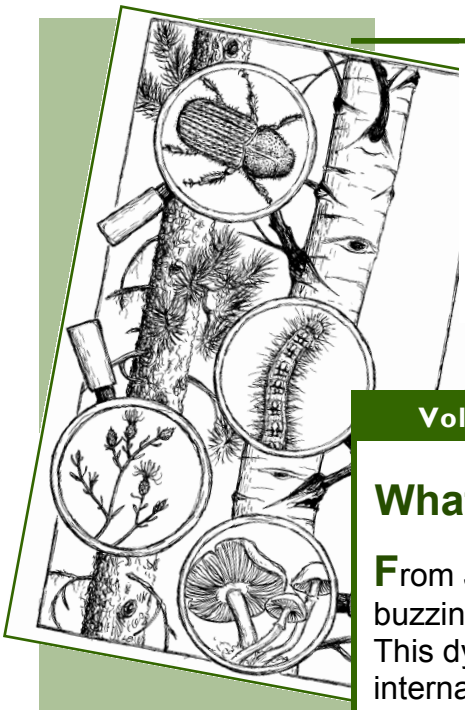


Bugs & Diseases

Vol. 28 No. 2 August 2017

Alberta's eye on forest health

Issue highlights:

What's the *Buzz* around Forest Genetics 2017?

From June 26 to 30, the University of Alberta campus in Edmonton was buzzing like a hive of excited bees. Was it a new forest pest? Thankfully no! This dynamic energy was catalyzed by the Forest Genetics 2017 international conference co-hosted by Forest Management Branch and University of Alberta. This year the conference was a joint meeting of the Western Forest Genetics Association and the Canadian Forest Genetics Association.

The theme, "Forest Health and Productivity in Changing Environments" yielded an amazing turnout of experts, practitioners, researchers, and students from 12 countries. Topics ranged from ways to drive innovation in forest genetics applications, to presenting cutting edge genomics research, to operational breeding and trial results. The breadth of presentations and posters covered a huge range of issues, from pests and diseases, to rapid screening, to biogeographic and evolutionary patterns in species and populations, to strategies for adapting to climate change.

A rapt audience at the University of Alberta Centennial Centre for Interdisciplinary Science .

Field trips were tailored for this knowledgeable group. A custom tour of the University of Alberta Botanical Gardens was led by the current and former directors and the resident ethnobotanist, including a sneak peek at the $25 million Aga Khan garden scheduled to open next year. Another tour highlighted the top-notch facilities and work done at the university genetics and genomics labs, ending at Delta Genomics downtown. A post-conference tour visited the Alberta Tree Improvement and Seed Centre (ATISC) and Coast to Coast Reforestation, where visitors got an Alberta perspective on applied tree improvement as well as seedling and native plant production.

Participants enjoyed great weather, lots of new connections were forged and many colleagues got a chance to reconnect. A delicious

banquet featured the amazing John Acorn speaking about effective communication about science and nature. The next meeting is planned for 2019 in Quebec… stay tuned! Details and the proceedings are available online here.

Thanks to the conference co-chairs Deogratias Rweyongeza and Andreas Hamann, the organizing committee, the sponsors, and volunteers for a successful event!

Touring the ATISC provincial reforestation seed bunker.

Larry Lafleur tours the group around operations at TreeTime/Coast to Coast Reforestation

Jodie Krakowski—Edmonton

New Forest Health Technician in Lac La Biche

The Lac La Biche and Fort McMurray Forest Areas have a new Forest Health Technician scouting through the woods. Home grown from Edmonton, Alberta, Devin graduated from the University of Alberta in 2014 with a Bachelor of Science in Forestry, with Distinction. Additionally, Devin is currently enrolled as a Forester-in-Training working towards a Registered Professional Forester designation.

Devin has worked in many different forestry environments spanning Alberta and British Columbia with a variety of field work experiences including Field Operations, Urban Forestry and Beautification, Wildfire Management, and is now eager to develop and expand his experience in Forest Health.

On his own time Devin enjoys archery, computer gaming, cycling, fishing, playing guitar, riding motorcycles, and is gaining interest in bodybuilding. Everyone in the Lac La Biche and Fort McMurray forest areas, as well as the provincial forest health community, would like to extend a huge welcome to Devin.

Welcome aboard and thanks for joining the team, comrade!

Fraser McKee — Lac La Biche Forest Area

Genomics of Western Gall Rust Resistance in Lodgepole Pine for Tree Improvement

Every forester in Alberta is familiar with western gall rust (WGR; *Endocronartium harknessii)*. The disease is wide-spread in the province affecting lodgepole pine and jack pine. It is hard to miss abnormal, globe-like growth (galls) on branches and stems often releasing bright orange spores in late spring or early summer. The spores directly infect other trees by germinating on elongating shoots. The direct pine-to-pine infection is unusual as rusts typically require an alternative host. For example, fusiform rust, the most serious disease of loblolly pine, first infects various oak species and then pines are infected by the spores released by oaks.

Since mortality cause by WGR is uncommon and the infected trees often seem to be growing well, some may consider this disease to be of little importance. While heavily infected young trees may die, or stems of older trees may break weaken by the gall, the mortality is indeed not common. The other obvious but more serious impact of the disease is on the wood quality and value of stem-infected trees. Less obvious and difficult to show is a long-term negative impact of branch and stem galls on tree growth. Alberta-based research gives examples of a significant 25% reduction in volume growth apparent 15-20 years after infections (Bella and Navratil, 1988). On the landscape level, the impact of the disease may become even greater in the future given the extent of pine plantation establishment following the mountain pine beetle outbreak.

Lodgepole pine stem broken at gall.

Tree improvement can help to reduce the rates of infection by selecting WGR resistant trees to be used for reforestation. For this to happen there must be genetic variation within the pine population – that is, some trees must be less infected than others when all are exposed to the same pathogen pressures in the same growing environment. Genetic variation with regards to WGR resistance has been shown in Alberta genetic tests (Cerezke et al, 2014). For example, in one field progeny test series 60% of all trees were infected but the infection rate per family (average of all trees from the same parent) ranged from 5% to 97%.

WGR susceptible and resistant tree in a progeny test near Whitecourt.

Relying on field experiments to select resistant trees can be challenging because it may take as long as 15 years to see the levels of infection that is high enough to allow for selection. The needed level of infection may not even occur in some sites and the pathogen pressures may not be uniform within the site. These obstacles to selection can be overcome by using greenhouse screening of artificially infected seedlings and/or molecular markers. With that in mind, a project entitled “Genomics of Western Gull Rust Resistance in Lodgepole Pine for Tree Improvement” was initiated by Alberta Innovates, the Government of Alberta and the University of Alberta. The project principal investigator is Dr. Janice Cooke, Department of Biological Sciences, University of Alberta.

Lodgepole pine germinants in the U of A inoculation screening for WGR resistance.

The overarching goal of the project is to find molecular markers for resistance to WGR by screening a large number of lodgepole pine families artificially exposed to WGR spores and genotyping the resistant and susceptible trees. Dr. Cooke's team has optimized the inoculation procedures and is currently at the early stage of the large-scale growth chamber screening. For that purpose seeds from a total of 70 families were supplied by the Alberta Tree Improvement and Seed Centre (ATISC). The selected families include resistant and susceptible ones based on the field progeny tests. Up to 1400 seedlings will be evaluated for resistance in the growth chamber study. In addition, it is planned to collect DNA from the trees growing in the progeny tests from a subset of the same families that are included in the growth chamber study. Close to 1600 individuals from the artificial inoculation screening and the field progeny tests will be genotyped. Association between the genotypes and phenotypes (resistant vs susceptible) will be investigated with the goal of identifying useful molecular markers. We expect the results in late 2018.

WGR- infected lodgepole pine seedling in the U of A growth chamber.

It should be mentioned that as part of this project, over 100 samples of the pathogen were collected from various locations in Alberta and across Canada and subsequently genotyped. Just as much as there are genetic differences among pine trees, there may be genetic differences among various strains of the pathogen. These differences may cause some strains to be more infectious than others. The analysis of the rust population genetic structure will help to identify appropriate inoculum source for the growth chamber screening. In addition, it may help to determine if the screening results will be relevant at the local scale (in case the WGR population is genetically variable) or at the larger scale (in case the WGR population is genetically uniform).

Andy Benowicz, Forest Genetics Specialist - Edmonton

References

Bella, I.E., and Navratil, S. 1988. Western gall rust dynamics and impact in young lodgepole pine stands in west-central Alberta. Can. J. For. Res. 18: 1439-1442.

Cerezke, H.F., Dhir, N.K., and Barnhardt, L.K. 2013. Review of insect and disease challenges to Alberta coniferous forests in relation to resistance breeding and climate change. Alberta Environment and Sustainable Resource Development. Forest Management Branch. Edmonton. 122 pp. ISBN 978-1-4601-1278-6.

Hot Spot Mapping – Characterizing MPB in the Northwest

Mountain pine beetle (MPB; *Dendroctonus ponderosae*) hit the Peace River Forest Area (PRFA) like a hammer in the late 2000s. MPB crossed the continental divide and established populations in NW Alberta for the first time ever, sweeping across our region rapidly. While MPB was eventually slowed and was prevented from establishing on the eastern slopes and in Saskatchewan, they were able to cause extensive damage in the PRFA and disperse to all adjacent forest areas. Since then, PRFA has been labeled an inactive holding zone. This means that the Province does not include this area as part of the Level 1 control program (removal of single MPB infested trees, often by hand) . Industry does however, continue to utilized the remaining at risk stands and salvage some of the damaged pine.

Although control no longer occurs it remains important to closely monitor the MPB situation in the PRFA. Accurate description of the damage can assist timber companies in salvaging MPB killed wood and help to prioritize harvest of pine stands that are still at risk. Moreover, since this MPB epidemic is a novel disturbance in NW Alberta, it is important to document the ecological process all the way from arrival to population crash. Unfortunately much of our detailed monitoring of MPB is associated with control with nothing in place to accurately describe the MPB situation regionally when control no longer occurs.

This year, a new technique for characterizing MPB populations called hot spot mapping was piloted in the Peace River and High Level Forest Areas. This method utilizes our aerial overview surveys and seeks to identify areas of high and low MPB population at the township scale. Townships with 1-20% coverage of susceptible pine were assigned a value of 0-5 based on MPB occurrence (Table 1). Townships with greater than 20% of coverage were split into quadrants and each assigned a hot spot value.

Hot Spot Value	Quantitative Description	Qualitative Description
0	No MPB observed	Man, we are good at this forest health thing!
1	1-5 single red trees	Psshh. Declining population, am I right?
2	5-15 red trees with red tree clustering	Well, obviously we're going to have a few small remaining hot spots…
3	5-10 clusters of red trees	At least we'll still have some surveys to do next year…
4	Greater than 10 clusters of red trees, considerable red observed throughout township or quadrant	That forest is positively festive, lit up like a Christmas tree!
5	Clusters of red trees nearly universally spread throughout township or quadrant	Great Scott!!! They're everywhere, they're everywhere.

Table 1: Descriptions of hot spot values assigned to township and township quadrants.

Although mountain pine beetle has declined significantly in our region, several hot spots remain (Figure 1). MPB in the core pine of our region NW of Fairview is steadily declining with a few remaining populations while considerable MPB is present NW of Manning. Moving forward, we will use the hot spot mapping values to prioritize green to red surveys, and provide a more accurate demonstration of the beetle situation regionally. The combination of green to red survey data, hot spot mapping values and remaining susceptible pine will give us

a clear indication of both mountain pine beetle hazard and risk which can be used to communicate salvage priorities to timber companies.

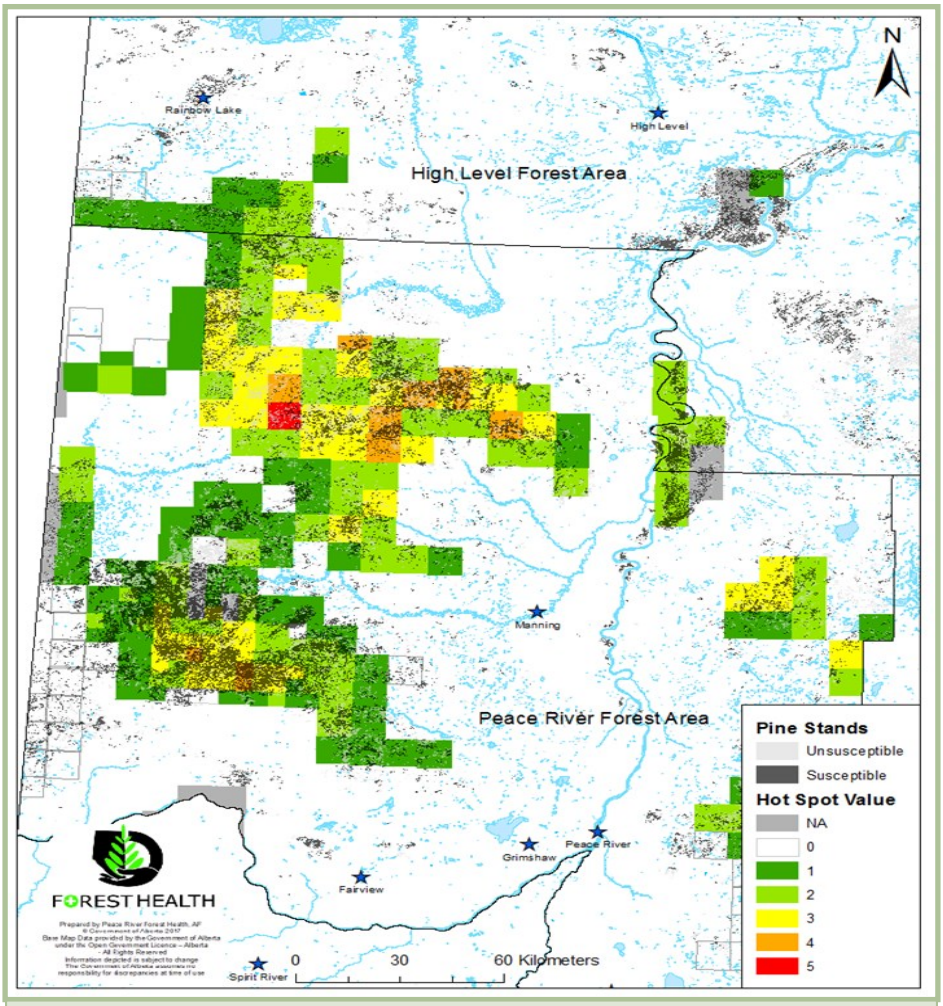


Figure 1: Results of the hot spot mapping conducted in the Peace River and High Level Forest Areas.

If you want to learn more about mountain pine beetle in Alberta, click here to view our new story map, developed by Aaron McGill (information management technologist–Edmonton).

Matthew Gelderman—Peace River and High Level Forest Areas

2017Defoliation Surveys

Maps for the 2017 aerial overview surveys of Alberta's forest areas will be available on the Forest Health & Adaptation website soon.

Forest Health and Adaptation

Whitebark and Limber Pine Recovery Update

Michael Rudy and Barb Gass

Another summer is flying by and work is in full swing. This year the field crew has two five needle pine enthusiasts: Barb Gass recently completed her MSc on range-wide limber pine adaptation, and Michael Rudy is an accomplished botanist and nature photographer.

Field data collection with a customized ESRI Collector app was very successful last year and even better this year. So far 59 new limber pine plus trees (trees with likely disease resistance compared to the stand, but not tested yet) and 4 whitebark pine plus trees have been identified, and about 20 more to follow up on when there is a better cone crop. About 12 limber pine trees are caged for cone collection later this fall – most trees across the Alberta range have few or no cones this season.

The Blairmore Junior Forest Rangers learned about the conservation program and assisted the crew. The Nature Conservancy of Canada kindly granted us access to their private and jointly held conservation lands with limber pine, allowing both agencies to share information and meet objectives. Many private landowners and leaseholders have generously granted access this year for recovery work.

Over 120 more polygons have been surveyed so far to collect ecological, health and (new for 2017) density data. The density data will be used to supplement the monitoring transect information to QA the habitat modelling before it is made available.

Speaking of habitat modelling, the habitat suitability (presence) modelling is publicly available on GeoDiscover Alberta – the data is in geodatabase format. There are 4 different files: whitebark pine and limber pine, LiDAR-derived (25 m resolution), and DEM-derived (1 m resolution). It is also on GOA Layer Manager under *Forest Health* in the *Five Needle Pine* folder.

Forest Health staff from Grande Prairie, Hinton, and Peace River joined us to re-survey 5 long-term monitoring transects in Willmore Wilderness Area in July. The data hasn't been analyzed in detail yet but there is definitely a noticeable increase in blister rust since the last assessments between 4 and 10 years ago – however it is still well below 50%, too low to reliably select plus trees from those stands. Stands surveyed had good whitebark pine regeneration indicating the seed source is still viable.

A silviculture restoration trial is planned for the fall at Vicary Creek about 20 km north of Blairmore. Cutblocks harvested 15-20 years ago have regenerated with 10-20% whitebark pine. A replicated, controlled study with permanent sample plots measured pre- and post-

treatment is being installed to do some release thinning around healthy whitebark pine regen at 2m and 5m around healthy whitebark stems to remove competition, and controls (no thinning), in stands of varying densities. Because the trees grow very slowly, results will take some time to become apparent. If you'd like to learn more about five needle pine in Alberta, click here to view our newly developed story map.

Upcoming event: the Whitebark Pine Ecosystem Foundation (US and Canada sections) is having their annual Science and Management workshop jointly in Jasper this September 21-23. Wednesday evening the 20th will feature a public talk by Diana Tomback "Whitebark 101", Thursday is a full day of presentations on the latest science, operational work, and policy to restore 5-needle pines. Friday and Saturday are field trips to native ecosystems, restoration projects, and prescribed burns. This casual meeting is $20 on site to attend, field trips will be by carpool, and there will be a poster session, silent auction, and social events. For pre-registration and agenda updates check the website. There is even more going on, but you'll have to stay tuned for the next edition of *B&D*!

A summary and update of what Alberta is up to with limber pine and whitebark pine is here.

Jodie Krakowski—Edmonton

How Old is *OLD*?

Many of us feel a little old sometimes...getting out of a bed on a cold morning, after a particularly hard day in the field...but compared to some tree species, the span of a human lifetime is merely a summer fling.

The Rocky Mountain Tree-Ring Research (RMTRR) organization specializes in tree-ring collection and dating. The analyses they conduct can be applied to a variety or forest ecology and management questions. A nonprofit organization founded in 1997, their website provides information on increment boring, mounting cores, links to publications on dendrochronology studies, and trip reports by its founder, Peter M. Brown. The photos alone are stunning.

Of particular interest is OLDLIST, "*a database of known maximum ages that individual trees of different species have attained at the time of sampling from around the world.*" From *Pinus longaeva* at 5062 years to *Quercus coccinea*, a mere babe at 122 years, OLDLIST covers a wide variety of both coniferous and broadleaved trees. Four different Alberta trees made the list too.

A massive limber pine along the Red Deer River—age unknown.

So the next time you're feeling a little 'old' check out RMTRR and OLDLIST. It likely won't get rid of the aches but it will certainly take your mind off them for a bit!

Marian Jones—Rocky Mountain House Forest Area

If You Go Out in the Woods Today...

Ask people 'what is your main concern when you go into the bush?' and they almost always answer 'coming across a bear'. In some ways I get it. They have big teeth, sharp claws and they have been known to charge a few of us out of the forest, but I don't find them as frightening as ticks. I am sure you are giggling at this, but trust me, I have done some research on these nasty parasites and I have a pretty good idea of what is in their vile little bodies.

Back in 2016, I did my honours project on ticks at Dalhousie University. Whilst exploring the literature, I was captivated by the studies that were trying to determine if certain bacteria increase the survival frequency of their hosts, ticks. It inspired me to try and uncover if dog ticks (*Dermacentor variabilis*) that are infected with a specific kind of bacteria (*Francisella tularensis*) have an altered physiology. Dog ticks are one of the top hosts for *F. tularensis*.

Ticks l to r: male, female, engorged female. B. Taylor

I selected *F. tularensis* for my research mainly because these little guys were used as a form of biological warfare in the Second World War...and because our supply of ticks came from veterinarians. Although this species prefers dogs, humans are not completely safe from their bites since they are known to be opportunistic feeders. Dog blood is like having a meal cooked by Gordon Ramsay and our blood is…well, like having a meal at McDonalds… convenient. *F. tularensis* causes a sickness called Tularemia and the symptoms include: ulcers around the bite site, swelling of the lymph nodes, and/or a mild to severe fever. Tularemia is curable but the infection can be fatal if proper treatment is not recieved.

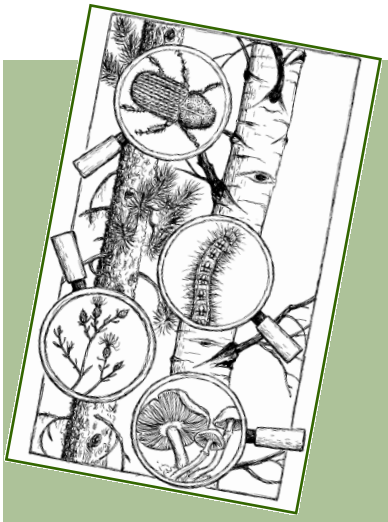
First, I looked into the infection rate of *F. tularensis* in dog ticks, then tried to find out if *F. tularensis* influences the supercooling point (similar to their freezing point) or size of *D. variabilis*. Turns out, the infection rate of *F. tularensis* in *D. variabilis* is low (~6%). This is good news for humanity, but bad news for my honours project. Given that so few of my ticks had the bacteria, it was impossible at the time to make any conclusions on any symbiosis between bacteria and tick. My data went into the database, and my former lab mates are continuing to study ticks.

Ticks do not directly disturb the forest, as the mountain pine beetle does, but they can disturb those who enter them. The main tick of concern for people is the deer tick, aka the black legged tick (*Ixodes scapularis*), because these ticks are potential hosts for *Borrelia burgdorferi*, a human-pathogenic bacterium which causes Lyme disease. Lyme disease can have serious, long-term consequences and there is currently no known cure.

We're all aware of bears and how to prevent unwanted encounters, but precautions taken to prevent tick bites is lacking at times. Like in bear aware, it is important to be aware of them (ticks or bears) and to take precautions to prevent them from biting you. You might not feel the bite of a tick as you would a bear, but the effects could follow you for a lifetime.

Information on tick prevention can be found here.

Brittany Taylor , Forest Health Assistant—Edson Forest Area



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Future Weather Quandary

Most climate research does agree

That weather more extreme will be

Occurring with more frequency

Causing more uncertainty

For disturbances that we will see

And their effects on land and sea

Both locally and globally

On every community

Wetter, drier, more windy

Cooler, warmer, topsy-turvy

Change - the only surety

So, not to sound too preachy

But, we must adapt ASAP

Planning more foresightedly

Change management accordingly

To cope much better, hopefully

With our erratic weather destiny

Tom Hutchison—Edmonton