This Research Prospectus provides a listing of research projects carried out with the support of fRI Research's MPBEP from 2007 to 2021. Research is categorized by Research Theme and further documented under the Critical Question (Priority) it addresses. In some instances the research project addresses more than one Critical Question.

NO.	Project Code	Revised Septemeber 13, 2018 to include all MPBEP Funder Projects 2007-2018	Investigator	**Research Theme No. 1** MPB Management and Biology								**Research Theme No. 2** Hydrological Impacts of MPB			**Research Theme No. 3** Dynamics of Natural and Managed Stands of Lodgepole Stands following MPB												**Research Theme No. 4** Social and Economic Implications of a Changing Landscape			
				Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q1	Q2	Q3	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q1	Q2	Q3	Q4
1	246.01	Effects of Mountain Pine Beetle attack on hydrology and post-attack vegetation and hydrologic recovery in lodgepole pine forests in Alberta; Phase 1	Silins, Macdonald										1		1																
2	246.02	Monitoring and Decision Support For Forest Management in a Mountain Pine Beetle Environment	Udell, Dempster, FGYA												1																
3	246.03	Alberta Forest Research Institute Funding to the MPBEP (no project name) Podlubny (MPBEP Lead)	Podlubny (MPBEP Lead)																												
4	246.04	Public and Expert Understandings of Mountain Pine Beetle in Alberta	MacFarlane, Parkins																												1
5	246.05	Does prescribed fire affect population dynamics of mountain pine beetle? Evaluating population success and fitness on fire-injured trees	Erbilgin					1															1								
6	246.06	Mountain Pine Beetle Phenology and Success in Whitebark Pine in Alberta	Langor			1																									
7	246.07	Using Oblique Historical Photos to Determine Past Mountain Pine Beetle Susceptibility	Stockdale			1																									
8	246.08	MPB population dynamics in new habitats and climates following range expansion: The potential for eastern and northern spread in Canada	Bleiker, B. Cooke					1																							
9	246.09	Comparison of understory burning and mechanical site preparation to regenerate lodgepole pine stands killed by mountain pine beetle	Lieffers, Ryu															1													
10	246.10	Ecological impacts of the mountain pine beetle on pine forest of the Foothills, Alberta	Alfaro, Hawkes, Axelson																						1						
11	246.11	Post mortality rate of wood degradation and tree fall in lodgepole pine trees killed by mountain pine beetle in the Foothills and Rocky Mountain regions of Alberta	K.Lewis																											1	
12	246.12	Climate project	Anderson, Carroll, Coops, Mahat, Roberts, Nielson, Stenhouse		1																										
13	246.13	MPBEP Communications	K. McClain																												
14	246.14	Cold tolerance of mountain pine beetle Implications for population dynamics and spread in Canada	K. Bleiker		1																										
15	246.15.1	Development of monitoring tools to detect mountain pine beetle at low densities on the eastern and northern edge of beetle expansion into Saskatchewan and NW Territories: **Phase 1**	N. Erbilgin						1																						
16	246.15.2	Development of monitoring tools to detect MPB at low densities on the eastern and northern edge of beetle expansion into Saskatchewan and NWT - **Phase 2**	N. Erbilgin						1																						
17	246.16	Dynamics of endemic MPB populations in novel pine habitats	TRIA Network: Allan Carroll					1																							
18	246.17	Stand dynamics after MPB attack	FGrOW - Sharon Meredith												1																
19	246.18 Part 1	Assessing the effectiveness of Alberta's forest management strategies against the mountain pine beetle	A. Carroll & H. Nelson	1																	1	1									
20	246.18 Part 2	Assessing the effectiveness of Alberta's forest management strategies against the mountain pine beetle	A. Carroll & H. Nelson	1																	1	1									

Research Themes and Critical Questions

Question No.	**Research Theme 1: MPB Biology and Management**
1	What is the efficacy of current control measures applied to MPB in Alberta?
2	Can a composite spread model that incorporates key variables and is broadly applicable be developed that significantly improves spread predictions against a backdrop of climate change?
3	What drives local and long distance beetle dispersal, promotes beetle establishment and affects population dynamics of MPB in novel host environments? Do indicators of stand susceptibility to beetle attack vary eastward and can they be exploited to curb expansion?
4	Can models / indicators of tree physiology be developed and incorporated in spread models?
5	What are the specific changes in population dynamics as the MPB moves into novel habitats? Can critical thresholds be defined in terms of population dynamics of beetles and used to guide operational management of infestations in novel habitats?
6	Detecting populations of MPB at low densities is a critical step in managing the beetle. Can baits and protocols for its placement with respect to endemic populations be developed and successfully deployed?
7	What can we expect from secondary injurious insect populations following MPB attack? Should we be concerned about residual pine and other species?
8	Demonstrate / evaluate the efficacy of genomic science to support management's response to mountain pine beetle (CF Research Theme No 3)

Question No.	**Research Theme 2: Hydrological Impacts of Mountain Pine Beetle**
1	What are the specific thresholds (forest cover, tree condition) in MPB affected watersheds that are indicative of pending negative conditions such as, changes in water quality and quantity, deterioration of aquatic habitats, flood potential?
2	What is the range of hydrological impacts at stand and watershed levels from variable MPB attack; can hydrological recovery be effectively determined using indicators of real-time forest cover and stand condition against a backdrop of predicted climate change?
3	Can currently available watershed assessment procedures be refined to accurately reflect the state of Alberta's watersheds affected by the dynamic nature of MPB and allude to remedial management options to ensure the flow of ecological services? (*)

Question No.	**Research Theme 3: Landscape and Stand Dynamics Following MPB**
1	What are the vegetation dynamics in managed and natural pine dominated stands across Alberta's ecosites following variable MPB caused mortality? Can interventions be applied to modify species compositions to make future stand more resistant to beetle attack?
2	How is soil chemistry and soil biology altered following MPB attack and how do these changes influence stand rehabilitation? (added May 6, 2016)
3	In order to achieve future site objectives what terrestrial and aquatic parameters ought to be evaluated to determine candidacy for treatment (including salvage) versus those that ought to be left for natural succession? What are the thresholds of these parameters by ecosite that suggest treatment success?
4	What operational measures can be taken to restore landscapes severely altered by MPB to ensure the flow of ecosystem services?
5	Can genetic traits of Alberta's pine species be efficiently identified and captured operationally to promote the development of healthy forests following mountain pine beetle and its consequences?

21	246.19	Impacts of MPB on hydrology and vegetative redevelopment in lodgepole pine forests of west-central Alberta: Phase II: Ecological responses in the grey stage and regionalization of data for MPB site selection (MPB Ecohydrology II)	E. Macdonald, U. Silins, A. Anderson										1		1				1			1											6	What level of overstory mortality in a spatially defined area indicates a level of thermal loading detrimental to threatened cold water fish? What kind and level of intervention would mitigate against potential impacts?
22	246.20	Beyond Beetle (updated Sept 4-14)	E. Macdonald, V. Lieffers, M. Fannigan, N. Erbilgin												1		1				1		1										7	How is wildlife habitat for grizzly bear and caribou affected by landscape change due to MPB, and what rehabilitative measures can be taken to restore their critical habitat?
23	246.21.1	MPB Attacks Alberta: Assessing trade-offs in food supply for two species at risk. (field support)	L. Finnegan. & G. Stenhouse																			1											8	How is population behavior of species at risk such as grizzly bear and caribou affected by MPB induced habitat change?
24	246.21.2	Mountain Pine Beetle Attacks Alberta: Assessing trade-offs in food supply for two species at risk.	Laura Finnegan, Gord Stenhouse																			1											9	How does fire risk and fire behaviour change following MPB?
25	246.22	Forest History (NOT PART OF MPBEP as of 2015)	Robert Udell																														10	How will the anticipated increase in soil water affect choice of silviculture options and what are the potential implications to the flow of ecosystem services?
26	246.23	Rehabilitation of beetle-killed stands by improving pine seedling performance with mycorrhizal fungi	Justine Karst, Nadir Erbilgin													1																	11	**What are the ecological impacts of the MPB across eco-sites?** Will the site ecologies of beetle killed stands change with respect to carbon fluxes? Is there a need to take mitigative action to achieve a desired forest future condition while minimizing carbon losses?
27	246.24	Extending the information from the Tri Creeks and MPB Ecohydrology projects with hydrological modelling	Axel Anderson										1																				12	What is the potential impact of managing net down areas versus no management to the spread of the beetle (scenario analysis / risk determination)?
28	246.25	Persistence or extinction? Quantifying the fate of invasive mountain pine beetles in eastern pine forests	Allan Carroll		1																												13	Can proactive measures, apart from harvesting, be taken to slow the spread of the beetle and how can the impacts of these measures be evaluated.
29	246.26	Simulating MPB spread management in Alberta and beyond using SpaDES	Eliot McIntire, Alex Chubaty		1																												**14**	**Can effective models be developed to guide silviculutre strategies following MPB (Added Sept 13-18). See 246.02.**
30	246.27	Assessing community resilience to mountain pine beetle outbreaks	Lael Parrott																										1					
31	246.28	Development of new formulations to monitor MPB at low and high densities	Nadir Erbilgin						1																								**Question No.**	**Research Theme 4: Social and Economic Implications of a Changing Landscape**
32	246.29	Identification of optimal attack densities of MPB in hybrid and jack pine in its expanded range in Alberta	Maya Evenden			1																						1					1	What are the characteristics of resilient communities that are able to ensure their social and economic stability in the midst of a landscape changing due to MPB, and what steps can be taken to enhance resilient capacity of communities?
33	246.30	Alternative approaches for integrated area-wide management of the MPB epidemic in Alberta	Allan Carroll	1	1	1	1																										2	How is fibre quality related to shelf life of MPB killed trees across ecosites across Alberta and what are the subsequent implications for manufacturing?
34	246.31	MPB effects on wildfire rate of spread and landscape fire risk	Chris Stockdale																		1		1										3	As a result of MPB in Jasper National Park, how do visitor perspectives and their behaviour influence local economies?
35	246.32	Pine genomic signatures of resiliency to mountain pine beetle	Janice Cooke								1								1														**4**	**What is the range of perceptions regarding MPB. See 246.04**
36	246.33	Caribou and Grizzly Bear Response to Pine Forests Killed by Mountain Pine Beetle	Terry Larsen																	1	1													
37	246.34	Effectiveness of Verbenone and Green-leaf Volatiles in protecting high-value Whitebark Pine trees through a mountain pine beetle outbreak in Jasper National Park	Brenda Shepard						1																									
38	246.35	Upper Foothills Mountain Pine Beetle Permanent Sample Plot Network	FGrOW - Brian Roth												1																			
39	246.13.3	Annotated Bibliography	Fuse Consulting																															
40	246.36	Phase-dependent dispersal of mountain pine beetle reared in lodgepole and jack pine hosts	Maya Evenden			1																												
		Number of studies addressing Priority Question		**3**	**5**	**5**	**1**	**3**	**4**	**0**	**1**	**0**	**3**	**0**	**6**	**1**	**1**	**1**	**2**	**3**	**5**	**3**	**3**	**0**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**1**		
				Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q1	Q2	Q3	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q1	Q2	Q3	Q4		
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