Bugs and Diseases

Vol. 30 No. 3 December 2019

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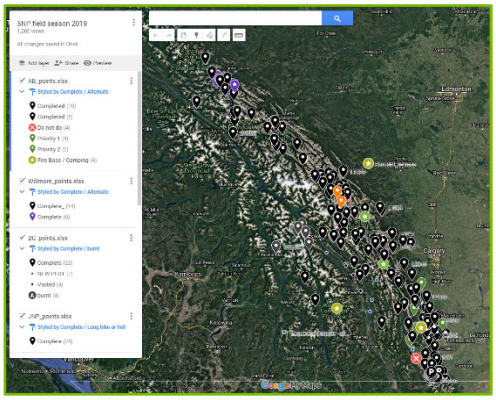
Forest Health and Adaptation

Monitor-a-palooza 2019

Forest health staff in the western regions of Alberta bravely charged into the mountains to answer the call of the wild. The call of the wild Clark's nutcracker, that is. That's because 2019 was the 5-year monitoring cycle for our network of almost 250 plots around the Rockies and foothills that provide long term data on health and regeneration of whitebark and limber pine.

It would fill up this entire issue of Bugs and Disease just to list everyone who deserves thanks for making this field season's work a success, but Brenda Shepherd of Jasper National Park was the dauntless project leader. The logistical challenges loomed, the weather was terrible, the paperwork was mountainous, the days were long, and the outlook can be depressing. But thanks to this monitoring, Alberta's recovery progress is modelling the way for our partners in Canada, and we are all working together to support this long term endeavour.

A summary of the monitoring results is being prepared and will be shared – earlier results have been published in a series of articles. Monitoring helps prioritize areas for recovery with limited resources, and provides critical data to identify federal and provincial status and trends. More fuels analysis is on the way and this should result in better guidelines for use of fire in these ecosystems in the north.



From Kakwa to Waterton, teams from multiple agencies collaborated to assess 244 of about 300 plots established across the interior mountain ranges (BC and AB). New plots were established to replace burnt and inaccessible sites, and to expand the sample area. Teams from Parks Canada, BC and Alberta trained together to ensure data was collected consistently and accurately. Resources were shared across agencies and data were updated in real time to help each team plan and back up data and photos.

 | Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)

Alberta

In a related project funded by the Wildfire Management Science and Technology program, fire history evidence and fuels data was also collected for 263 plots to answer the burning question of whether whitebark and limber pine regeneration are really linked to fire in the northern part of the species' ranges, and to evaluate conditions where prescribed fire or wildfire would benefit or harm restoration. Fuel data was also collected to assess wildfire exposure risk to these valuable sites. This data will be added to the provincial wildfire data sets and used to prioritize site protection.

Some of the key results so far:

- Unsurprisingly, GIS fire history layers failed to identify most of the fires in these remote areas.
- GIS layers of fuel type aligned poorly to those identified in the field.
- Half the sites showed evidence of historic fire, with about 2/3 of areas burnt over 20 years ago and 1/3 within the past 20 years.
- Within plots, ground fires either were less frequent, but more likely to have been burnt repeatedly by fires of varying severity, obscuring signs of low-severity fire – a mixed fire severity regime with more frequent stand-maintaining fires and occasional stand-replacing is seen as typical for these ecosystems.
- Analysis is still underway, but there were no relationships between regeneration and latitude for whitebark pine, and weak relationships for limber pine.
- No patterns were evident for regeneration with elevation.
- There were fewer fires in northern sites, and there was far more regeneration in whitebark pine than limber pine stands.
- Overall, unburnt sites showed similar limber pine regeneration densities to sites with old burns and more recently burnt sites had less regeneration of all sizes.

Whitebark pine unburned stands had intermediate densities of regeneration of all sizes compared to more recent burns, which had more, and old burns, which had less. This suggests there may be different fire dynamics for limber and whitebark pine ecosystems.

Jodie Krakowski – Edmonton

Welcome Back Valerie Milner!

The Whitecourt Forest Area would like to welcome back a familiar face. Valerie Milner has returned to the Whitecourt office to cover Eryn Snoddens' maternity leave as the Forest Health Technician. Valerie started with the government of Alberta as a Helitack crew member fighting fires and was most recently employed as a Lands Officer, where she did inspections on dispositions, timber operations, as well as forest health inspections. In her spare time, Val enjoys hobbies such as travel, reading, and hiking with her husband and son.

Welcome Val, we're glad to have you join the FH team!

Allison Brown – Whitecourt Forest Area

 | Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)

Growth of Siberian larch in Alberta

Siberian larch (Ls, *Larix sibirica* Ledeb.) is known for fast early growth, high strength decay-resistant wood, and tolerance to drought, low temperatures and low intensity fires due to its thick bark. Ls distribution in its native Russia covers locations with climatic conditions similar to those in the Canadian Prairie Provinces. Given the above, the species was introduced to Alberta and other prairie provinces, first in the early 1900's for use in small private woodlots, shelterbelts and as an ornamental plant.

The species caught attention of Dr. Narinder Dhir, the leader of provincial tree improvement programs from 1975 to 2008, who decided to compare Ls performance with that of native lodgepole pine (Pl), white spruce (Sw) and jack pine (Pj). From 1980 to 1998 he established a number of trials in 15 climatically diverse locations in Alberta. The number of locations allowing comparison with Pl, Sw and Pj were 12, 10 and three, respectively. A total of 6984, 4865 and 1285 Ls trees were planted in tests comparing performance with Pl, Sw and Pj, respectively. A seed orchard was established in Alberta Tree Improvement and Seed Centre (ATISC) in 1980.

Siberian larch seed orchard in ATISC

Ls has a very wide geographic range in Russia (3800 km east-west, 2700 km north-south and 10 to 2400 m elevation). Therefore, in addition to testing Ls performance as a species, Dr. Dhir set to find out which Ls geographic seed sources ("provenances") would be the best in Alberta environment. He selected 17 Ls geographic seed sources for planting in various tests. These sources include 11 seed collections from Estonia, Finland, Russia (Central, Volga, southern Siberia and south-central Siberia) and six collections from mature trees in Alberta, Saskatchewan and Manitoba of unknown origin. (It should be noted that Ls is not native in Estonia and Finland). The species and provenance tests in Alberta have been measured periodically with the average available data age of 18 years (ranging from 3 to 27 years).

What have we learned from these tests? In short, the performance of Ls in Alberta has so far been very impressive. Based on all available data from all tests, the average Ls stem volume per unit area was 378%, 105% and 64% greater than that of Sw, Pj and Pl, respectively (Figure 1). Stem forking rates were similar among the four species. It is not surprising that Ls outperformed Sw by a much wider margin than it did Pl within the experimental timeframe. Pl and Ls share many characteristics: both are early seral species characterized by relatively fast early growth and low shade tolerance, colonizing following fire disturbance. In contrast, Sw is a later successional species exhibiting slower initial growth and greater shade tolerance.

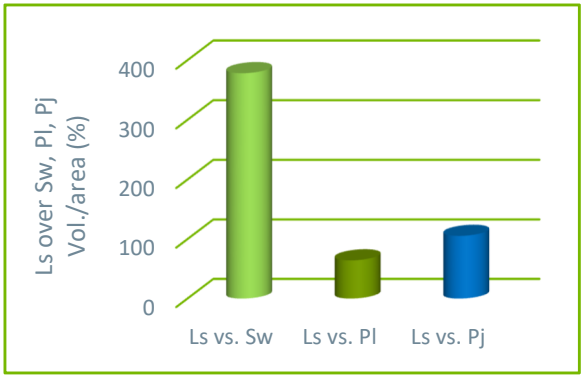


Figure 1. Siberian larch (Ls) stem volume/ha as a proportion of that for white spruce (Sw), lodgepole pine (Pl) and jack pine (Pj). Based on all available data from Alberta tests (the average data age 18 years).

With regards to the geographic seed source selection, it turned out that the best seed sources for Alberta were those collected from mature trees in Alberta (Beaverlodge) for higher elevation sites and from Saskatchewan (Indian Head) for medium and lower elevations. At high elevations the Russian Altai Mountain source also grew well. The Finnish "Raivola" collection was a very good source for low elevation/high latitudes and a slightly below average source for locations with medium elevations and/or medium latitudes. This seed source must be avoided in higher elevations. The superiority of Canadian sources may have resulted from their origin. It is also likely that the original plantings have gone through selection in situ that eliminated the less hardy

 | Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)

and slow growing individuals. This effect combined with some phenotypic selection at the time of seed collection likely resulted in a certain level of improvement over the seed sources directly from Russia and Europe.

The Ls tests in Alberta have been so far free from serious pests and diseases. Lester and Cerezke (2001) listed larch sawfly, Armillaria root rot and snowshoe hare as the most important native pests in the province for Ls, but they lacked certainty regarding differences in susceptibility to *Armillaria* spp. between Ls and native conifer hosts.

Figure 2. Carbon sequestered by age 28 by Siberian larch (Ls) and white spruce (Sw) in a test planted near Calling Lake. Carbon in roots and branches is not included.

Given its high early growth rate, wood density higher than that of native Alberta conifers, and high resistance to wood decay, Ls is an attractive carbon sequestration species. In the Alberta site with the oldest comparison data (age 27 Calling Lake) the average Ls tree size was 14.4 m height, 17 cm diameter and 0.14 m3 over bark stem volume. Adjusted for mortality, the volume per unit area was 198 m3·ha-1. On the same site with the same planting density and age Sw yielded 59.9 m3·ha-1. Assuming the following: (1) average juvenile wood density for Ls at 471 kg·m-3 and 340 kg·m-3 for Sw, (2) 50% of dry wood is carbon, (3) 1 kg of carbon is equivalent to 3.67 kg of CO2, the Ls stand sequestered 171.1 tonnes of CO2 /ha vs 37.4 tonnes of CO2 /ha in the Sw stand (excluding roots and branches) (Figure 2).

Introduction of a non-native commercial tree carries risks and benefits and is subject to a number of challenges. The introduction of Ls may increase forest productivity, provide more choices for forest products and result in greater species diversity of managed forests. Greater species diversity may increase forest resilience to the detrimental impacts of climate change. Pl in British Columbia and Alberta has suffered a colossal outbreak of mountain pine beetle. Ls could be considered as an alternative reforestation species in suitable areas to reduce future impacts of mountain pine beetle on Alberta forests.

Before any larger scale introduction is considered, more should be learned about the species in Alberta to form a basis of a thorough risk and benefit analysis. Information gaps include wood properties, growth and yield, stem form, frequency and size of knots, bark to wood ratio, seed and seedling production, animal damage, silvicultural options, potential for hybridization with tamarack, native species displacement, and ecological changes including potential impacts on natural disturbance (e.g. fire) regimes. The already established Ls plantings in Alberta can provide a wealth of information as they age and should be periodically evaluated for growth, stem quality, presence of pests and diseases, and environmental damage.

Siberian larch stem section

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Andy Benowicz - Edmonton

 | Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)

The Famished Forester

Q: What is one of the longest living species of beetle? A: Paul McCartney[1]

The practice of consuming insects, known as entomophagy, occurs in roughly 113 countries with 2000 known species of edible insects[2]. The most commonly consumed insects include individuals of the Coleopteran, Hymenopteran, Hemipteran and Orthopteran orders[3]. Entomophagy frequently occurs due to famine, a need for pest control or to celebrate traditional uses of the insect[2].

Although studies regarding the nutritional value of insects has increased, information is limited[2]. Payne 2016[3] found 100 grams of insect dry matter contained protein levels of 30 – 65% and caloric energy levels comparable to other protein sources. Fat content is dependent on their food sources and is variable between species and developmental stage[2]. Larvae and soft bodied insects were found to have greater fat content than those with hardened exoskeletons[2]. Zinc, calcium and vitamin A have been found in insect dry matter, but there is limited data on quantities present[2]. Micronutrient levels are affected by food, environmental conditions and contaminants, as well as the processing technique used. As such, there are large interspecies and intra-species variations in micronutrients[2].

For those of you considering eating your samples there can be risks associated to consuming insects[3]. Contaminants are dependent on the insect species and life stage, type of food, concentration of contaminants in the environment and, by processing methods[3]. Whether collected in the wild or raised on farms, insects may be infected with pathogenic microorganisms, viruses, fungi and protozoa, such as *Staphylococcus*, *Bacillus* and *Micrococcus*[3]. Sanitary and regulatory requirements for insect processing/cooking may eliminate some of the microbial and chemical contaminants[3]. Metal contaminants, such as lead and selenium, have been found in insect fat, reproductive organs, digestive tracts and exoskeletons[3]. A study identifying potential insect food allergies found all test subjects with known shellfish allergies had reactions to insects[2].

So, you know the risks and are still looking for that squirmy snack? Well if you forgot your lunch, there are some insects recommended over others. Dragonflies, ant larva, grasshoppers and crickets, aphids, mealworms and termites are commonly used for entomophagy in North America[4,5]. For those of you looking at a cost-efficient method of reducing a local mountain pine beetle population, beetle larva is a common snack around the world and may have a bacon-like flavor when cooked[2,3]. Avoid slugs and snails, as they often carry worms[4]. Also avoid caterpillars, as some are toxic and may also consume toxic plants[4]. If you don't know how you will react to the insect, but still feel adventurous, make sure you have access to a hospital before trying an insect. If you are unsure, choose the safest option and don't eat the insect.

The most common cooking methods are deep-fried, oven cooked, vacuum cooked, boiled, dried and frozen processing methods[3]. If you are looking for some cooking ideas, Oaklander[5] has a few chefs' ideas.

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Laticia McDonald – Calgary Forest Area

 | Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)

Bart McAnally Retires

I've always wondered if Bart was a vampire. Not in a creepy, bloodsucking sort of way, but because of is eternal youth. Maybe it's just me, but it seems that Bart has not changed a bit since I met him 25 years ago in Manning where he was stationed as a Forest Officer. At that point in his career, Bart already had about a decade of work with the Department under his Alberta Forest Service belt buckle.

Bart, a native Albertan, was seduced into a career in natural resource management in 1982 as a Junior Forest Ranger member in Hinton. He then graduated NAIT Forestry Tech school in 1983 and shot off on a whirlwind tour of Alberta small towns. First was a posting was on a seasonal timber management crew in High Level in 1983. From 1984-1988 he continued on as a seasonal crew member undertaking silviculture surveys, timber cruising, and recreation guardian work. In the winters Bart was doing what he does best… exploring the globe.

Eventually Bart did land a Forest Officer position in Smith where he worked from 1988-1991. Around this time it appeared that Bart was simultaneously bitten by the travel bug and the love bug. So it was off for a year-long honeymoon, travelling with his better half, Maureen. Luckily upon returning he was able to land another Forest Officer position, this time in Manning where he remained until 1998. During this time Maureen undertook a teacher exchange and the young couple headed to Australia. For that 1996 school year down under, Bart had his dream job - a fisherman house husband. It was not long after returning to Canada that Bart accepted a job as a Wildfire Ranger in Calgary.

After about 7 years in the wildfire program, Bart had an interest in reclaiming his summers to spend time more time with his wife and young kids. In 2005 he had the opportunity to join the forest health team as the Forest Health Technician in Calgary. After a decade of learning the ropes in the business of forest pest management, Bart was promoted to Calgary Forest Health Officer in 2015 and has not looked back since.

With Bart's departure in the new year, I asked him about his short and long-term retirement plans. He said the first order of business is "to get organized this winter". Fortunately Bart is getting organized for an exciting year that includes a 175 km Sunshine Coast trail hike on the west coast in July, heading across Canada in a camper van to hike in Newfoundland in August and September, and if all goes according to plan he will be escaping the next Canadian winter to hike and camp in New Zealand.

Over the next 10 or so years, Bart and Maureen plan on spending the winters somewhere warm, moving around every month or so. The following decade will likely be snow-birding to some of their favorite destinations they will have recently discovered. After that, the plan is to set up a routine and fully retire. Bart mentioned he is really looking forward to spending time with his wife and family, and hopefully some friends along the way as well. But it may not all be fun and games, as Bart may pick up odd jobs and maybe a contract or two to help fund future travel plans.

Bart accepting his blue-stain bowl from Mike.

Over his more than 36 year career, Bart noted his highlight has been working with the Forest Health group. "As you know I have worked in land use, timber management, wildfire and recreation, and by far the most adaptive hard working crew that really cares about their work has been this forest health bunch" noted Bart. He added, "I don't have enough fingers to count all the top notch folks in our group. I felt supported respected and I could not have asked for a better group of professional people to work and socialize with. Thank you for making my last few years enjoyable."

A big thanks right back at you Bart from the forest health 'bunch'! I will speak on behalf of the rest of the group and say that it has been a pleasure working with you.

Happy retirement and safe travels!

Mike Undershultz – Edmonton

 | Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)

The Battle after the Beetle

In recent years, there has been a significant amount of ecological change in the pine forests of Alberta due to the mountain pine beetle (*Dendroctonus ponderosae*) (MPB). In Canada, MPB populations have been spreading eastward across the boreal forest, leaving behind them a path of red and dead trees.

When it comes to ecological change, wildlife can exhibit a wide range of responses to beetle-killed forests. More often than not, wildlife species are adaptable and exhibit neutral responses to MPB outbreaks. The animals that can flourish from such disruptions are the ones that are quick adapting or disturbance thriving species[2]. After a "successful" MPB attack, the pine tree dies and becomes a snag. Snags are an important aspect of healthy ecosystems for a variety of reasons: one of them being that they provide space for nest-cavity birds to build nests[2,3]. An increase in beetle-killed trees ultimately means an increase in available nesting sites for a variety of birds.

Snags also attract an array of decomposing insects, such as carpenter ants. Xylophagous (feeding on or boring into wood) decomposers make a great meal for insectivores such as the American three-toed woodpecker (*Picoides dorsalis*)[2]. With an increase in food and habitat, animal populations have the opportunity to thrive. Once beetle-killed trees start weakening and falling to the ground, the forest ecosystem starts changing again. As the trees fall, habitat for animals that thrive in coarse woody debris increases. Animals such as voles will most likely benefit from this type of shift. As the wood breaks down, different insects come in and decompose the resource. These insects are then a potential food source for other insectivores[2].

While some wildlife may benefit, others may not. The animals that are thought to be the most vulnerable to beetle-killed forests are the mature forest specialists such as American martens (*Martes americana*), grizzly bears (*Ursus arctos ssp*), lynx (*Lynx Canadensis*) or wolverines (*Gulo gulo*). These animals either require a lot of space, have territorial behaviors, and/or are less adapted for migrating[2,4]. Other wildlife species that are predicted to be impacted are the ones that rely on cones for food, needles for building nests, or foliage for protection or hiding[1,2,4]. A few studies have found that American red squirrels (*Tamiasciurus hudsonicus*) have been negatively impacted by MPB outbreaks in the USA. Despite this impact, red squirrels can survive this adversity under certain circumstances (e.g. access to live non-host trees)[2].

Currently there is a gap in research on how mammalian, amphibian and reptilian species respond to MPB-killed forests. Although the available literature does appear to agree on one thing: several wildlife species positively respond to beetle-killed forests[2,3]. The current lack of research makes it difficult for land managers to make decisions to meet forest health, wildlife conservation, and restoration goals. For example, if forest managers salvage harvest in beetle-killed forests, how much retention should be set aside in order to benefit wildlife species? In the meantime, the best people can do is presume how wildlife will respond to beetle-killed forests.

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Brittany Taylor – Edson Forest Area

| Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)

First Canadian Ski Area Certified as “Whitebark pine friendly”

What sweeter feeling is there than carving fresh turns through pristine powder in the beautiful mountains? How about knowing that the lodge or ski hill you’re supporting has “whitebark pine friendly” certification!

This program, initiated by the Whitebark Pine Ecosystem Foundation, recognizes and encourages voluntary efforts by large and small facilities to educate guests and staff about whitebark pine, take specific measures to promote its conservation, management, and research, and report on activities. There is an accreditation checklist that applicants need to fulfill. The mountains foster a natural connection between skiing and preserving and promoting whitebark pine.

In 2016 Whitefish Mountain in Montana became the first certified ski hill. Their award was presented at the annual Whitebark Pine Ecosystem Foundation science and management workshop in Whitefish. This fall, Sorcerer Lodge, a backcountry ski lodge near Golden received their certification at a community event in Revelstoke, recognizing the owner’s years of engagement with researchers, cone collectors, and sharing her passion for whitebark pine with guests. Ten other ski areas are interested or working through the process, including two in Alberta.

For more information:
https://whitebarkfound.org/our-work/ski-area-certification/
https://www.cbc.ca/news/canada/british-columbia/lodge-owners-recognized-protect-endangered-whitebark-pine-1.5375861
https://www.bclocalnews.com/news/saving-trees-lodge-near-glacier-national-park-honoured-for-its-efforts/

Jodie Krakowski – Edmonton

Tree Seed Fun facts

Did you know that the seed bunker located at the Alberta Tree Improvement and Seed Centre (ATISC) stores all the tree seed used for reforestation on Alberta’s public land? That’s a whopping 59,000 kg of tree seed! Taking a closer look, there are 24,900 kg of pine (lodgepole and jack pine) seed for a total of 6.6 billion seeds. Factoring in the number of seeds per kilogram, seedlot purity, and germination specific to each seedlot, those seeds have the potential to produce 2.6 billion seedlings. The provincial black spruce inventory stands about 430 kg. That doesn’t sound like much but those seeds are tiny and mighty and have the capacity to grow 146 million seedlings. But it’s the white spruce and Engelmann spruce inventory that wins the day. There are over 30,000 kg of seed in the bunker totalling 14.3 billion seeds for those two species. That seed supply could produce 4.1 billion seedlings.

If all the seeds were placed end to end they could go around Earth more than one and a half times!

Donna Palamarek – ATISC

 | Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)

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ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)
Published Apr., Aug. & Dec.
Editor: marian.jones@gov.ab.ca
Bugs & Diseases informs forestry-related personnel about current forest health issues.
Articles are welcome.

Really About Time

Sung to the tune of Auld Lang Syne

Should all the beetles have died off
In the cold of ought one nine
Should all the beetles have died off
It's really about time

Chorus
It's really about time, oh yeah
Really about time
We're not too sure, but if it's true
It's really about time

And surveys hopefully will show
Of MPB demise
If far and wide they are quite dead
It's really about time

Chorus

We've spent the money, toil and sweat
And hoped for help divine
So if they've frozen in their trees
It's really about time

Closing, rousing, chorus

Tom Hutchison - Edmonton

 | Published: January 2020 | ISSN No. 1499-5859 (print)
ISSN No. 1499-5867 (online)