Historic Fire Regime Reconstructions in the Western Canadian Cordillera

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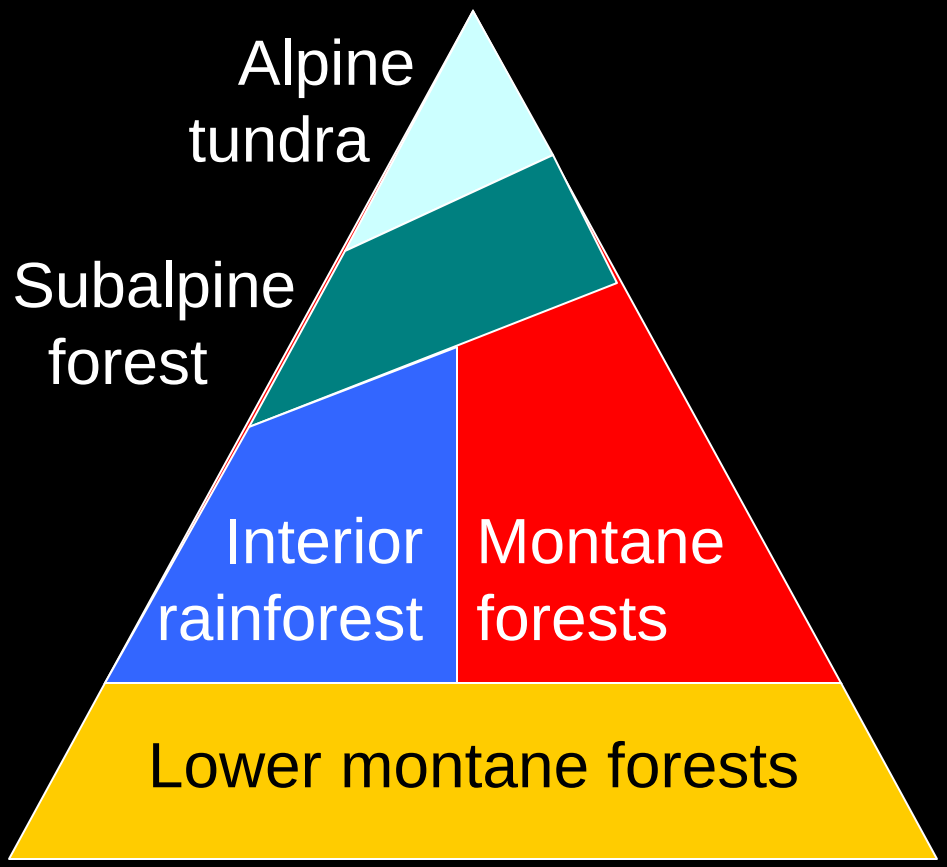
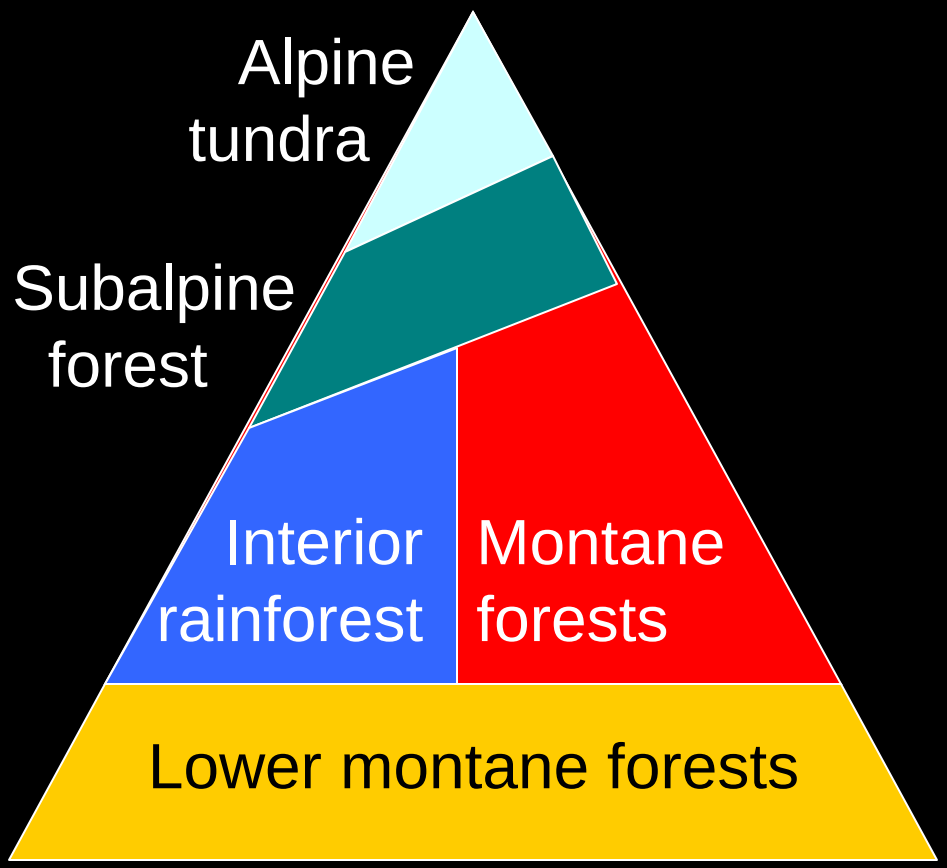
Wildland Fire Canada

October 2014

Classification of Mountain Ecosystems in British Columbia



Fire Regimes in the Mountains of BC

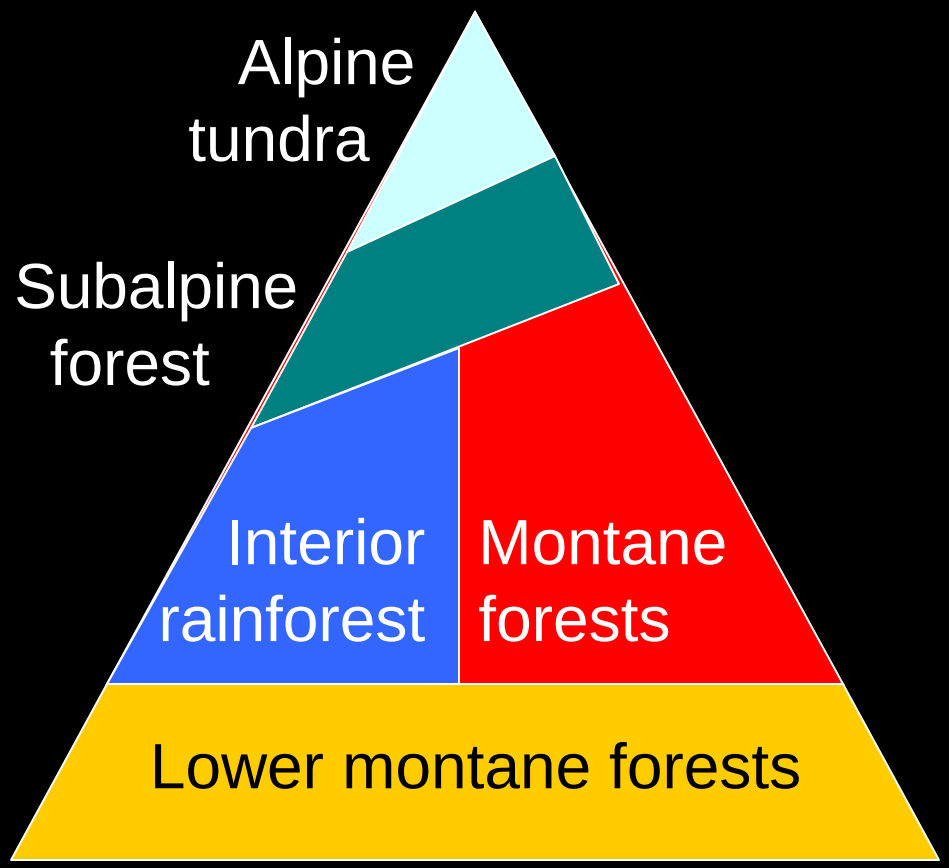


Fire Regimes:

High severity
Intervals: ≥100 years

Low severity
Intervals: <50 years
(Infrequent high severity)

“Ecosystem-Based Management” in BC

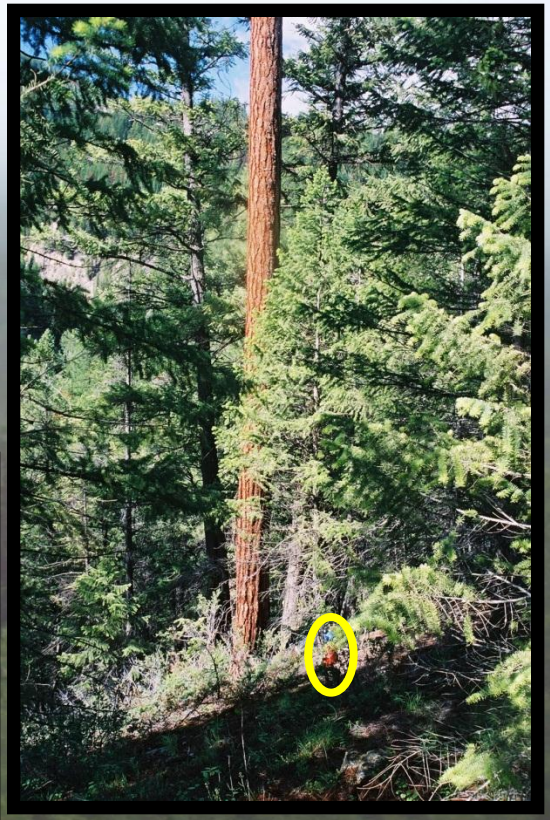


Stand-Replacing Fire Regime:

Even-aged silviculture
Rotations of 100+ yrs
Old-growth forests
Fire suppression

Mid-Elevation Forests:

- Complex, mixed-species
- Large, old veteran trees
- Abundant fire scars



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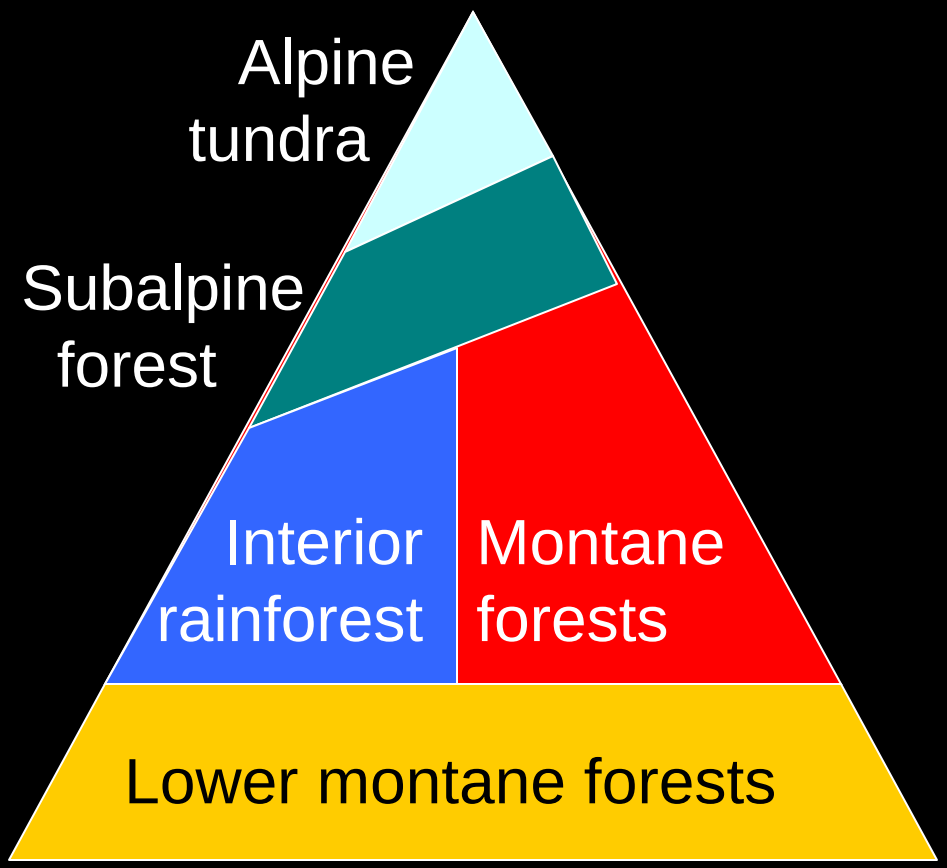


Stand-Replacing Fire Regime:

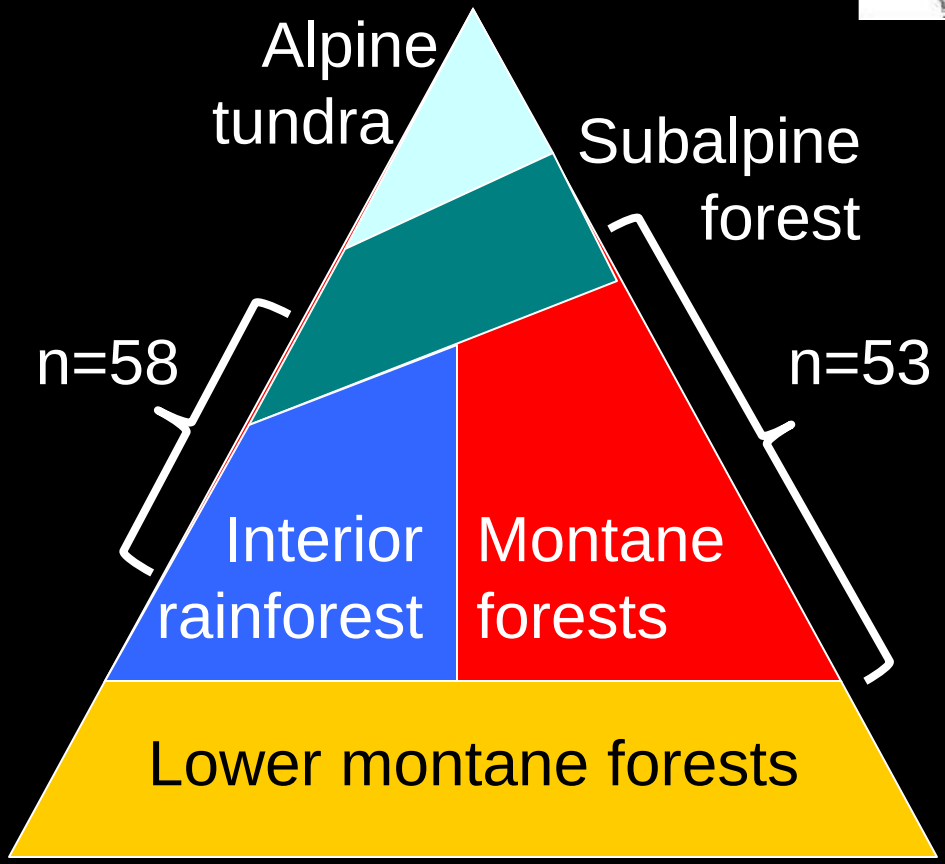
Even-aged silviculture
Rotations of 100+ yrs
Old-growth forests
Fire suppression

What if we have misinterpreted the fire regime?

Research Questions

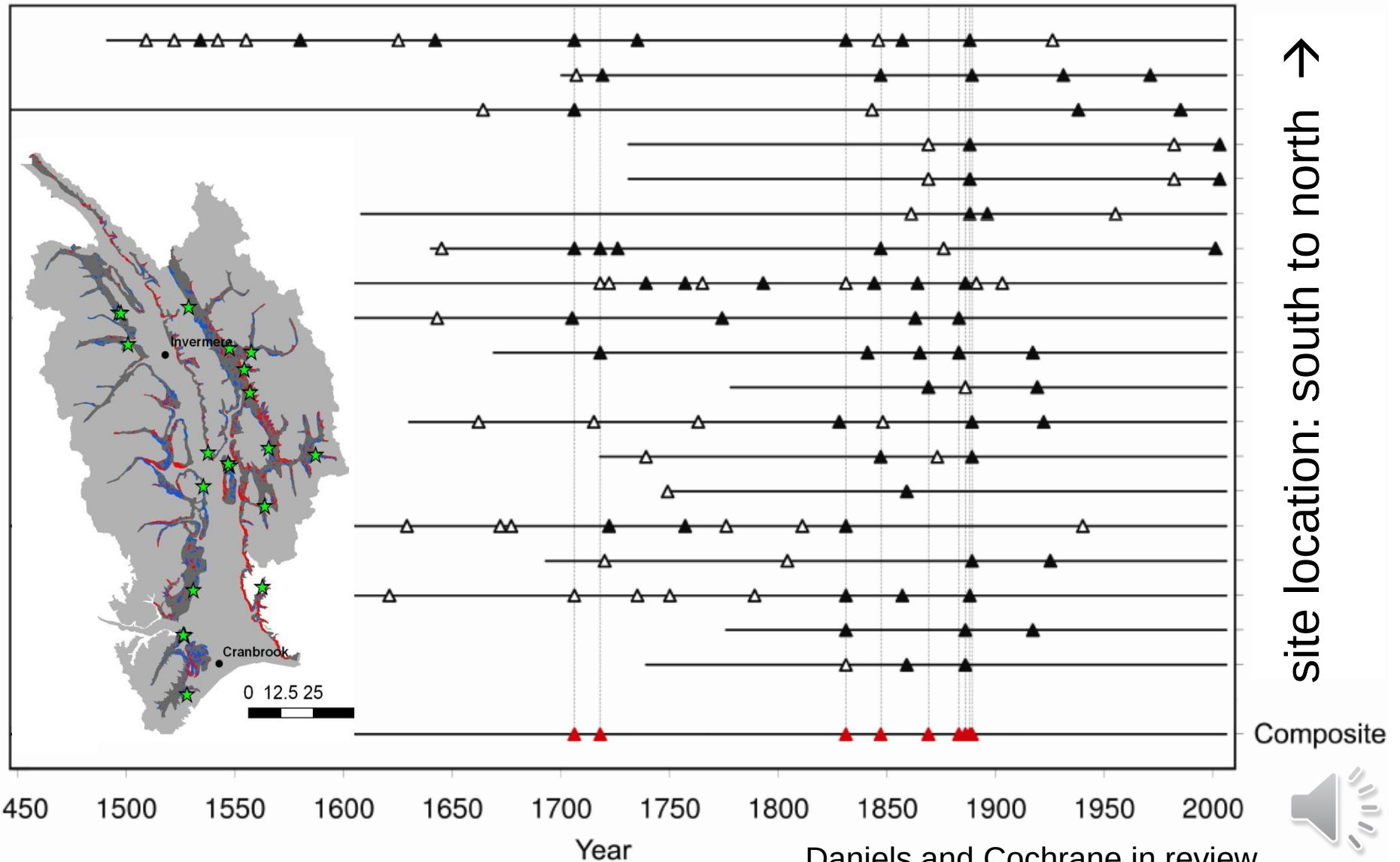
- How do fire regimes vary in the mountain ecosystems of British Columbia?
- Have humans altered fire regimes?
- How does climate affect fire regimes?

Study Areas



Cochrane 2007, DeSliva 2009, Nesbitt 2010, Greene 2011, Marcoux 2013

Pervasive Low-Moderate Severity Fires
Montane Forests, East Kootenays



Daniels and Cochrane in review

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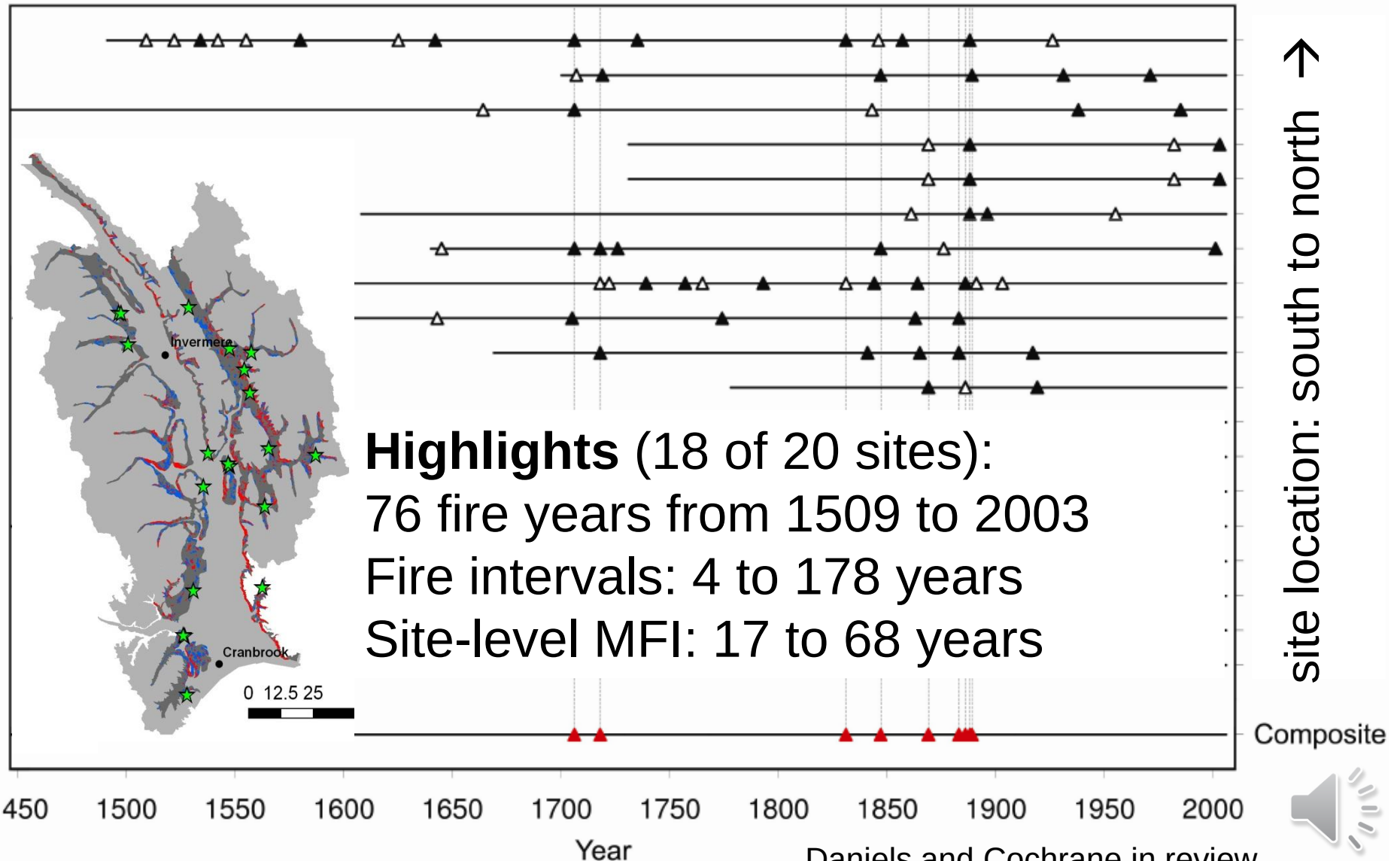
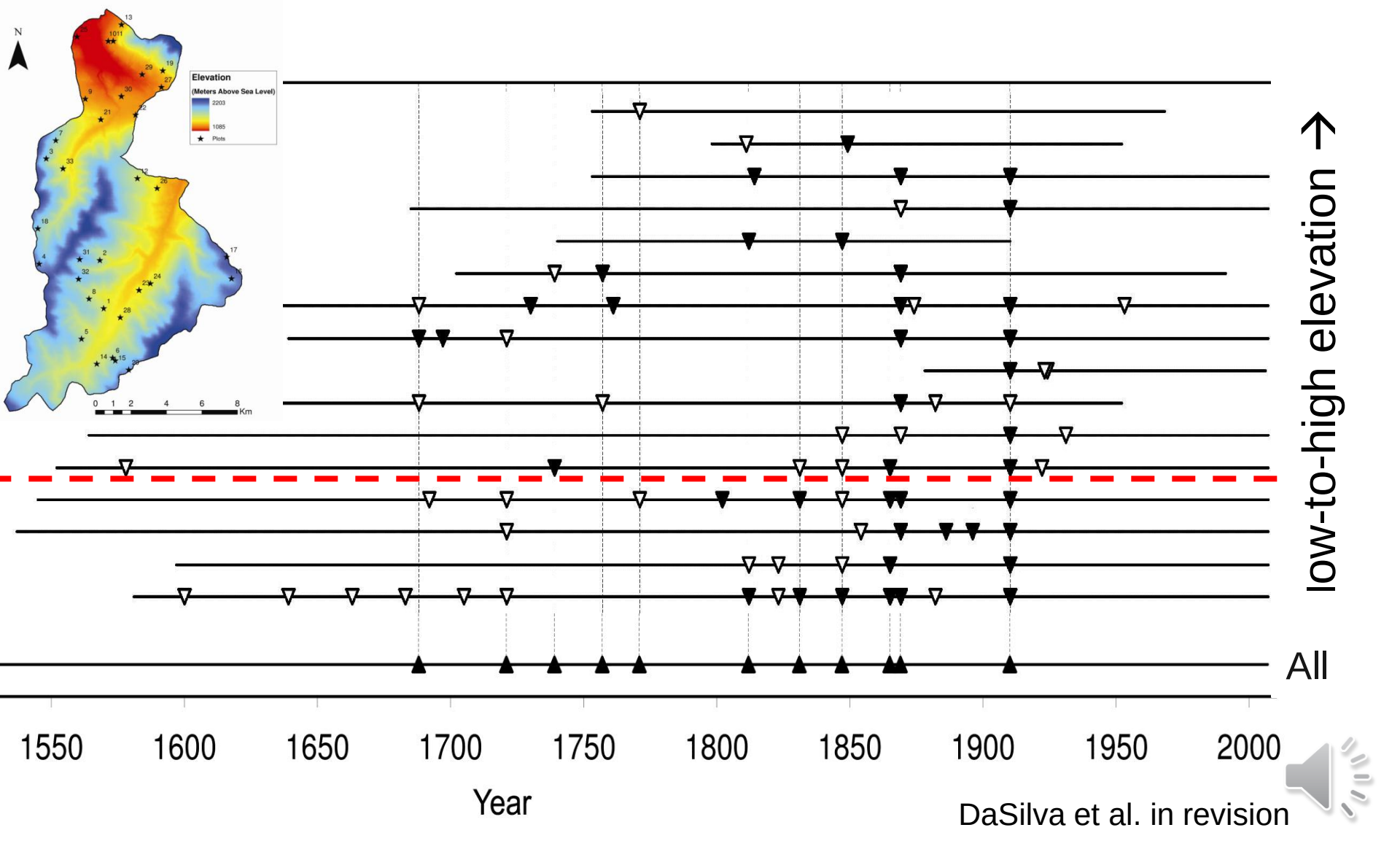


Highlights (18 of 20 sites):
76 fire years from 1509 to 2003
Fire intervals: 4 to 178 years
Site-level MFI: 17 to 68 years

Daniels and Cochrane in review

Low-Moderate Severity Fire Across Elevations

Cranbrook, East Kootenays



DaSilva et al. in revision

Low-Moderate Severity Fire Across Elevations

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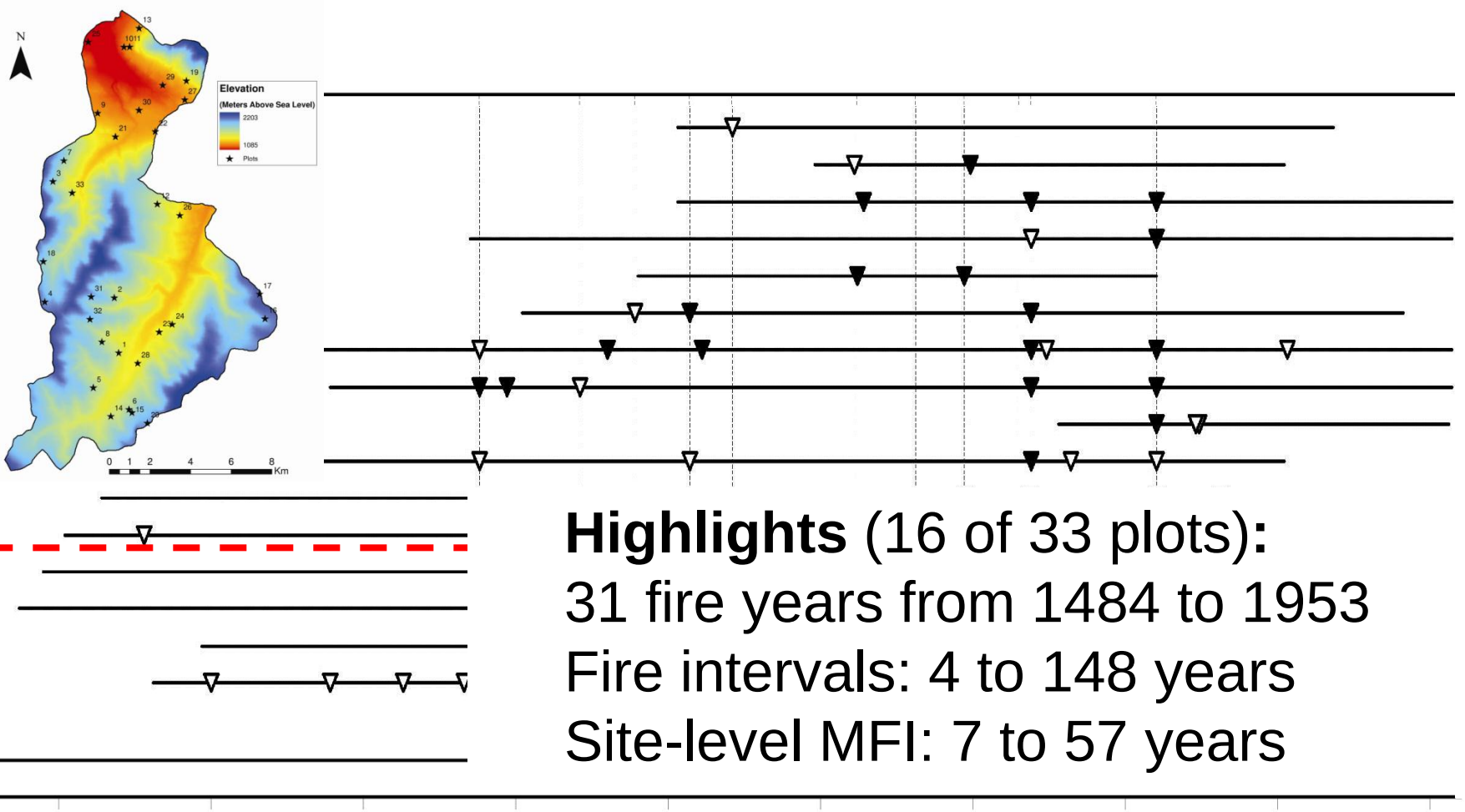


Highlights (16 of 33 plots)**:**

31 fire years from 1484 to 1953

Fire intervals: 4 to 148 years

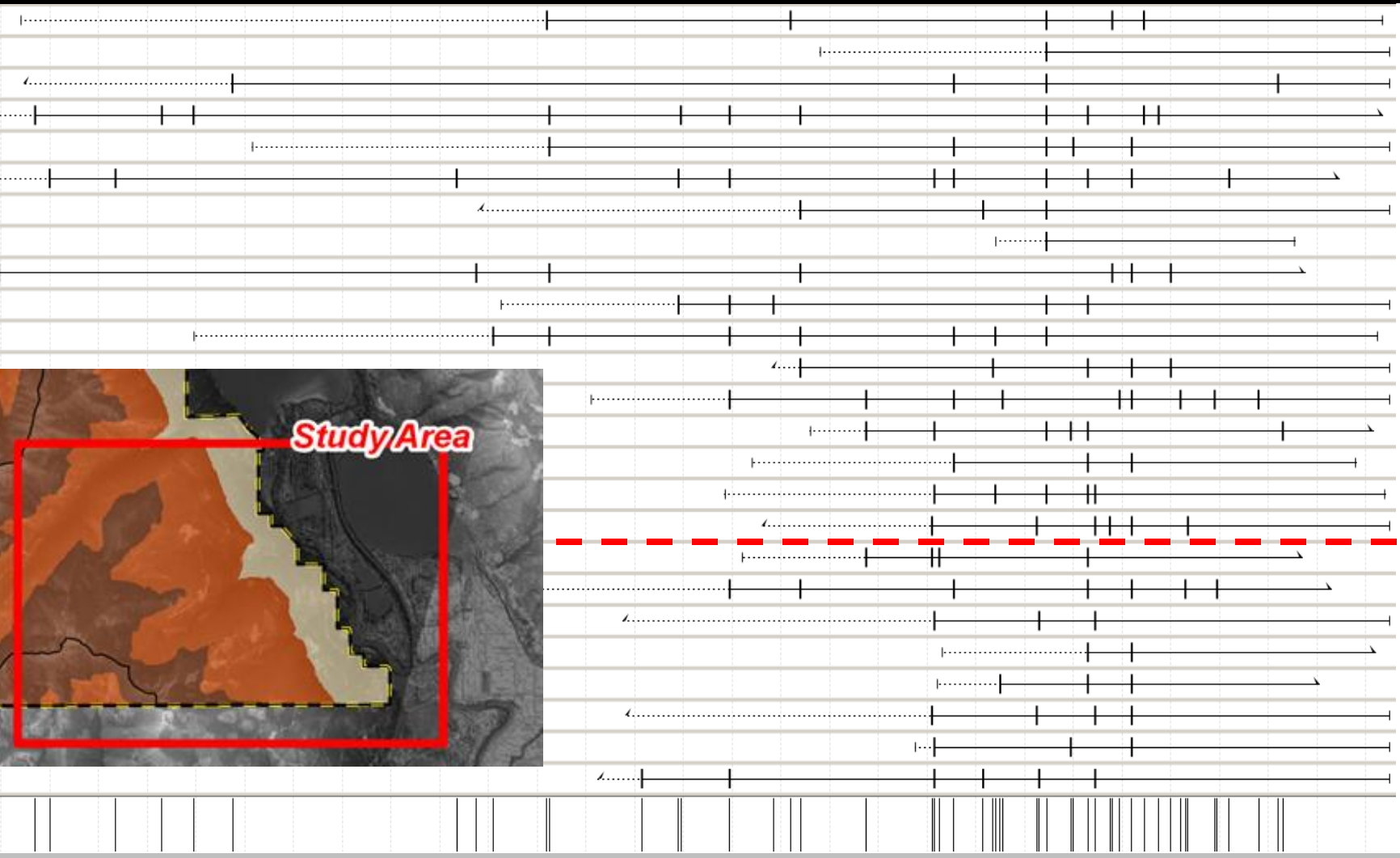
Site-level MFI: 7 to 57 years

DaSilva et al. in revision

Low-Moderate Severity Fire Across Elevations

Darkwoods near Creston, West Kootenays

(Greene 2011, Greene and Daniels *in prep*.)



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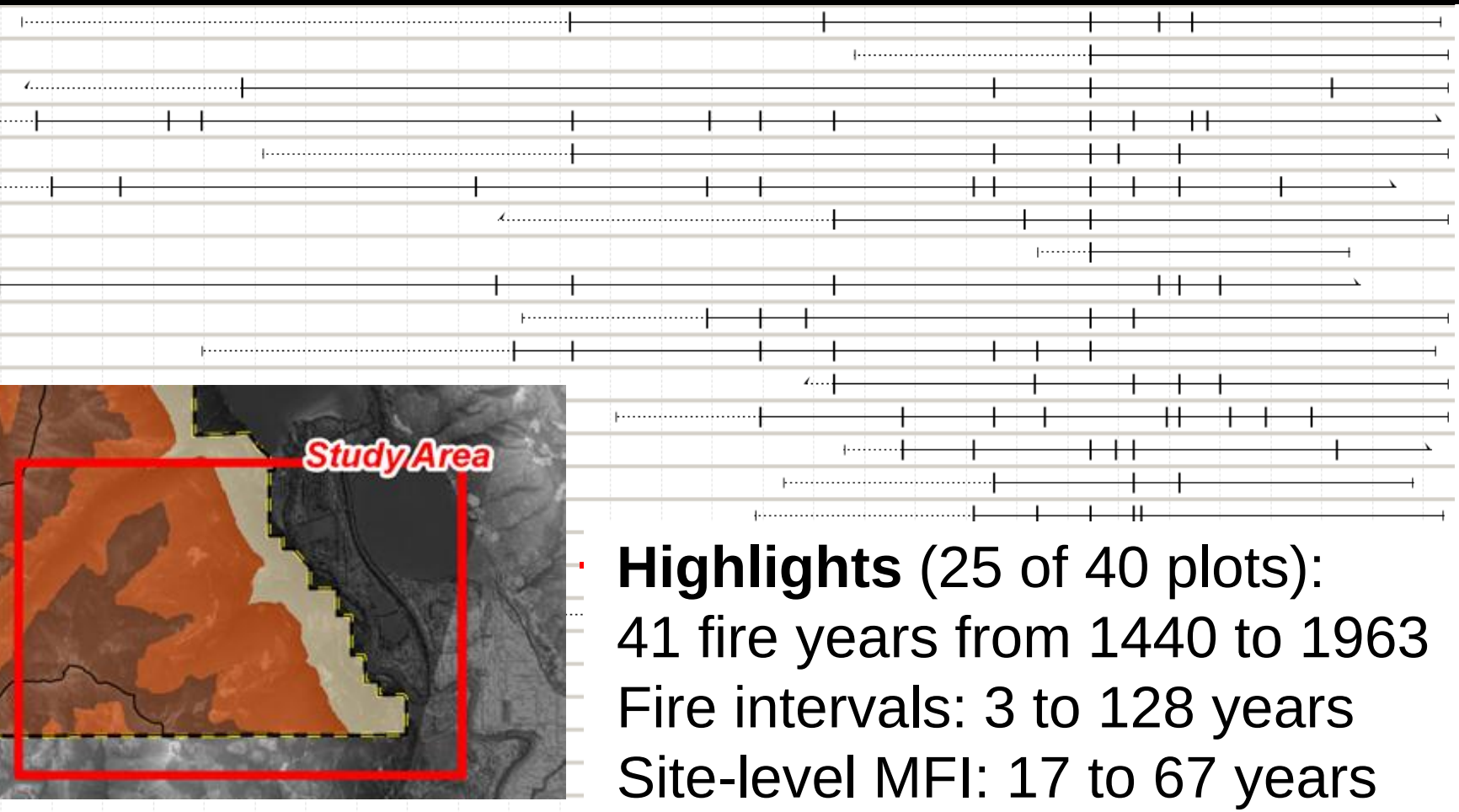


low-to-high elevation →

Highlights (25 of 40 plots):

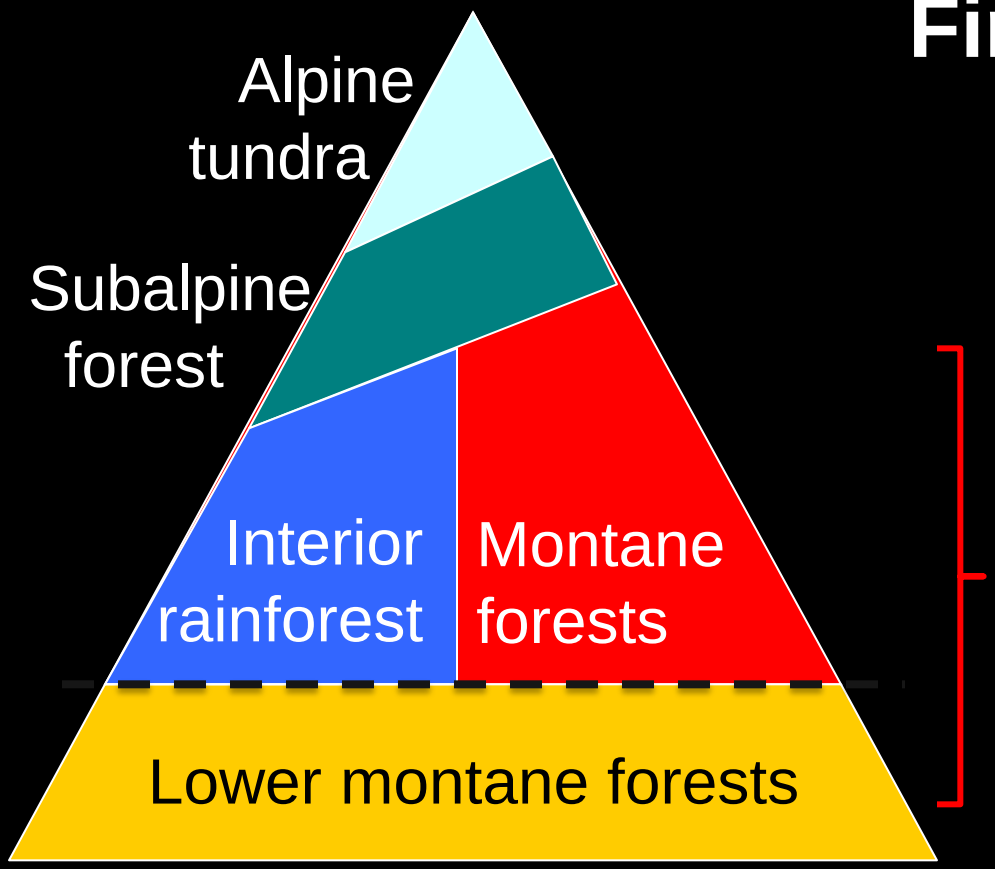
41 fire years from 1440 to 1963

Fire intervals: 3 to 128 years

Site-level MFI: 17 to 67 years

1500 1600 1700 1800 1900 2000

Fire Regimes in the Mountains of BC



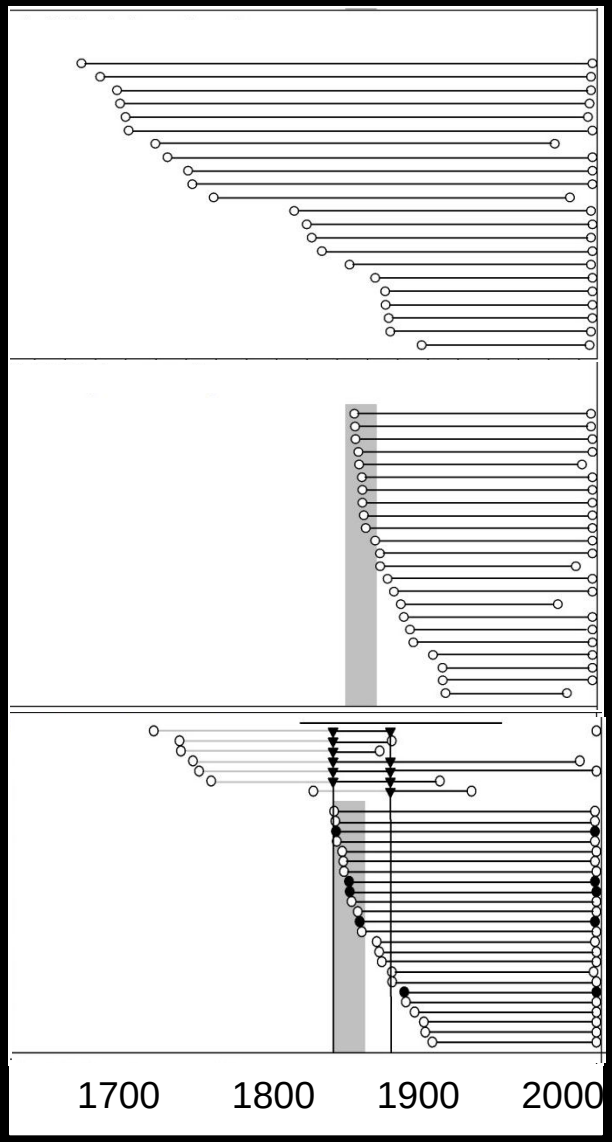
Fire regimes:

Low-moderate severity
Intervals: 5-70 yrs

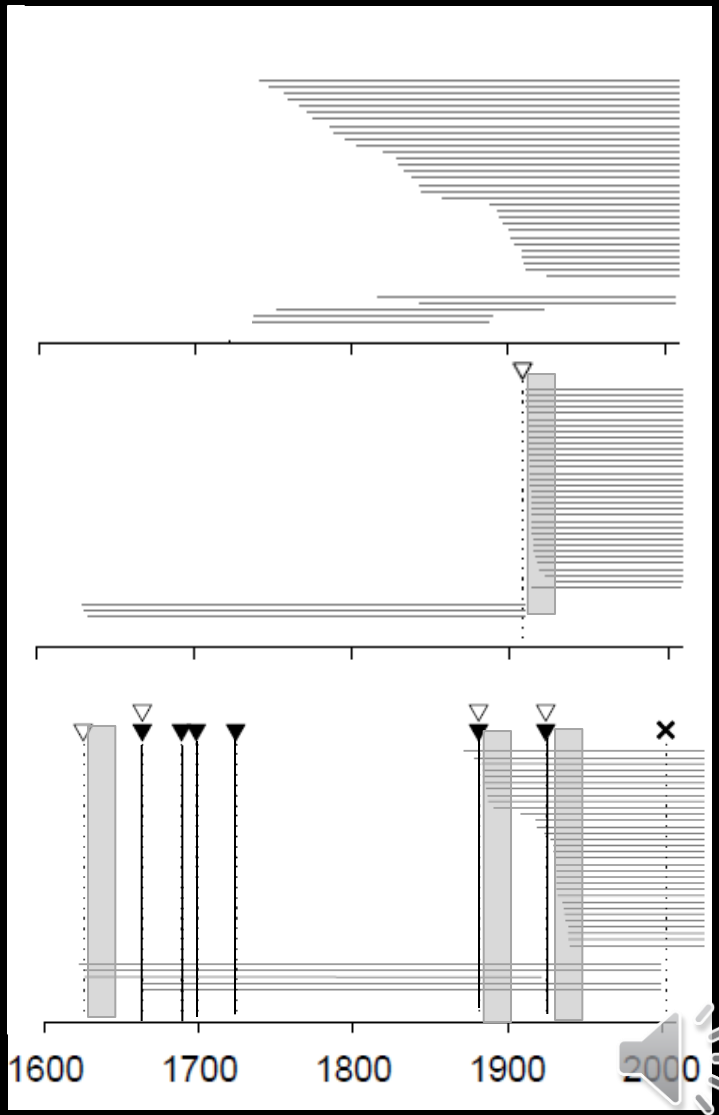
Marcoux, Gergel and Daniels 2013, *Canadian Journal of Forest Research*

Fire Regimes in the Mountains of BC

West Kootenays (n=18)



East Kootenays (n=20)



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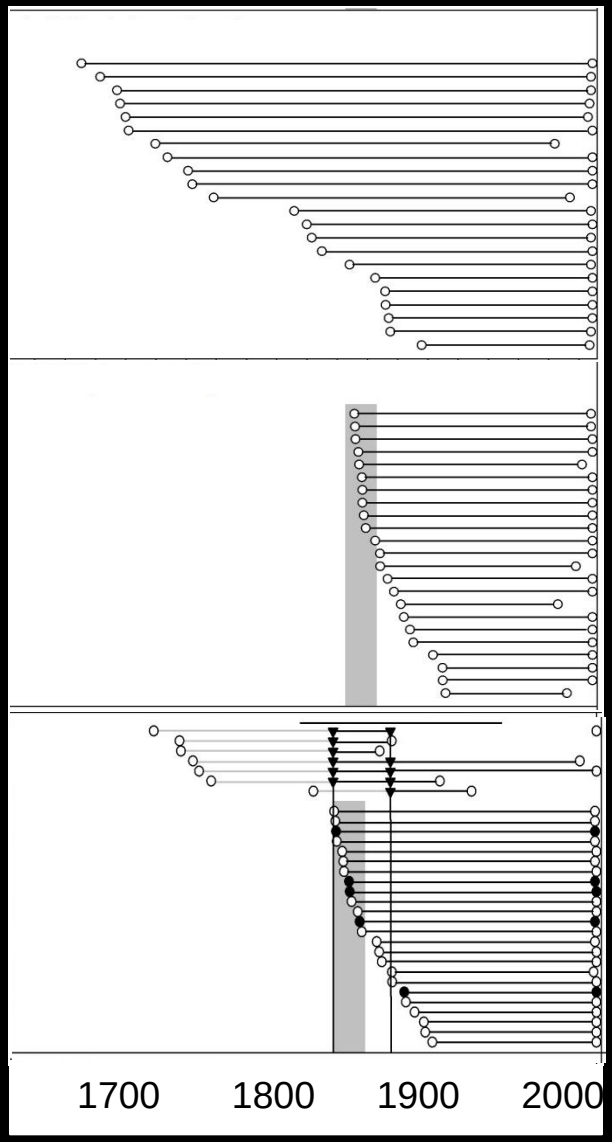
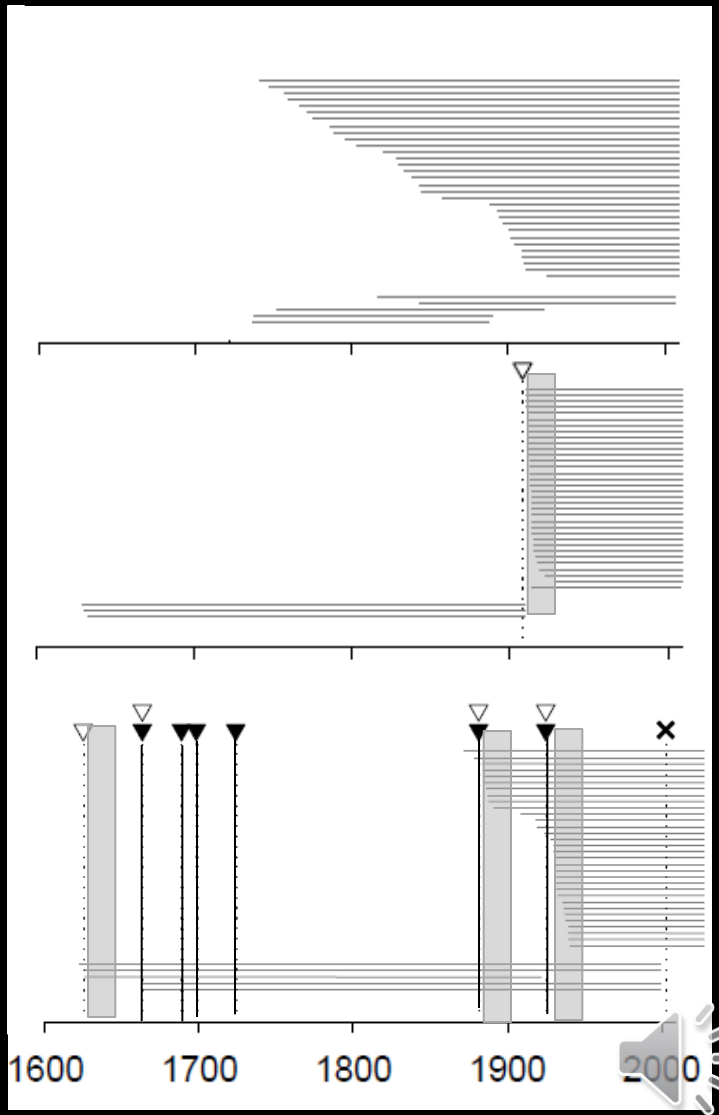


Mixed-severity
= fire scars
+ cohorts

55% **55%**

East Kootenays (n = 20)



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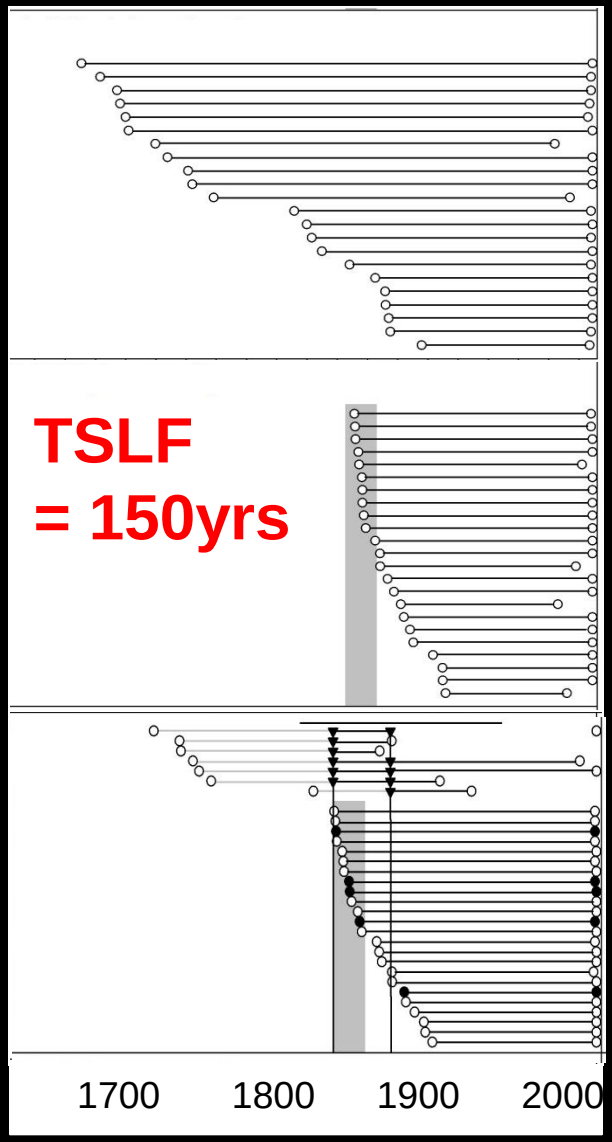


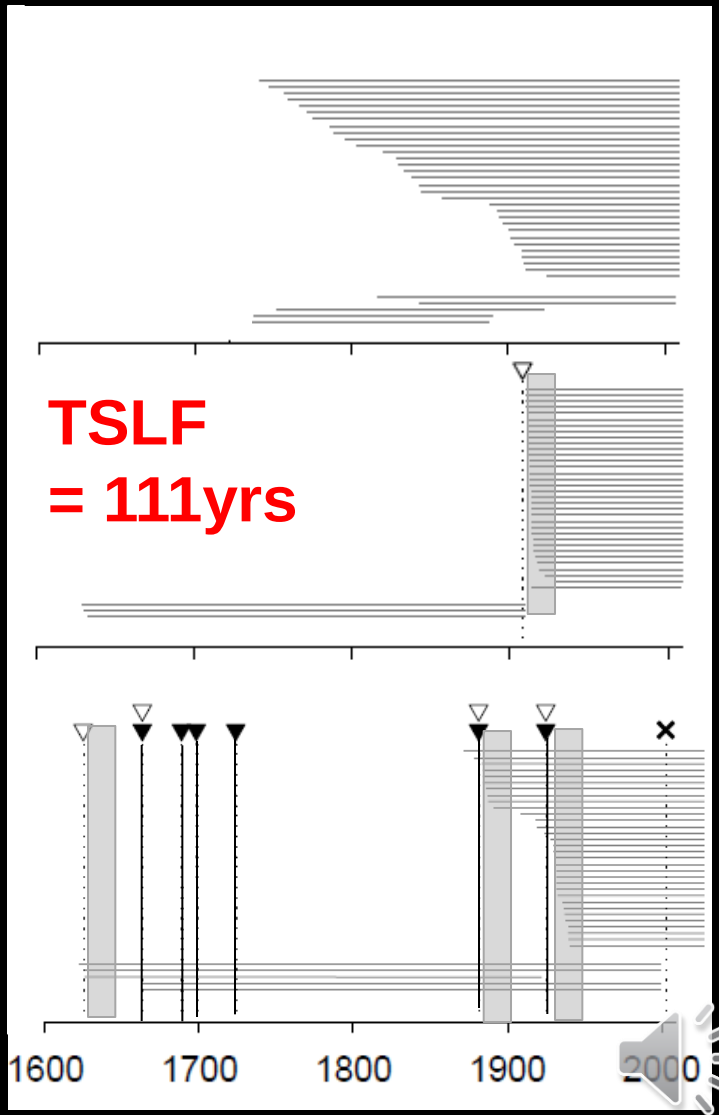
High-severity
= post-fire
cohort

28% 20%

Mixed-severity
= fire scars
+ cohorts

55% 55%

East Kootenays (n = 20)



Fire Regimes in the Mountains of BC

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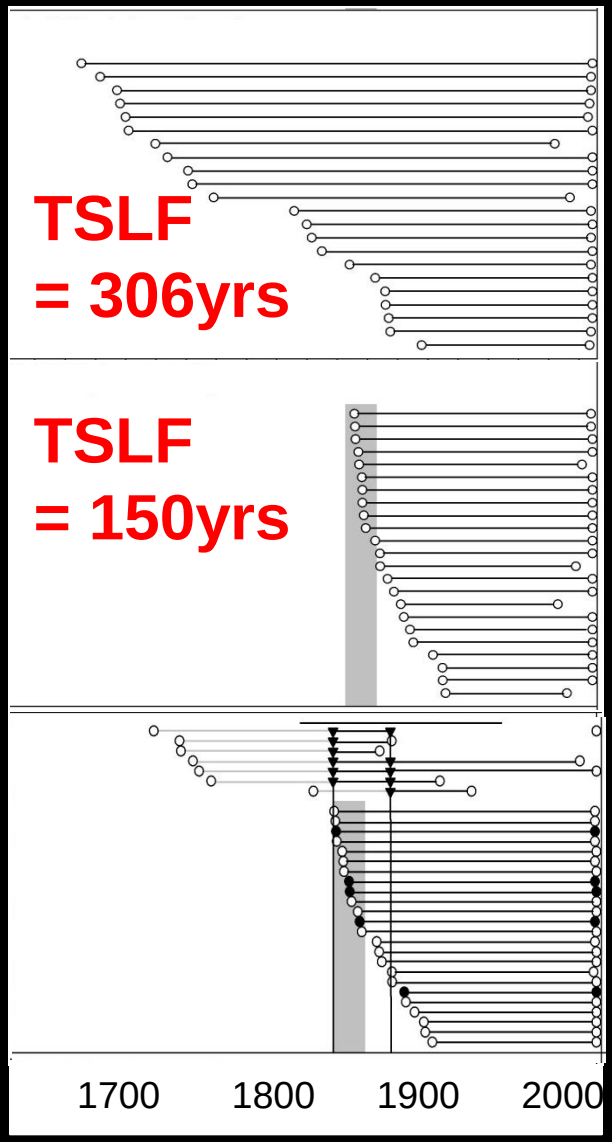
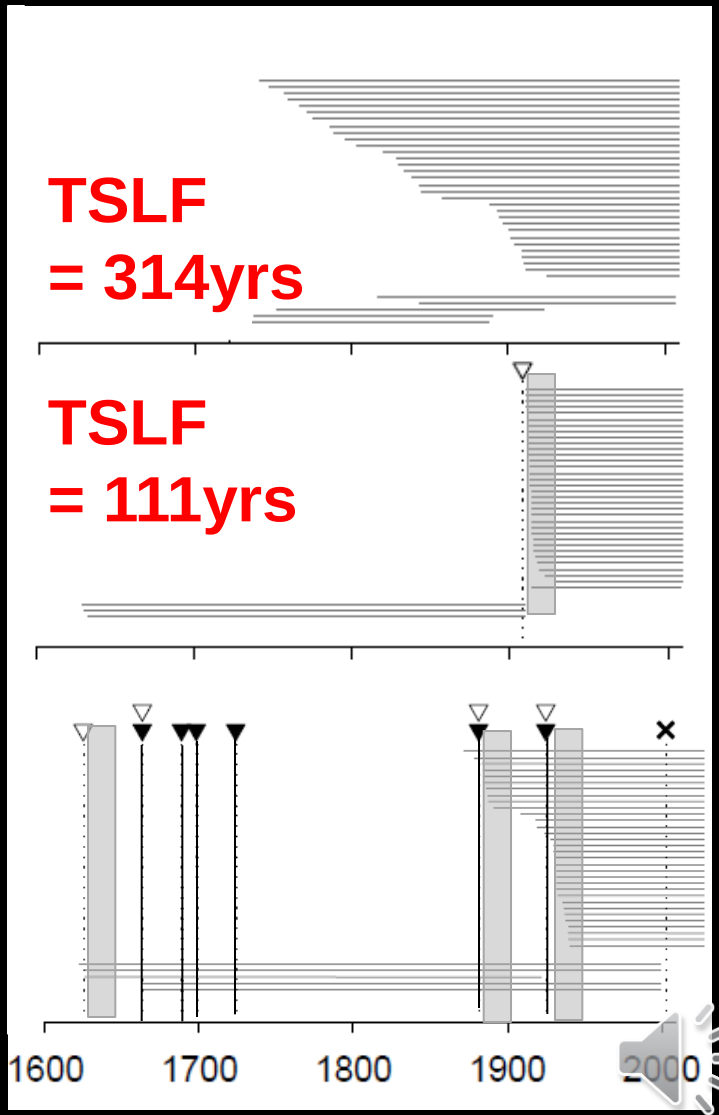


Undetermined time since fire
17% 25%

High-severity = post-fire cohort
28% 20%

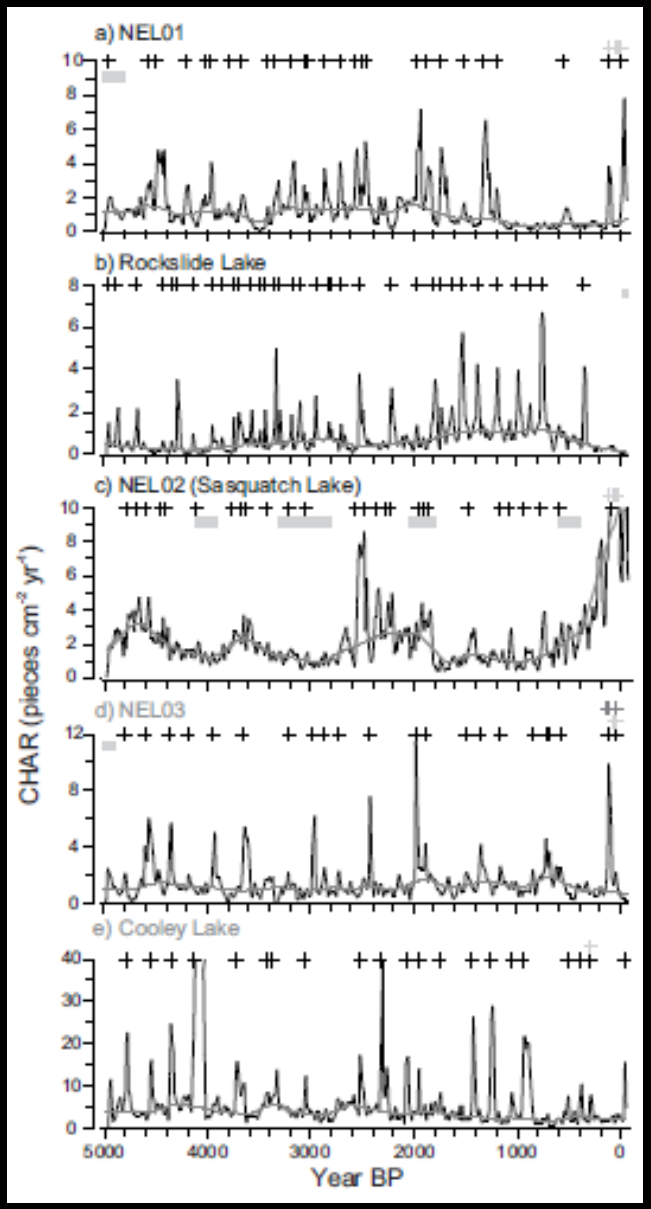
Mixed-severity = fire scars + cohorts
55% 55%

East Kootenays (n = 20)



Macroscopic Charcoal in Lake Sediments

Mustaphi and Pisaric 2013, *Journal of Biogeography*



MFI= **190yrs** (139-250), n = 26

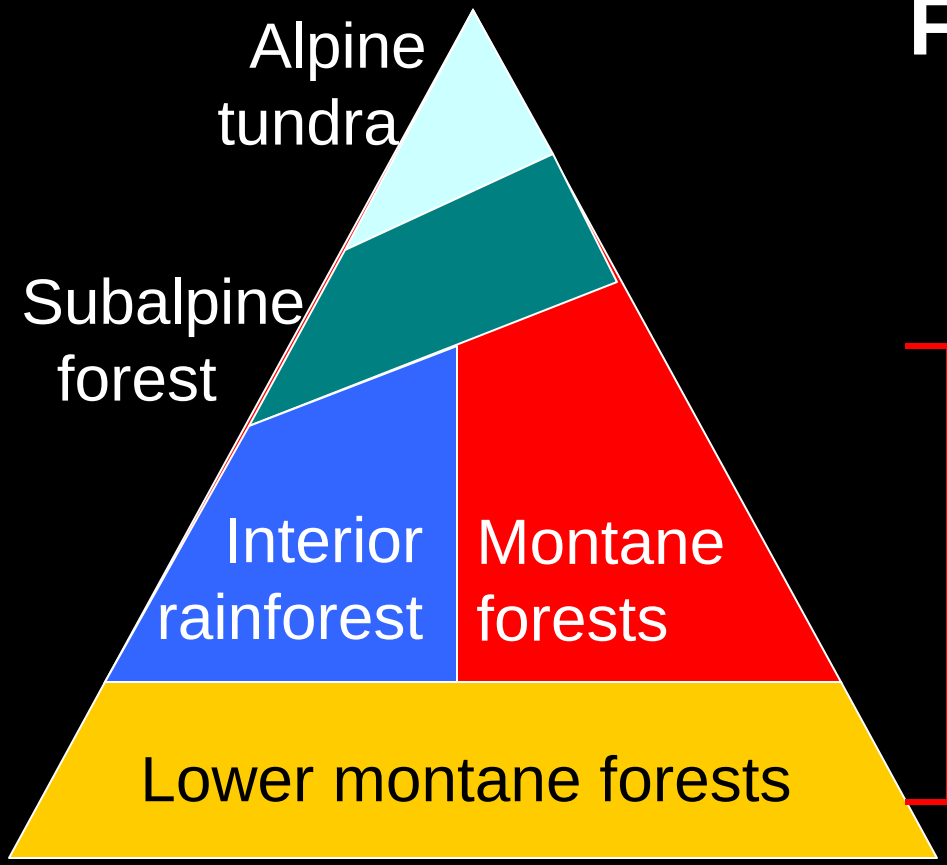
MFI= **135yrs** (110-164), n = 34

MFI= **180yrs** (132-236), n = 26

MFI= **226yrs** (174-280), n = 21

MFI= **241yrs** (192-295), n = 26

Fire Regimes in the Mountains of BC



Fire Regimes:

High severity
Intervals: 100-250yrs

Low-moderate severity
Intervals: 5-70yrs

Mustaphi and Pisaric 2013, *Journal of Biogeography*

Marcoux, Gergel and Daniels 2013, *Canadian Journal of Forest Research*

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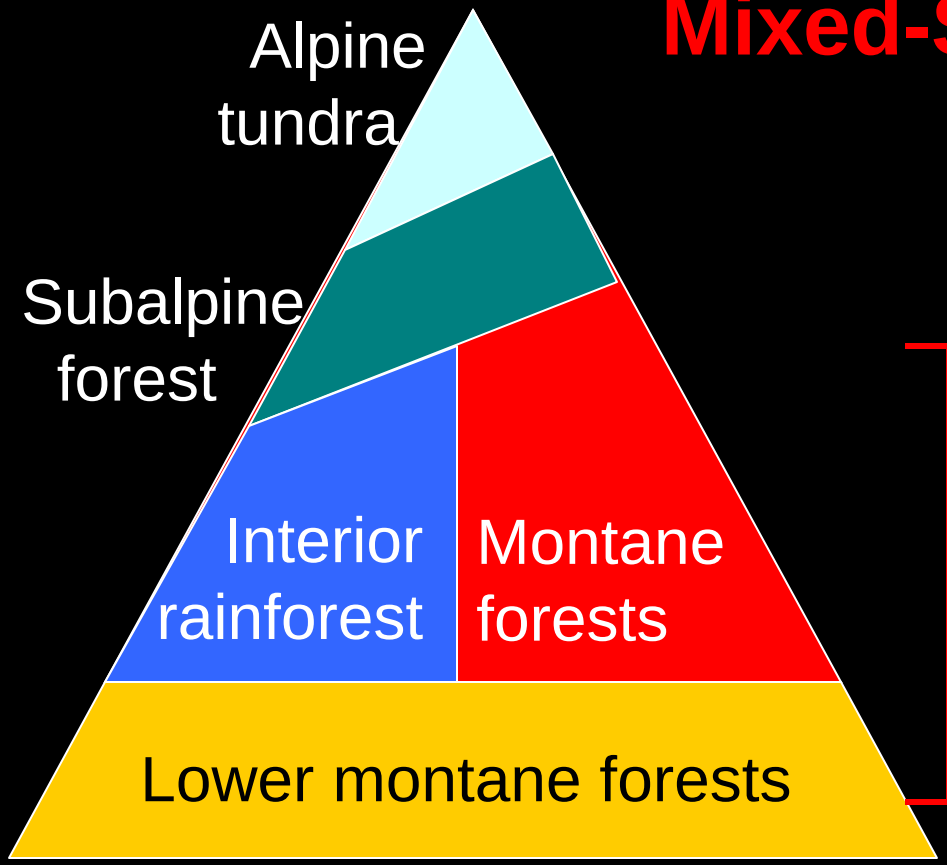

Mixed-Severity Fire Regime:

High severity
Intervals: 100-250yrs

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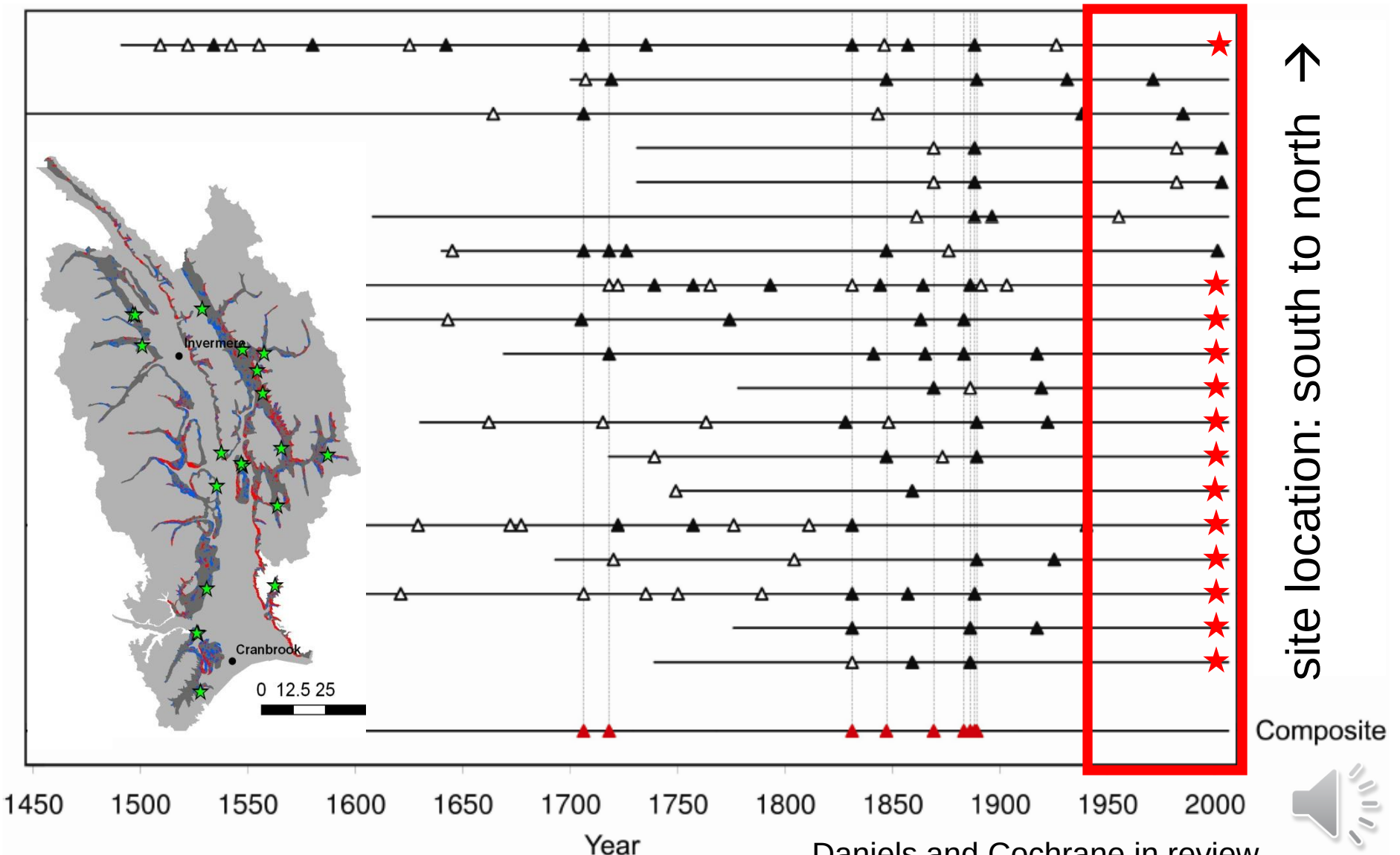
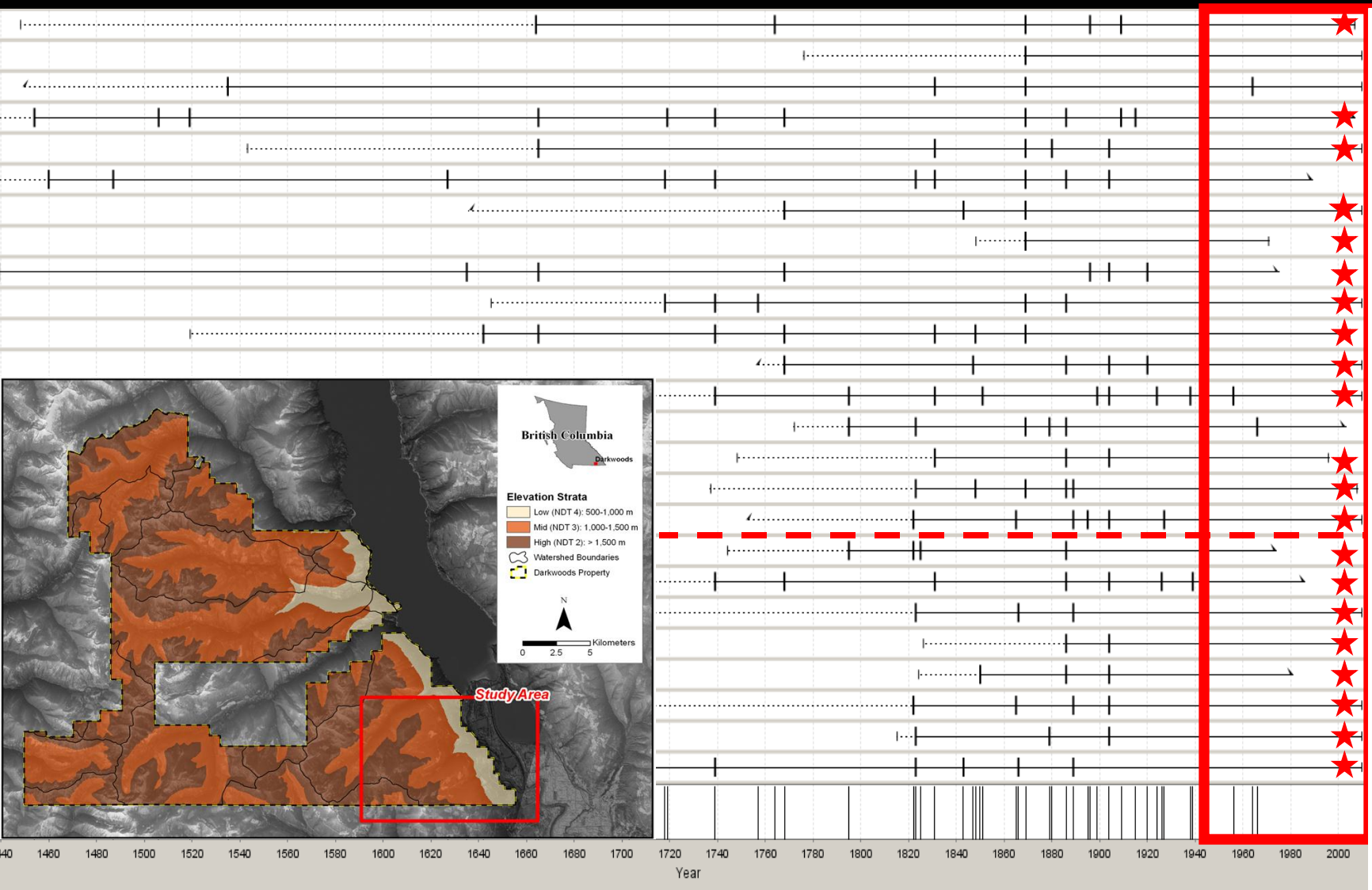
20th Century Changes to Fire Regimes
Montane Forests, East Kootenays



Daniels and Cochrane in review

20th Century Changes to Fire Regimes
Darkwoods, West Kootenays (Greene 2011)



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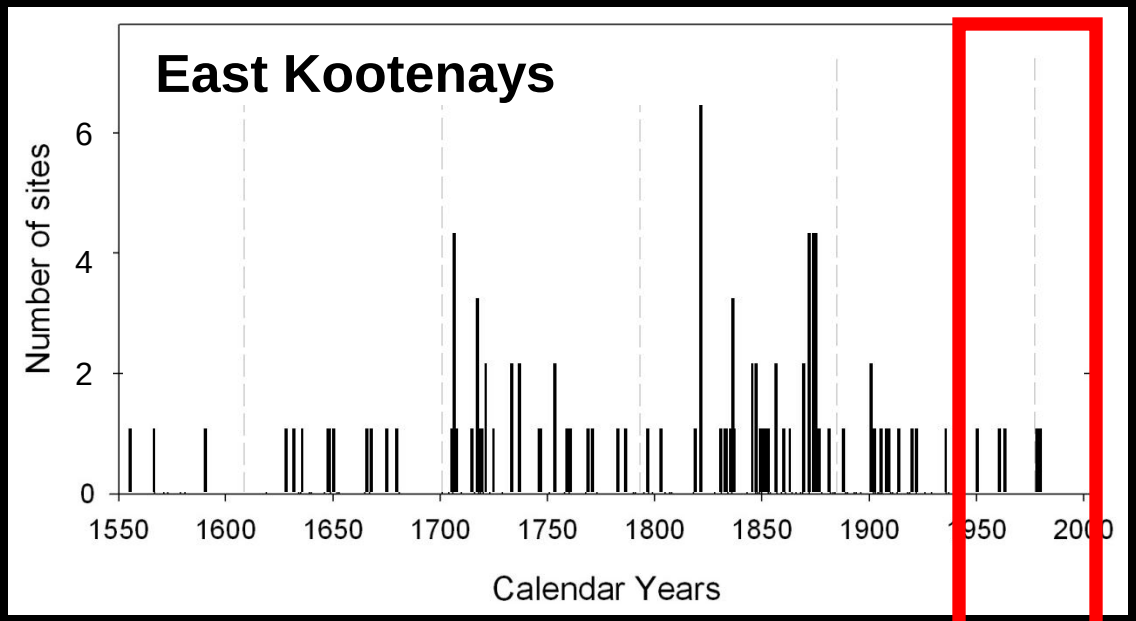
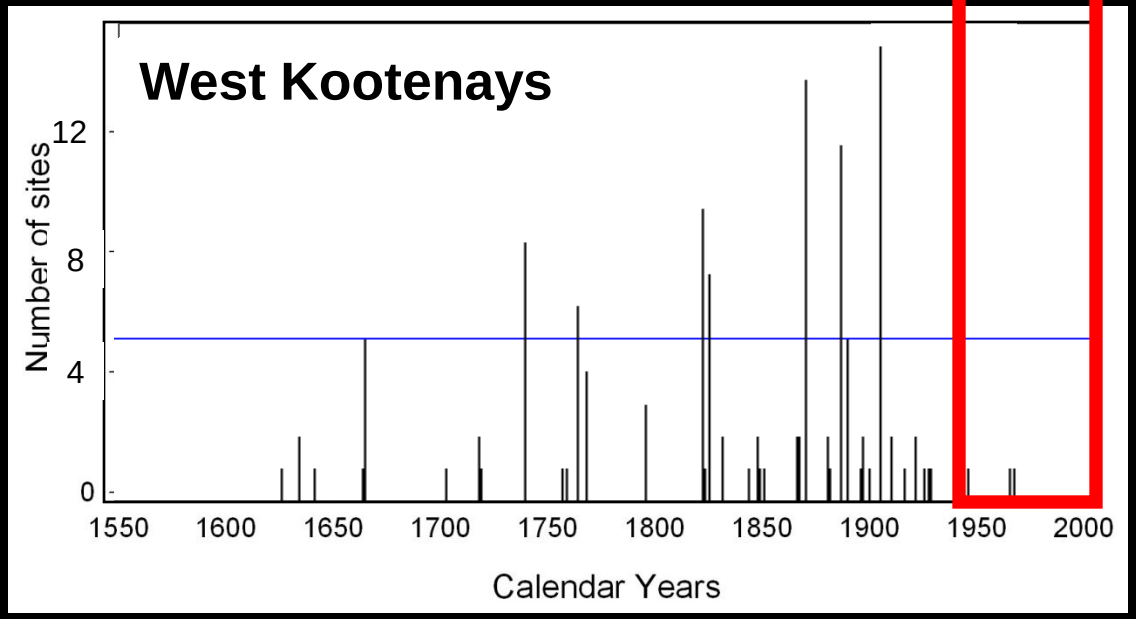




Causal factors:

1. Human impacts
   - Fire exclusion
     - land use change
     - First Nations
   - Fire suppression

2. Climatic variation
   - PDO + AMO
   - El Niño + La Niña

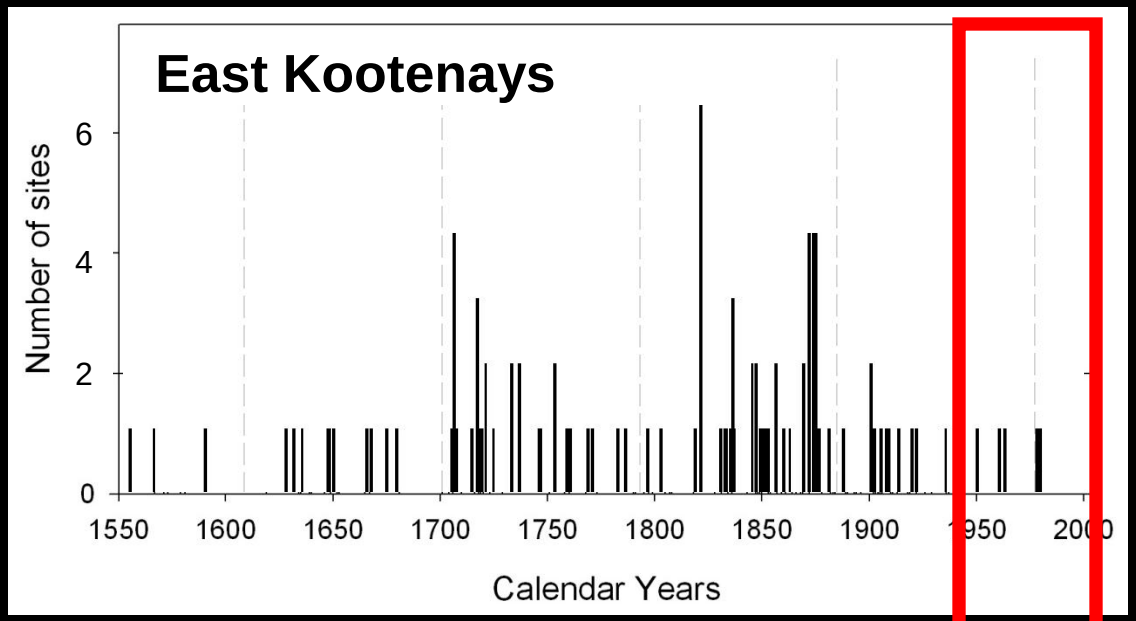
Global Climate and 20th Century Fires

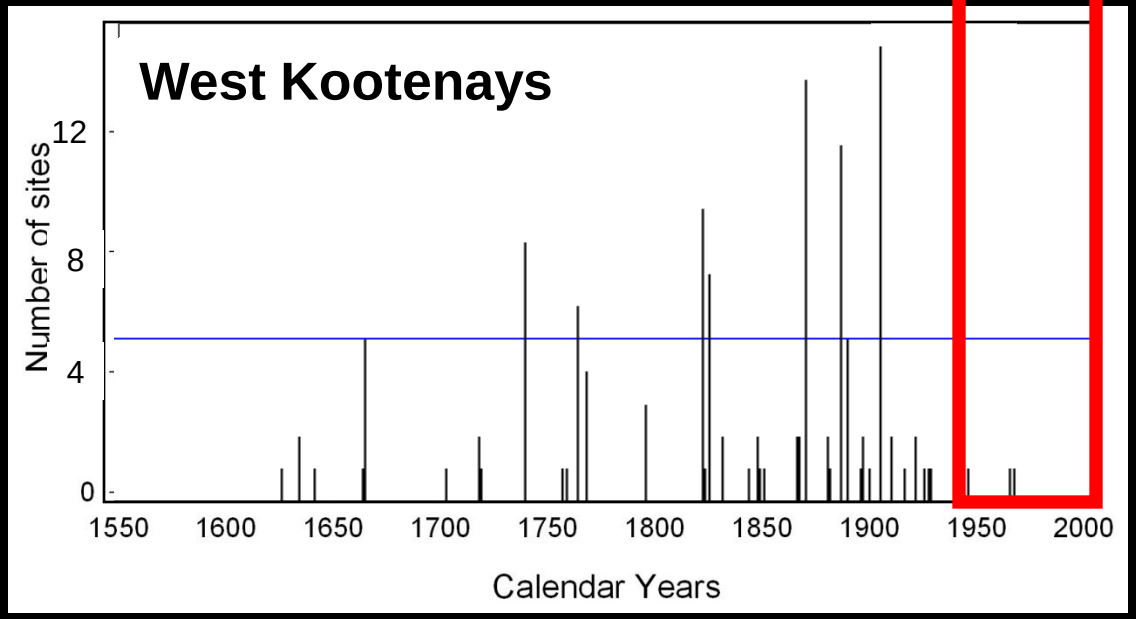
	+AMO	- AMO
+ PDO	El Niño	El Niño La Niña
- PDO	Few fires	La Niña

- 1900-22 – highly susceptible to fire
- 1923-43 – more fires during El Niños
- 1944-66 – less conducive to fire
- Since 1981 – more fires during El Niños (e.g. 2003)

Daniels et al. 2011 *Canadian Journal of Plant Pathology*

20th Century Changes to Fire Regimes





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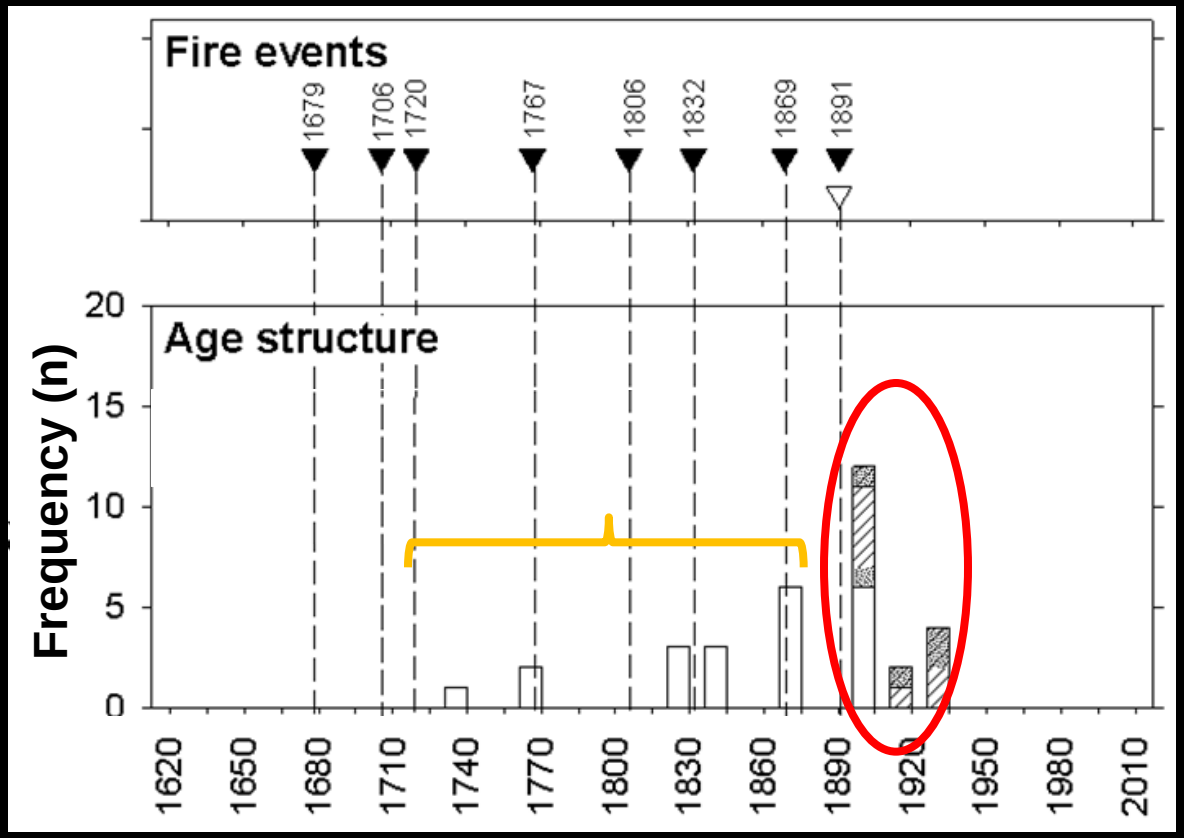
Consequences?

Consequences of Fire Exclusion



Canopy
Subcanopy
Fire intolerant

Veterans

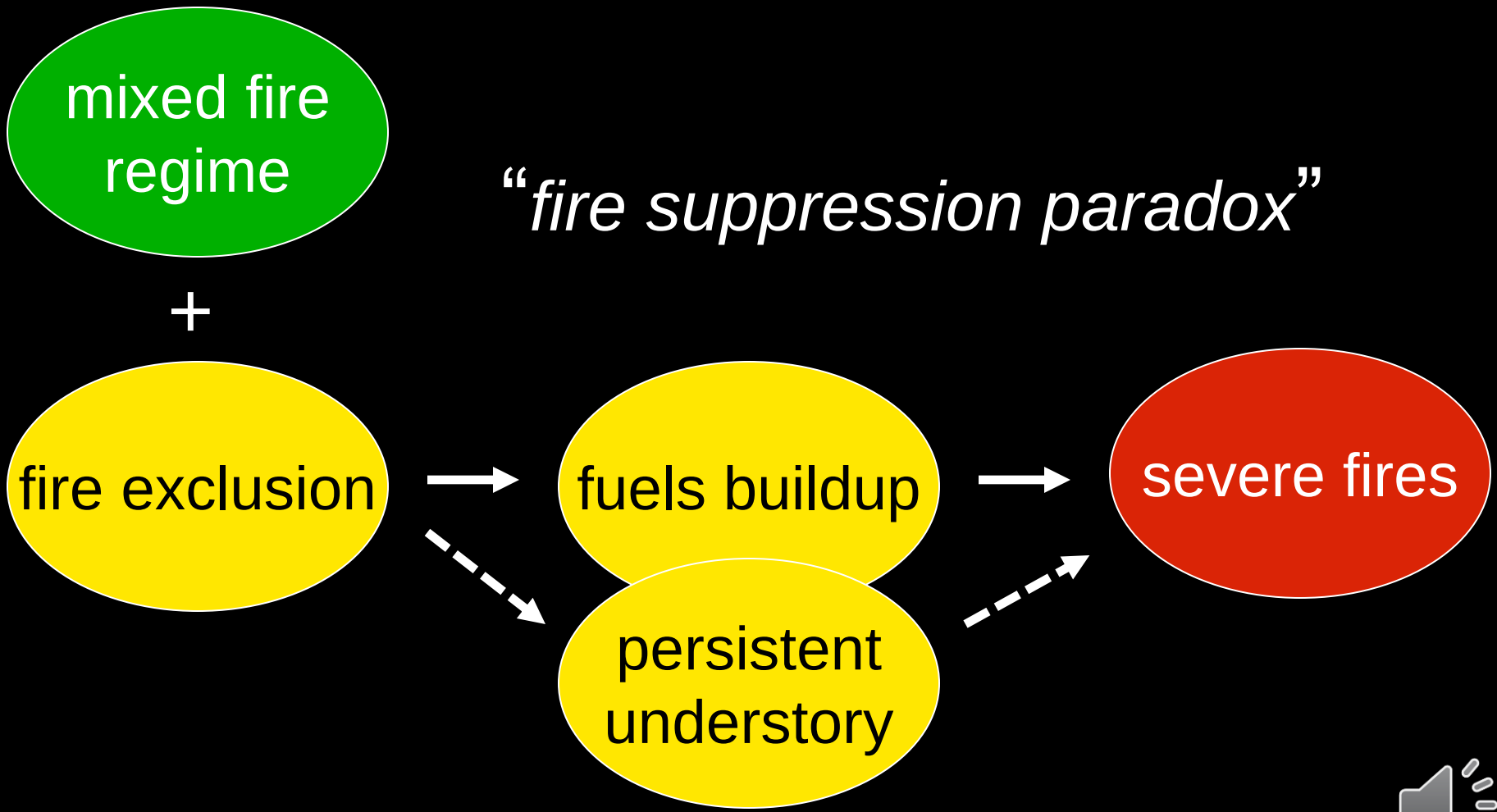
- low density
- uneven-aged
- fire tolerant

Post-fire cohort

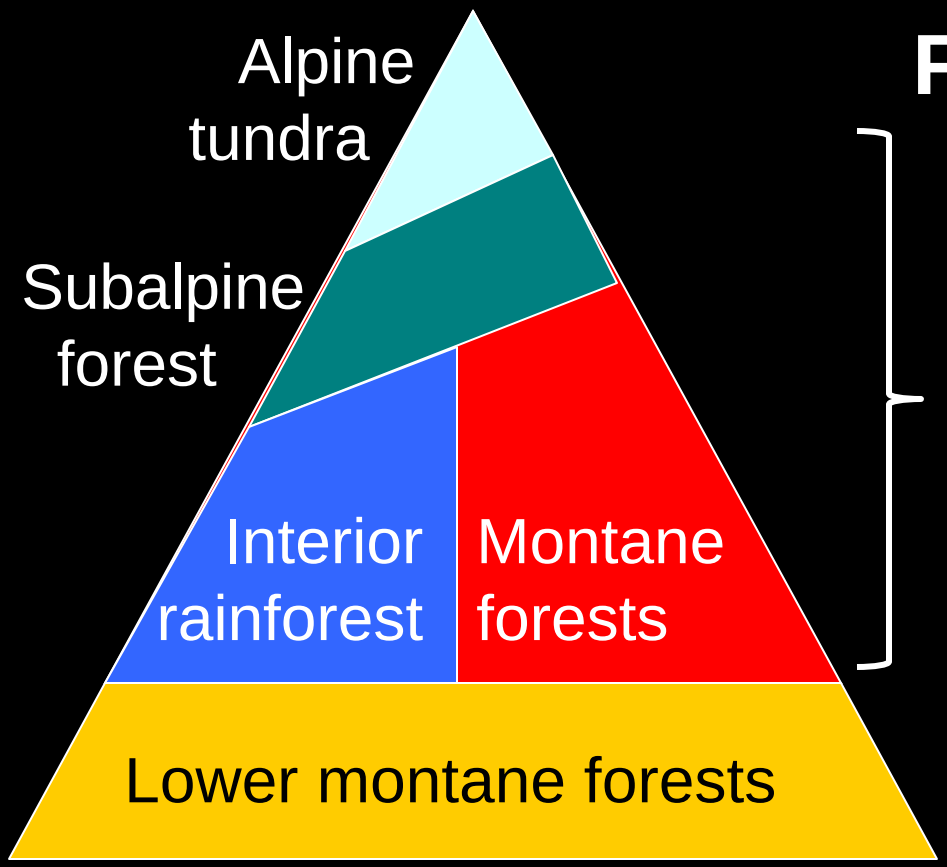
- dense
- even-aged
- persistent
- fire-intolerant
- ladder fuels

(Nesbitt 2010, Marcoux et al. in review)

20th Century Changes to Fire Regimes
Consequences of Fire Exclusion



“Ecosystem-Based Management” in BC



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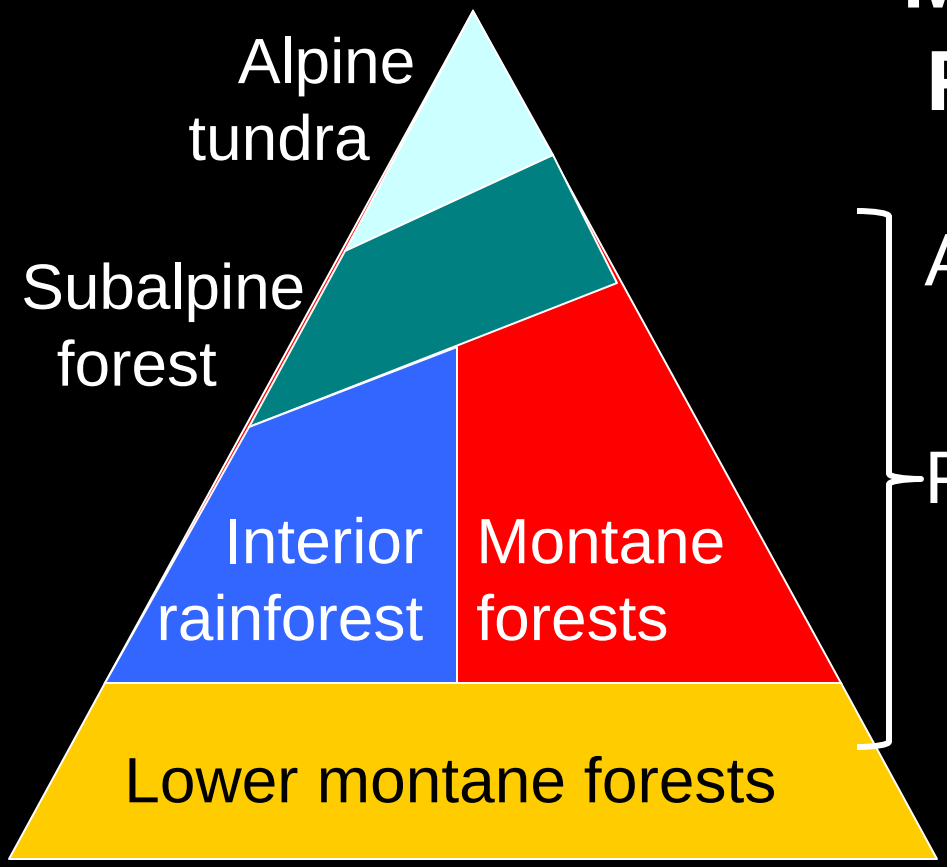

Mixed-Severity Fire Regime:

Alternative silviculture + old-growth strategy

Proactive fire management

New Wildfire Management Strategy

Use of wildfire management, prescribed fire, and silvicultural treatments to…

mitigate fuel hazards,

restore ecosystem structures, and

increase forest resilience to climate change.

Thanks to many people and organizations…

CARLETON UNIVERSITY PALEOECOLOGICAL LABORATORY

People. Discovery. Innovation.