Pre-Industrial Forest Conditions

Spray Lake Sawmills FMA

June 28, 2011

Research Objectives

I. To determine the Pre-Industrial Condition of the forest
   - What were the lead disturbance agents;
   - What was the natural range of variation of the seral age distribution of the forest;
   - What was the spatial distribution of young, mature, old growth forest;
   - What was the natural variation in the historical forest disturbance rate.

II. To provide forest management guidelines

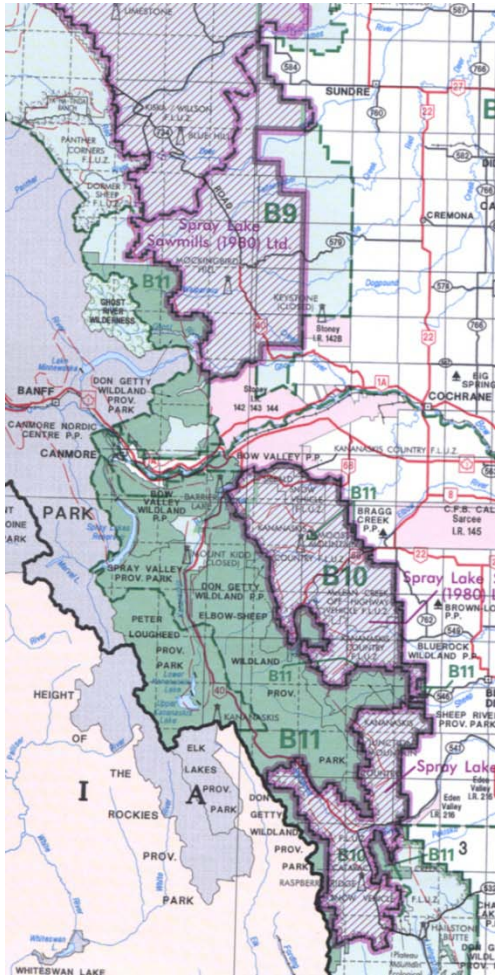
Presentation Outline

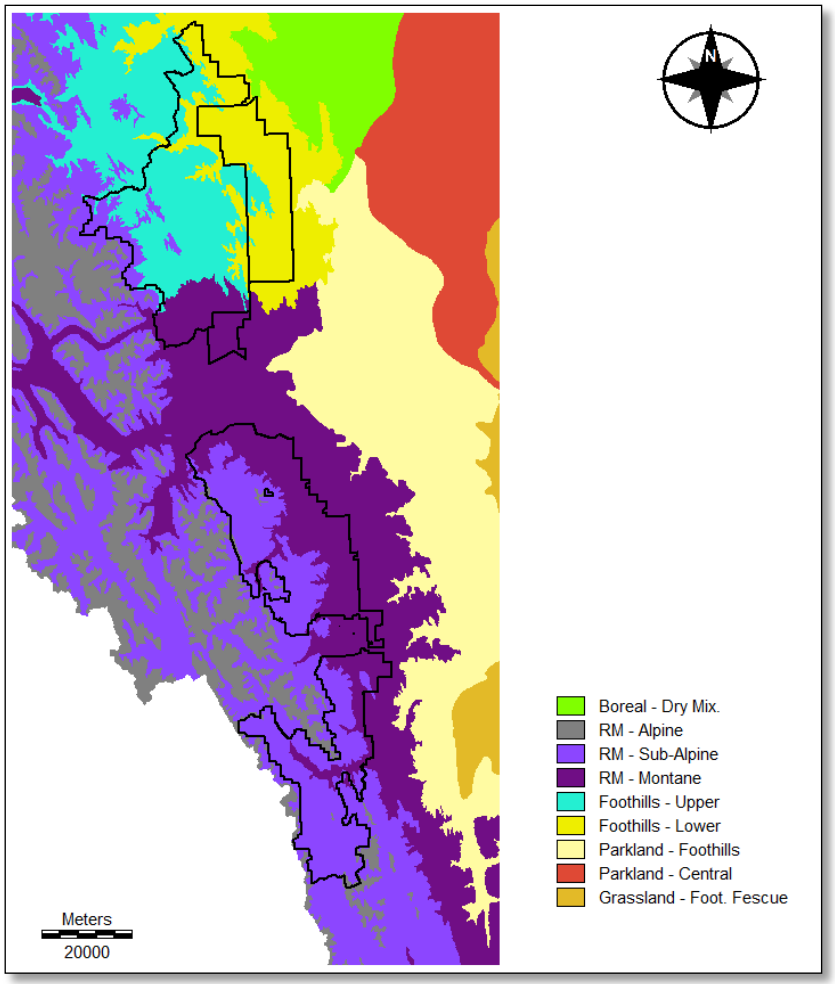
- Go over some definitions
- Overview of natural disturbances
- PIC fire regime of the SLS FMA
- Results of fire history study
- Fire regime simulations
- Forest management guidelines in accordance with NRV of historical mean-fire-return-intervals

Definition of PIC

- Pre-industrial conditions refer to the state of the forest prior to being significantly affected by human use.
- The FMA was never really settled, in 1950 there was still very limited access.
- 1930 was chosen as a turning point. It is associated with a change in fire management policies that removed fire from the landscape through implementations of fire use bans, and increasingly more efficient fire suppression tactics. The last fires of significance date back to 1936 and 1942.

Study Area - NSR





Natural Disturbances

- Lead agent: forest fires. The vegetation of the SLS FMA has been shaped by fire for hundreds of years.
- Windthrow: very localized and small events; were not visible on 1950 aerial photos.
- Insect and diseases: if present, too localized with sparse killing of trees to be noticeable on 1950 aerial photos. No reports of cases from the provincial files for the FMA. Infestations to the south in the Crowsnest region.
- Avalanche: limited to the Highwood region in rugged subalpine terrain.

Fire Regime Study vs Fire History Study

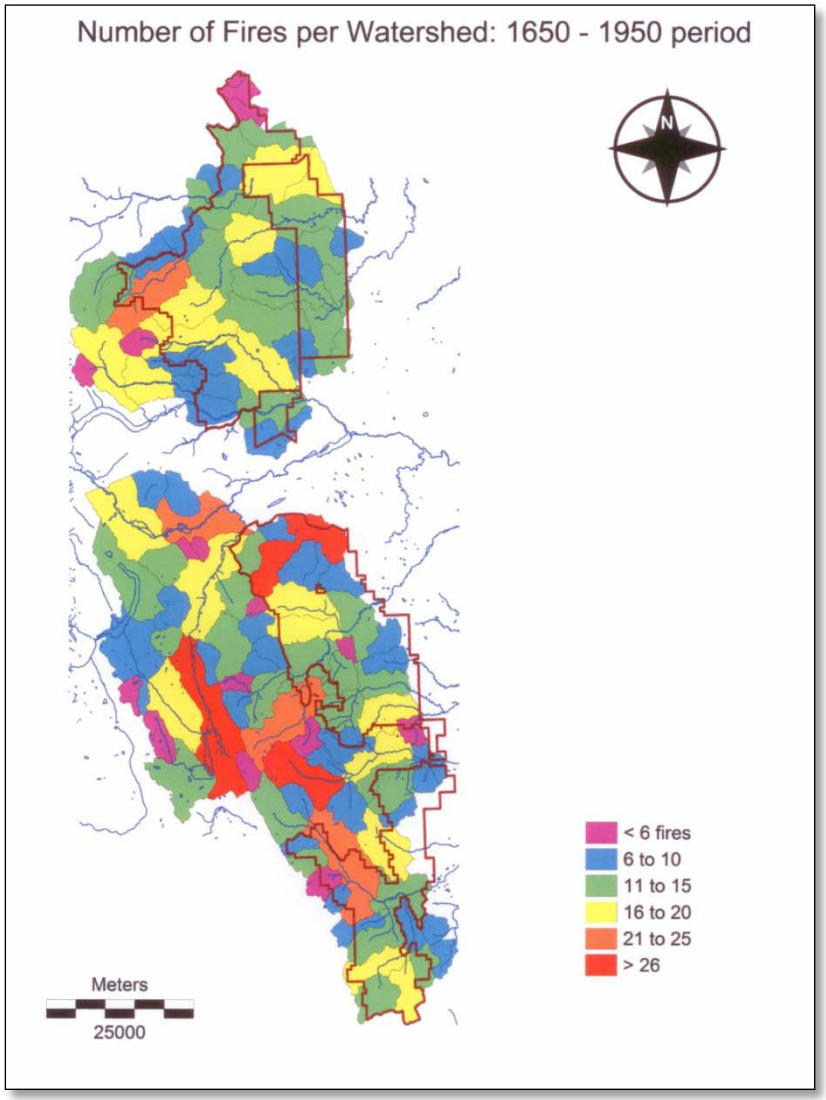
- **Fire regime study:** is the understanding of the prevailing cause of forest fires, their frequency, size and spatial distribution. It also documents the season of burning, area burned by month, the annual disturbance rate of the forest, as well as the prevailing intensity and severity of these fires.

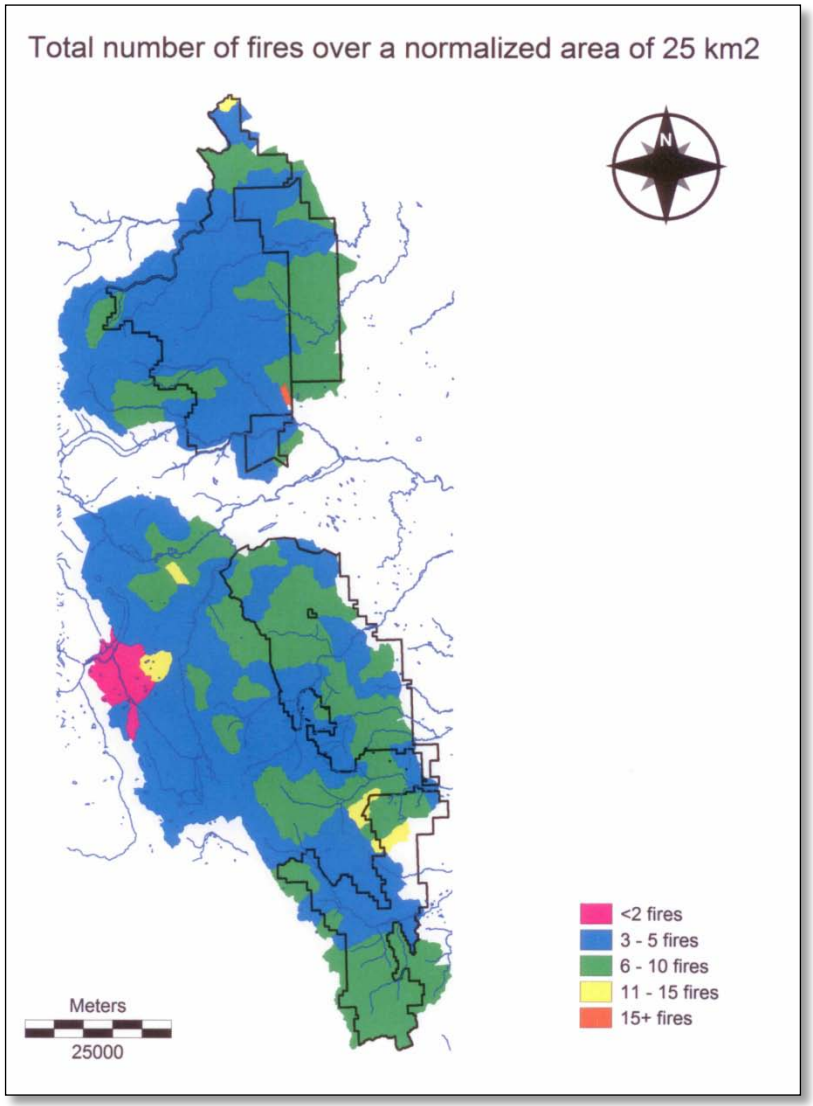
- **Fire history study:** one of the components of the fire regime assessment. It involves the collection of tree age and fire scar data to date all fires that occurred in the past. It also uses fire occurrence reports, old newspapers and journals of explorers to date historical fires. Fires are tabulated in a chronological order to determine the fire return interval. They can also be mapped to produce a stand origin map or fire map.

PIC Fire Regime Methods

- Screening of 1950 aerial photography by watershed:
  - Number of fires, time-since-fire
  - Vegetation complexity (indicator of fire severity)
- Archives: turn of the century forestry reports, first surveyors photography (The Legacy Project: http://mountainlegacy.ca), first explorers account, news paper.
- Fire history study: 2004 (B9), 2005 (Upper B10), 2011 (Lower B10)
- ASRD provincial fire occurrence data: 1961 – 2003
  - (season of burning, fire causes)
- Lightning strike distribution: 1990 to 2003

Number of Fires





Fire Severity Differences

Subalpine

Low vegetation complexity
Long fire intervals
Higher burning severities

Montane / Foothills

High vegetation complexity
Short fire intervals
Lower burning severities

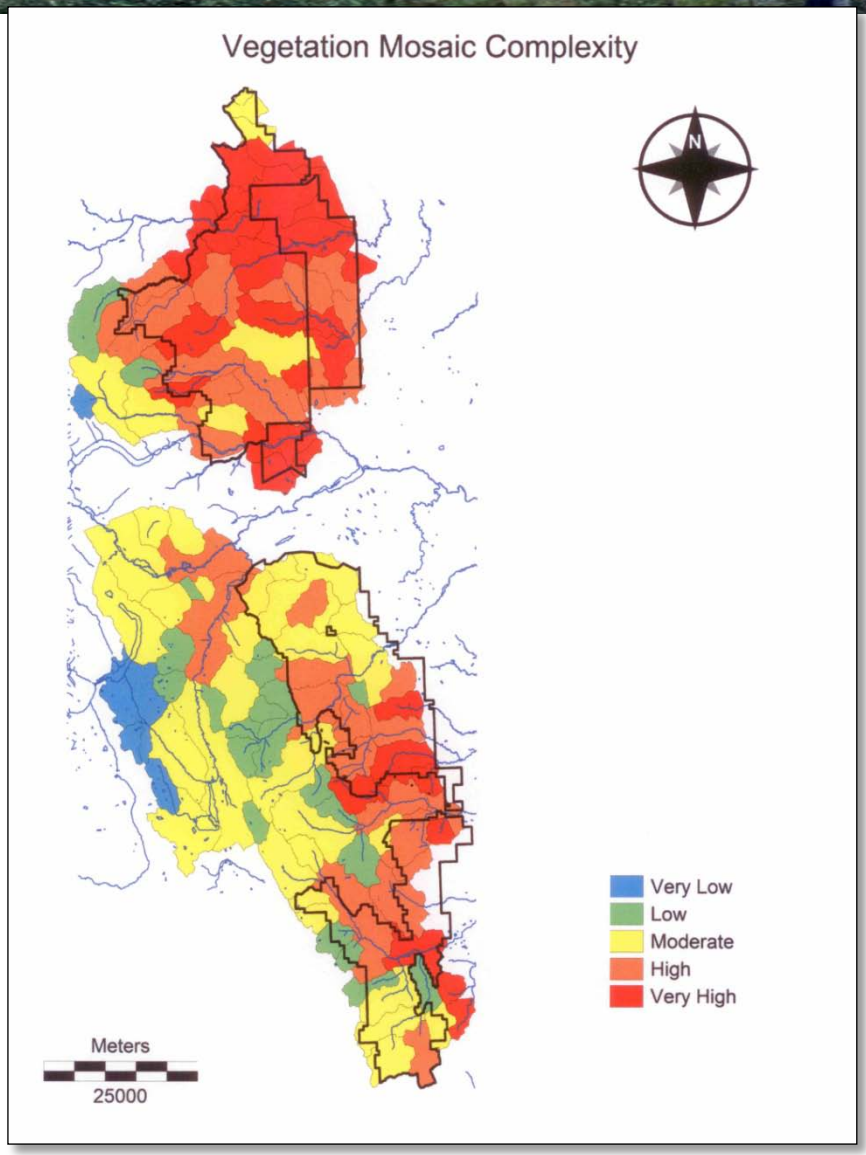
Vegetation Complexity

SLS FMA

69% of the area showed very high and high veg. complexities.

29% of the land had a vegetation mosaic of moderate complexity

Only 2% showed low complexities



Historical Landscape

North Quirk Valley
Arthur Wheeler -
1897

Source: mountainlegacy.ca

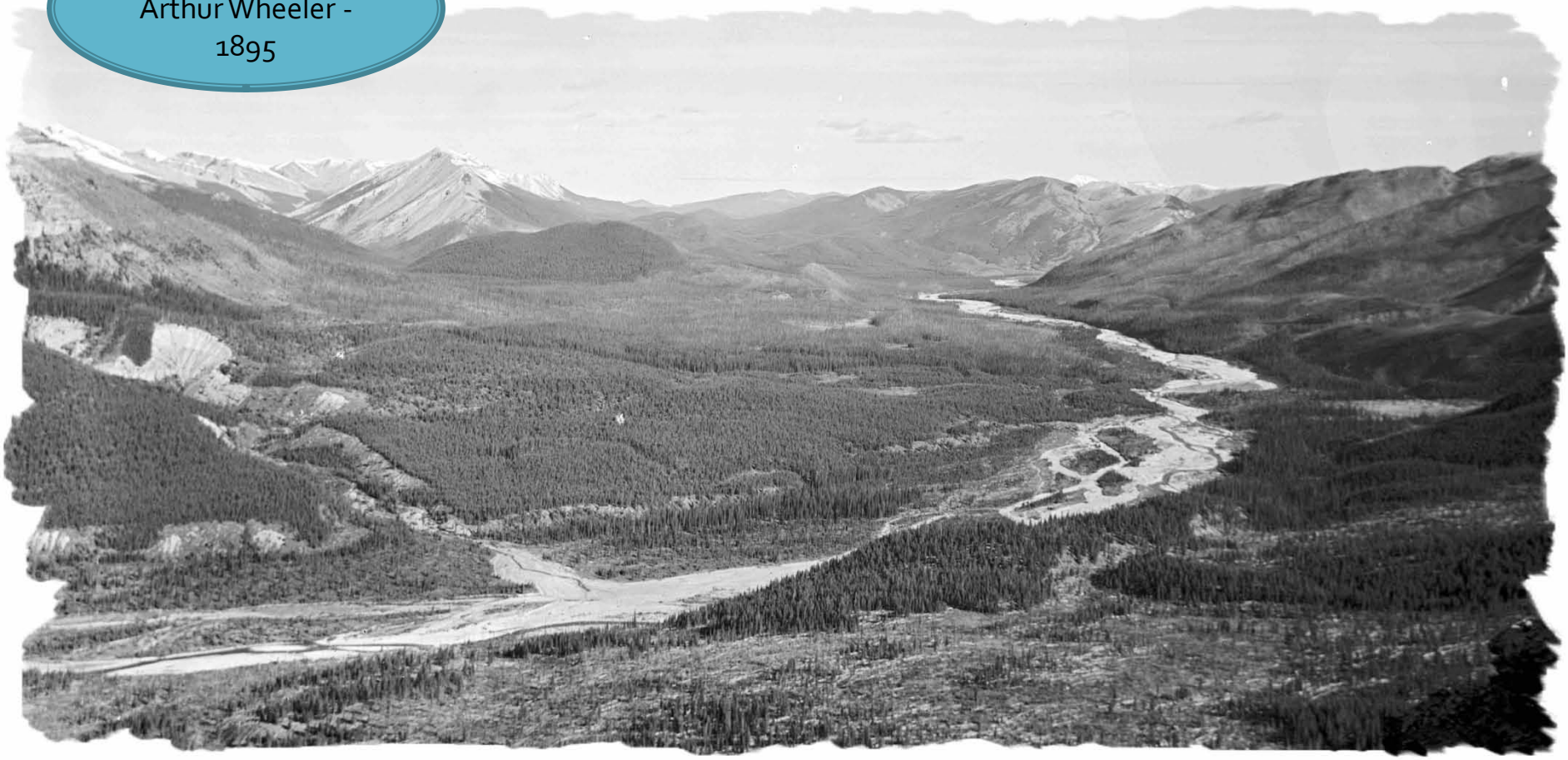
Historical Landscape

South Quirk Valley
Arthur Wheeler -
1897

Source: mountainlegacy.ca

Historical Landscape

Elbow Valley
Arthur Wheeler - 1895



Source: mountainlegacy.ca

Historical Landscape

Bow Valley –
Mt Yamnuska
James Mc Arthur - 1890

Source: mountainlegacy.ca

Fire History Study

- 2004: B9 FMU
  - Upper Foothills, Montane NSRs
  - 242 plot sites, 921 sample trees collected
- 2005: Upper B10 FMU
  - Lower Foothills (Montane), Subalpine NSRs
  - 270 plot sites, 1066 sample trees collected
- 2011: Lower B10 FMU
  - Subalpine NSR
  - Estimated 125 plots, 500 trees

Fire Evidence

Fire Evidence

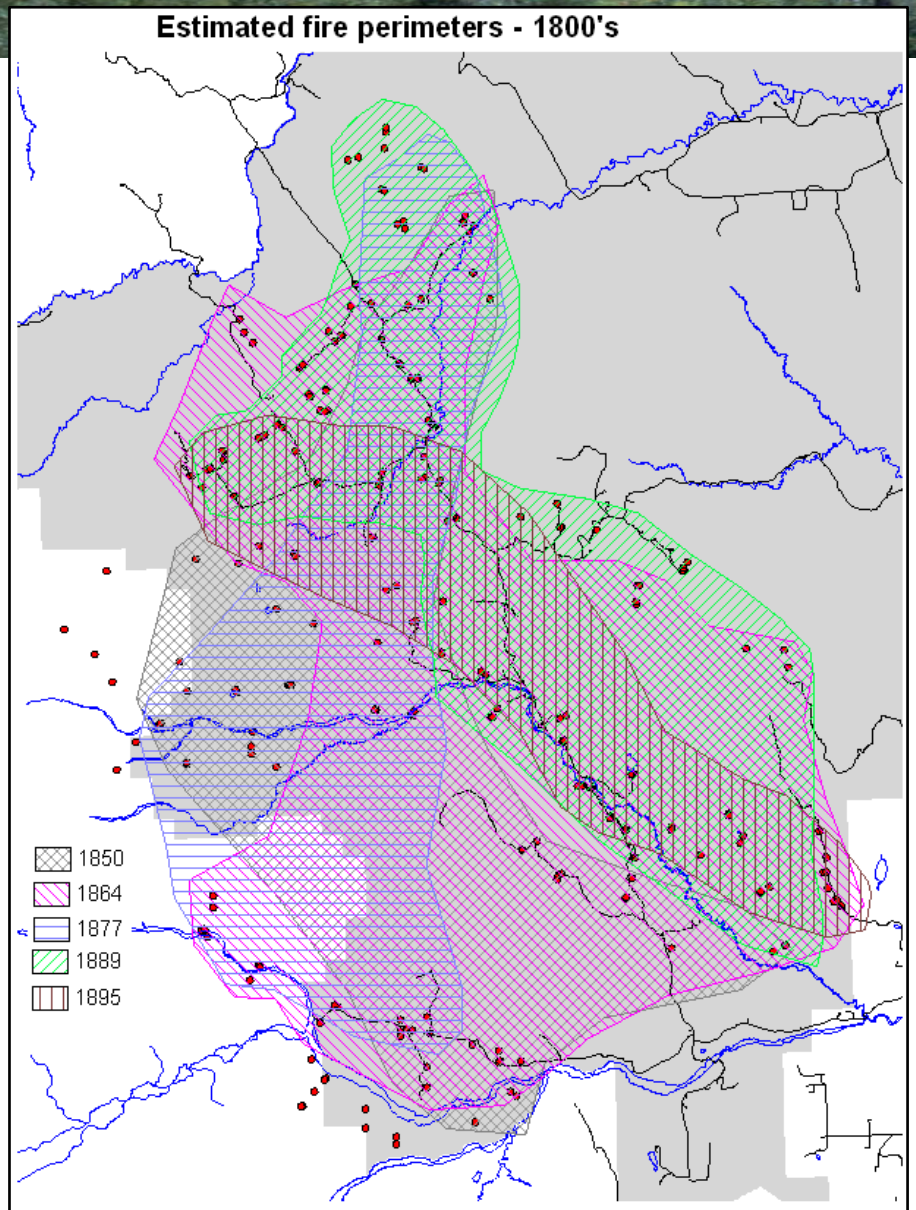
Charcoal – burnt debris

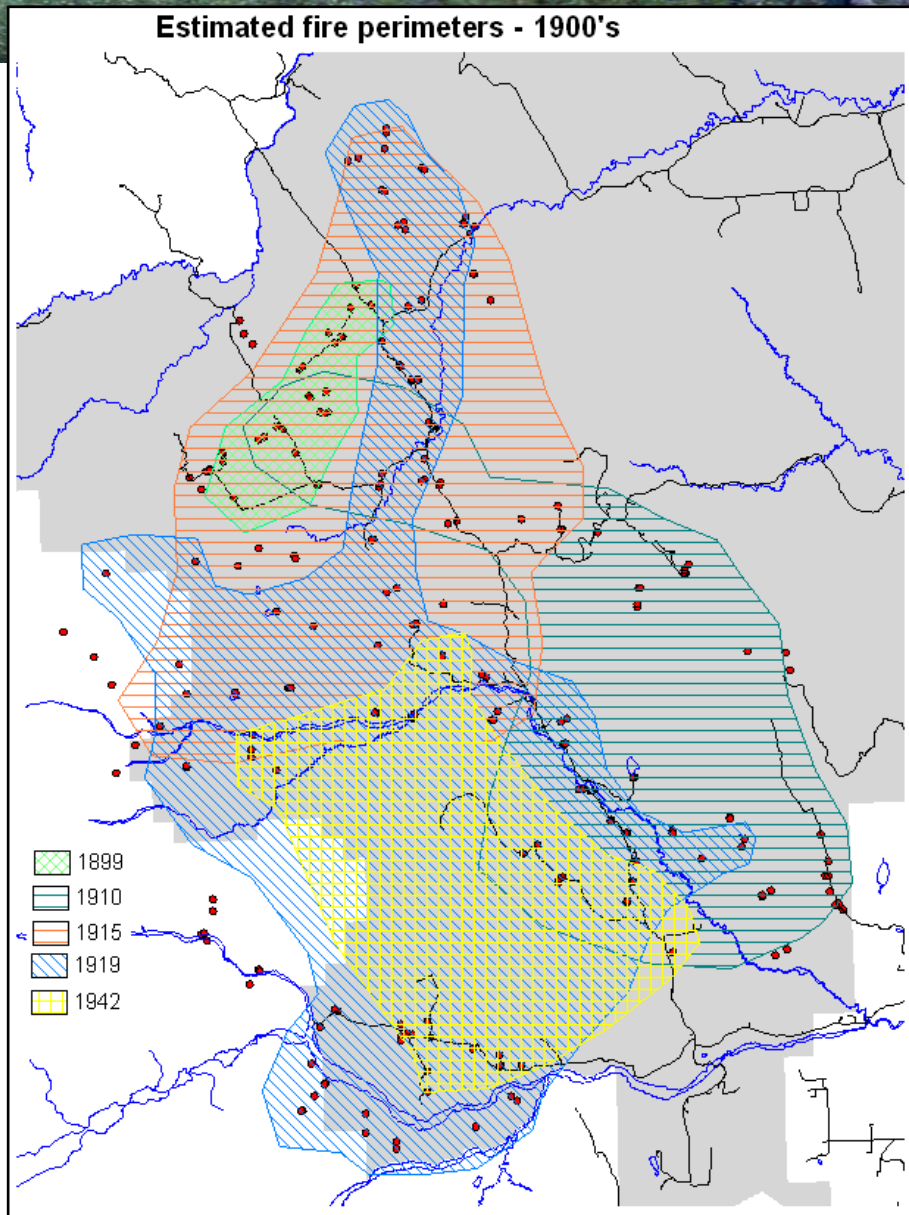
Release

External and Internal scar

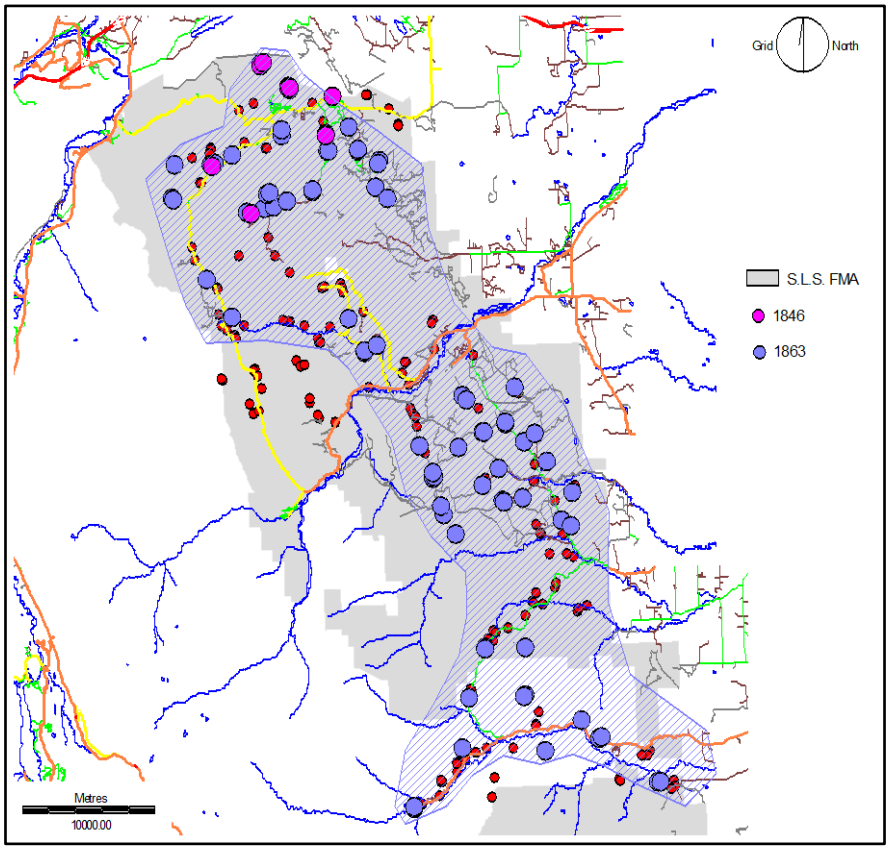
Internal scar

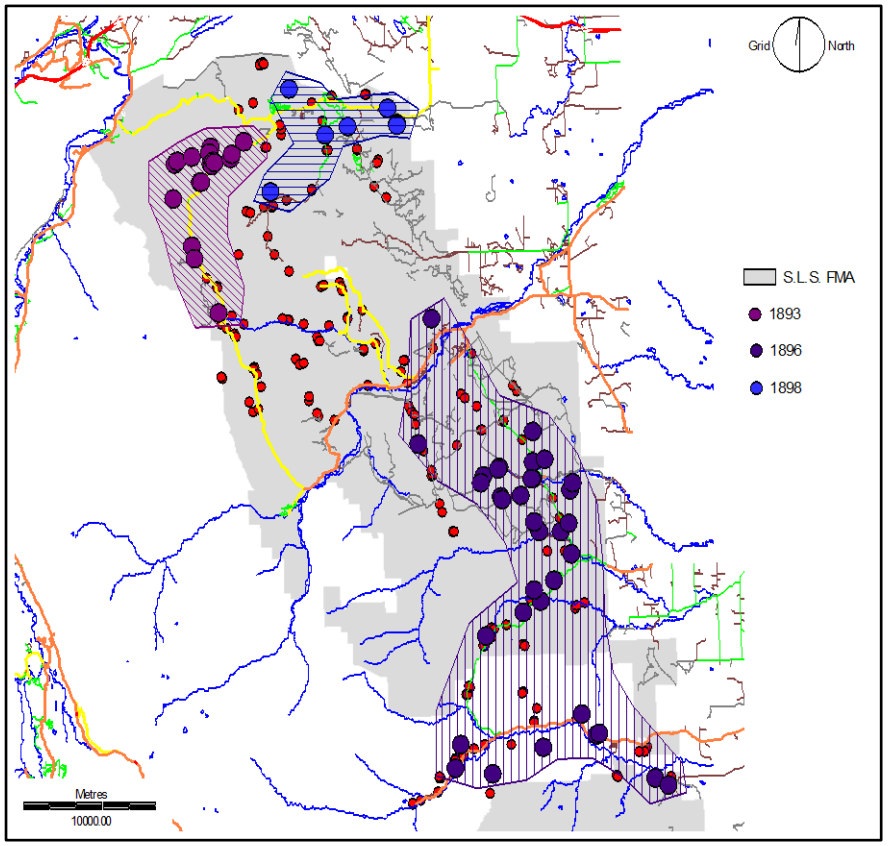
Montane: MFRI=8, FC=50
UF: MFRI=11, FC=30





Montane/LF: MFRI=15, FC=55





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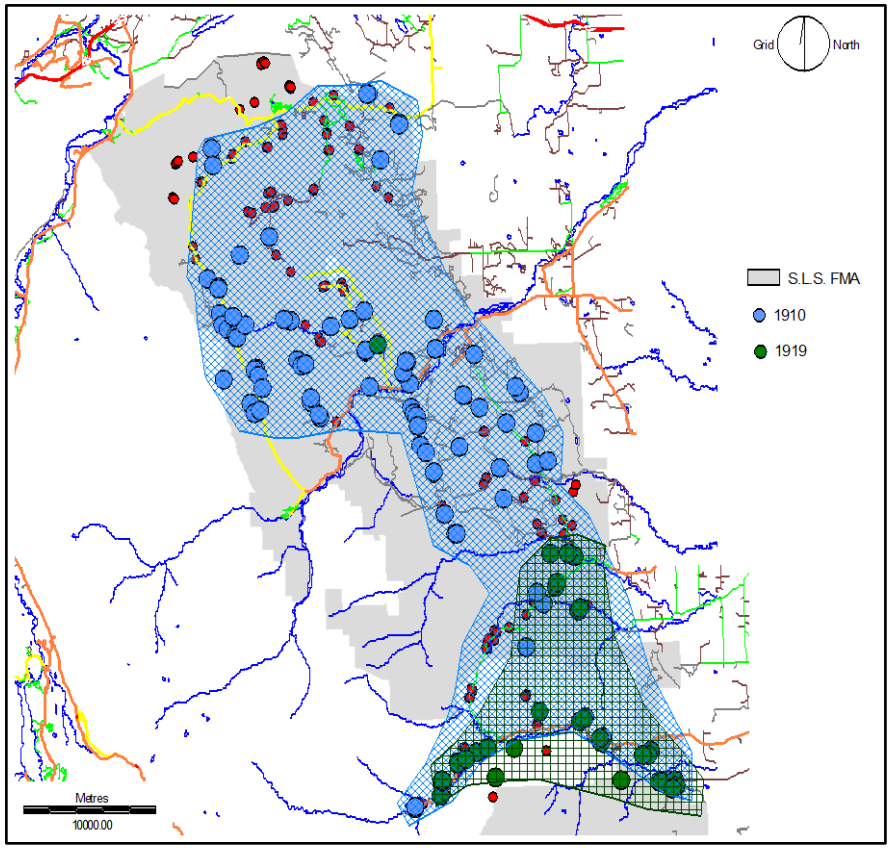
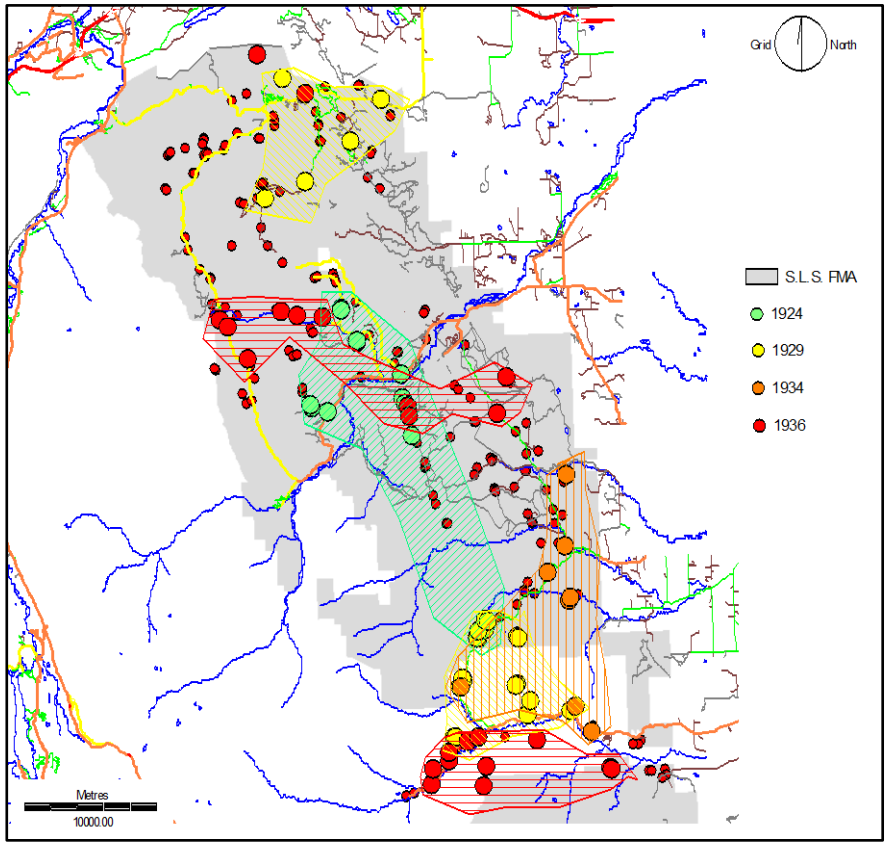
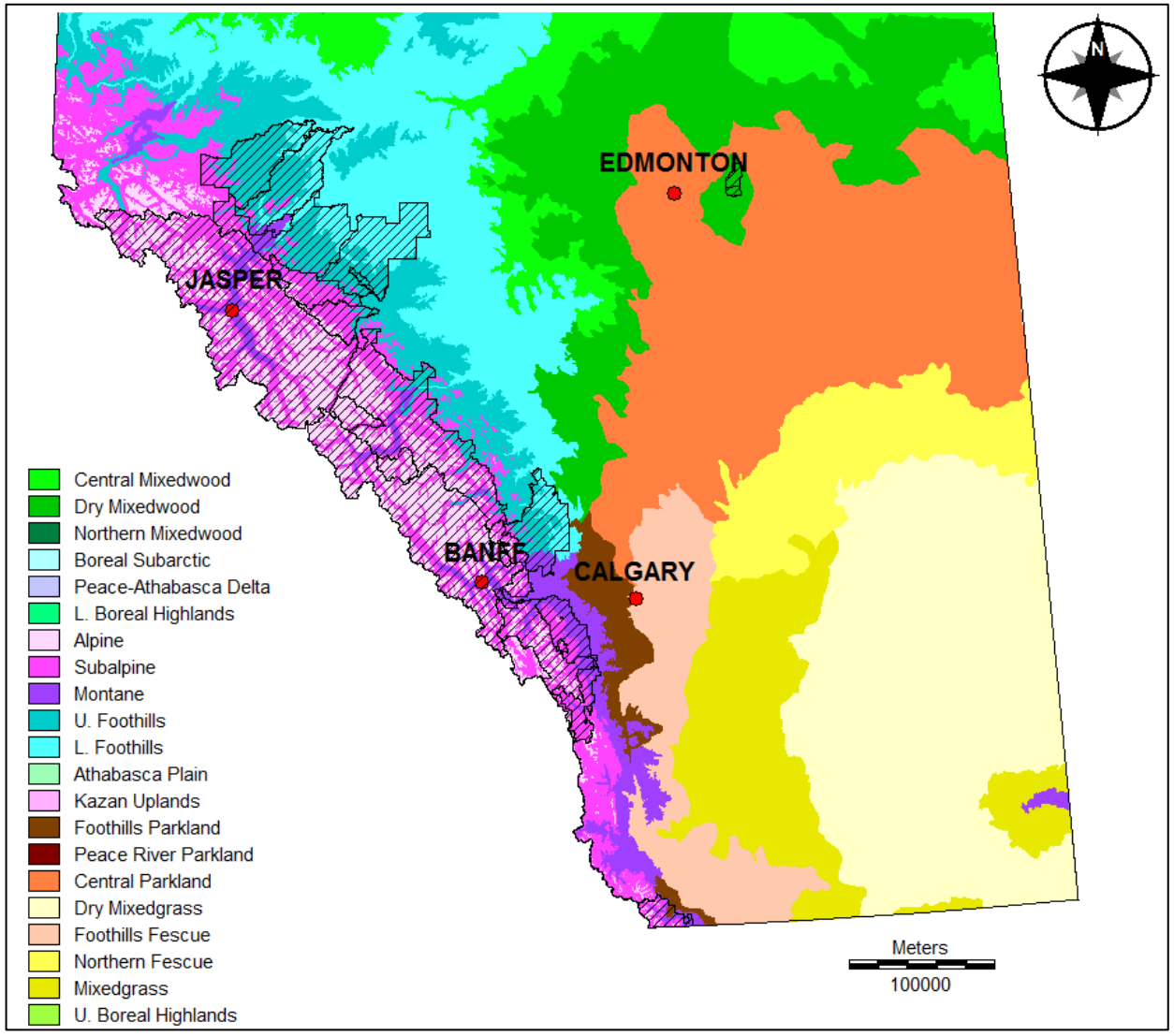




Fire History Studies



Jasper N.P.,
Hinton Pulp FMA,
ASRD FMUs: E4, E5, E11, R11,
Banff N.P,
Kananaskis Country,
Spray Lake Sawmills FMA,
Whitegoat & Siffleur Wilderness Areas,
Waterton N.P.,
Cypress Hills P.P.,
Elk Island N.P.,
Blackfoot-Cooking Lk Rec. Area

42,662 km² or 16,472 mi²

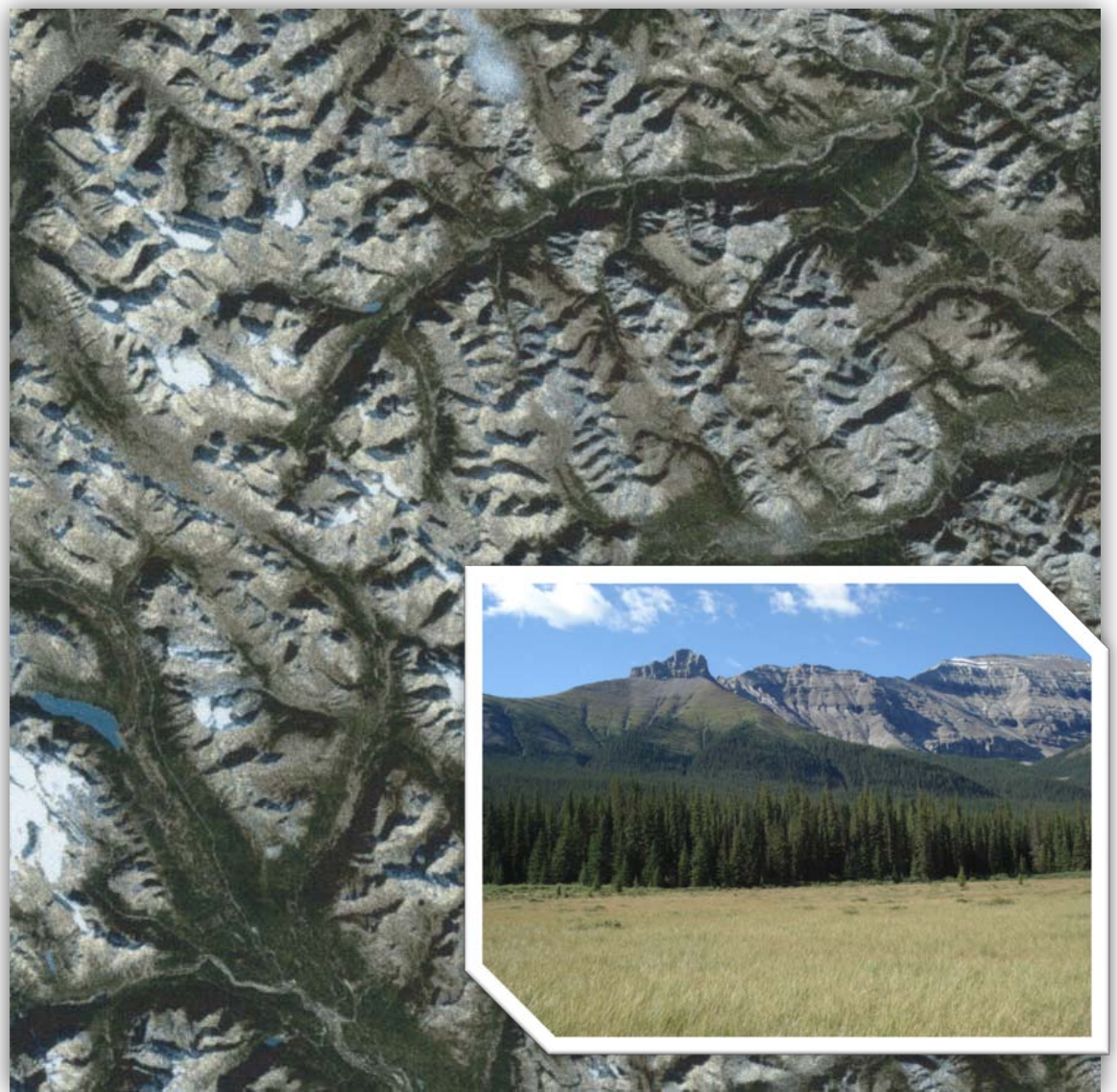
15 Severe Fire Seasons since 1840's

1. 1843 – 45
2. 1848 – 50
3. 1863 – 64
4. 1867 – 68
5. 1869 – 70
6. 1875 – 77
7. 1885
8. 1888 – 89
9. 1894 – 96
10. 1909 – 10
11. 1913 - 15
12. 1917 - 19
13. 1924 – 25
14. 1927 – 29
15. 1934 - 36

2003 Verendrye Fire, Kootenay N.P.

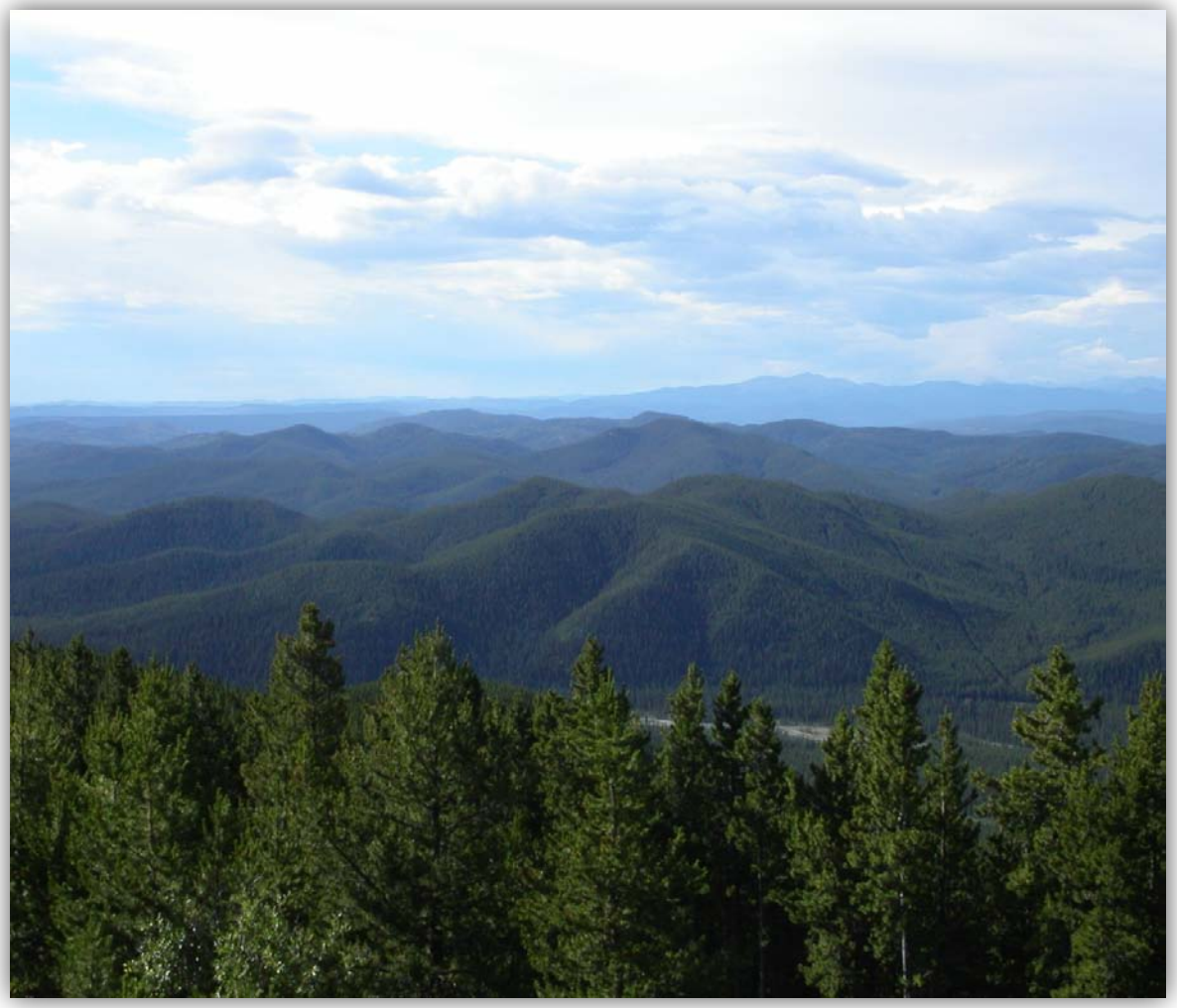
Mountain Subalpine Landscape

- High intensity -stand replacement
- High severity
- Mean fire size remains small:
  < 1000ha
- Max. size: up to 10,000 ha
- Long intervals
- Fire cycle > 100yrs
- Effect of topography on fire distribution and spread pattern is significant

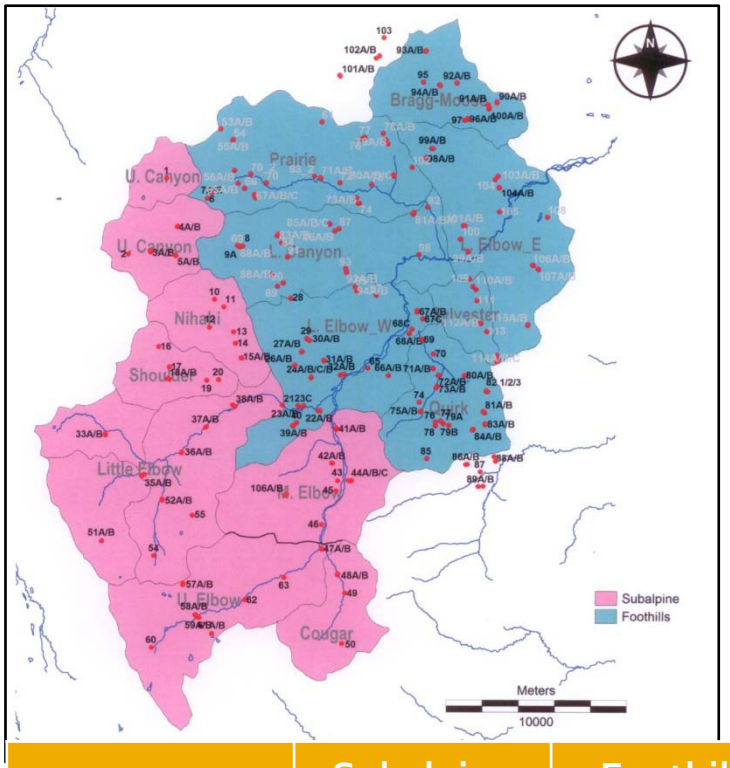


Foothills / Montane Landscape

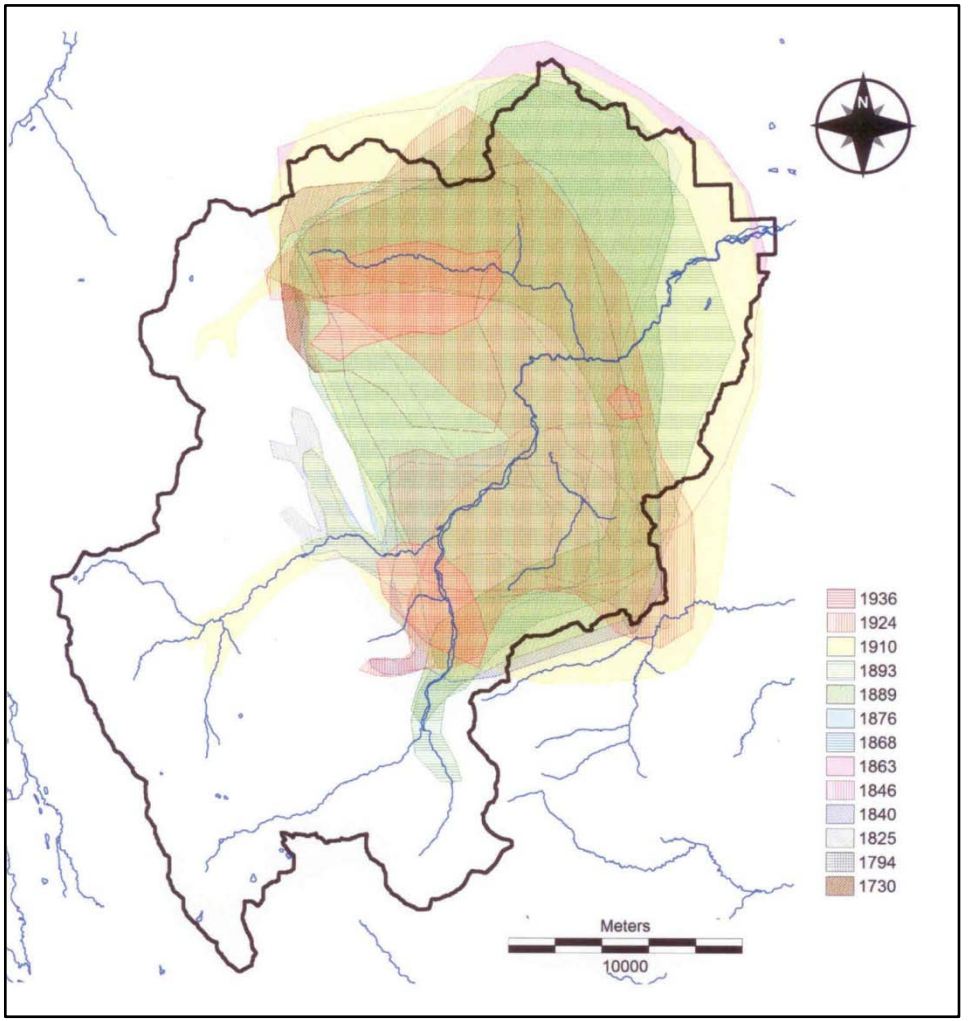
- Mixed intensities partial to full stand replacement
- Mixed severity
- Mean fire size: ~ 1400ha
- Max. size: 20,000 to 50,000 ha
- Short intervals
- Fire cycle: 30 – 50 yrs
- Effect of topography on fire distribution and spread pattern not as marked as subalpine



Elbow Watershed Fire Distribution



	Subalpine	Foothills
MFRI	58 – 133	29 – 70
Max fires/site	4 – 6	4 – 8
Avg TSF	141 – 373	118 – 168
Max age	365 - 635	147 - 360



Today's Fire Regime

	Alpine	Subalpine	Montane	U. Foothills	L. Foothills	Parkland
% occurrence (N)	1	12	44	27	14	2
% lightning	45	25	9	58	15	13
% anthropogenic	55	75	91	42	85	88
Burning season	July-Aug.	July-Sept.	May-Sept.	May-Oct.	May-Oct	April-Oct.
Fire size	<1 ha: 91.5% of fires, <10ha: 98%					
Fire cycle	1457yrs, 395ha/yr or 0.07% of forested area					

Source: SRD fire occurrence reports 1961 - 2003

Fire Cause
Lightning Strike Shadow

- Not a perfect linear correlation between lightning fire ignitions and lightning strike density.

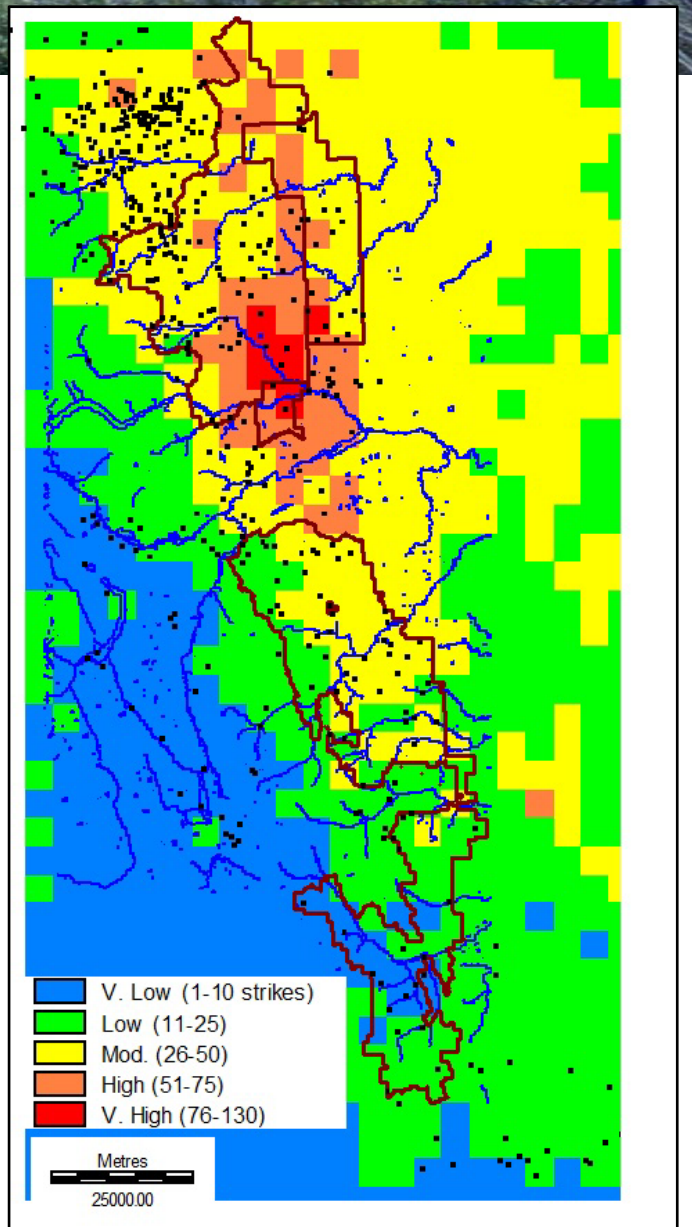
-Lightning fires are not randomly distributed.

- Areas of high ignitions correspond with strike density zones that are mod. to very high.

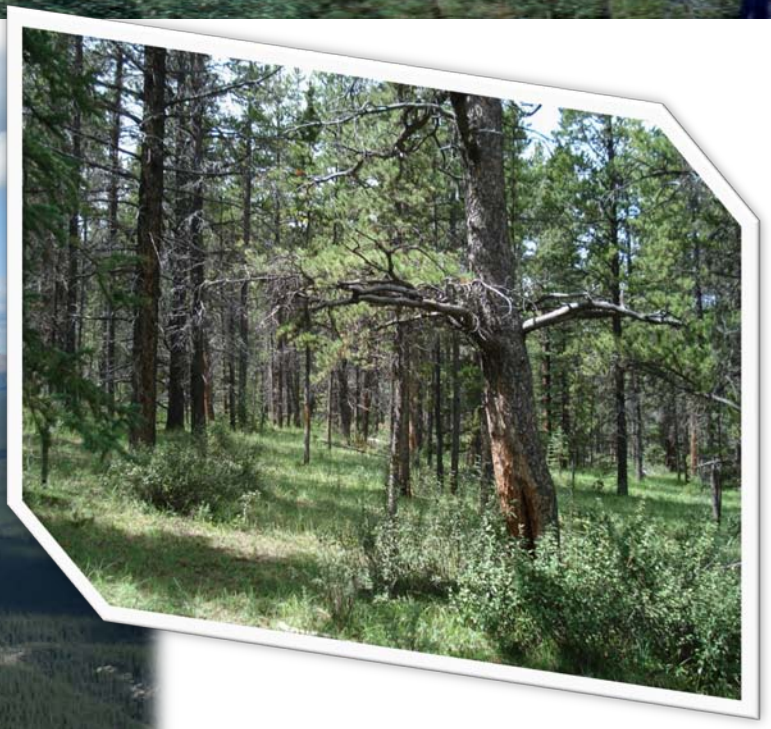
- Lightning ignitions decrease with higher elevations

-Lead tree sp.: Sb&Sw more ignitions followed by Pl and At

-Aspect: no sizable differences but 3 groups of aspects emerged: S and flat (most ignitions), N and E dominant aspects, and W aspects



Fire Cause:
Traditional burning



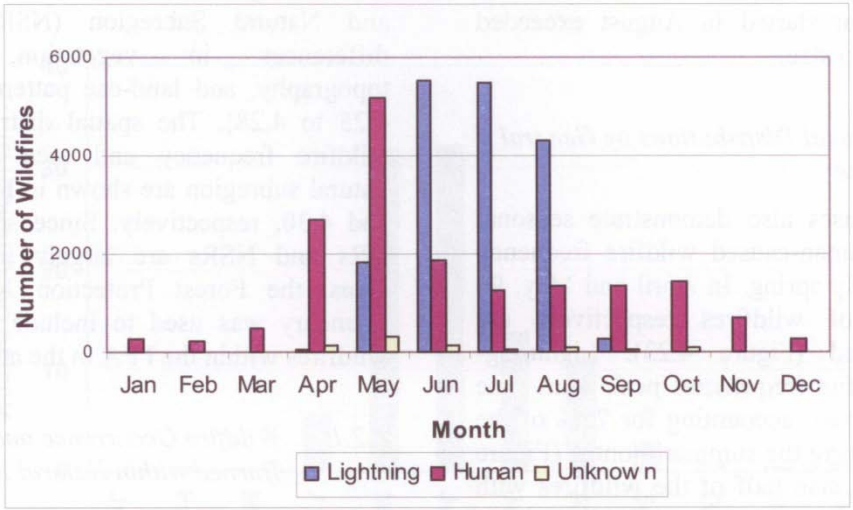
Clearwater River east of Banff N.P.

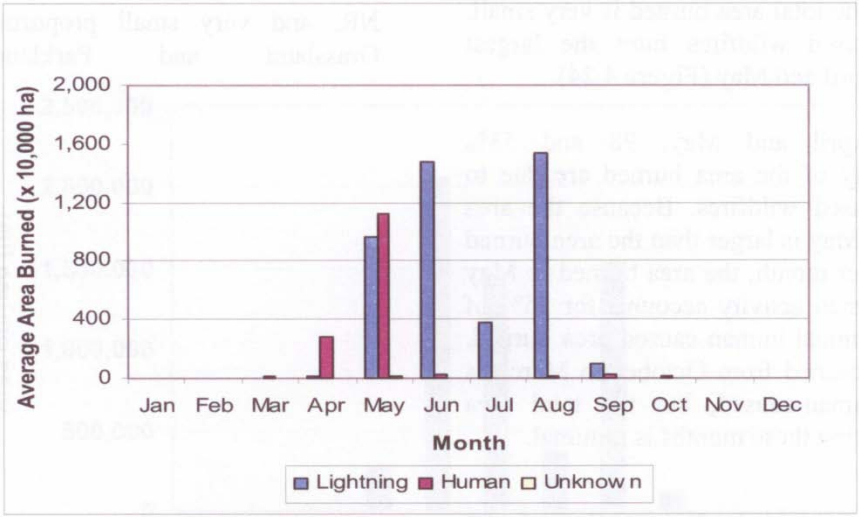
11+ fires

1905, 1892, 1875, 1856, 1804, 1820, 1795, 1778, 1768, 1765, 1725

Seasonal Distribution

Source: Tymstra et al. 2005



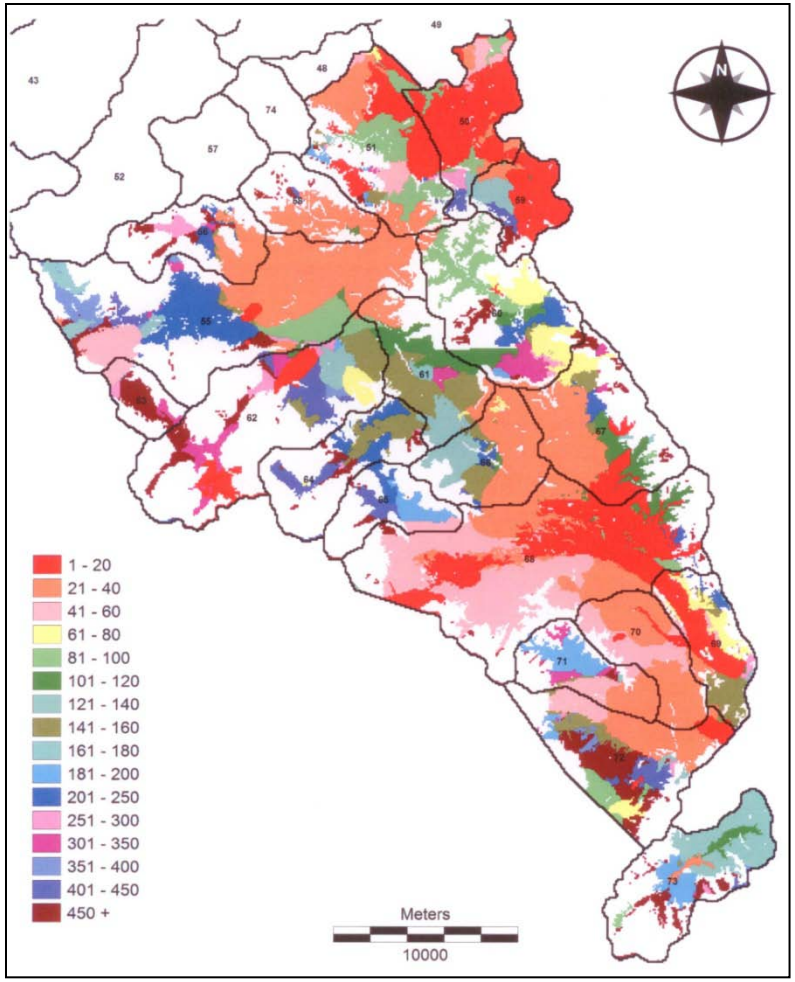


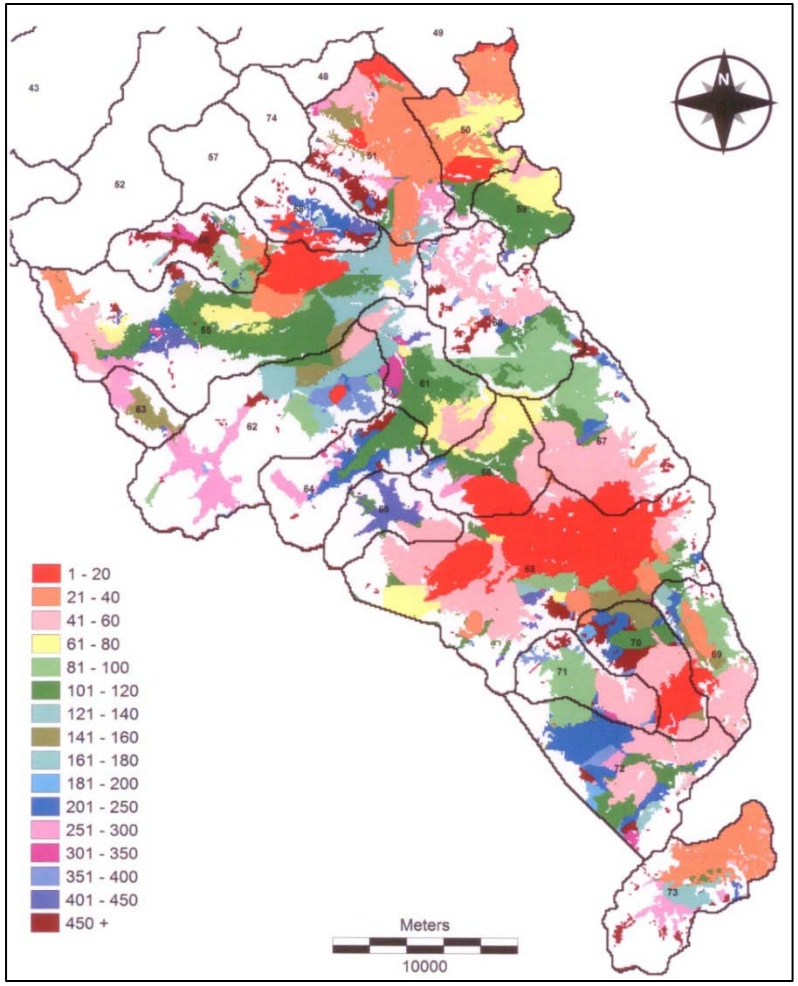
Over 75% of fire scarring occurred during the dormant, very early or late growing season

Fire Regime Simulations

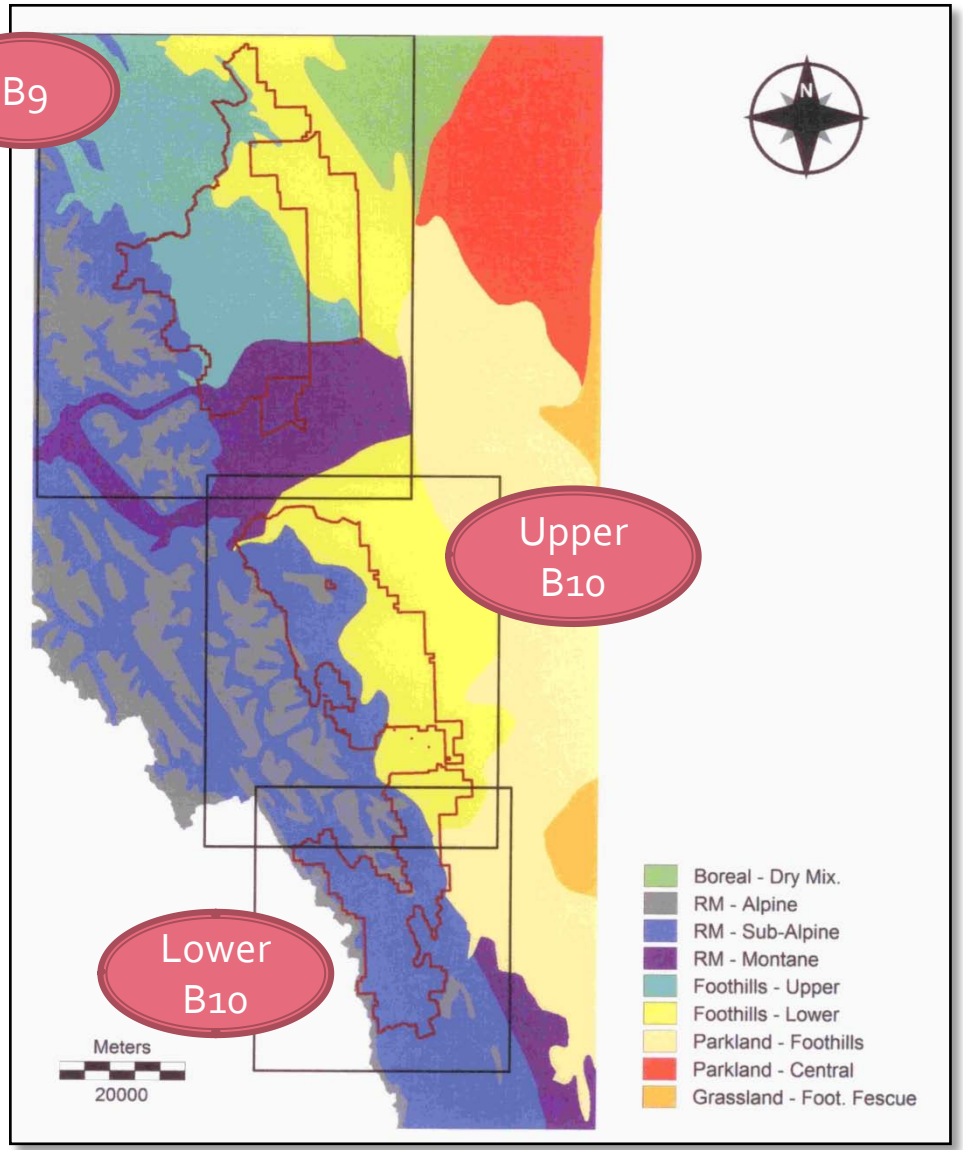
- Program STANDOR: recreates the historical fire regime using empirical data
  - Produces stand origin and fire frequency (MFRI) maps
  - Keeps track of individual burn areas before being overlapped by subsequent fires
  - Process that allows for the calculation of the fire cycle
- Advantages:
  - More than a sample of one
  - Natural range of variation of fire distribution and age-class distributions

Example of simulation output



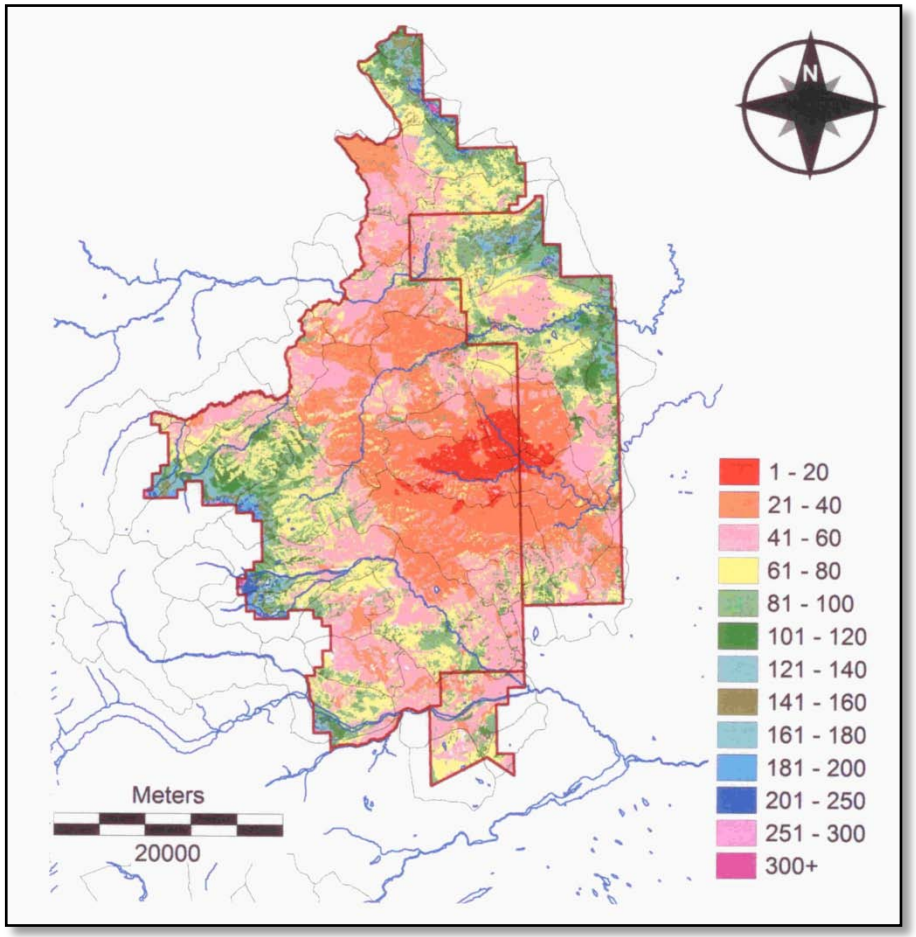


Modelling Regions

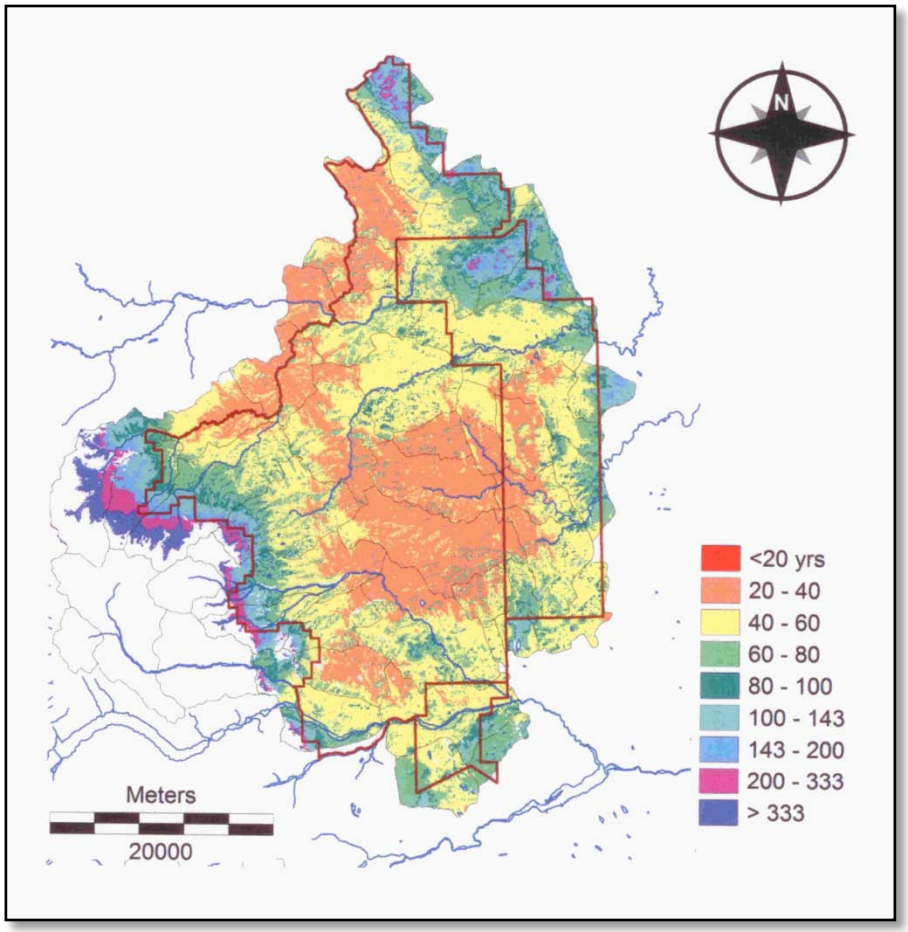


B9 FMU Spatial Results

Mean stand origin

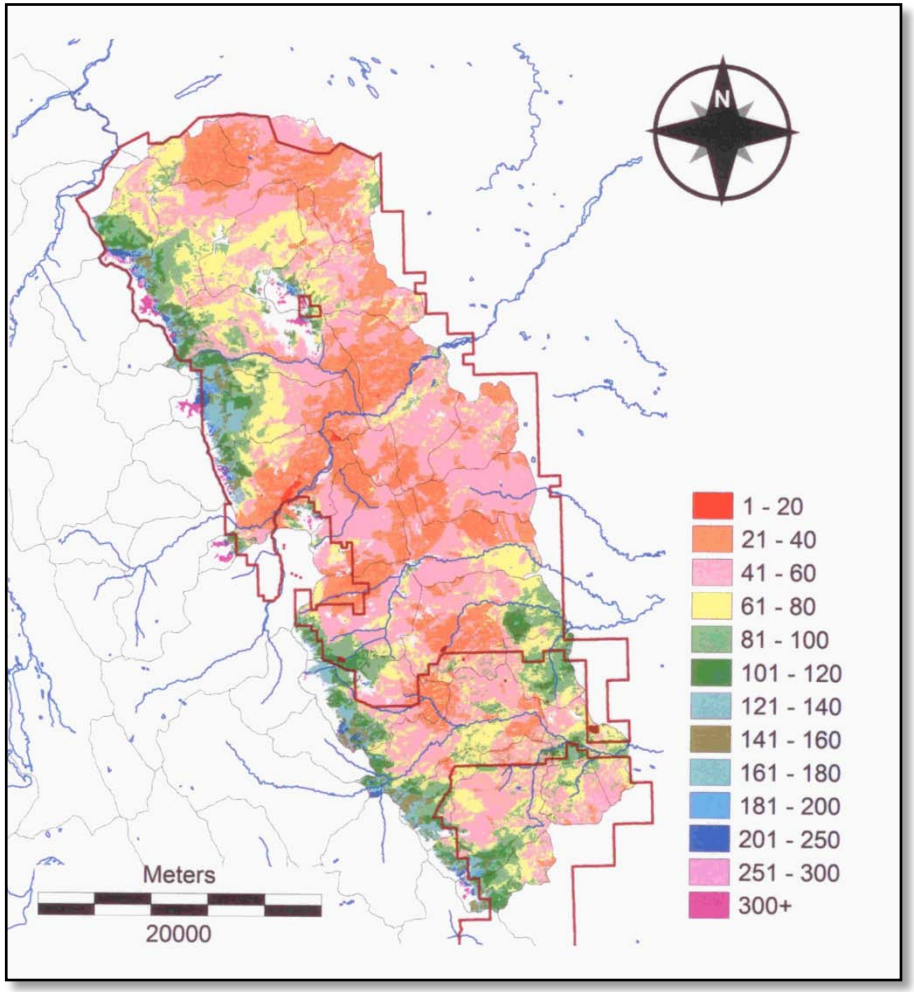


MFRI

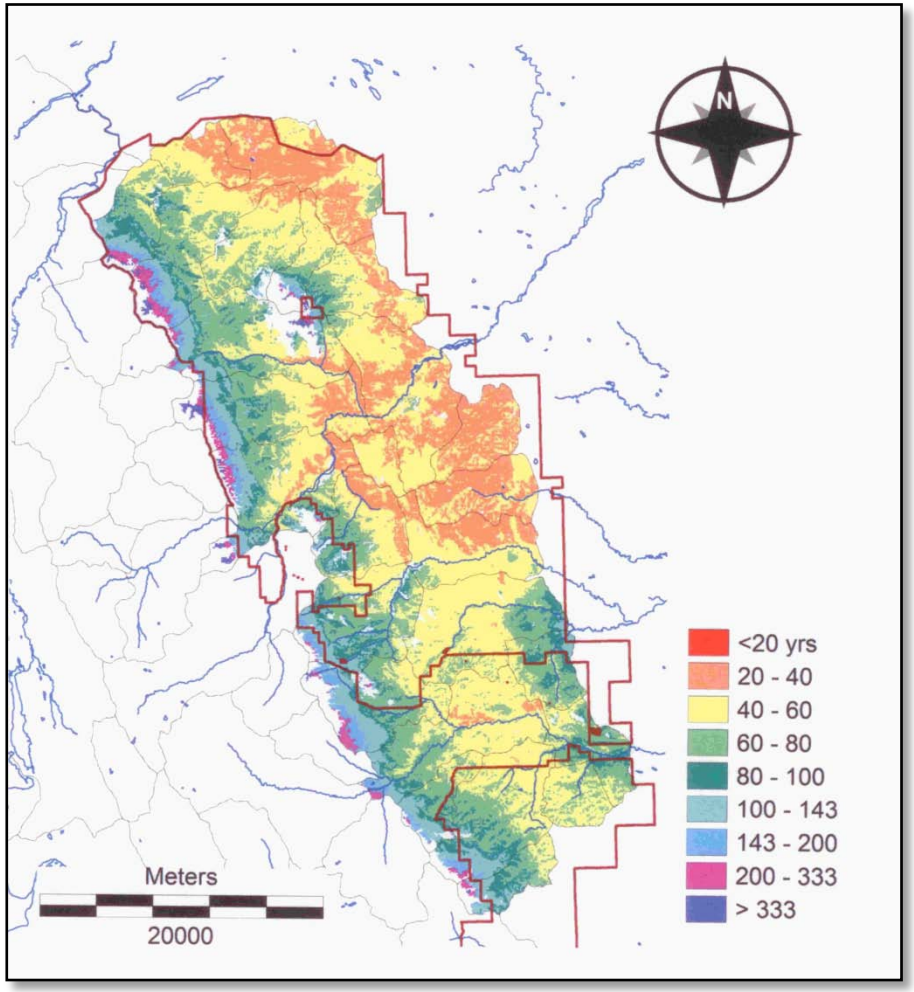


Upper B10 FMU Spatial Results

Mean stand origin

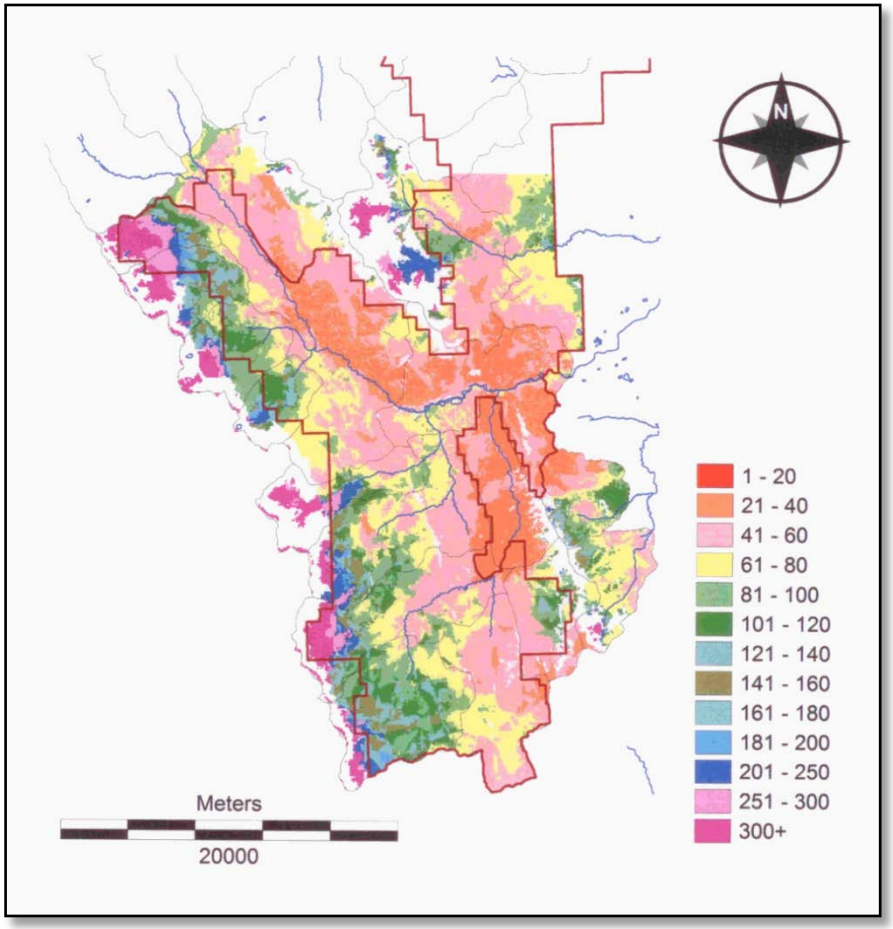


MFRI

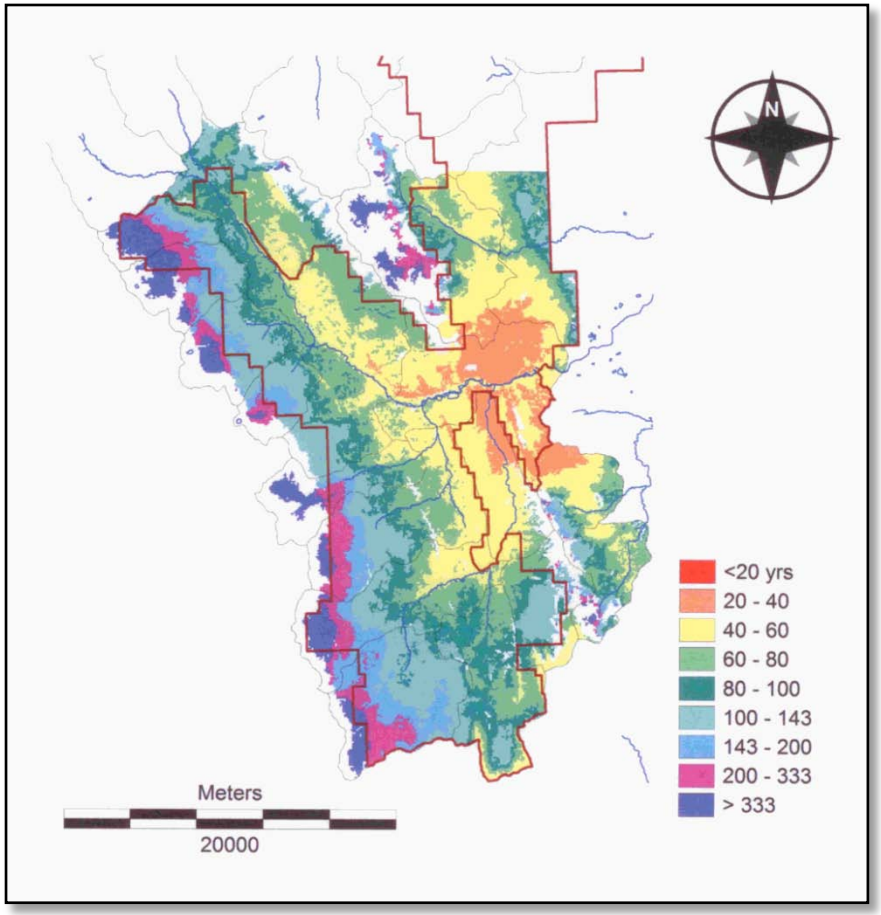


Lower B10 FMU Spatial Results

Mean stand origin



MFRI



Management Guidelines
Spatial Distribution

- Harvesting to be focused on areas with a MFRI < 60yrs
  - Today these forests are 100 to 140 yrs old
- Protect fire refugias. These are zones that have the ability to naturally escape fire for a long period of time and tend to have unique ecological values
  - Use 2 to 5% of the old age tail of the PIC stand origin age-class distribution to determine threshold values

Management Guidelines
Annual Disturbance Rate

- It would be unsustainable and unrealistic for SLS to harvest at the same rate and frequency as PIC disturbances.

B9 FMU

Fire cycle	Annual rate	Ha / yr
40	2.5%	1,143
60	1.7%	1,289
80	1.3%	346
100	1%	96
Total		2,874 (29km2)

Management Guidelines
Disturbance Size

- PIC disturbances
  - B9: 79%, U. B10: 65%, L. B10: 68% > 100 ha in size
  - Bulk of disturbances: 11 to 5000 ha

Management Guidelines
Disturbance Size

- Harvesting strategies
  - Build on the same cutblock over a number of years
  - Leave a patchwork of island remnants based on topographic features and knowledge of fire behaviour
  - Maintain connectivity and protective cover of wildlife corridors
  - Ensure connection points with riparian protection buffers
  - Reduce number of access roads
  - Target one watershed at a time to limit interference on wildlife and alleviate pressure on other areas

Management Guidelines
Seral ages

- As a result of short MFRI and fire cycles, PIC seral age distributions have the bulk of their age group at less than 80 years of age.
- Harvesting would need to focus largely on stands that are less than 160 years old (today) due to the flat aging of the forest for 80 years.
- Maintaining a similar seral age distribution as PIC is not sustainable
- Special attention is required of forest stands that fall within the old age tail of the seral distributions. These stands are not abundant in the Upper Foothills and Montane and have ecological value. These are mainly the small spruce patch remnants found in small draws and depressions.