Climate Change: Implications for Forest Dynamics



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TREE RING LAB *at* UBC

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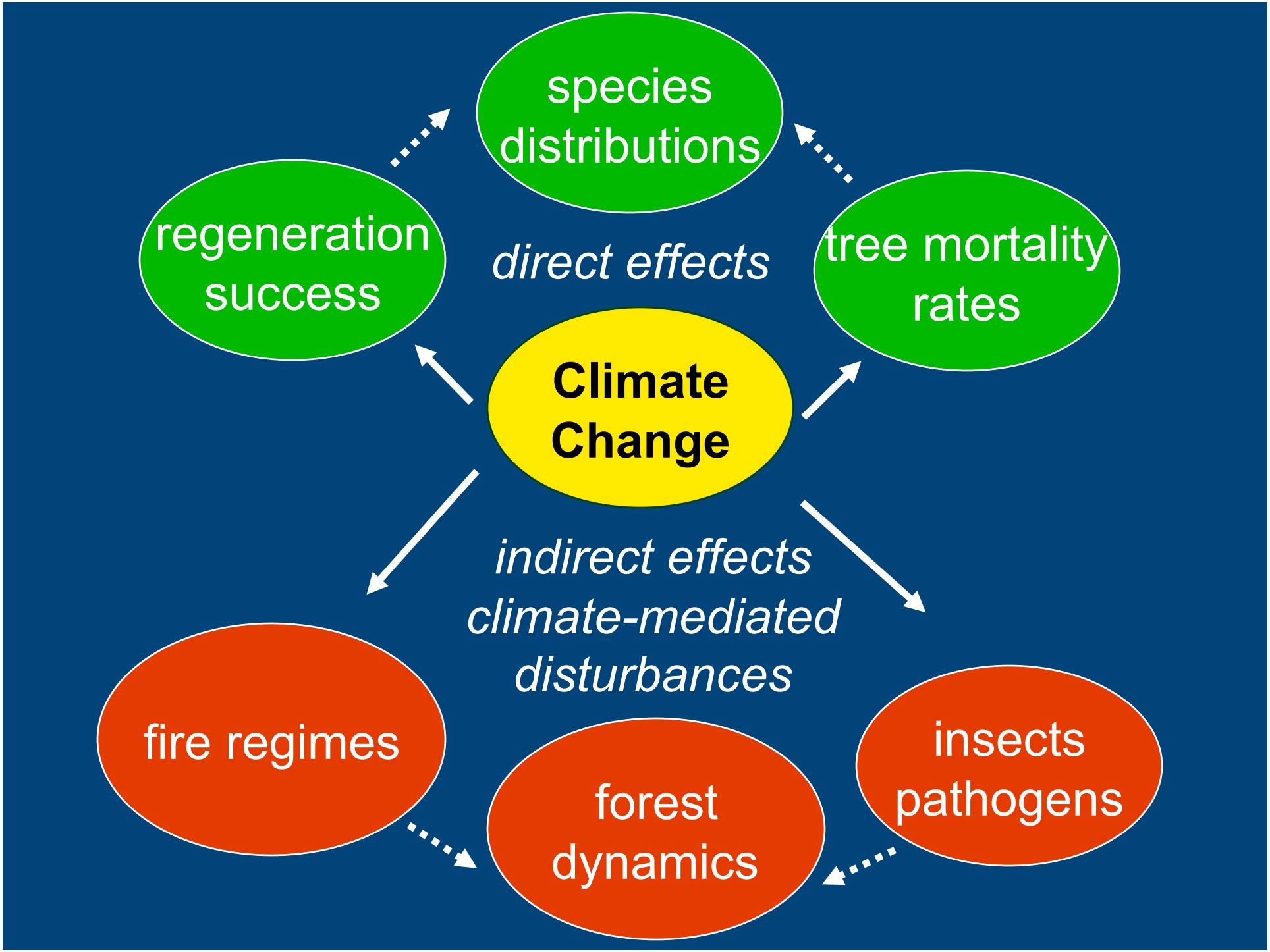
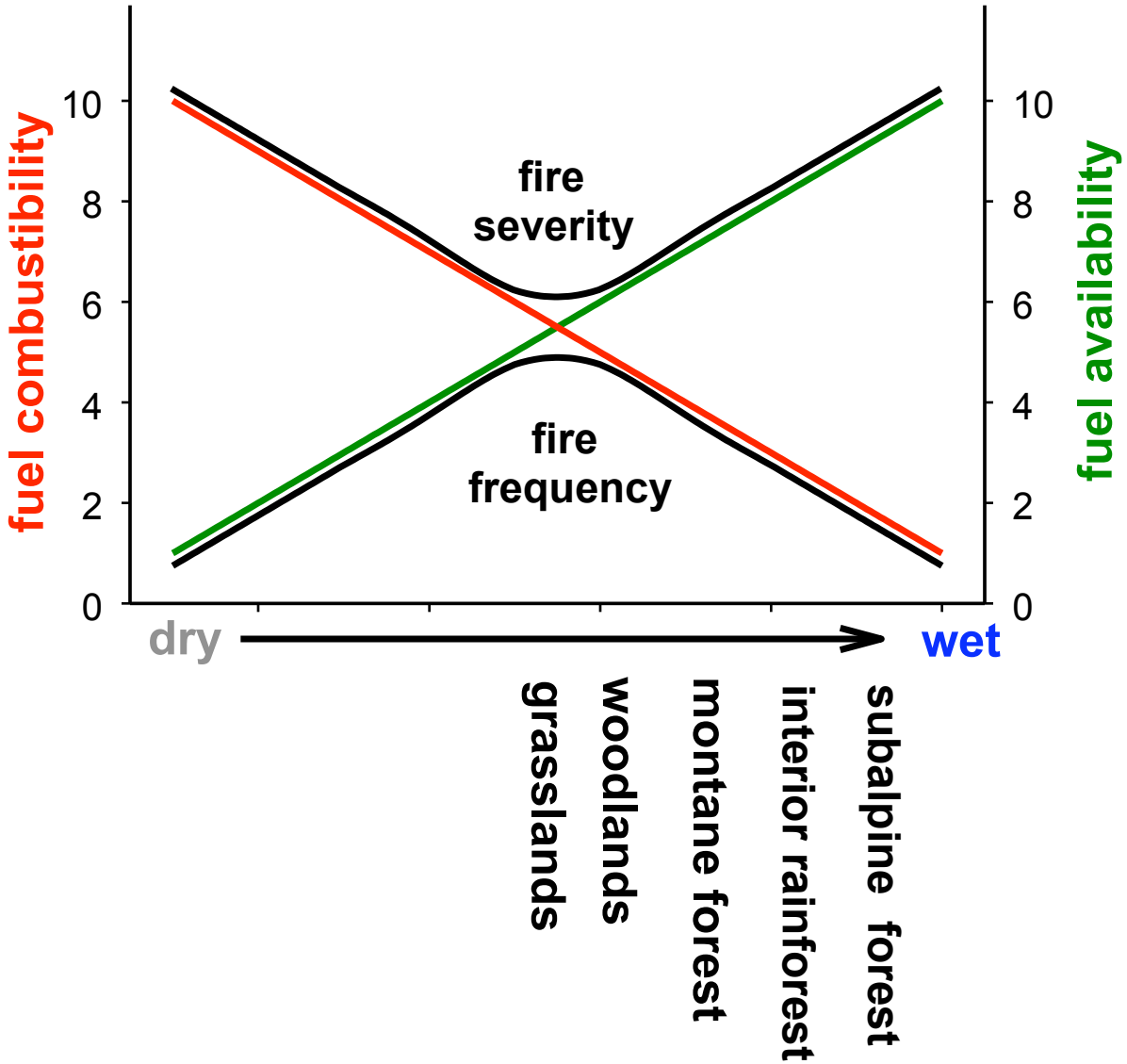
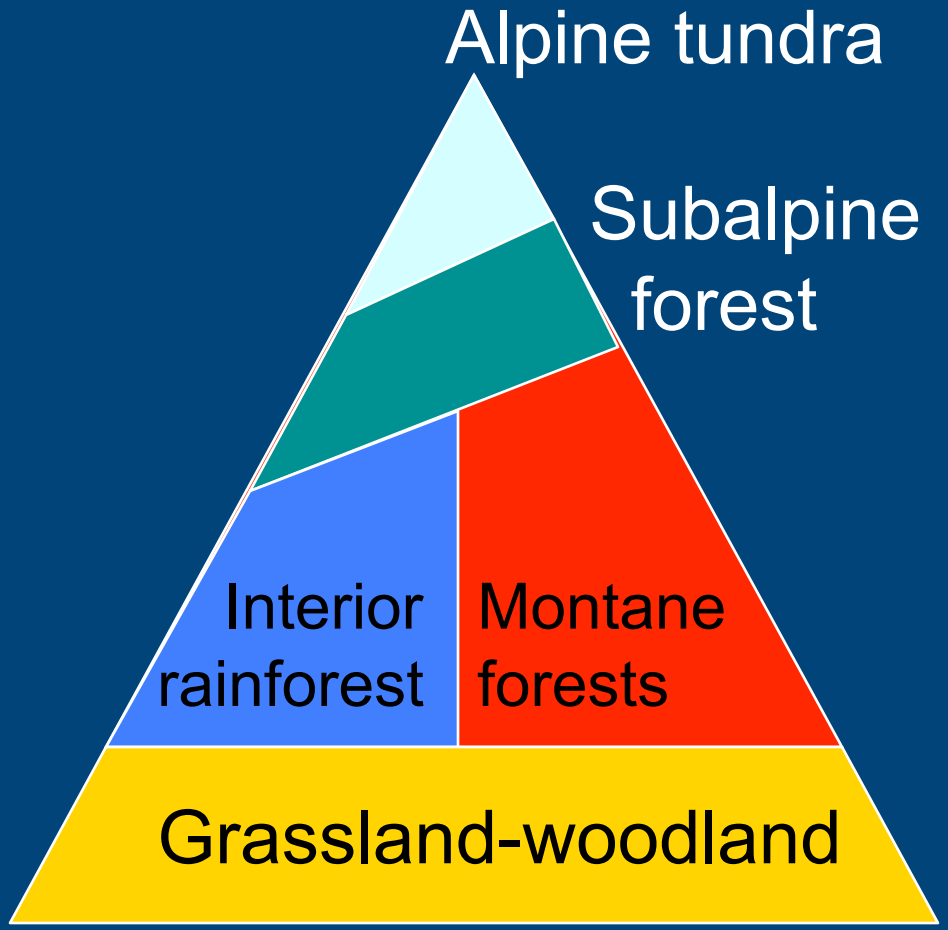
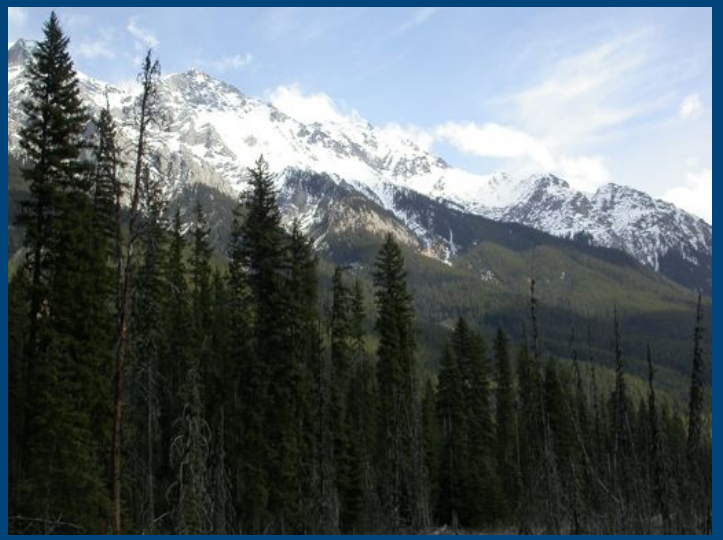

species distributions
regeneration success
tree mortality rates
direct effects
Climate Change
indirect effects climate-mediated disturbances
fire regimes
forest dynamics
insects pathogens

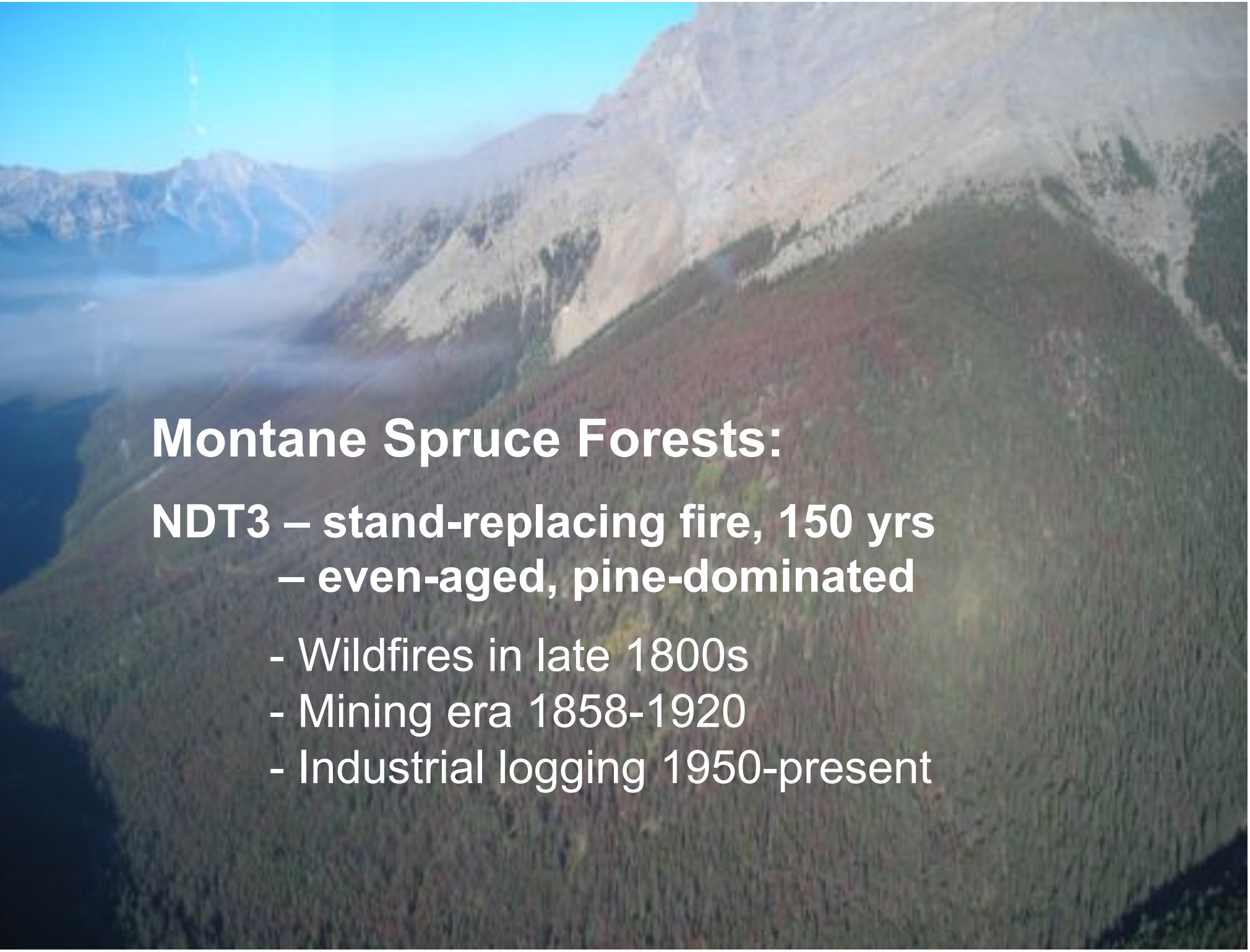
Interpreting Fire Regimes



Historical Fire Regimes in Mountain Ecosystems





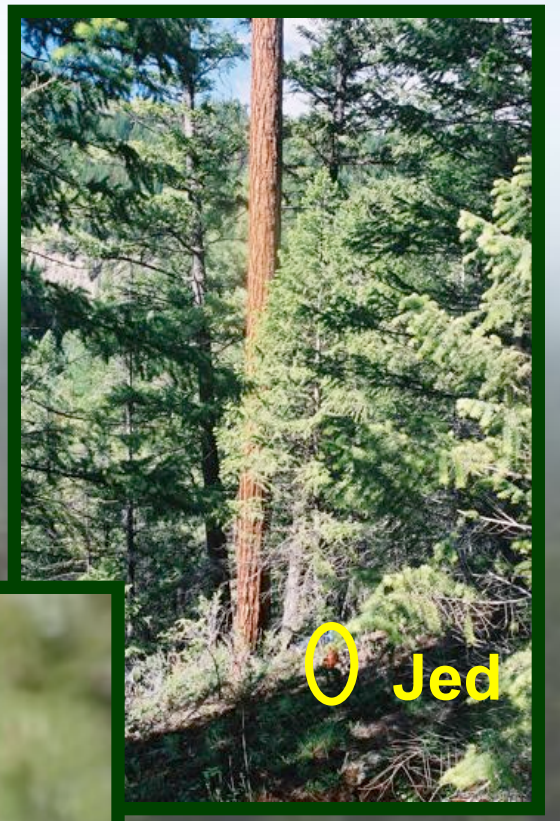


Montane Spruce Forests:

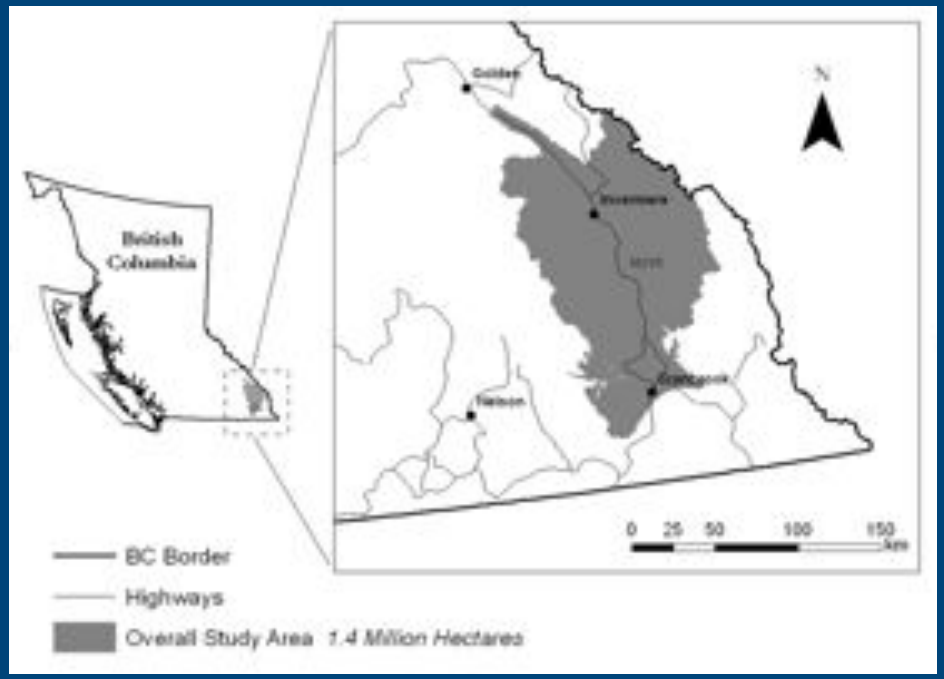
NDT3 – stand-replacing fire, 150 yrs
– even-aged, pine-dominated

- Wildfires in late 1800s
- Mining era 1858-1920
- Industrial logging 1950-present

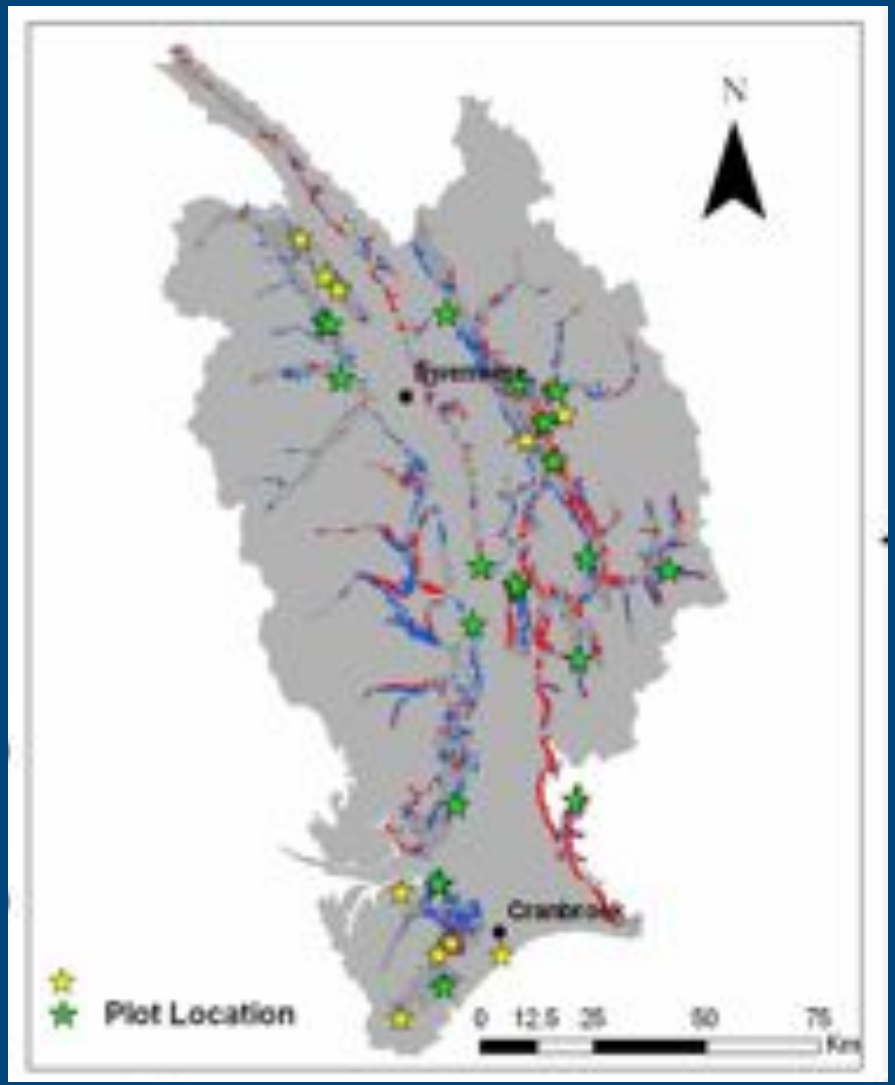
Montane Forests



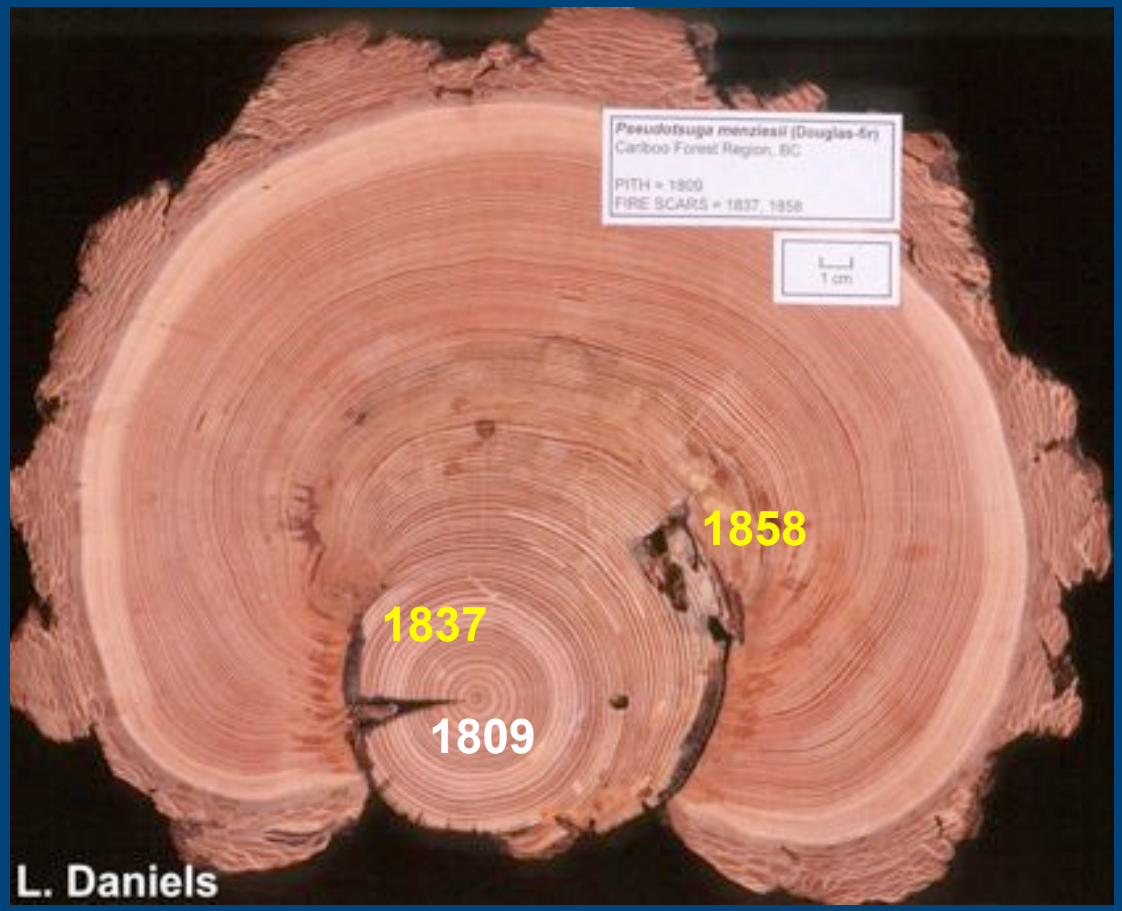
Montane Spruce Forests in the East Kootenays



Structurally complex stands = 25% of montane forests

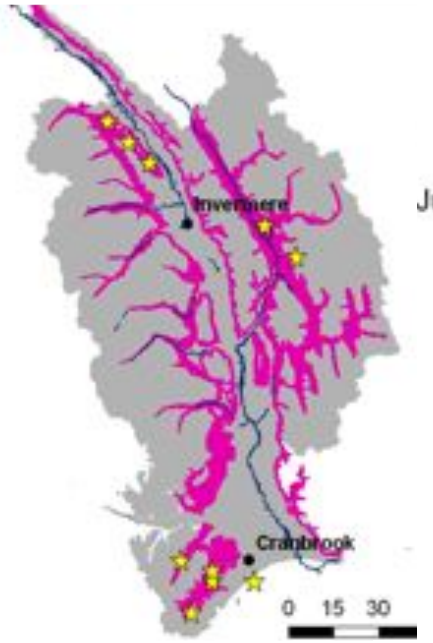


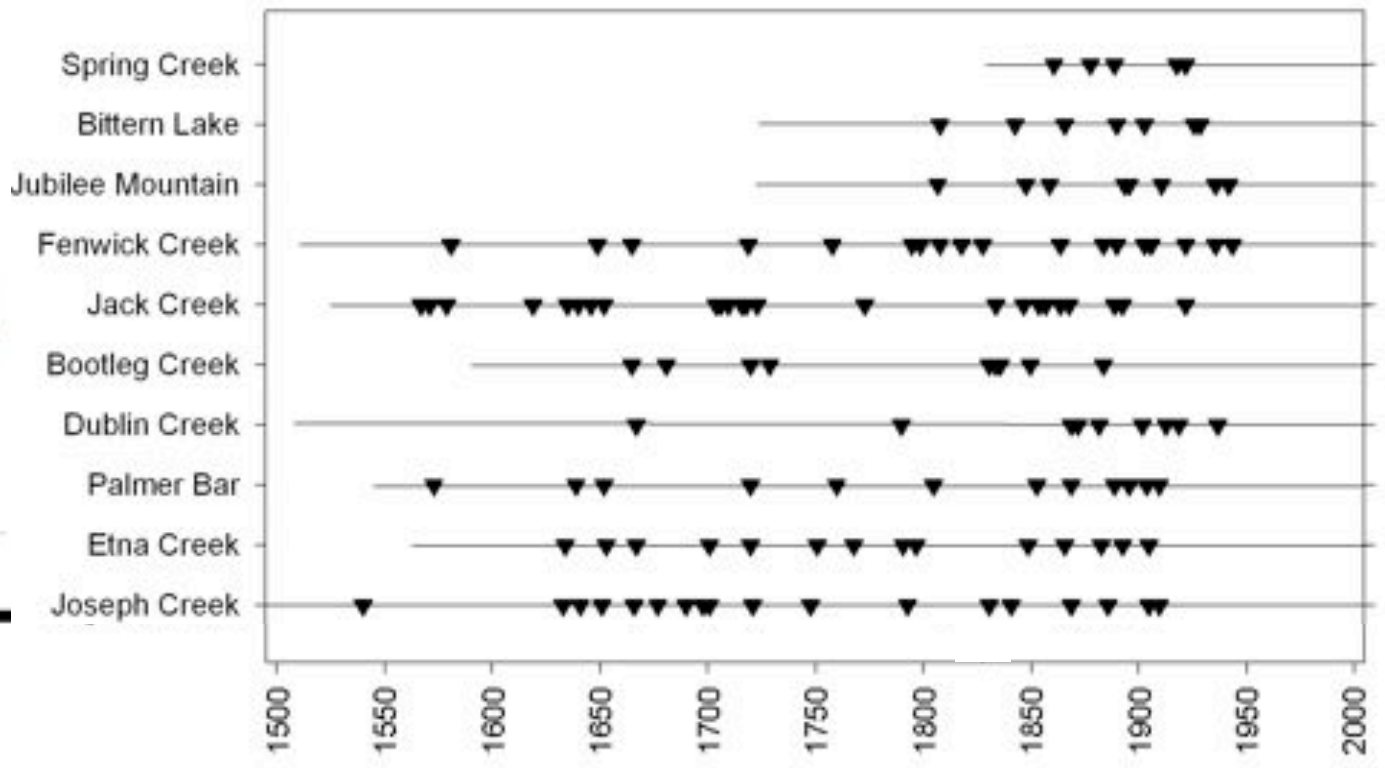
Crossdated Fire Records



- **Fire records**
  - 30 sites
  - >250 trees
  - >400 scars
- **Return Interval**
  - local scale
  - regional scale

Site-Level Fire Chronologies

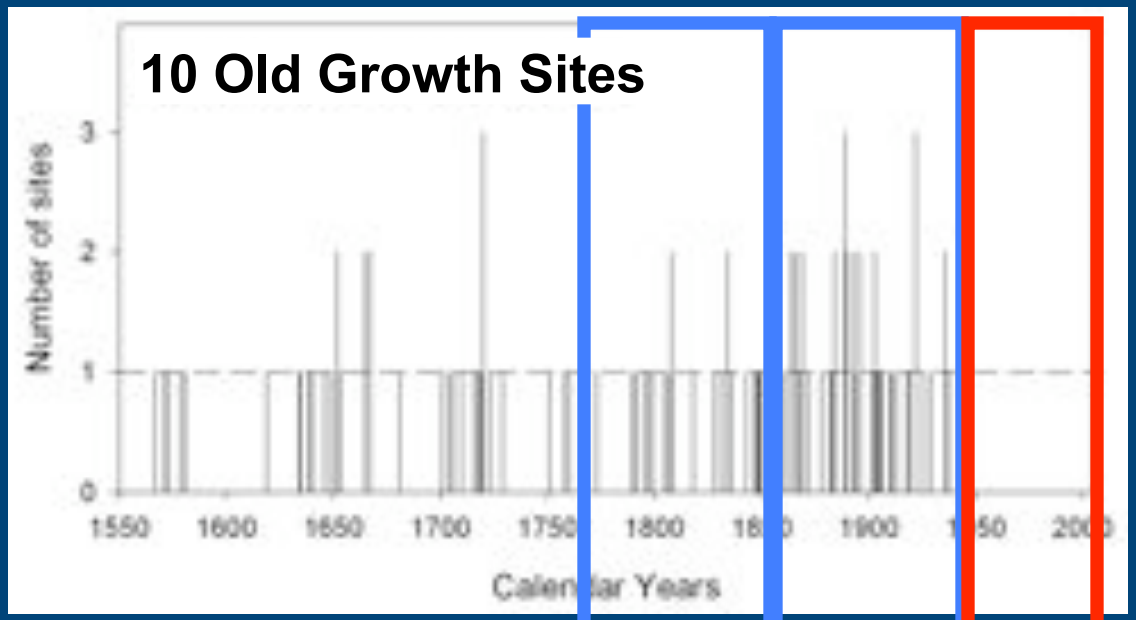


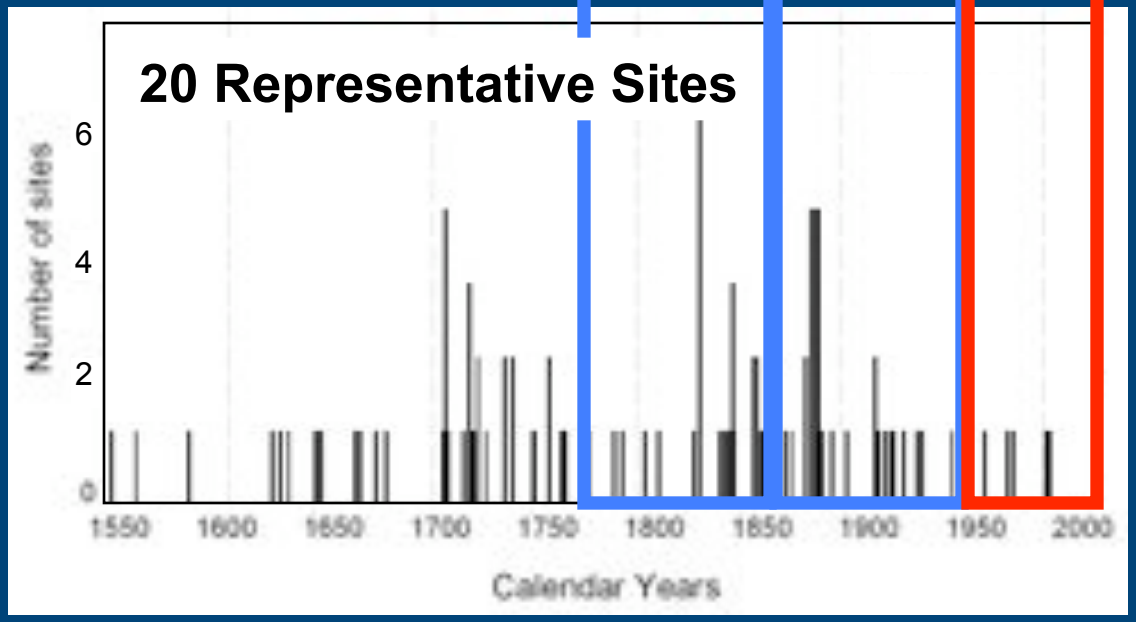


Start dates: 1449 to 1828

Median fire intervals: 10 to 26 yrs

Interval range: 2 to 123 yrs





1770-1857: pre-settlement
1858-1944: settlement
1945-2006: modern era

1509-1944
1 fire every 3 years

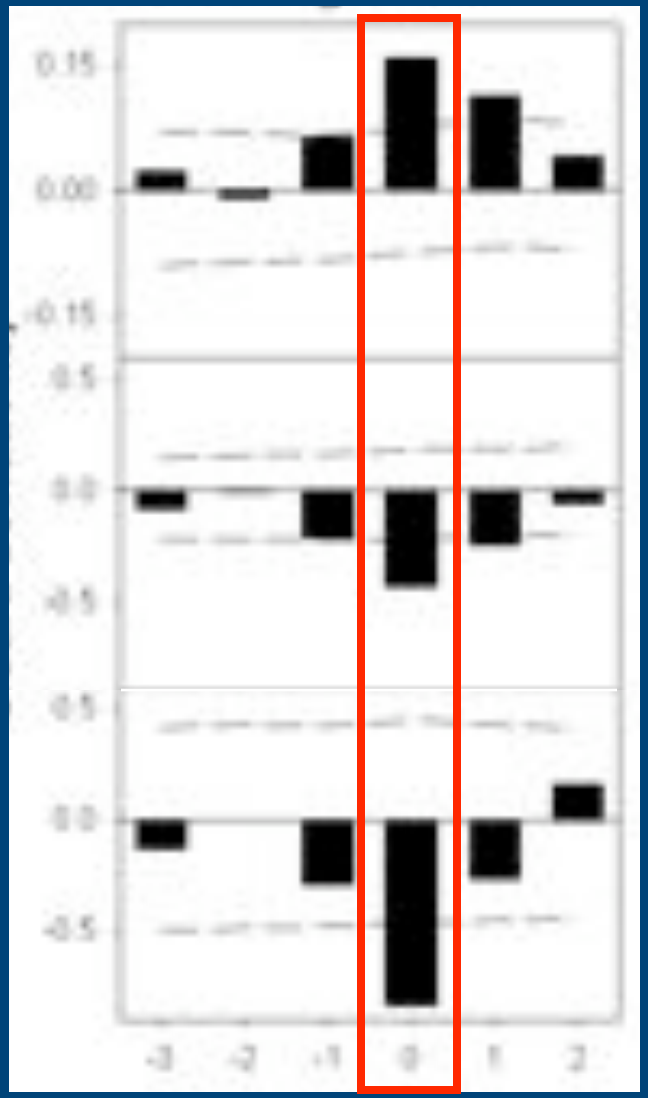
1945-2006
Expected c. 20 scars
Observed 6 scars

Contributing factors:

- fire exclusion/suppression
- cessation of burning by First Nations
- climate variation

Daniels et al. 2007, Cochrane 2007

Drought-Fire 1700-1970

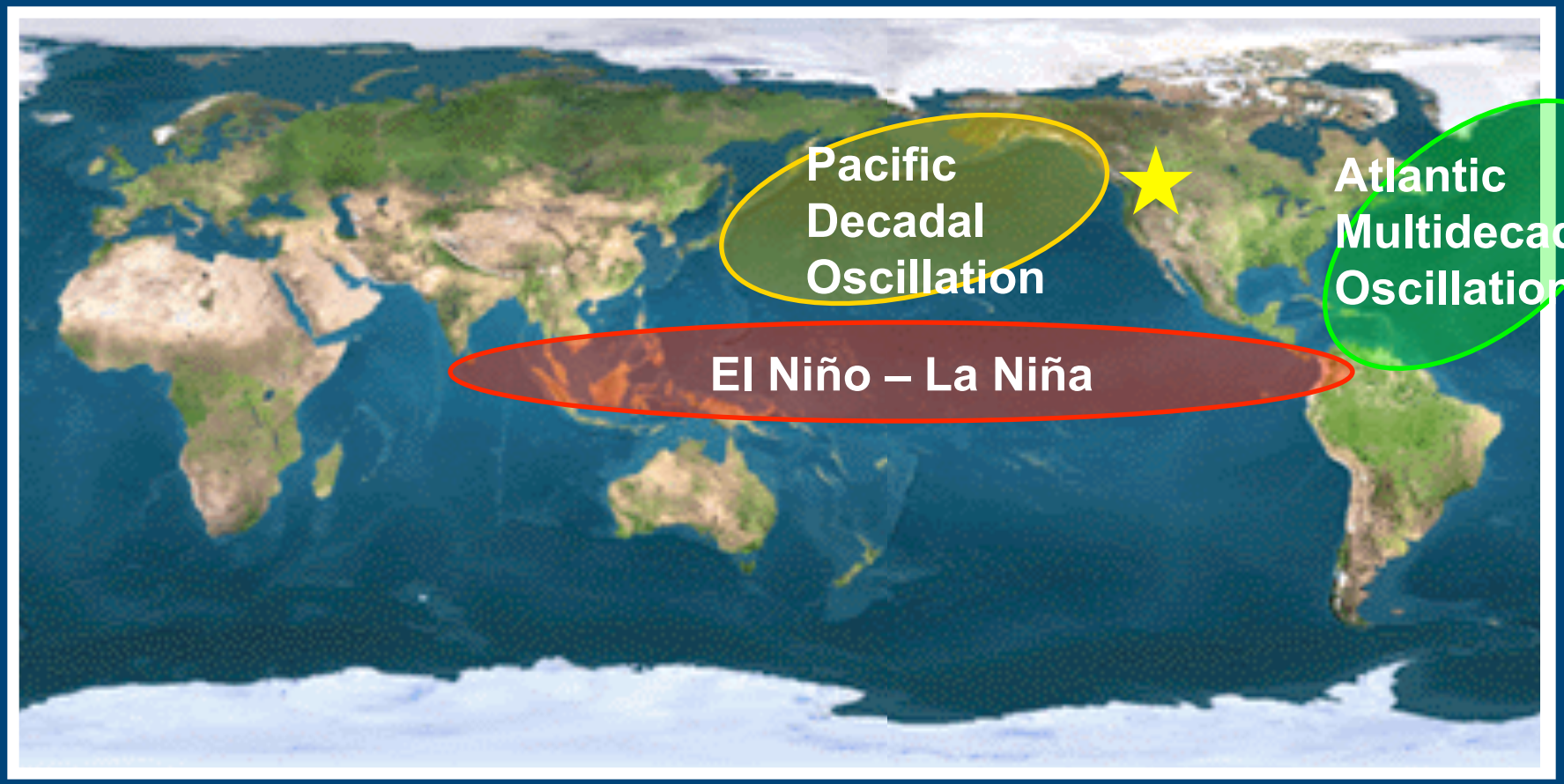


No fires
(n = 196)

All fires
(n = 74)

Regional fires
(n = 18)

Global Climate and the Kootenays



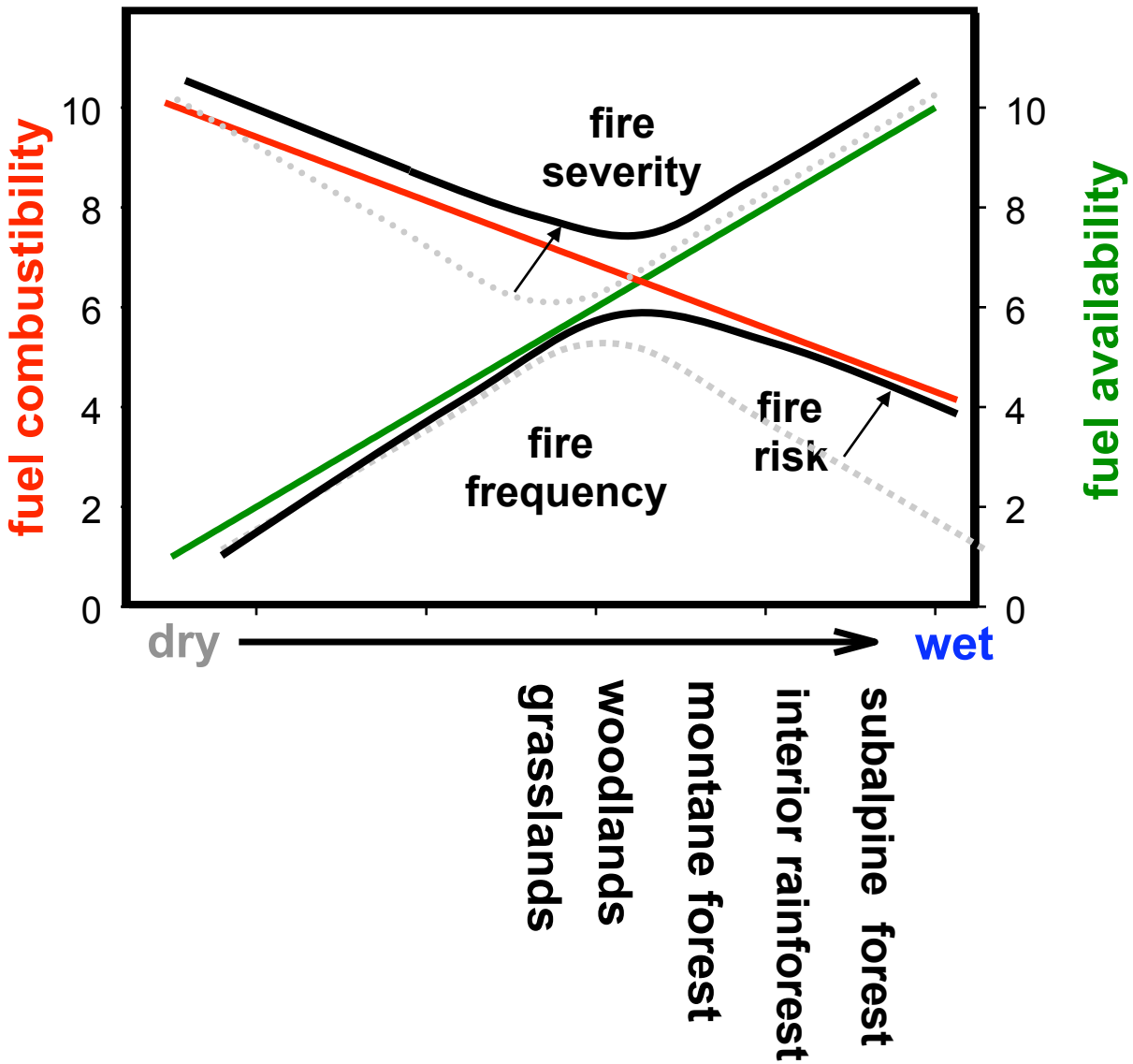
"teleconnections"

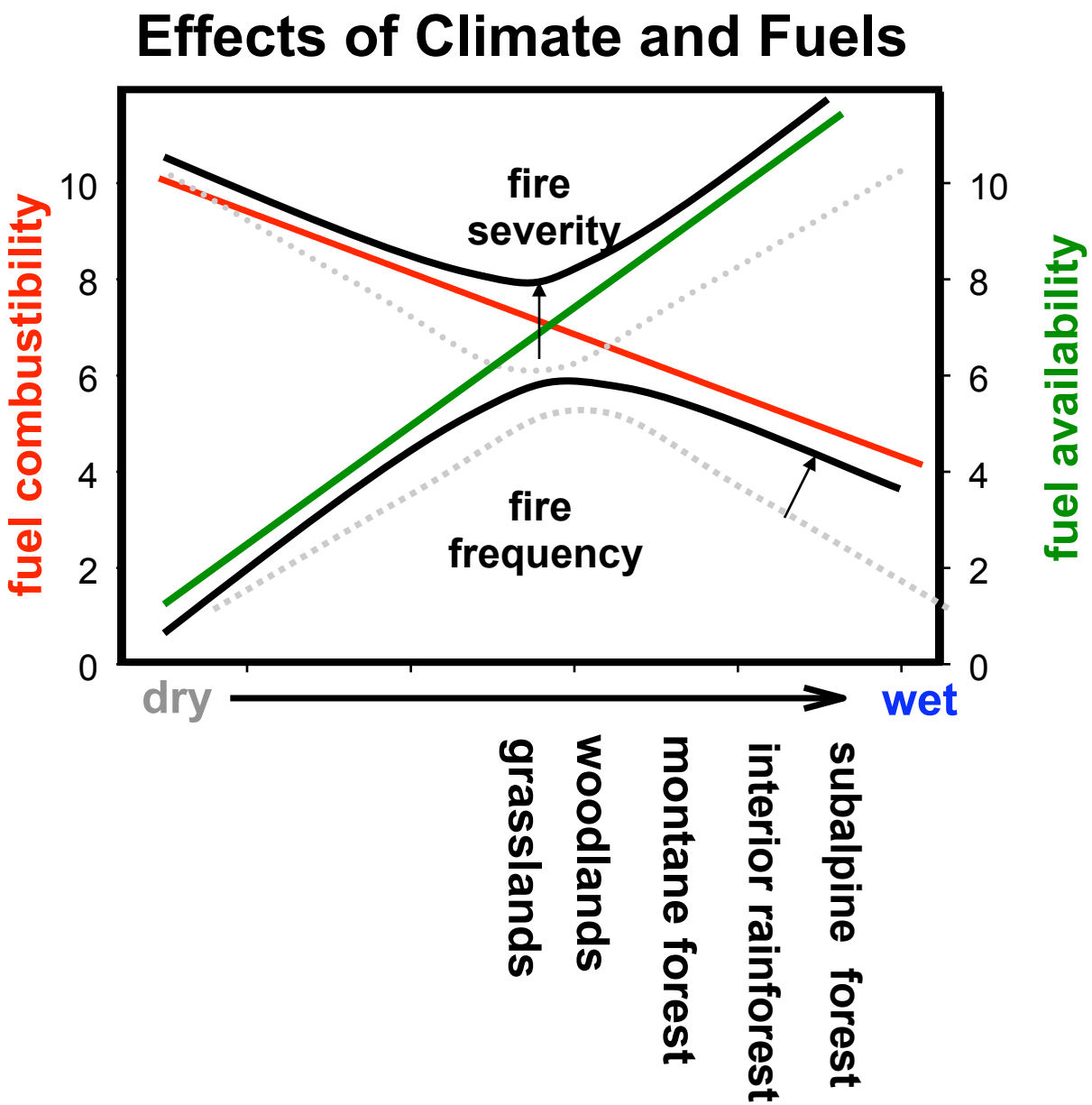
Global Climate and Fire

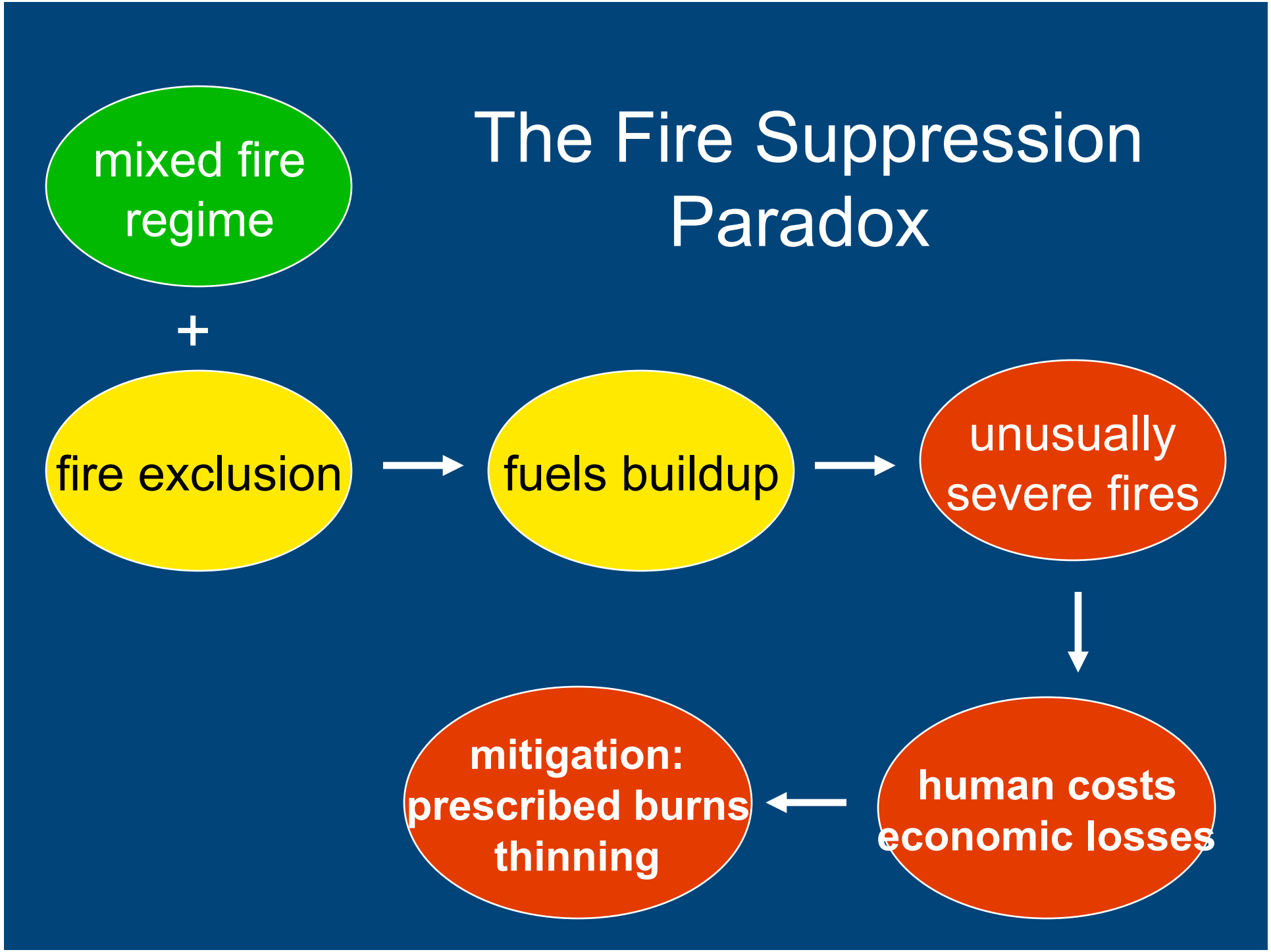
	+AMO	- AMO
+ PDO	El Niño	El Niño La Niña
- PDO	Few fires	La Niña

- 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)

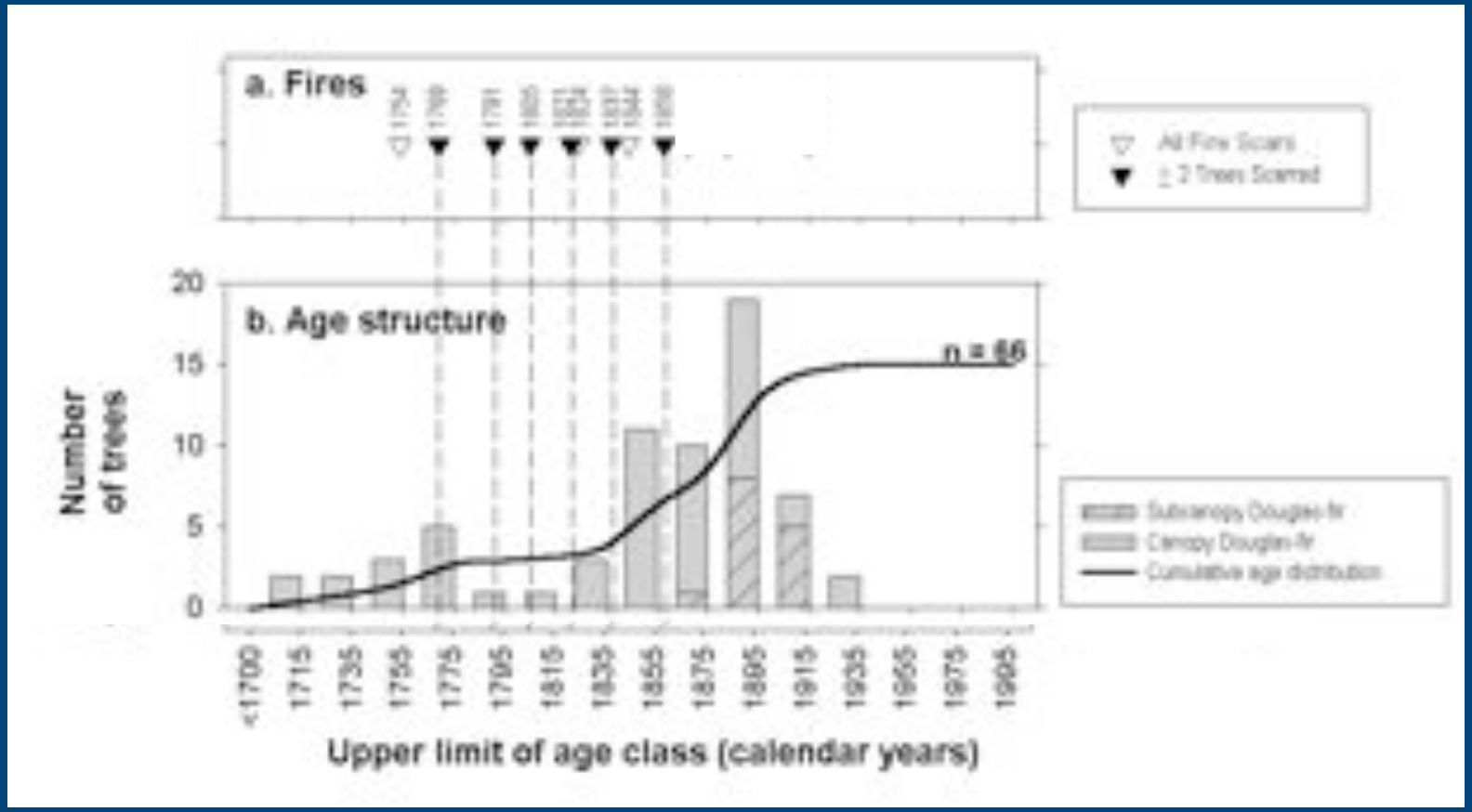
Effect of Climate Change




Effects of Climate and Fuels
fuel combustibility
fuel availability
fire severity
fire frequency
0
2
4
6
8
10
dry
wet
grasslands
woodlands
montane forest
interior rainforest
subalpine forest

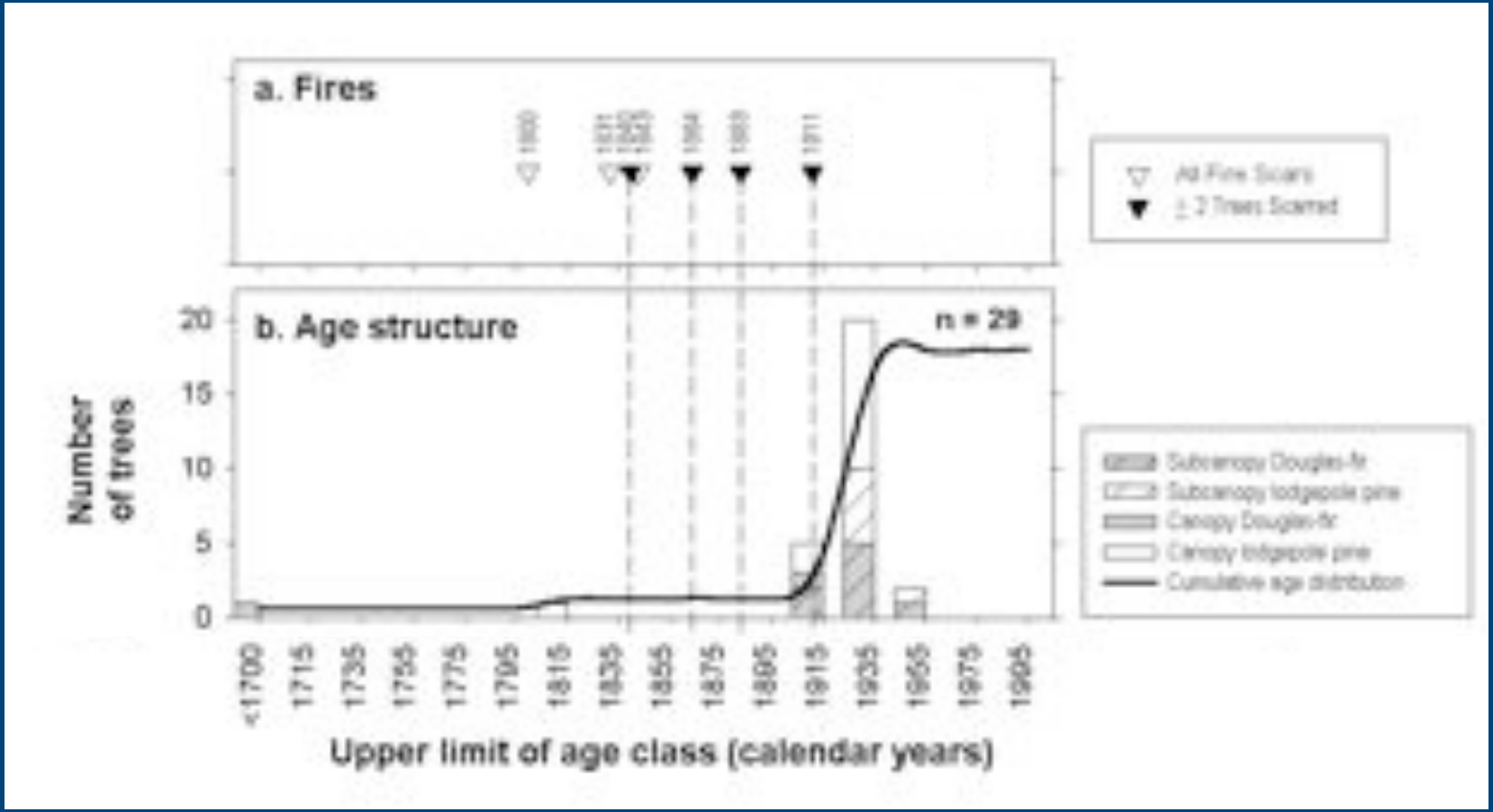

The Fire Suppression Paradox
mixed fire regime
+
fire exclusion
fuels buildup
unusually severe fires
human costs economic losses
mitigation: prescribed burns thinning

Fire Effects on Forest Dynamics



Survival of understory trees in absence of low severity fires + self thinning = departed from NRV

Fire Effects on Forest Dynamics



Stand establishment following severe fire in 1911
Evidence of mixed severity regime, within NRV

Climate-Fire-Mountain Pine Beetle Interactions ?

increased fuels due to tree mortality

+

high fire risk during regional droughts

Prescribed Fire
Kootenay National Park
May 31 2008

Fire and Mountain Pine Beetle
Operational Prescribed Burn
Kootenay National Park

No MPB	Red Attack	1980s MPB
100% mortality 22% loss logs 24% loss snags	98% mortality 29% loss logs 16% loss snags	100% mortality 51% loss logs 44% loss snags
0.11m/sec FI < predicted	0.13m/sec FI < predicted	0.46m/sec FI 2-10x predicted

Lessons learned …

- Historical fires in mountains
  - low to high frequency + severity
- Climate influences on fire
  - global climate influences drought and fires
- Human influences on fire
  - fire free period = natural variation
    + fire suppression

Implications for Ecological Restoration

- Historical fires ranged from low to high severity
- Suppressed many stand-maintaining fires
- Current forest structures =
  natural processes + fire suppression effects

Should we thin the forest and prescribe fire…
to mitigate to reduce fire hazard?
to restore the ecosystem?

Conclusions

- Fire is natural and important for forests
- Increased risk of severe fires
  - humans impacts, droughts + global warming
- Solutions: mitigation and restoration
- BUT, fires will burn in future
  - with positive and negative effects

Acknowledgements

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