Brief to the Parliamentary Committee on Natural Resources

Mountain Pine Beetle and What Science Is Saying About It

Keith M. McClain, Ph.D., RPF
Program Lead, Mountain Pine Beetle ecology program
fRI Research

INTRODUCTION

Let there be no mistake, Mountain Pine Beetle (*Dendroctonus ponderosae* Hopk.) is one of many insects that is an integral member of ecosystem biota. It occurs naturally in pine forests in western Canada and the United States and generally commands little attention except when populations increase to epidemic proportions. The rapid emergence of the mountain pine beetle in British Columbia in the early 2000's was prompted by warming temperatures and the abundance of nearly even aged host Lodgepole Pine (*Pinus contorta* var. latifolia) stands. The explosive growth of the Mountain Pine Beetle in BC lead to early estimates of approximately 80% of the provinces' pine volume destined for destruction by 2021, but has since been revised downward to 57%. Nevertheless, the volume of pine lost to the mountain pine beetle is significant, and losses are expected to continue at a reduced rate into the future.

At the time BC was experiencing the rapid expansion of the beetle, Alberta felt reasonably protected from an eastward expansion by the Rocky Mountains. Although having experienced previous outbreaks of the beetle in 1939, 1985 and 1997 Alberta experienced an unprecedented overflight of beetles in 2006 and in subsequent years. The mountain pine beetle since have become firmly established in novel Lodgepole Pine habitats. Forest resource managers felt confident that operational procedures to battle the beetle could be adopted from BC, but it was soon realized that eco-site conditions in Alberta were just too different to apply similar mitigative techniques effectively. Moreover and unlike in BC, Alberta's pine did not co-evolve with the mountain pine beetle making it more susceptible to attack as a result of poorly developed defense mechanisms. Accepting the inevitability of rapid expansion of the beetle and the vulnerability of its pine forests, Alberta provided financial support to promote research specific to its pine resources (Lodgepole pine, Jack pine), climate, eco-site conditions, and landscapes. The intent of the research was to develop science-based knowledge to support operational decisions and influence policy development. fRI Research[1] was well positioned to take a leadership role in defining information needs, developing research priorities, implementing research, partnership building, communicating and technology transfer. Through its outreach the fRI Research has develop a solid base for addressing current and emerging concerns.

fRI Research's focus on Mountain Pine Beetle research began in 2007 and currently maintains a portfolio of four Research Themes Areas[2] that embrace critical questions (priorities) to support mitigative actions for managing the spread of the Mountain Pine Beetle.

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1 fRI Research: https://friresearch.ca/

2 fRI Research Mountain Pine Beetle Ecology Program: *Research Prospectus*

What science is saying about the Mountain Pine Beetle

In the time and space that are available to address this topic several questions and associated research will be highlighted.

a) Will MPB threaten Canada's pine resource?

Mountain pine beetle host-range expansion threatens the boreal forest

Catherine I. Cullingham, Janice e. K. Cooke, Sophie Dang, Corey S. Davis, Barry J. Cooke and David W. Coltman. 2011. Molecular Ecology: 20, 2157–2171.

- Lodgepole pine has been the primary host for the mountain pine beetle. However, with it now being in the central interior of Alberta there is the concern over its transition into Jack Pine which constitutes Canada's major pine resource east of Alberta. Research has confirmed for the first time successful attack of Jack Pine by mountain pine beetle in the hybridization zone of Lodgepole Pine and Jack Pine in north central Alberta. Strong inference can be drawn that Canada's entire Jack Pine Resource is at risk leading to significant impacts to the forest industry and communities if the spread is allowed to progress. **The spread of the mountain pine beetle is a national problem**.

b) Can we depend on climate to control MPB populations?

Active Project: *Cold Tolerance of Mountain Pine Beetle (Coleoptera: Curculionidae) Eggs From the Historic and Expanded Ranges*. K. P. Bleiker, G. D. Smith and L. M. Humble. 2017. Environmental Entomology, 46(5), 1165–1170

- Winter mortality is expected to be a key factor determining the ability of mountain pine beetle to expand its range in Canada. Eggs were tested to determine if an extended period of chilling is required to enhance their cold tolerance and winter survival. Eggs not well-adapted to overwintering are unlikely to survive winter throughout much of the beetle's range. These scientists determined that eggs suffered significant pre-freeze mortality and to survive in novel habitats may require an extended period of chilling before winter to develop cold tolerance. The relationship between temperature and cold tolerance acquisition can be incorporated into survival and population models to predict range expansion. Such research is essential especially during the present period of climatic warming suggesting that we can no longer depend on critically low freezing temperatures to inflict high rates of mortality on mountain pine beetle during winter.

c) Will population dynamics of MPB in novel habitats east of the Rocky Mountains support the transition of endemic populations to epidemic population level?

Active project: *Dynamics of endemic mountain pine beetle populations in novel pine habitats. Dr. Allan Carroll, Professor, University of British Columbia.*

- Research conducted under this topic is aimed at examining the trophic interactions in novel habitats (for example, Jack pine stands) to determine the potential of newly established populations of beetles to transition to an epidemic state and expand its range. The composition of the bole-infesting secondary bark beetle assemblage and their natural enemies, the type and strength of the competitive interactions associated with each species, and the role of the host tree in mediating these interactions were used to determine generation mortality and the potential for mountain pine beetle to persist at endemic levels in novel pine forests. Research suggests that the threshold density for a successful mass attack of lodgepole pine in Alberta is significantly lower than that associated with the native range of mountain pine beetle. This result implies that epidemic behavior by MPB may persist at lower overall population levels. This

finding amongst others raises concern over the ease with which eastern pine may be attacked and killed facilitating the eastward spread of the mountain pine beetle.

d) Can we forecast the spread of the beetle before it is too late?

Active project: *Improving monitoring tools to detect mountain pine beetle at low and high densities in novel habitats. Dr. Nadir Erbilgin, Professor, University of Alberta*

- During the mass attack of healthy trees, there is are close interactions between host volatile chemicals mainly monoterpenes and beetle pheromones. When a female beetle initiates an attack on a tree, it releases trans-verbenol that is preferentially attractive to males, but females are also attracted. Males responding to the aggregation pheromone mate with females and release exo-brevicomin that attracts mainly females. The mixture of both male and female aggregation pheromones promotes mass colonization of host trees. This aggregation process is required for depletion of host tree defenses, successful host colonization, and reproduction. It was hypothesized that if these attractants could be duplicated they could be used to attack beetles at leading edges of the range expansion thus providing information to necessary for the deployment of actions to contain the spread of the beetle. Direct monitoring of beetle populations is critical to the management of the spread of the mountain pine beetle. Field testing has been successfully implemented and work is proceeding to develop operational procedures for early detection of beetles at low densities. Research manuscripts are in preparation.

e) What will our forests look like a post MPB environment?

Active Project: *Beyond Beetle. Drs. Ellen Macdonald, Nadir Erbilgin, Vic Lieffers, Mike Flannigan; University of Alberta*

- Field observations have heightened the concerns of researchers over extremely low regeneration (low densities) of lodgepole pine. Low levels of pine regeneration are attributed to variable residual canopy cover, stand mortality and site quality. Lodgepole pine is a shade-intolerant species and with variable canopy closure or aggressive ground vegetation following beetle attack, pine seeds that fall on a favourable microsite (seedbed) and germinate will likely fail to survive and grow. Understanding the range of variability of regeneration across ecosites impacted by mountain pine beetle is important in projecting stand succession, future productivity and developing appropriate remedial silviculture operations to promote future healthy lodgepole pine forests. This research is nearing completion and will provide critical information to ensure cost-effective approaches are developed and implemented to restore damaged landscapes. Failure to respond has serious peripheral implications such as increased fire hazard, loss of wildlife habitat, impacts on water quality and quantity. Research manuscripts are in preparation.

f) What are the impacts of the MPB on community well-being?

Active Project: Assessing community resilience to mountain pine beetle outbreaks. Dr. Lael Parrott, UBC, Okanagan Campus, BC.

- Understanding the factors that contribute to community resilience to natural disturbances and environmental change is increasingly important for informing policy that seeks to enhance livelihoods and opportunities for Canadians living in resource-dependent rural communities. The recent mountain pine beetle outbreak in Western Canada is one of many disturbances affecting timber quality and supply, with potentially devastating social and economic impacts for some communities. In Alberta, the degree of vulnerability of communities to the MPB outbreak will depend on their degree of reliance on the forest sector and on their ability to adapt and transform in response to a changing ecological landscape. Researchers are connecting with communities to determine specific attributes that communities rely on to ensure resiliency in the event of catastrophic events that not only include mountain pine beetle, but also, fire, flooding, high wind events. Results from this research will be shared with communities as a backdrop to assist in their preparedness planning.

Summary

The foregoing is a cross-section of the research that is being conducted and is in various stages of completion. Much of the text is excerpted from research proposals and is not intended to be original on my part. What is clear about the mountain pine beetle outbreak is that immensely large landscapes have been affected. It must also be appreciated that ecological changes may be subtle or dramatic. Landscape response to ecological events are difficult to predict, but equipped with a broad base of science-based knowledge managers can make informed decisions and by monitoring, outcomes can continually nudge ecosystems in directions that continue to provide desired ecological goods and services.