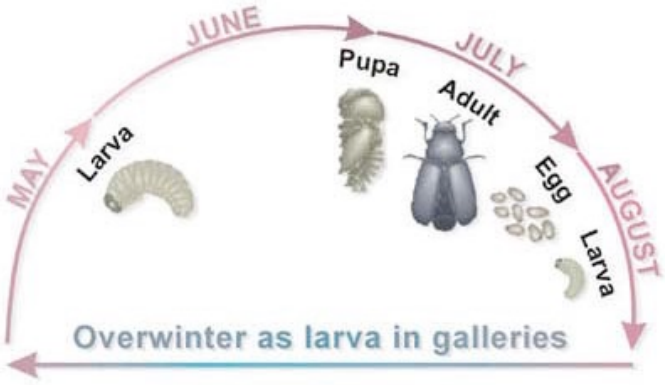
Mountain Pine Beetle in Alberta
Outbreak & Management Summary – June 2023

- In Alberta, MPB was historically restricted to the pine forests in Kananaskis, Banff National Park, and Cypress Hills Interprovincial Park. Several outbreaks occurred in this region between 1940 and 1983 with small, detectable populations occurring in the early 2000's.
- The first outbreak reported in the province occurred in Banff National Park in 1940 and was attributed to drought conditions in the previous 20-year period. It is thought that this outbreak was a result of local MPB population build-up and not the result of beetles migrating in from other regions. Fall and burn operations commenced in 1941 and continued until the outbreak subsided in 1944. An extremely cold period in January 1943, extreme minimum temperature reaching -44 °C, along with aggressive control activity aided in the collapse of the outbreak. The outbreak area spanned 4,073 hectares and 17,911 infested trees were treated.
- The second outbreak in Alberta started in 1980 and collapsed a decade later. This outbreak occurred over a larger area than the first and encompassed Waterton Lakes National Park, Kananaskis, and the Crowsnest Pass regions. This outbreak was due to the expansion of populations in the Flathead River drainage in southeast British Columbia and northeast Montana. The Government of Alberta initiated a treatment program immediately and controlled 106,379 infested pines – 1/3 of those being the now endangered limber pine. The population crashed in 1983 due to a combination of winter cold and control efforts.
- The third and current outbreak began in 2006 when MPB rapidly expanded its range into in central and northern Alberta. Beetles originating from a large outbreak in central British Columbia underwent a long-distance migration event, breached the Rocky Mountains, and settled into the forests in areas around Grande Prairie, Peace River, central Alberta, and almost as far east as Lesser Slave Lake.
- Subsequent to the initial breach of the Rocky Mountains, MPB has continued to spread eastward and persist at outbreak levels, causing widespread pine mortality. Another long-distance migration of beetles from British Columbia occurred in 2008.
- MPB is now established in pine forests in the expanded range as far east as Slave Lake in central Alberta. MPB can occasionally be detected further east in jack pine stands north of Lac La Biche but these populations are small and isolated and do not persist year-to-year.
- In the last few years, the outbreak has begun to decline in the expanded range. Significant cold events during the winters of 2019 and 2020 caused greater-than-normal mortality in MPB populations above the snowpack. Additionally, the subsequent summers in these years were cool and wet - conditions that interfere with MPB flight and reproduction. Along with provincial control efforts, weather, and, in some regions of the province, host depletion are likely responsible for the slowed growth of MPB populations.
- To date, over 2.4 million hectares of forest in Alberta have been affected by MPB. Damage ranges from light, with only a few attacks per hectare, to severe, where nearly all the pine is dead. Since the early 2000s, 42 million MPB-killed have been identified through aerial and ground surveys in Alberta. This is a large underestimate of the total damage to date as some infested areas were not surveyed consistently.
- It can be expected that outbreaks of MPB will occur in the future due to the fact that it is established in Alberta's pine forests and the reality of climate change. In the past, the environment in central region of Alberta was too harsh to support MPB, however winters have become milder on average and this habitat will support both epi- and endemic populations.

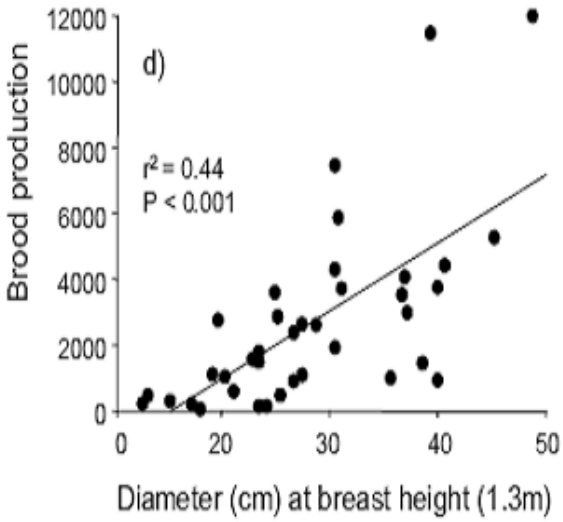
Mountain Pine Beetle in Alberta

(Dendroctonus ponderosae)

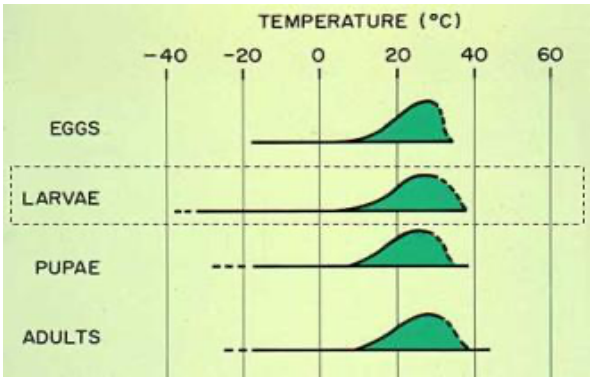
Life Cycle



Host Characteristics



Cold Tolerance by Life Stage



Symptoms and Signs of MPB Attack

Fading, yellowish-green crowns in the spring turn reddish-brown in the summer

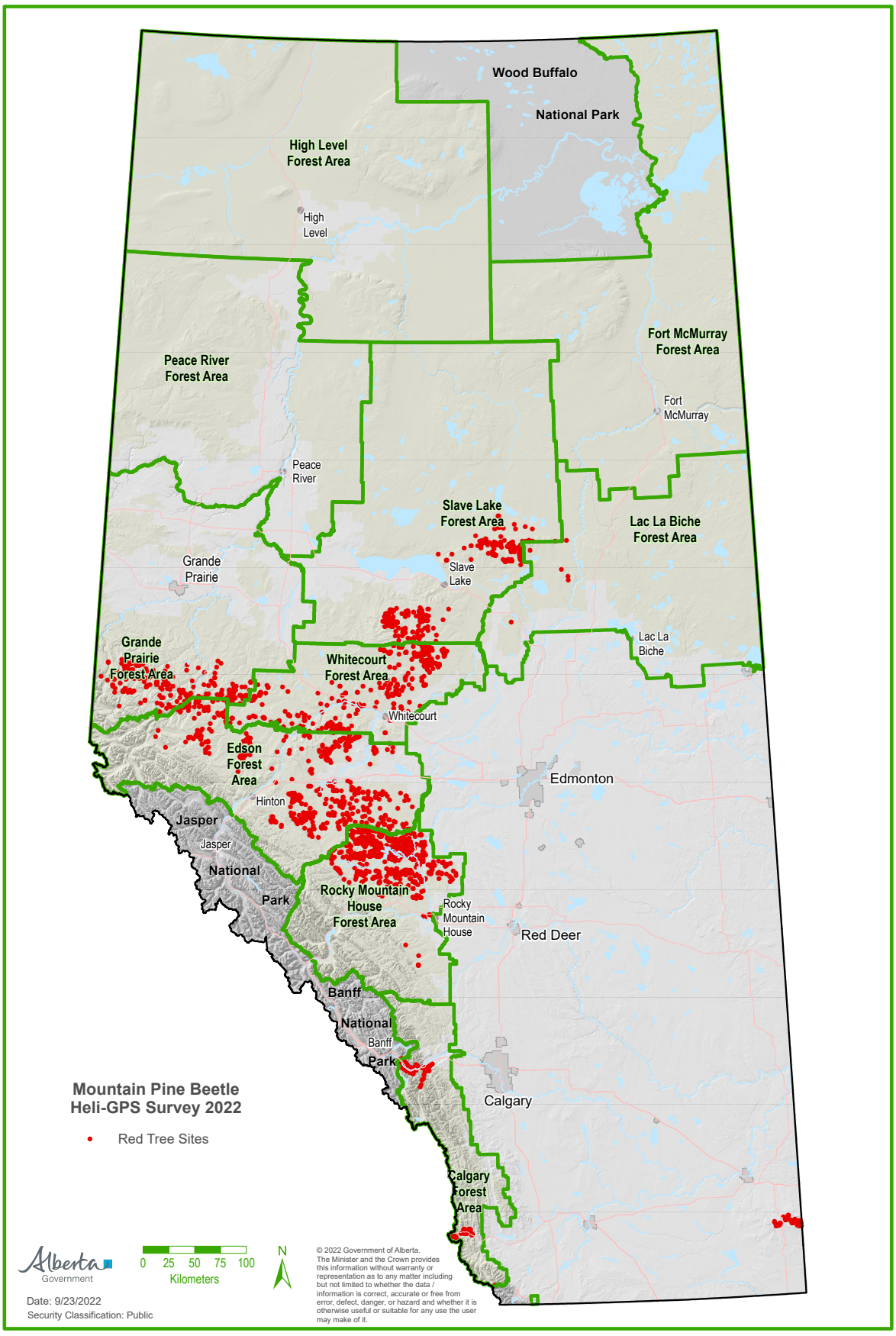

Pitch tubes


Sawdust (reddish-brown) around entrance holes, on bark scales, and at the base of the tree


Galleries under the bark

Greyish-blue staining of sapwood

Adult beetles that are cylindrical, stout-bodied, brown to black, and 4.0 to 7.5 mm long


Wood Buffalo
National Park
High Level
Forest Area
High
Level
Peace River
Forest Area
Fort McMurray
Forest Area
Fort
McMurray
Peace
River
Slave Lake
Forest Area
Lac La Biche
Forest Area
Grande
Prairie
Slave
Lake
Grande
Prairie
Forest Area
Whitecourt
Forest Area
Lac La
Biche
Whitecourt
Edson
Forest
Area
Edmonton
Hinton
Jasper
Jasper
National
Park
Rocky Mountain
House
Forest Area
Rocky
Mountain
House
Red Deer
Banff
National
Park
Banff
Calgary
Calgary
Forest
Area
Mountain Pine Beetle
Heli-GPS Survey 2022
Red Tree Sites
Alberta
Government
0 25 50 75 100
Kilometers
N
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Date: 9/23/2022
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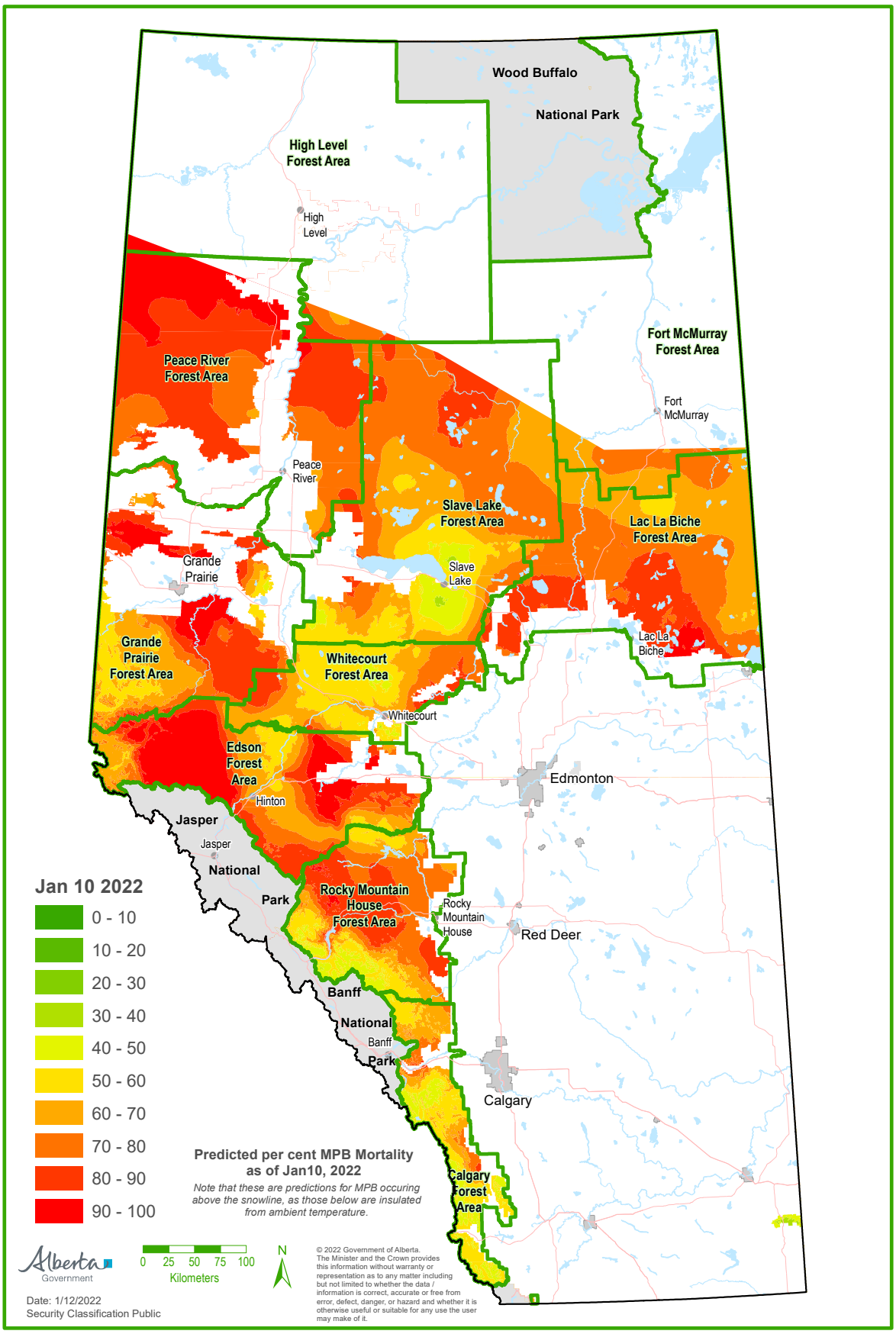
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Biche
Whitecourt
Edson
Forest
Area
Edmonton
Hinton
Jasper
Jasper
National
Park
Rocky Mountain
House
Forest Area
Rocky
Mountain
House
Red Deer
Banff
National
Park
Banff
Calgary
Calgary
Forest
Area
Jan 10 2022
0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100
Predicted per cent MPB Mortality
as of Jan10, 2022
Note that these are predictions for MPB occuring above the snowline, as those below are insulated from ambient temperature.
Alberta
Government
0 25 50 75 100
Kilometers
N
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Security Classification Public

Mountain Pine Beetle – Permanent Sample Plot Program

A partnership between FGrOW and FRIAA MPB Rehabilitation and Ecology Programs

More than 230 plots spanning the MPB-affected areas in west-central Alberta. About half of the plots are Government or company PSPs with pre-attack measurements between 1997-2008 and the others installed post-attack but with measurements of standing dead trees that can be used to re-construct pre-attack conditions. Relying on ground data alone, the data will be used to address questions including:

Empirical Analysis of Stand Development: Examine at both the tree, species, and plot level the responses to pine mortality and the empirical trajectory in survival and ingress, basal area, and volume.

Comparison of Development Trajectories: Initialize growth models with pre-attack stand conditions and compare the observed, empirical trajectory to that expected by models..

Evaluate Growth Models: Initialize growth models with post-attack stand conditions and compare the observed, empirical trajectory to that expected by models. Assess likely accuracy and reliability of model projections beyond the last measurement.

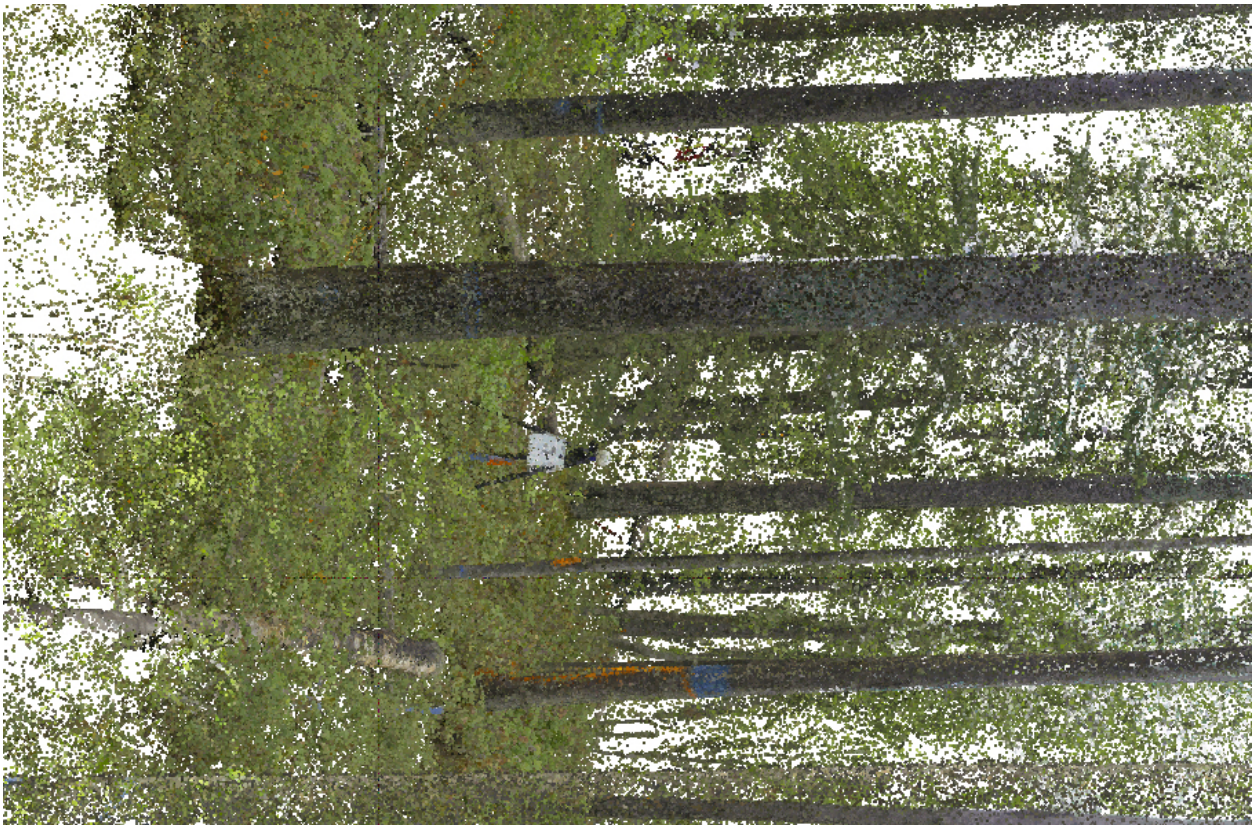
The MPB PSP network also provides and exceptional opportunity to add a new component involving the collection of additional LiDAR data and matching where possible with operational-scale data collected by individual companies. New LiDAR data paired with existing MPB PSP data enables new analyses, including:

Refine Application of Individual Tree Detection (ITD) Algorithms with Airborne LiDAR: Enumerate competing ITD algorithms, software, and tuning options including spatial smoothing parameters and the relationship with stand structures. Identify key decisions in application, and test in the context of MPB disturbed stands that exhibit layering and species mixtures that challenge current approaches.

Initialize Growth Models: Generate model initialization data using both area-based and ITD approaches using airborne and drone LiDAR compare to field measurements. Evaluate the relative accuracy of stand vs. tree level approaches (i.e., in the context of GYPSY vs. MGM). Compare the empirical trajectory to that implied by models under alternative initializations.

Evaluate Segmentation Algorithms for Terrestrial LiDAR: Explore the ability to segment terrestrial point clouds to identify individual trees in disturbed stands that exhibit increasing complex structures.

Compare Mobile to Stationary Terrestrial LiDAR: Test data collection practice using contemporary stationary (tripod-mounted) and mobile LiDAR data collection systems, including data collection, management, and processing to produce co-registered point clouds.

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Mountain Pine Beetle Ecology Program

Upper Foothills PSP Network

PSP	Measure-ment	MPB		Density (trees/ha)		Live Basal Area (m^2/ha)			Conifer Regen (trees/ha)	Shrub cover %	Forb cover %	Grass cover %
		% Canopy Loss	Attack Year	All	Conifer Only	All	Conifer Only	Pine Only				
58.4	2021	3	2006	2025	1556	48.5	28.8	3.0	0	10	40	5
59.2	2021	10	2009	902	902	23.6	23.6	7.7	0	10	55	5
76.1	2021	4	2009	1876	1753	53.1	49.2	36.8	250	35	40	0
77.1	2021	24	2009	1565	1565	39.0	39.0	34.8	250	70	75	35
78.2	2021	11	2009	1395	1395	43.4	43.4	32.0	0	5	65	5
80.1	2021	17	2014	1007	1007	37.2	37.2	12.4	0	45	35	10
106.1	2021	1	2018	1837	1837	39.3	39.3	36.2	750	50	55	0
8060.1	2021	39	2018	2075	1875	31.9	22.5	9.3	750	50	30	50
8061.1	2021	58	2016	875	875	29.3	29.3	5.1	0	25	35	30
8062.1	2021	72	2016	250	250	14.1	14.1	3.1	250	40	75	40
8063.1	2021	56	2018	1075	1075	12.1	12.1	6.4	2250	65	45	70
8064.1	2021	56	2018	1850	1850	15.6	15.6	10.2	750	25	30	65
8507.1	2021	20	2019	877	877	31.6	31.6	21.2	250	75	45	70
8508.1	2021	18	2015	962	962	21.9	21.9	20.7	0	5	60	40

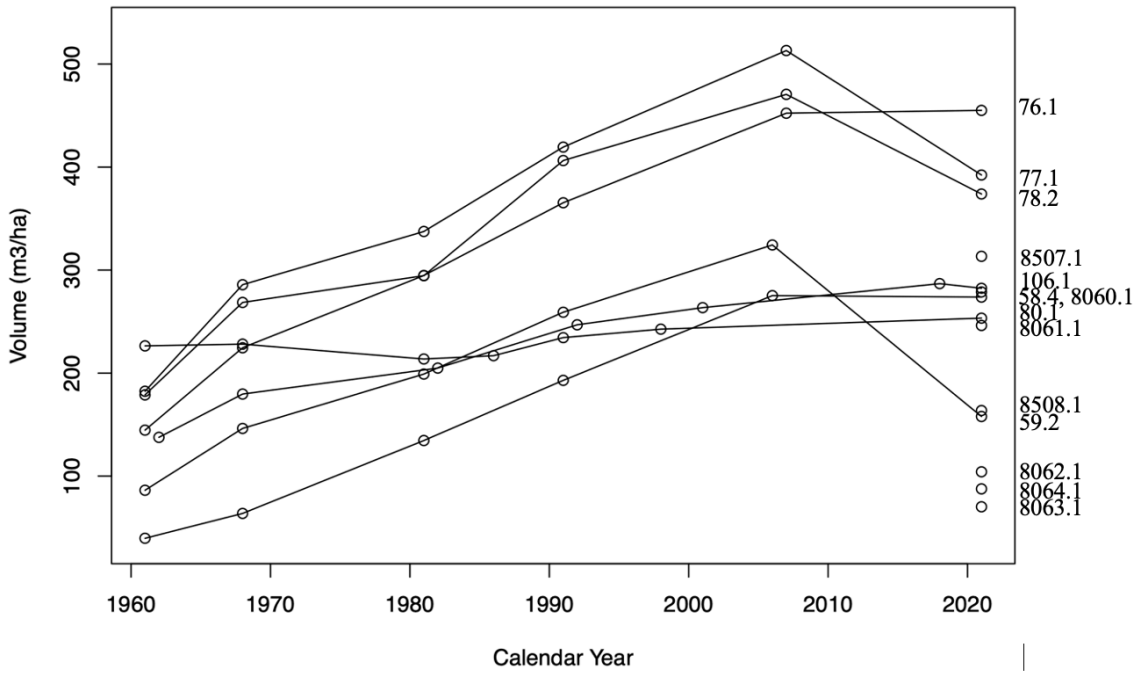
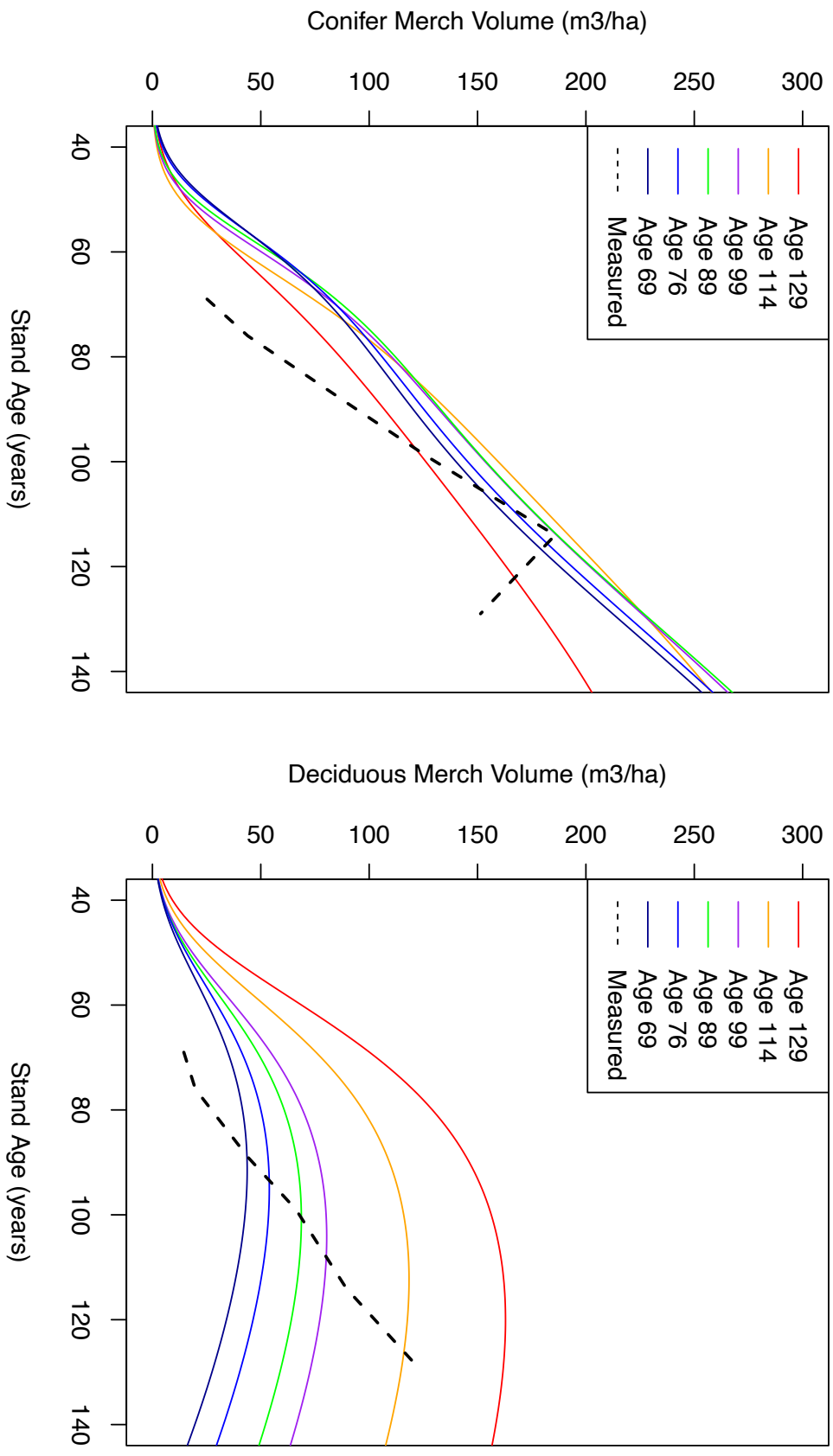
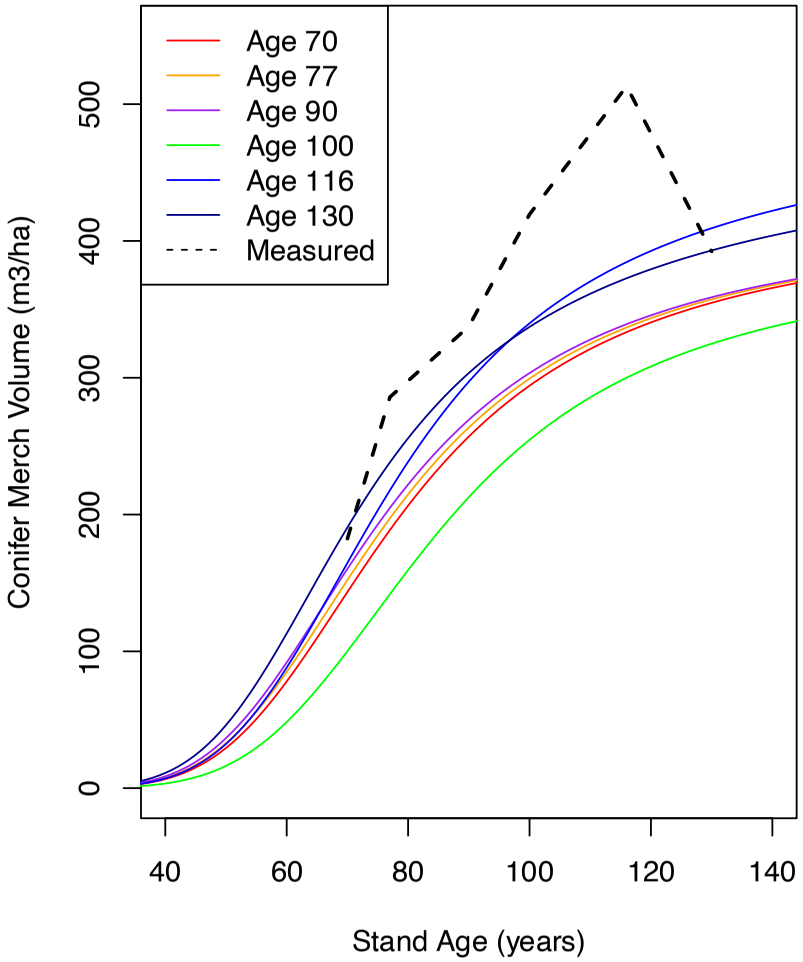


Figure 3. Merchantable volume of all species (conifer plus deciduous, 15/10 limit) through time.

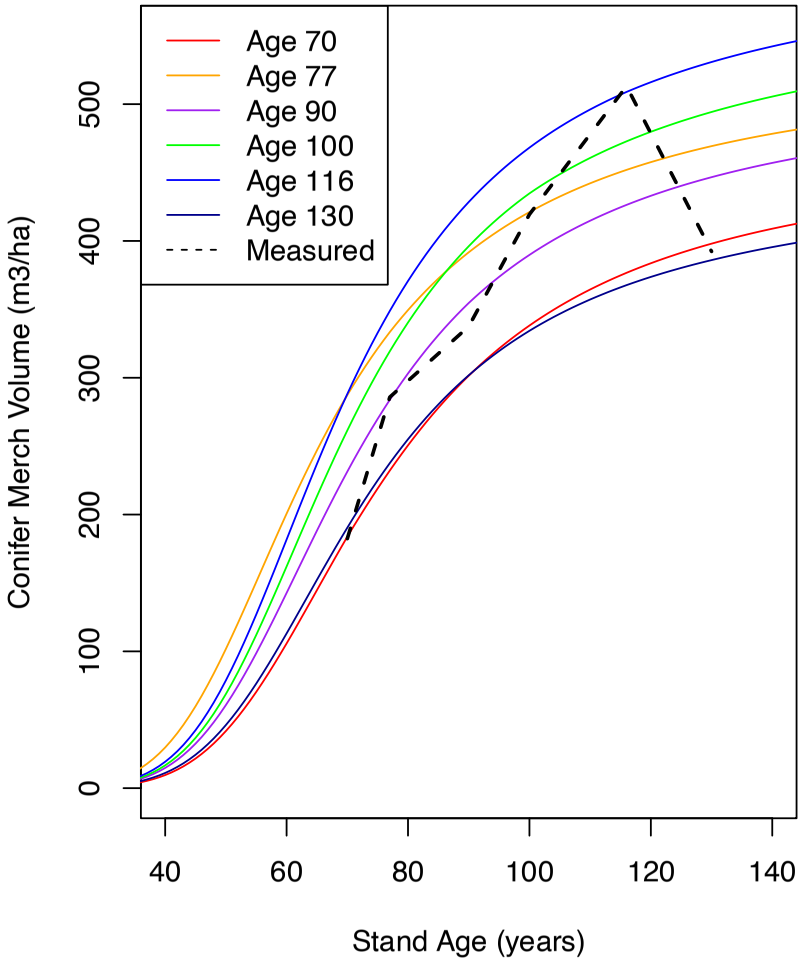
PSP 58.4 – 48.5 m^2/ha - 3% Canopy loss, Mixed pine, spruce and Aspen



PSP 77.1 – 39.0 m^2/ha - 24% Canopy loss, pure pine with spruce understory



GYPSY default projection



With conditioning on BA