



December 2021 Issue | Volume 1

## TRIA-FoR: Transformative Risk Assessment and Forest Resilience Using Genomic Tools for the Mountain Pine Beetle Outbreak

Bi-Monthly Newsletter





## Why TRIA-FoR?

*Written by Janice Cook and Catherine Cullingham*

*Illustration by Kaylen Brzezinski*

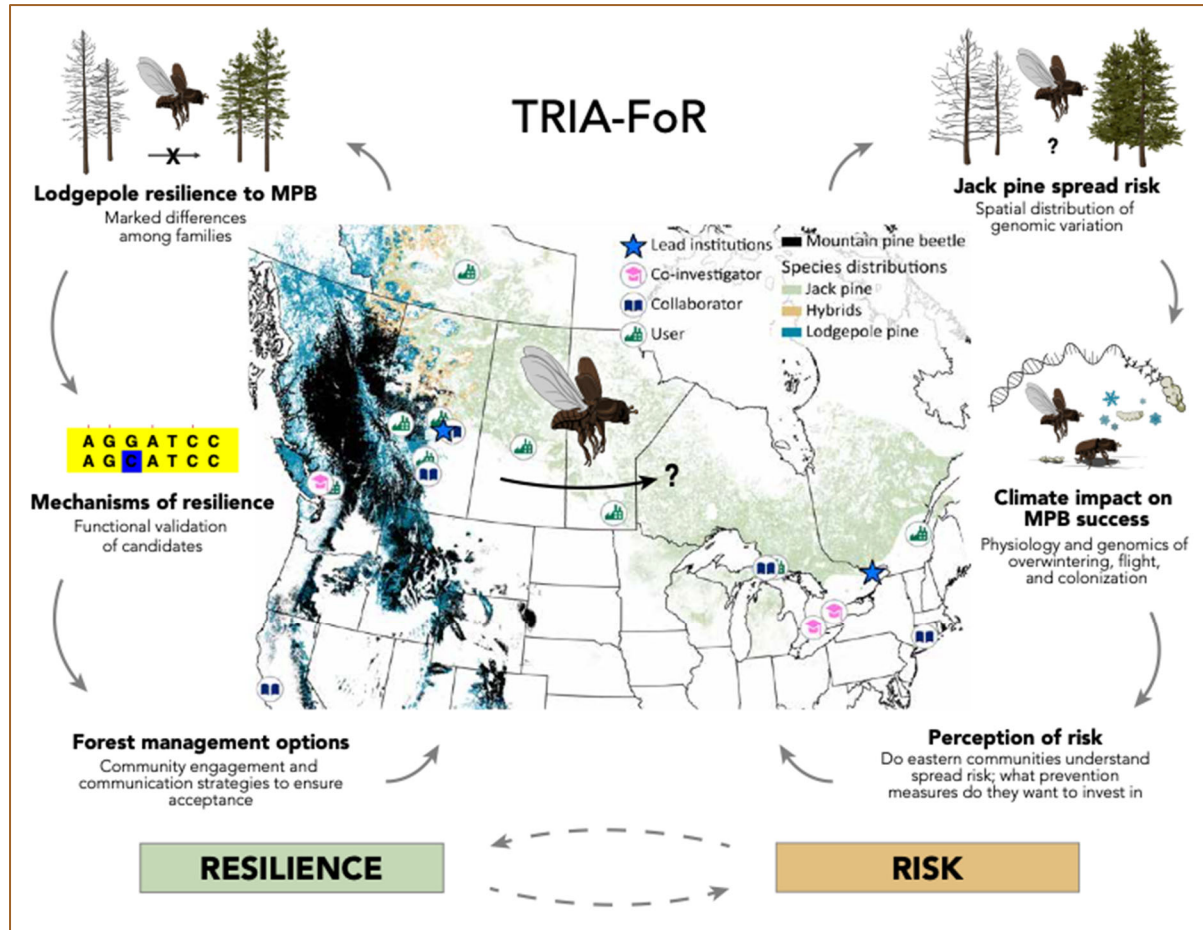
The current mountain pine beetle (MPB) epidemic has killed approximately 20 million hectares of mainly lodgepole pine forests in British Columbia and Alberta. Climate change and forest management practices have contributed to unprecedented range expansion of MPB. From its historic range in central British Columbia, MPB has spread through novel habitats in Alberta, establishing in a new host, the jack pine. Jack pine is a boreal forest species with a range that extends to the Atlantic Ocean, raising the spectre of continued eastward spread of MPB. Given the importance of lodgepole and jack pine to the forest industry, their central role in providing ecosystem services and their cultural importance, there is an urgent need to enhance resiliency of forests replacing MPB-killed stands, and to quantify eastward spread risk potential of MPB.

TRIA-FoR builds upon the foundational work carried out under TRIA 1, TRIA 2 and TRIA-Net (<http://tria-net.srv.ualberta.ca/>), and the strong collaborative network between researchers and partners (users) arising from these projects. TRIA-FoR is taking a state-of-the-art multidisciplinary and integrative approach to develop genomics-informed knowledge, tools and application frameworks that mitigate risk for the present MPB epidemic and improve resiliency in future epidemics. Risk and resiliency will be investigated in the context of MPB-pine-climate interactions that affect MPB population dynamics, human dimensions in forest resource management, and impacts on diverse communities connected to forests at risk.

### In This Newsletter

|  |    |
|--|----|
| Why TRIA-FoR.....  | 1  |
| Meet the Team.....   | 4  |
| Collaborators.....   | 5  |
| GE3LS Team Explores Mountain Pine Beetle Impact in Western Canada..... | 6  |
| In the News.....   | 7  |
| Presentations.....   | 8  |
| Publications.....  | 8  |
| Acknowledgements.....  | 9  |
| First Nations Land Acknowledgement.....                                | 9  |
| Funding & Support.....   | 10 |

## Schematic Overview of the TRIA-FoR Project:



## TRIA-FoR research encompasses three overarching goals:

- (1) To enhance lodgepole pine genetic resiliency to MPB.
- (2) To improve risk assessment efficacy for MPB northern and eastern spread into the boreal forest by examining MPB – pine host – climate interactions.
- (3) To develop a social sciences framework of risk management planning and resilience building that can facilitate adoption of genomics-informed practices or technologies.

As TRIA-FoR progresses, future newsletters will detail research advances/milestones, spotlight the various research teams and collaborators, as well as the educational and outreach efforts taking place to transmit the knowledge being generated to the various end-users and stakeholders, to facilitate the uptake of new practices or technologies.

## Meet the Team

TRIA-FoR consists of a team of Investigators and Highly Qualified Personnel located at institutions across Canada, a Project Manager based at each of the two lead institutions, UAlberta and Carleton University, as well as numerous national and international Collaborators. In addition, several end-user and stakeholder partners are providing support and data.

### Project Investigators:



The **University of Alberta team** comprises Janice Cooke (Co-Lead Investigator), Maya Evenden, Mark Lewis and R. Glen Uhrig (Co-Investigators). Asterisks, left to right: **Dr. Cooke's** expertise is in forest tree genomics, physiology, and defense, and she served as Co-Lead for previous large-scale, MPB-focused projects. **Dr. Lewis** provides expertise with mathematical modelling of MPB outbreak and risk assessment. **Dr. Evenden** brings MPB chemical and behavioural ecology expertise, while **Dr. Uhrig** (not pictured) brings expertise in protein functional characterization. In addition to the PIs,

current HQP pictured, left to right, include Marion Mayerhofer, Dr. Devang Mehta, Leanne Petro, Colleen Fortier, Samuel Beck, Antonia Musso, Dr. Micah Brush, Duowen Pu, Yiyang Wu, and Taylor Brophy.



UBC's **Dr. Joerg Bohlmann** (Co-Investigator) brings expertise in forest tree and bark beetle genomics and biochemistry, and tree defense.



Western University's **Dr. David Coltman** (Co-Investigator) provides expertise in population genomics as it relates to the pine host.

The **Carleton University team** comprises Catherine Cullingham (Co-Lead Investigator), Heath MacMillan, Vivian Nguyen, and Stephan Schott (Co-Investigators). Asterisks, left to right: **Dr. MacMillan's** focus is on the molecular biology and ecophysiology of insect thermal performance. **Dr. Cullingham's** expertise is in forest tree population and landscape genomics, and previous MPB-focused project management. **Dr. Nguyen's** expertise is in conservation and environmental issues, knowledge mobilization and communication, and the science-policy interface. **Dr. Schott's** expertise is in natural resource management and public policy.



In addition to the PIs, current HQP pictured, left to right, include Jessica Duffy, Dr. Mads Andersen, Dr. Rhiannon Peery, Jenna Hutchen, Serita Fudlosid, Dr. Barry Flinn, Dr. Christopher Orr, and Valerie Berseth. As Project Bioinformatician, **Dr. Rhiannon Peery's** expertise includes conifer genomic resources, population/comparative genomics, and custom bioinformatics pipeline development. As the Carleton University-based Project Manager, **Dr. Barry Flinn's** expertise includes molecular biology, forest biotechnology, and project management for large-scale conifer, potato, and sorghum genomics efforts.

## Collaborators

The TRIA-FoR research team will be aided by collaborators from several national and international organizations and institutions. In Canada, these collaborators are based at Brock University; Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre; Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre; Neogen; and the University of Calgary. Our international collaborators are based at the Max Planck Institute, Germany; the University of California - Berkeley; the University of Georgia, USA; the University of Pretoria, South Africa; and the US Department of Agriculture, United States Forest Service, Northern Research Station. Our various collaborators will be in the spotlight in future newsletters.

## GE3LS Team Explores Mountain Pine Beetle Impact in Western Canada

*Written by Valerie Berseth*

Members of the GE3LS (Genomics, Ethical, Environmental, Economic, Legal and Social Aspects) team travelled to Quesnel, BC and Cypress Hills, SK for fieldwork this past October. Cypress Hills Interprovincial Park is a unique and fascinating place, as Canada's only inter-provincial park and Saskatchewan's only stand of lodgepole pine. Since the 1980s, Cypress Hills has experienced an infestation of Mountain Pine Beetle in the West and Centre blocks. Saskatchewan's Ministry of Environment has been working with the park to monitor and control the spread. During our visit to Cypress Hills, we had the chance to see this management firsthand. We toured management sites with Melody Nagel-Hisey, Park Naturalist and West Block Supervisor, who shared information about the park's history and significance, showed us fall and burn sites, bait trees, and gave us a window into the unique ecosystem that they are working to save.

Our visit to Quesnel, BC provided a different insight into Mountain Pine Beetle risk management. Beetle outbreaks in the 1990s and in the mid-2000s reduced the amount of timber available for forestry operations, impacting forests and forestry communities like Quesnel. We met with Quesnel mayor Bob Simpson and Erin Robinson and Lacy Scuffi with the Forestry Innovation Program to learn about their work to support the city's transition post-outbreak, the changes taking place in BC's forestry policies, and the challenges of anticipating and managing for future risks to healthy, sustainable forests. We also toured several orchards in Quesnel and Prince George with Select Seed Co., where we learned about tree improvement operations in British Columbia.



GE3LS team representatives in Quesnel, BC. *Left to right:* Dr. Nicole Klenk, Jenna Hutchen, Valerie Berseth, Dr. Vivian Nguyen, and Dr. Stephan Schott.

## In the News

Genome Canada's press release on July 22nd announcing support for TRIA-FoR has sparked interest in our project. Several media reports are listed below, with links included if available.

### 770 CHQR Calgary Global News Radio (July 28, 2021).

Radio interview with Janice Cooke, arising from the Genome Canada media release, with an overall focus on Canmore and MPB.

### CBC News Web Article (Aug. 24, 2021).

Title: Warrior trees: Distinct DNA of 'survivor' pines may hold the key to mountain pine beetle resiliency.

Print interview with Janice Cooke.

Link: <https://www.cbc.ca/news/canada/edmonton/mountain-pine-beetle-survivor-trees-dna-genetic-markers-1.6154155>

### CBC Edmonton Evening News (Aug. 26, 2021).

TV interview with Janice Cooke.

This was a follow-up from the August 24th web article, with a focus on MPB in Jasper and lodgepole pine resilience.

### Carleton University Newsroom (Sept. 13, 2021).

Title: Stopping the Spread of the Mountain Pine Beetle (Dan Rubinstein).

Web article and interview with Catherine Cullingham.

Link: <https://newsroom.carleton.ca/story/stopping-spread-mountain-pine-beetle/>

### City of Quesnel Forestry Initiatives Program Newsletter - (Oct. 27, 2021)

Title: Mountain Pine Beetle Research

Newsletter produced by the City of Quesnel, with a story on the recent visit by the GE3LS team.

Link: [https://www.quesnel.ca/sites/default/files/docs/city-services/fip\\_newsletter\\_october\\_2021.pdf](https://www.quesnel.ca/sites/default/files/docs/city-services/fip_newsletter_october_2021.pdf)



## Presentations & Publications

TRIA-FoR builds upon the wealth of pine and mountain pine beetle information generated during the earlier TRIA 1, TRIA 2, and TRIA-Net efforts. Several recent presentations and publications by team members focused on the work leading into and impacting this current project.

### Presentations:

Blanchette-Arnold A, Musso AE, Evenden ML (2021) Investigation of range expansion of mountain pine beetle into the Canadian Boreal Forest. ISteam Pathways Research Celebration, University of Alberta, August 20, 2021.

Cooke J, Cullingham C, Peery R, Miller J, Fortier C, Mahon E, Mayerhofer M, Arango-Velez A, Meents M, Normington L, Lindgren S, Huber D, Zaharia LI, Coltman D (2021) Genetic and environmental factors influencing pine host quality in the mountain pine beetle outbreak: A view through the lens of big data. 2021 North American Forest Insect Work Conference. Virtual, May 25-28. **Invited oral presentation.**

Cooke J (2021) Using genomics to understand how genetic and environmental factors influence pine responses to mountain pine beetle. Frontiers in Genomics Public Lecture, Universidad Nacional Autónoma de México Campus Morelos, Aug 31, 2021. **Invited presentation (via Zoom and YouTube).**

Cooke J (2021) Genomic approaches to dissecting pine interactions with forest pests and pathogens. Frontiers in Genomics Student Lecture, Universidad Nacional Autónoma de México Campus Morelos, Aug 30, 2021. **Invited presentation (via Zoom).**

Musso AE, Huber DPW, Carroll AL, Evenden ML (2021) Lodgepole and jack pine terpene response at different stages of mountain pine beetle mass attack. Entomological Society of Alberta 2021 Virtual Conference and AGM. October 15-16, 2021.

### Publications:

Shegelski, V.A., Evenden, M.L., Huber, D.P.W., Sperling, F.A.H. 2021. Identification of genes and gene expression associated with dispersal capacity in the mountain pine beetle, *Dendroctonus ponderosae* Hopkins (Coleoptera: Curculionidae) PeerJ 9: e12382. <https://doi.org/10.7717/peerj.12382>



O'Neill, E., Davis, H.E., MacMillan, H.A. 2021. A lack of repeatability creates the illusion of a trade-off between basal and plastic cold tolerance. *Proceedings of the Royal Society B* 288: 20212121. [https://doi.org/ 10.1098/rspb.2021.2121](https://doi.org/10.1098/rspb.2021.2121)

Reyes, R.S., Nguyen, V.M., Schott, S., Berseth, V., Hutchen, J., Taylor, J., Klenk, N.L. 2021. A research agenda for affective dimensions in climate change risk perception and risk communication. *Frontiers in Climate* 3: 751310. <https://doi.org/10.3389/fclim.2021.751310>

Ramazi, P., Kunegel-Lion, M., Greiner, R., Lewis, M.A. 2021. Predicting insect outbreaks using machine learning: A mountain pine beetle case study. *Ecology and Evolution* 11(9): 13014-13028. <https://doi.org/10.1002/ece3.7921>

Koch, D., Lewis, M.A., Lele, S. 2021. The signature of endemic populations in the spread of Mountain Pine Beetle outbreaks. *Bulletin of Mathematical Biology* 83: 65. <https://doi.org/10.1007/s11538-021-00899-z>

## Acknowledgements

### First Nations Land Acknowledgement:

The various TRIA-FoR University researchers are based at institutions located on traditional/ancestral First Nations lands. As such, we respectfully offer these acknowledgements:

- 1) UBC Vancouver is situated in the traditional, ancestral and unceded territory of the  $x^w m \theta k^w \theta y' \theta m$  (Musqueam).
- 2) The University of Alberta acknowledges that it is located on Treaty 6 territory, and respects the histories, languages, and cultures of First Nations, Métis, Inuit, and all First Peoples of Canada, whose presence continues to enrich our vibrant community.
- 3) Carleton University acknowledges the location of its campus on the traditional, unceded territories of the Algonquin nation. In doing so, Carleton acknowledges it has a responsibility to the Algonquin people and a responsibility to adhere to Algonquin cultural protocols.
- 4) Western University acknowledges that it is located on the traditional lands of the Anishinaabek, Haudenosaunee, Lūnaapéewak and Attawandaron peoples, on lands connected with the London Township and Sombra Treaties of 1796 and the Dish with One Spoon Covenant Wampum. This land continues to be home to diverse Indigenous peoples (First Nations, Métis, and Inuit) who are recognized as contemporary stewards of the land and vital contributors of our society.

## Funding & Support:

Funding for this research is being provided through grants to the TRIA-FoR Project from Genome Canada, the Government of Alberta through Genome Alberta, and the Ontario Research Fund – Ontario Ministry of Colleges and Universities through Ontario Genomics. Additional contributions are coming from the University of Alberta, Carleton University, Western University, the University of British Columbia, the Canadian Wood Fibre Centre – Natural Resources Canada, the Great Lakes Forestry Centre – Natural Resources Canada, West Fraser, Canfor, Alberta Agriculture and Forestry, fRI Research, and the Forest Improvement and Research Management Branch - BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

In addition to financial support, we also acknowledge the various samples and/or data sets or other information being generously provided through the Forest Improvement and Research Management Branch - BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Alberta Agriculture and Forestry, the Saskatchewan Ministry of Environment, the Department of Environment and Natural Resources - Government of Northwest Territories, the Forestry Branch - Manitoba Agriculture and Resource Development, and the Ontario Ministry of Natural Resources and Forests.



**Newsletter Production:** Kaylen Brzezinski and Barry Flinn.

**Artwork Credit:** Kaylen Brzezinski.

**Photo Credits:** Valerie Berseth, Catherine Cullingham, Antonia Musso and Rhiannon Peery.

