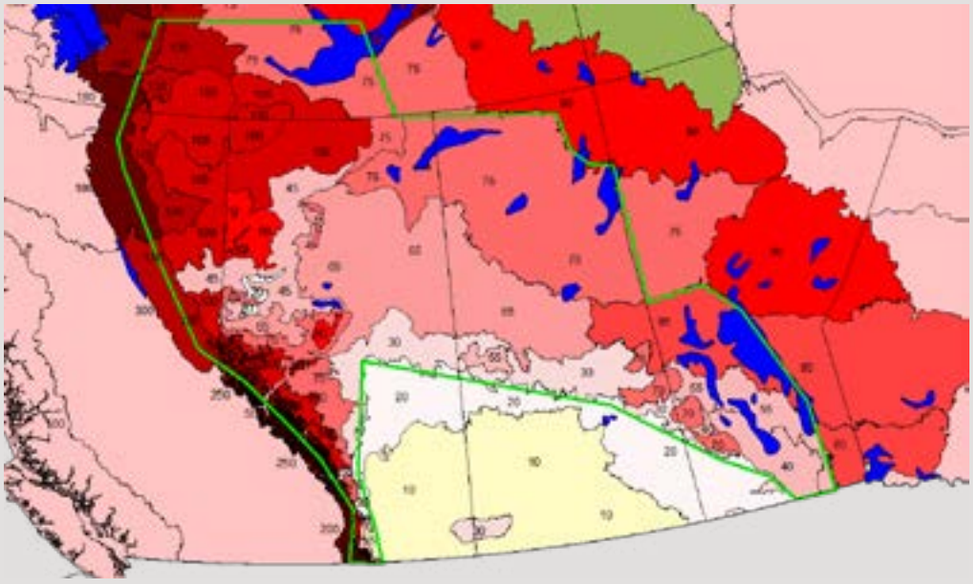
MAPPING ANCIENT WILDFIRE CYCLES



In a first for the Healthy Landscapes Program, Dr. Dave Andison recently completed a project that didn't use peer review, data collection, or even the scientific method. Instead, the results were constructed explicitly from expert opinion. The program remains, at its core, devoted to rigorous science, and expert opinion will not replace careful peer review. However, Andison has come to appreciate that there is a lot of utility in exploring other ways to understand complex systems like the western Canadian landscape.

As an example, Andison points out that, "traditional ecological knowledge taps into generations of knowledge of how ecosystems work, and how to manage them sustainably." Another source of expert opinion can come from eminent scientists with a lifetime of experience in the field. This source of knowledge is already an integral part of the regular process of science – in framing scientific questions, designing methodology, and interpreting results, but it is typically only acknowledged implicitly.

"We wanted to create a map of pre-industrial long-term fire-cycles for western boreal Canada," says Andison. There are advantages and disadvantages to any method, but, "this was a problem ideally suited for the use of expert opinion."

This is because there aren't published studies with hard data on large portions of the study area, and because of the vast scale, it might take years or even decades to fill in all the gaps through peer review. That work can and will continue, but in the mean-time, policy makers need to make decisions today. To assist with this, the Healthy Landscapes Program started with a literature review to summarize the data that was available from published and unpublished sources. This formed the foundation for a two-day fire regime workshop that included more than 20 scientists and other experts from across Canada.

From this, the experts created a long-term fire-cycle map for western Canada. What followed was four years of iteration. Experts weighed in on the map, it was updated, experts gave more feedback, it was further fine-tuned, other experts offered more feedback, and so on. "It turns out there is no shortage of opinions regarding historical fire regimes in boreal Canada," says Andison.

The final product represents the best available knowledge on which to base management decisions. As more research is done, the map can continue to be improved, but it can work the other way too. "The map itself establishes a benchmark," says Andison. "Scientists can use it to help guide future research efforts."

HEALTH CHECKUP FOR ALBERTA'S WATERSHEDS


Caitlin Tomaszewski

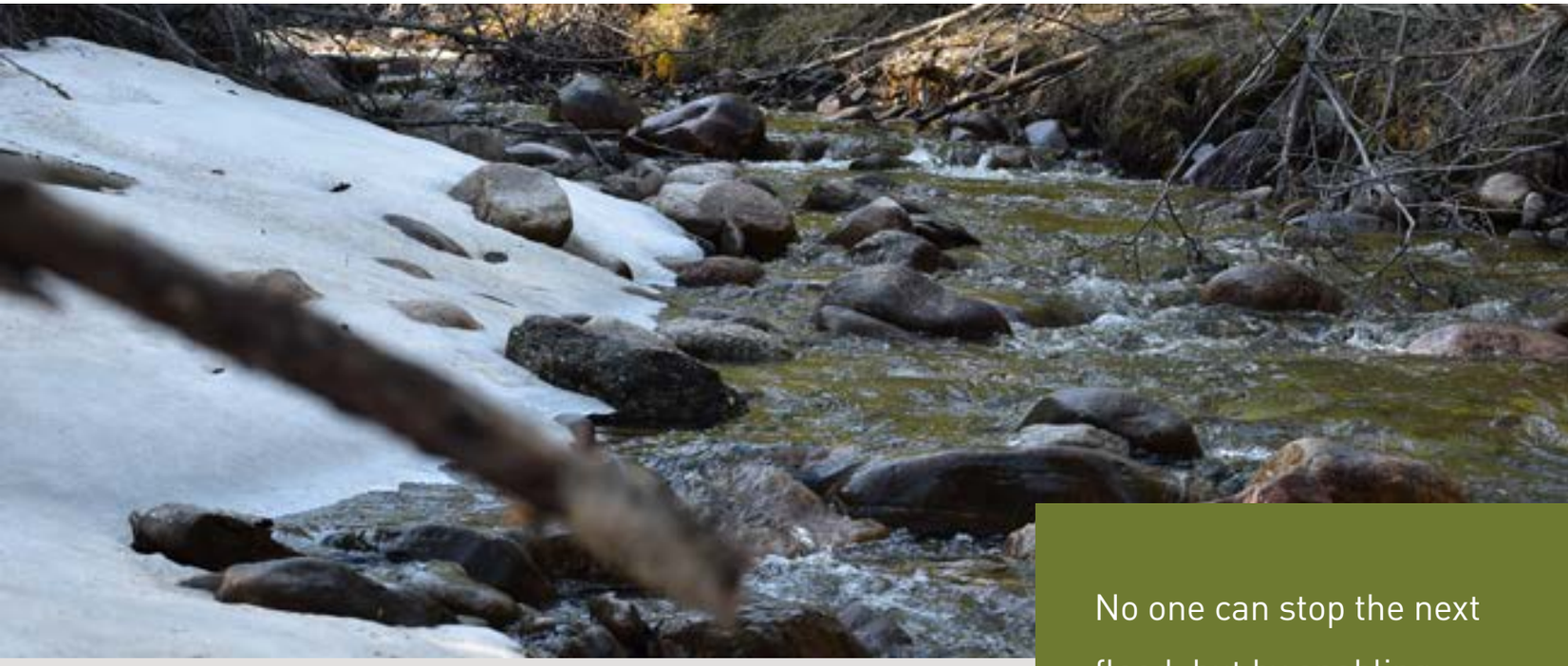

Caitlin Tomaszewski


Caitlin Tomaszewski


Caitlin Tomaszewski

The 2013 flood that devastated communities in southern Alberta began far from the majority of the damage to Calgary and towns like High River. That June, a torrential amount of rain inundated two great watersheds, the Bow and the Oldman. These rivers and their multitude of tributaries are born high in the Rocky Mountains to the west. All the way down from the glaciers, the Bow and the Oldman rivers grew as they gathered in tiny trickles and large streams. When the thin rocky soil of the eastern slopes was saturated and the rain did not relent, the water ran over the ground, scouring earth, sweeping away plants, collecting in—and overflowing—stream banks. Finally the violence, still being fed by the downpour, burst upon the sandbags and settlements.

The flood changed the landscape, but the landscape also affected the flood. The forests intercepted and soaked up a considerable amount of the rain, the



contours and grade guided the flow of water, the wetlands slowed and filtered it. A healthy watershed has a high capacity to absorb, store, and gradually release water after heavy rain or the spring melt-up. It is resilient to extremes of flood and drought.

The stark reminder of the importance of healthy watersheds spurred the provincial government to start the Watershed Resiliency and Restoration Program, which is where our Water Program comes in. Our part of the project was to visit the far reaches of the Bow and Oldman and find out if the watersheds are functioning as they should be. For three summers, Emma Hawksworth and Caitlin Tomaszewski hiked through the Castle and Kananaskis areas assessing riparian health. The team borrowed an evaluation from central BC, and part of the project was running it through its paces to see what modifications would be needed for Alberta. After the first field season, the team already realized that the assessment needed to consider Alberta's diverse ecoregions. In the BC interior, it's generally a bad sign for ecosystem health to have no trees along a river but in Alberta, especially around places like Pincher Creek, it might just be prairie.

But overall, the assessment was useful. The technicians had to answer 15 yes or no questions about each section of river they visited. They looked, as mentioned, at the vegetation, which not only helps buffer extreme precipitation, but also reduces erosion by holding surrounding soil together. Fish and insect presence is a related indicator, because a disturbance that wiped out these communities has probably left the area less resilient. And of course, there were questions about the channel, for example, whether the banks have been "blown out" by a sudden surge, as happened in the 2013 flood on a tributary of the Elbow River in Kananaskis.

In fact where watersheds were not fully functioning, the flood was a factor about half the time. Other common things that degraded a stream's resiliency was erosion off of roads, recreation, and livestock. Across 312 sites in the two watersheds, on average, the condition was rated "functional but at high risk". However, there is a lot of variability between areas at all scales, providing an opportunity to choose priority areas for restoration. Some streams are doing well and will not require any big fixes, while putting resources towards restoring other areas could provide a significant boost to flood and drought resiliency.

No one can stop the next flood; but by enabling the province to improve the health of our watersheds, we hope our work will make Alberta more resilient.

THE MOUNTAIN PINE BEETLE'S MANY SURPRISES


Antonia Musso

There is still much more work to do on this study and there are fascinating observations at every turn.

Antonia Musso needed to improvise. She had just released 1,000 live mountain pine beetles under wire mesh tree skirts and the beetles were going to town on the trees. The plan was to cut off the attack by vacuuming up excess beetles after she saw a certain number of pitch tubes—the sap-oozing holes they make in the bark of the tree. The problem was that the drought-stressed jack pine weren't making big juicy pitch tubes that she could confidently count.

It wasn't this lab's first crack at finding out how many beetles it takes to successfully mass-attack a tree. Led by Dr. Maya Evenden, they had seen that it takes about 40 beetles per square meter to take down a lodgepole pine in Alberta, which is comparable to central BC and Washington, but far fewer beetles if the Alberta lodgepole was drought-stressed. Now they wanted to see how it plays out in jack pine. In 2016, they went to a jack pine stand that the beetle had just reached, but, it turned out, not in sufficient numbers—only two trees were mass-attacked. In 2017, they brought the beetles to the trees in infested logs. Again, there weren't enough beetle attacks; this time it was because the beetles preferred to return to the dead, defenseless logs that they came from, rather than tackle a living tree.

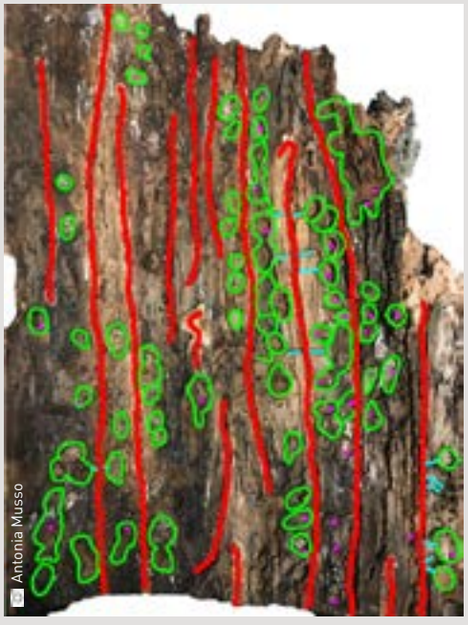
Determined to make it work in 2018, Musso gathered mountain pine beetles and stored them in jack pine wood chips ("to give them a taste for it") and brought the beetles in buckets. Finally the beetles were mass-attacking the jack pine, but now it was the trees that weren't cooperating. Musso's solution was simple and practical. She left the buckets at all the trees for a day. Then, for the trees assigned a low attack density, she took away the buckets—still containing quite a few lollygagging beetles—and added them to the other trees to simulate a high attack density.

Musso harvested half the trees after the next generation of beetles had hatched and started chewing out their galleries under the bark. She left the other half to see what would happen to them over the winter before going back in May and harvesting those too. Back in the lab, Musso steamed the logs and peeled the bark off and, for a minute, she had no idea what she was even looking at.

Typically, the colonizing beetles, once under the bark, mine vertical galleries, females laying eggs along the sides. When the larvae hatch, they head out horizontally, growing and developing into a pupa. At that stage, they seem to favour an oval gallery. What Musso saw did not resemble that. Most of the under-bark layer was just gone, and there were these really big galleries with a bunch of pupae all together.

Musso figures that because this layer, called the phloem, is thinner in jack pine, the beetles had to eat way more of it to get the same amount of nutrients, causing their galleries to run into each other. This suggests that even if it takes fewer beetles to colonize a healthy jack pine than a lodgepole (and analysis is still underway on that), the flip side is that the tree will not support nearly as many offspring.

Another interesting thing was that, upon counting the number of beetles in the logs, she realized that her improvisation with the buckets had happily provided a really nice gradient of attack density from 10 beetles per square meter up to



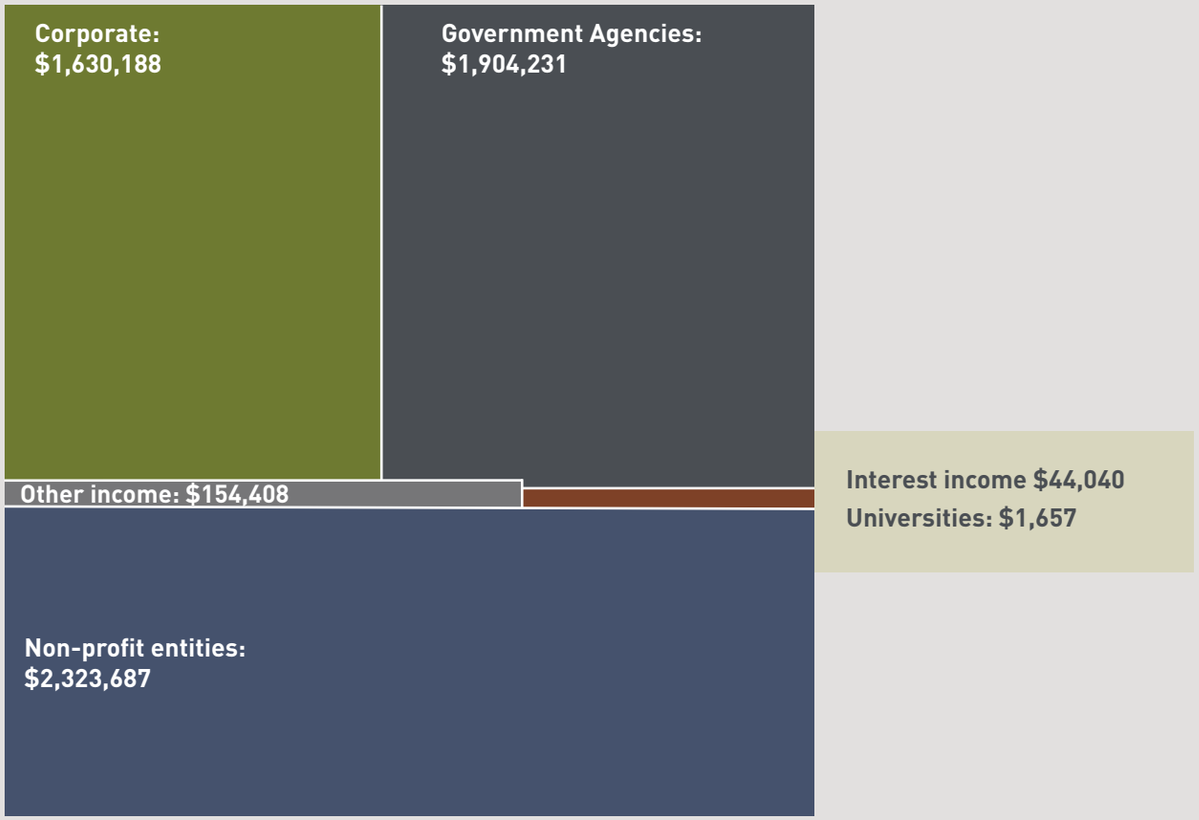
90 rather than the arbitrary thresholds of 20, 40, or 60 that she would have had with the original study design.

There is still much more work to do on this study and there are fascinating observations at every turn. The overwinter logs are just beginning to be peeled and not a single mountain pine beetle had survived the first cold snap. There are also many other large, predatory bark beetles that apparently bored into the trees above the mesh tree skirts and dug down to the mountain pine beetles, which they do eat. And then there's the energetics work where Musso and the team raise beetles on different tree species, then glue a thin wire to their thorax to measure their flights and fitness.

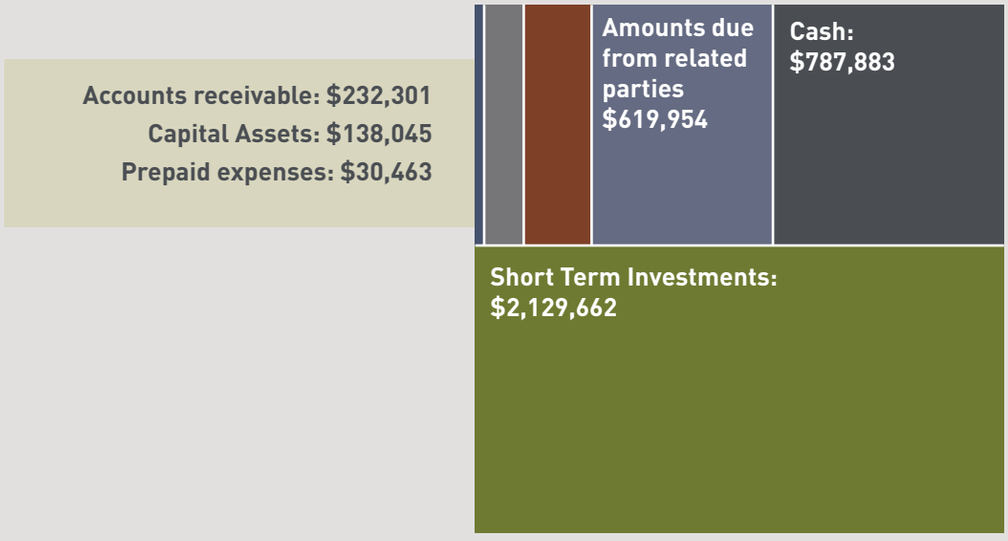
As tantalizing as all this is, the team must still peel trees, count beetles, and—stay tuned—reveal the answers.

SUMMARY OF 2018–2019 FINANCIAL STATEMENTS

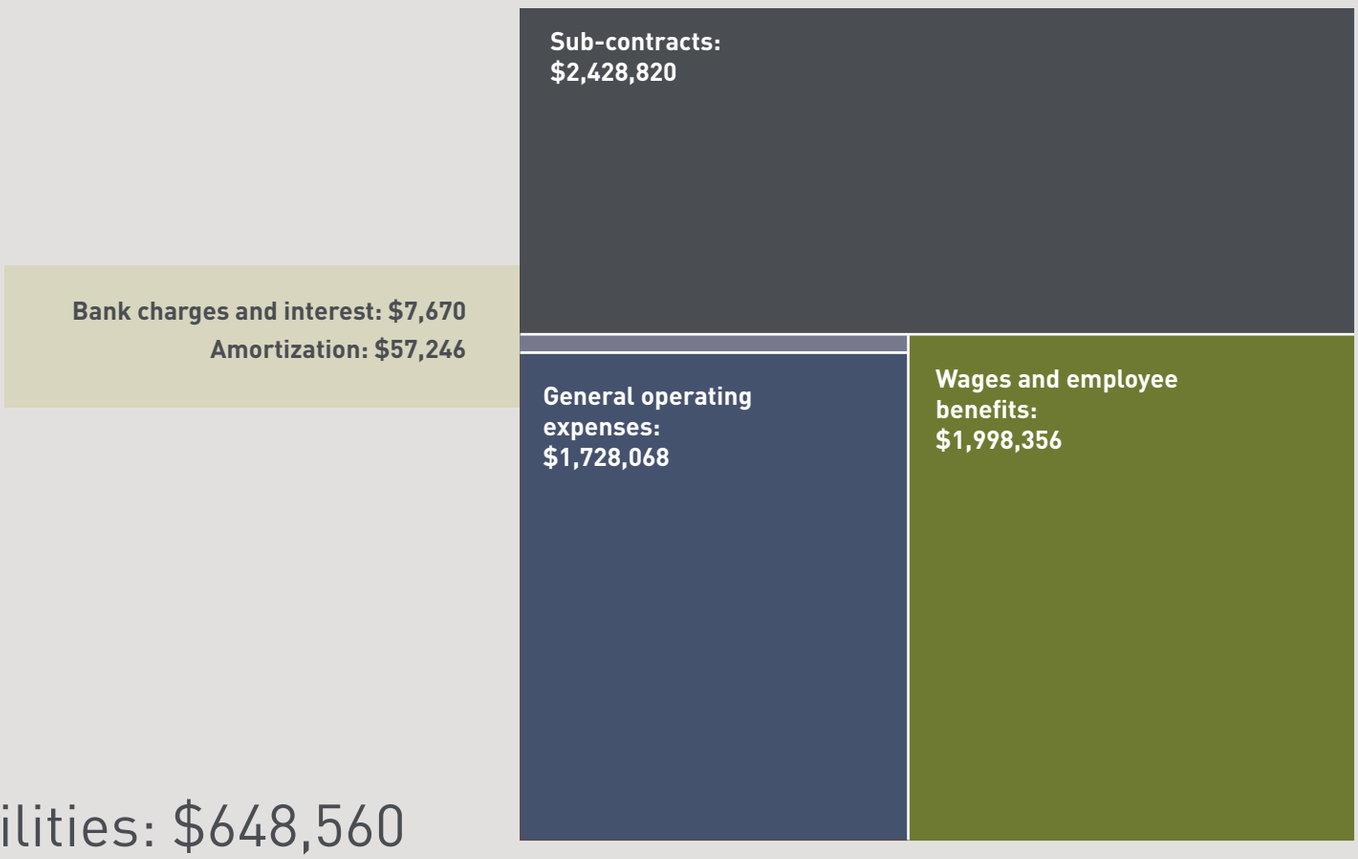
Revenues $6,058,211



Total Assets: $3,938,308



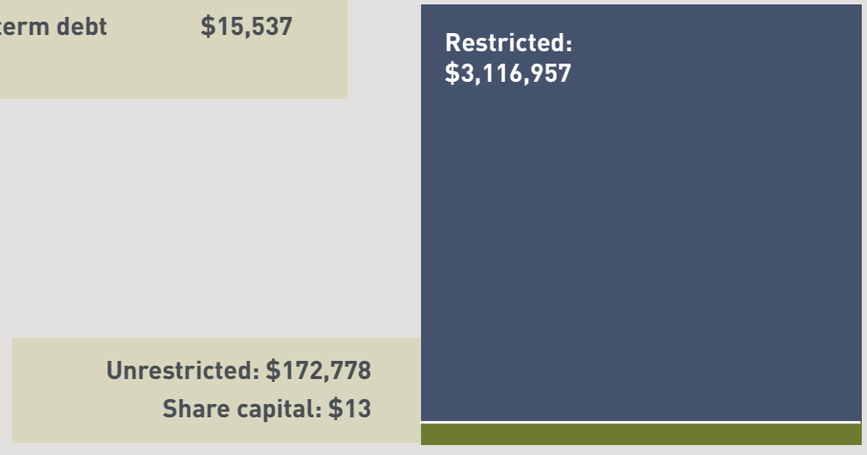
Expenses: $6,220,160



Liabilities: $648,560

Accounts payable and accrued liabilities	$308,093
Deferred Revenue	$300,000
Current portion of long-term debt	$24,930
Long-term debt	$15,537

Fund Balance: $3,289,735



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