From Grasslands and Woodlands to Closed Forests: What Dendrochronology can tell us about Fire History and Landscapes Changes

Carson Sprenger, February 20th, 2019

Outline:

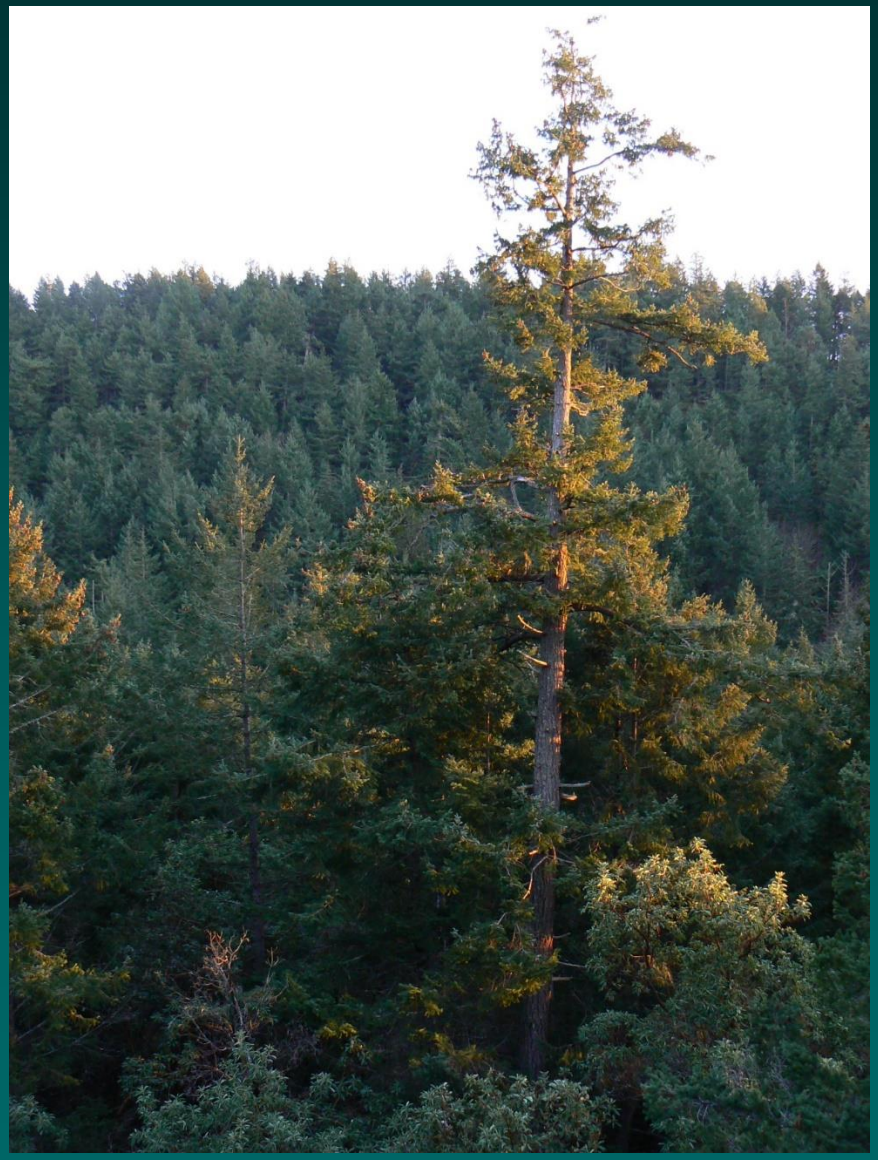
- *Forests*** and what factors help to define them?
- What's a "fire history" and why study this?
- 2004 Waldron study
- Other SJI fire studies
- Fire and forest health
- Role of charcoal

Please ask Q's any time!

**(mosaic of different habitat types)

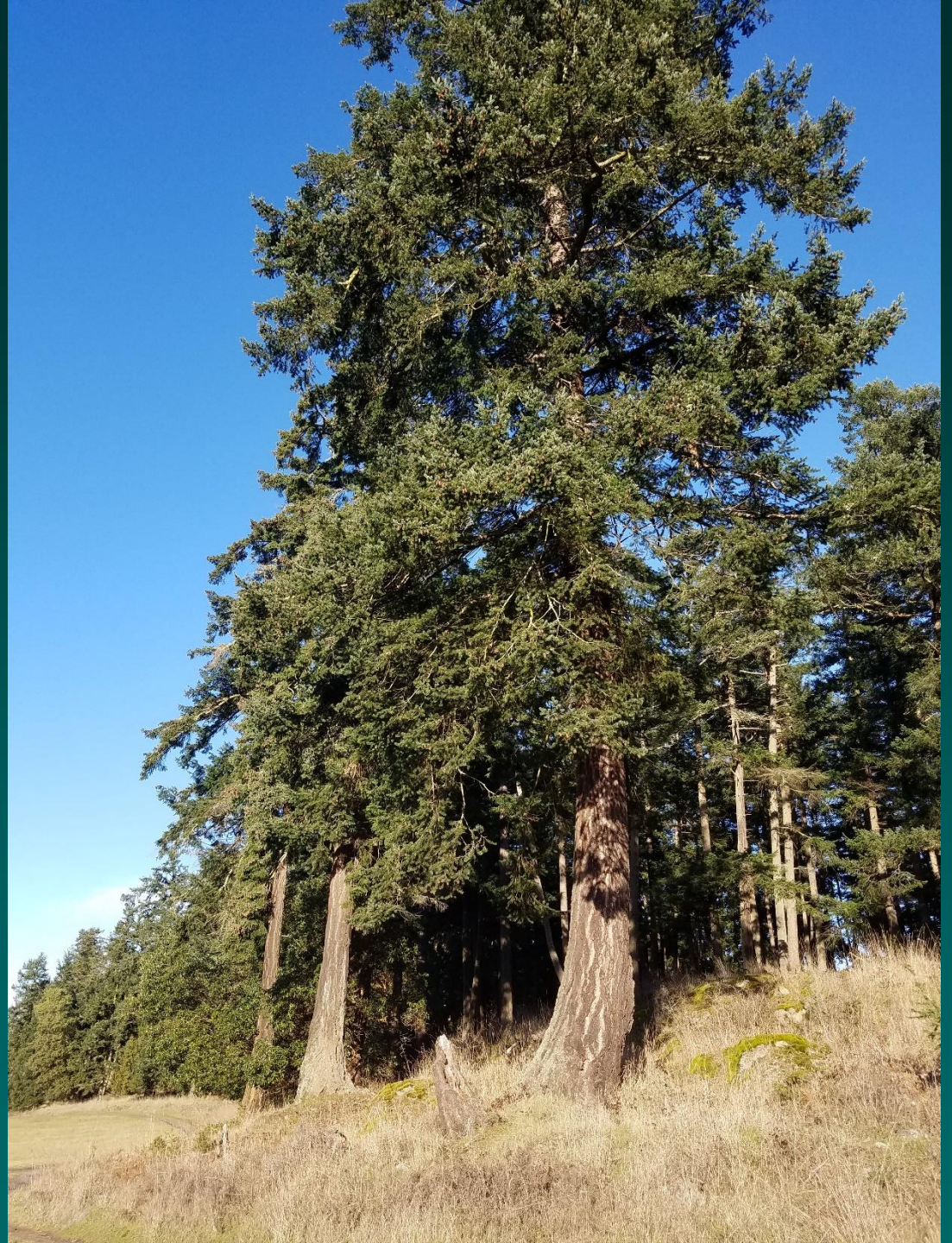
What defines our forests?

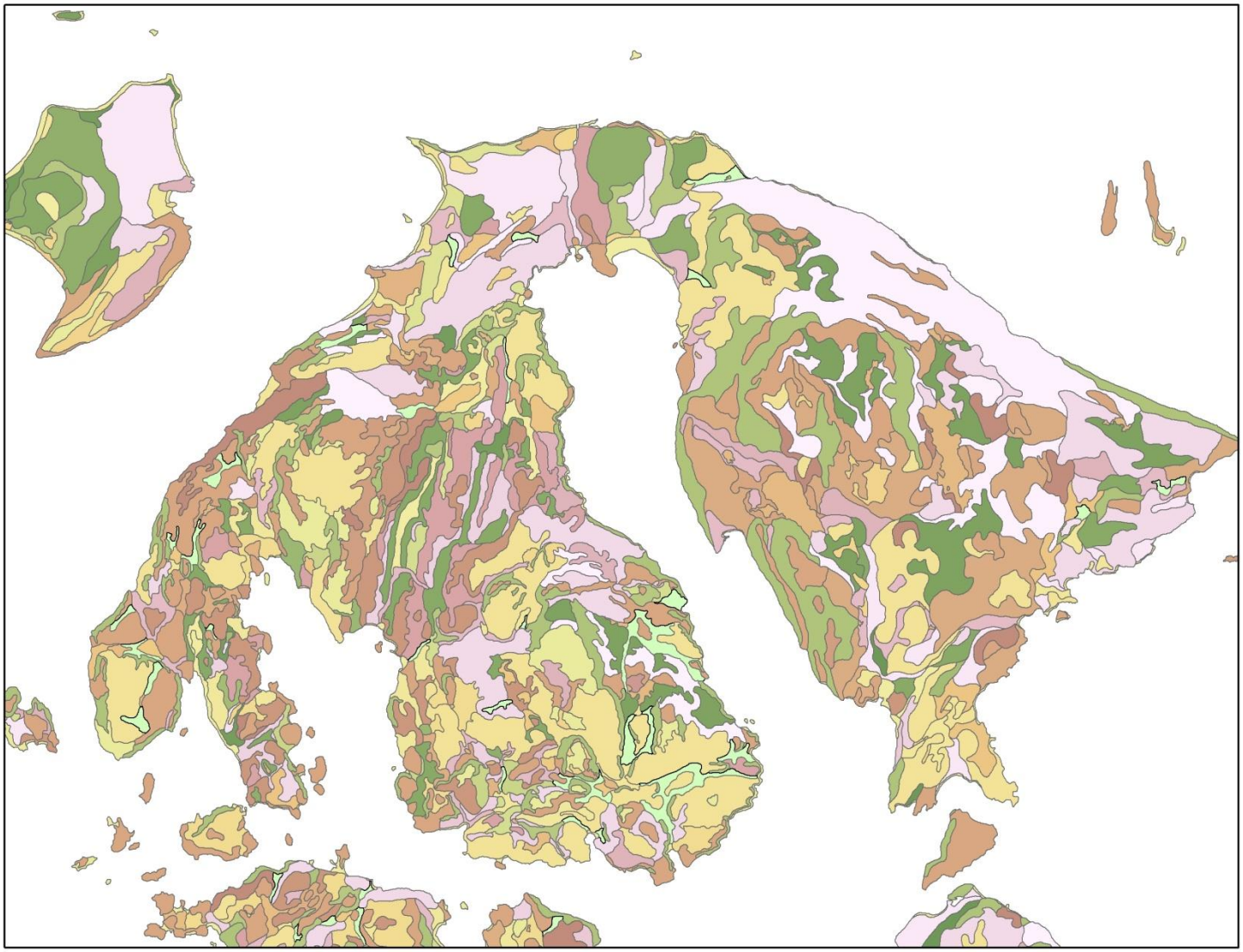
- High geophysical variability
- Climate
- Soils
- Disturbance
  - Abiotic (wind, snow & ice)
  - Biotic (disease & insect)
- Fire



What else defines our forests?

- Human History?
- Big Influence
  - Pre-settlement
    - Fire
  - Post-settlement
    - Grazing/ farming/ clearing
    - Logging
    - Lack of Fire (fire exclusion & suppression)



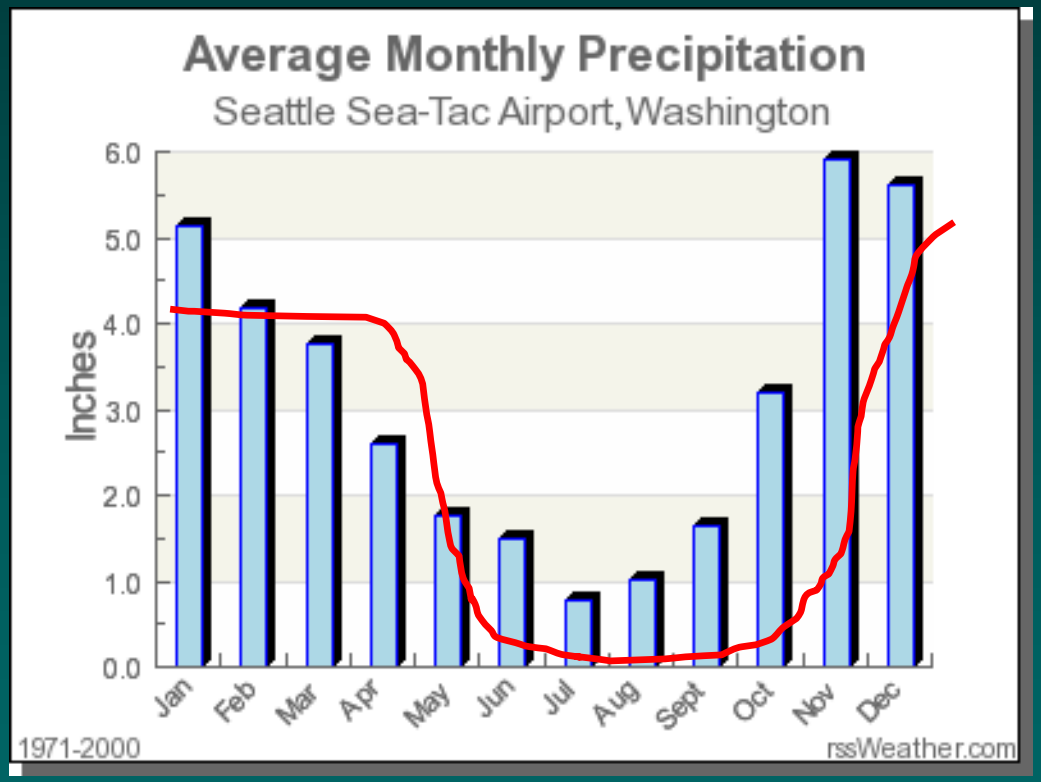


Plants must be drought tolerant!

Friday Harbor average Precip 28 inches

Seattle 36 inches

Portland 43 inches



Disease

What is *Dendrochronology?*

- The science of dating events & environmental change through the study of tree rings.

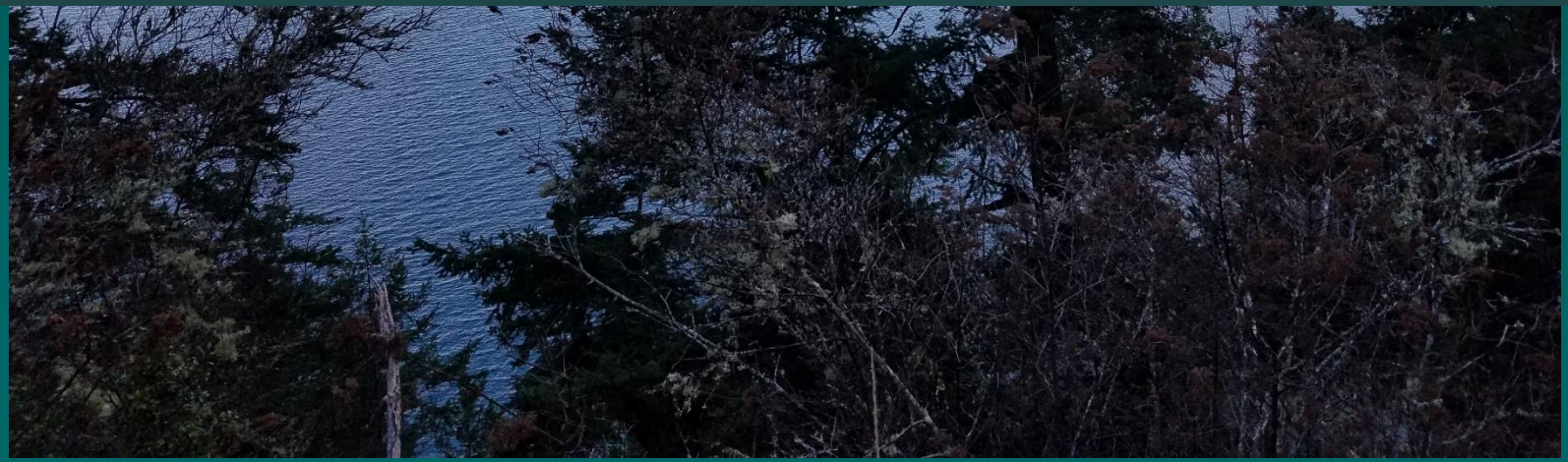
- Can provide annual resolution.

What is a *Fire History?*

- Characterizes the role of fire in ecosystems.
- Describes the natural range of variability in fire frequency, severity, extent, and spatial complexity in a given system.
- .

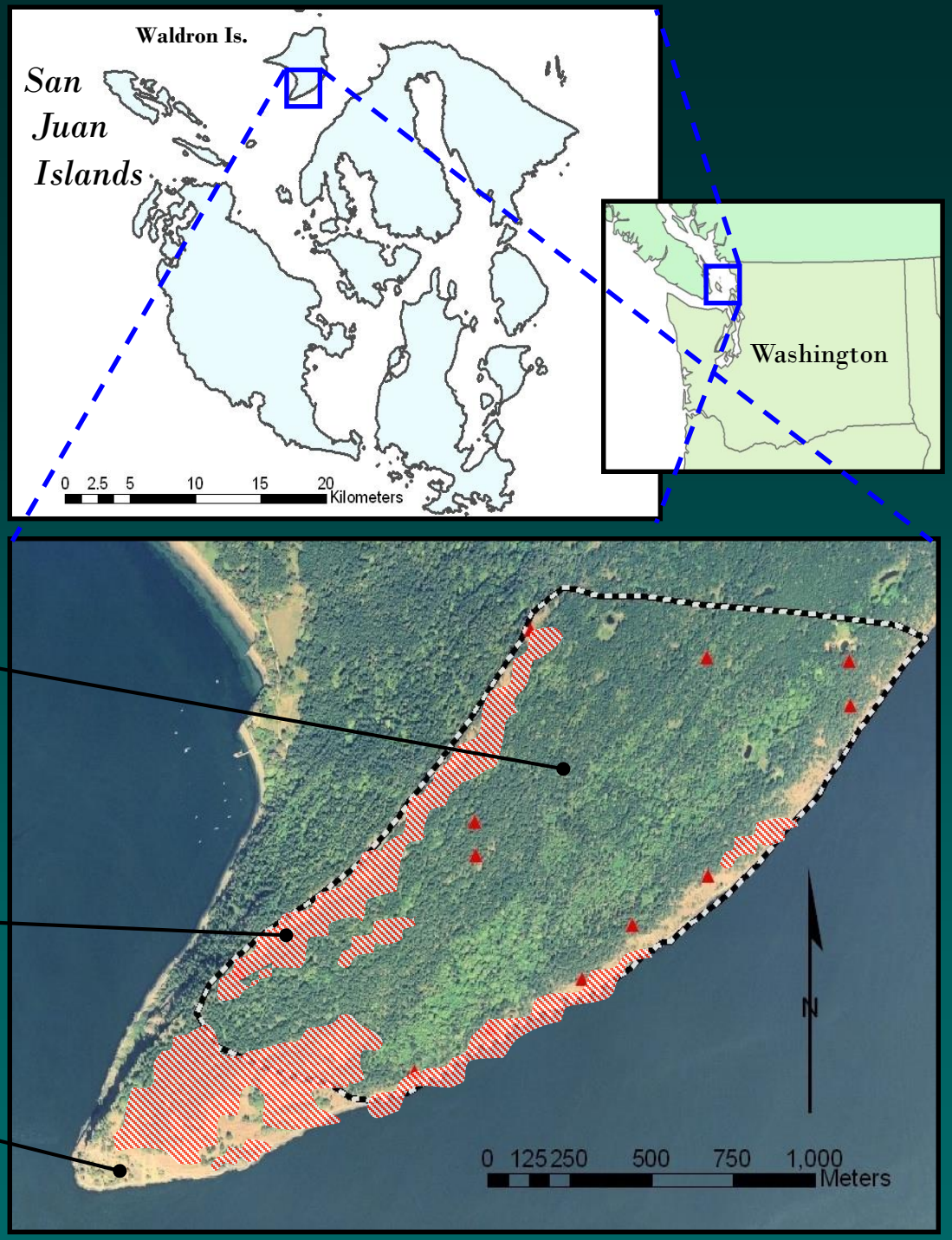
Case Study: Waldron Fire History

Fire History of a Douglas-fir—Oregon White Oak Woodland, Waldron Island, Washington (2011; Northwest Science)



Study Site

- 155 ha
- SE aspect
- Dry site
- Thin soils + outcrops



Encroachment into open areas (grasslands & savannas)

1965

1998

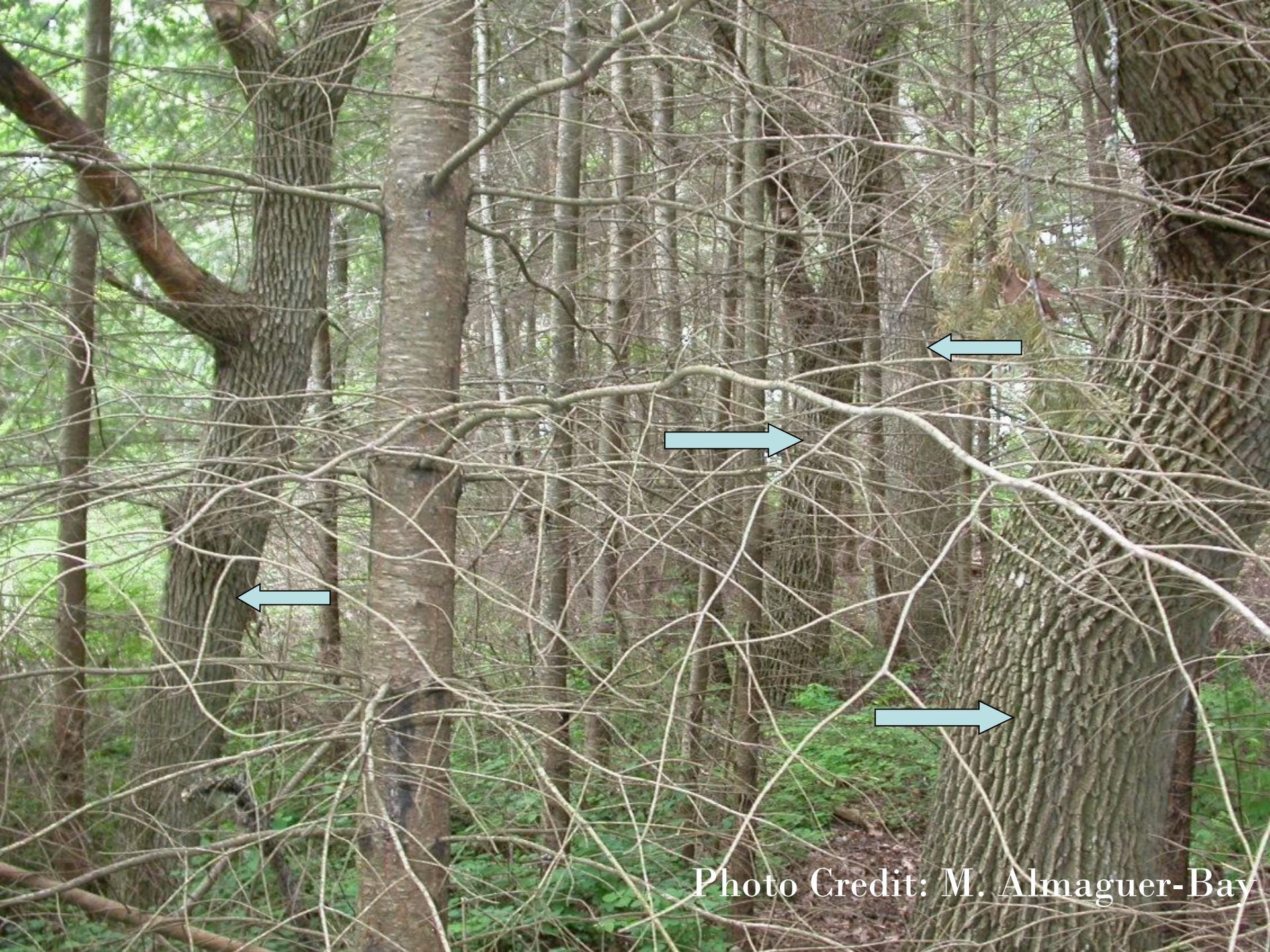


Photo Credit: M. Almaguer-Bay

Sampling Methods:

- Located multiple scarred trees
- Removed partial and full cross-sections
- Removed 20 tree cores for site chronology (cross-dating)

Lab Methods

Sanded & aged

Scars identified

Dates assigned

Dates cross-dated against chronology

(Grissino-Mayer)

Analysis time periods:

1. Historic (1700-1879)

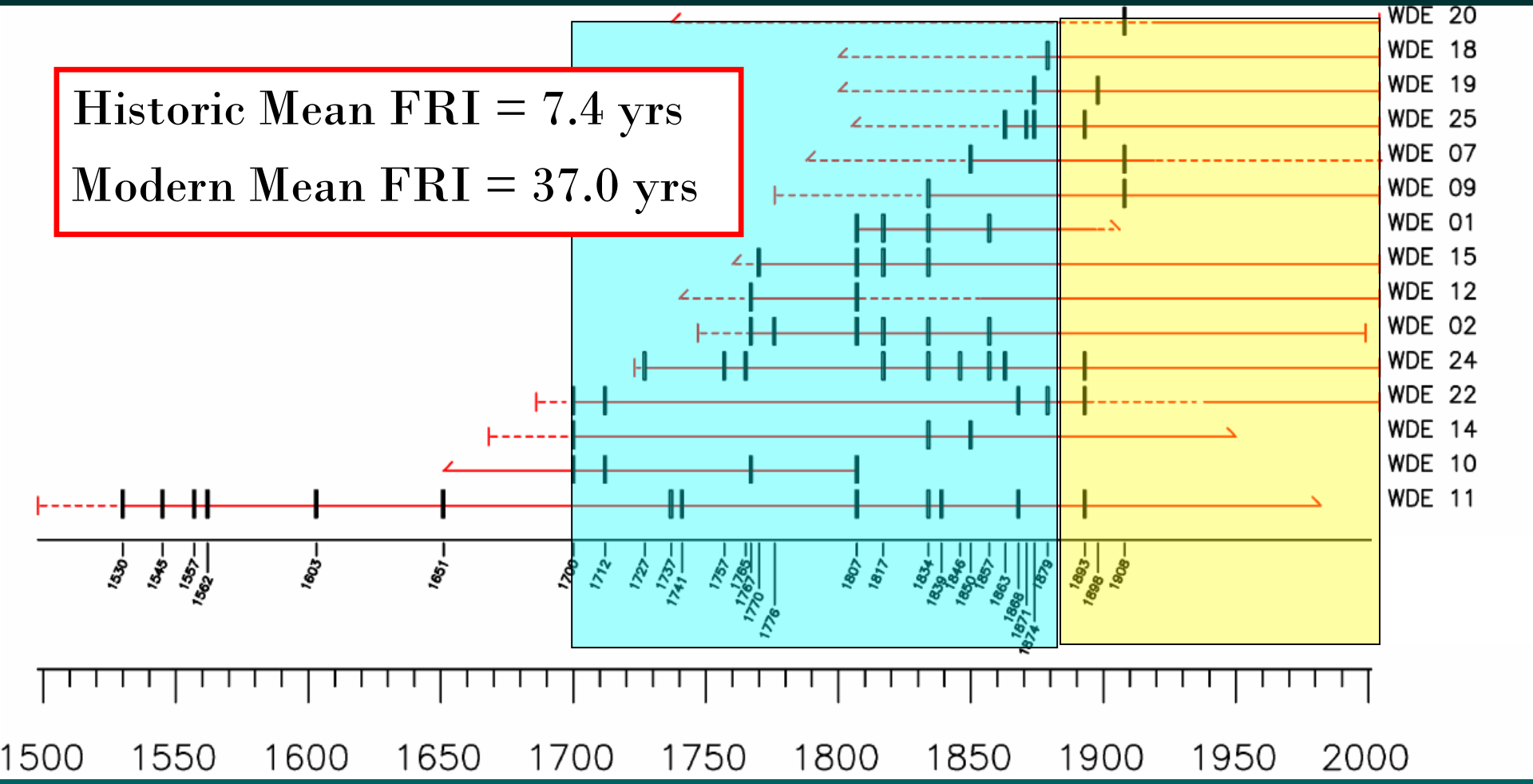
2. Settlement/modern (1880-2004)

Results

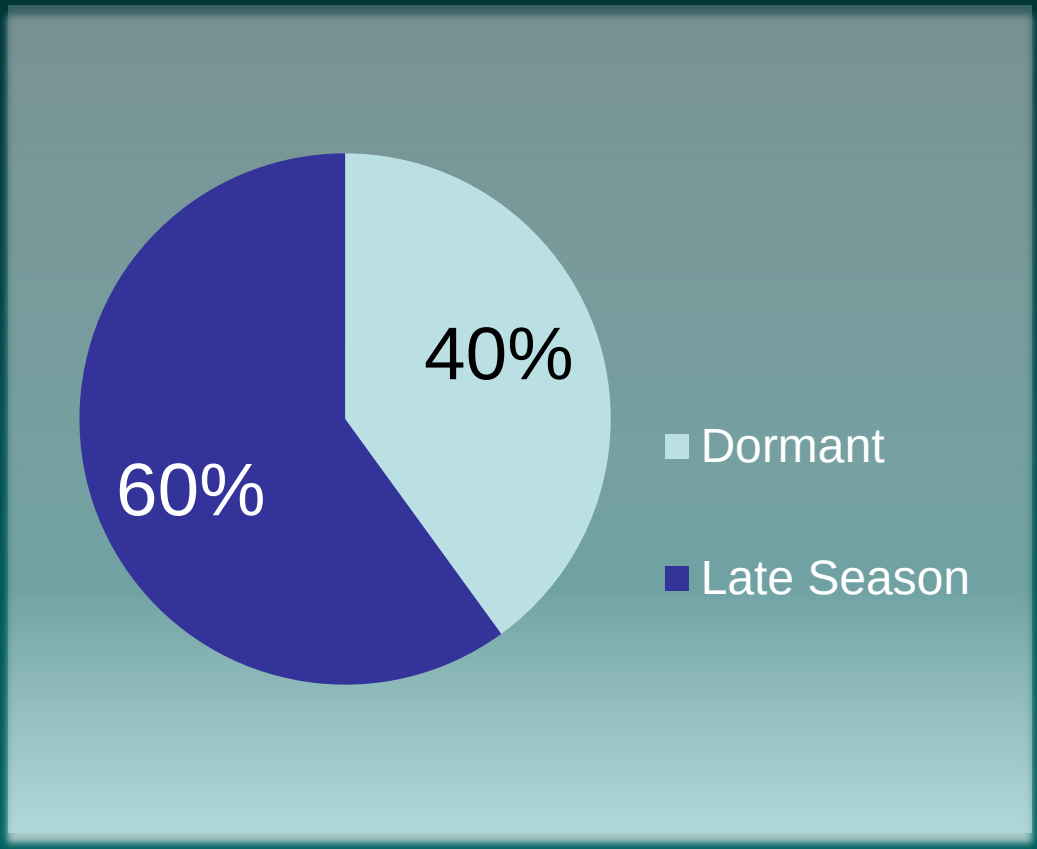
- 15 of 29 samples cross-dated
- 62 total fire scars, 31 fire years from 1530 - 1908

Analysis period	No. of intervals	Mean (MFI)	Med	s.d.	Range	WMPI	87.5% WCI
Historic (1700-1879)	21	8.5	6.0	6.8	2-31	7.4	2.4-15.8
Settlement / modern (1880-2004)	3	37	10	51.2	5-96	-	-

Fire History



Results : Seasonality (scar position)



Dormant = Late Sept/October/November
Late Season= July/August/September

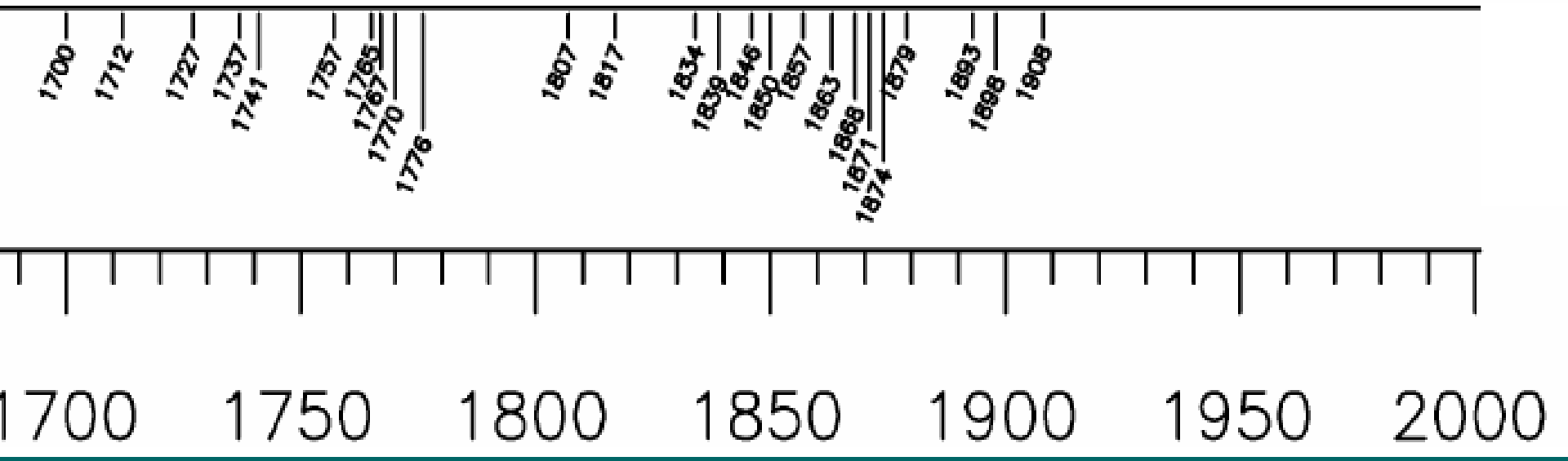
Summary

- Despite decay, insect damage, ½ of samples unreadable,
  - Sampled Douglas-fir were effective recorders of fire events
  - Likely missed some fire events

- Historic FRI (7.4 yrs) is frequent, yet highly variable (2-31 yrs)
- Longer intervals lead to larger fires (increased fuel)
- Seasonality = late summer & fall

What caused these fires? Humans?

1) Lightning strikes rare, fire suppression nearly absent
2) Known coast Salish sites on Waldron
3) Long fire free periods
   (31 yrs from 1776-1807)
   (1908 to 2010)

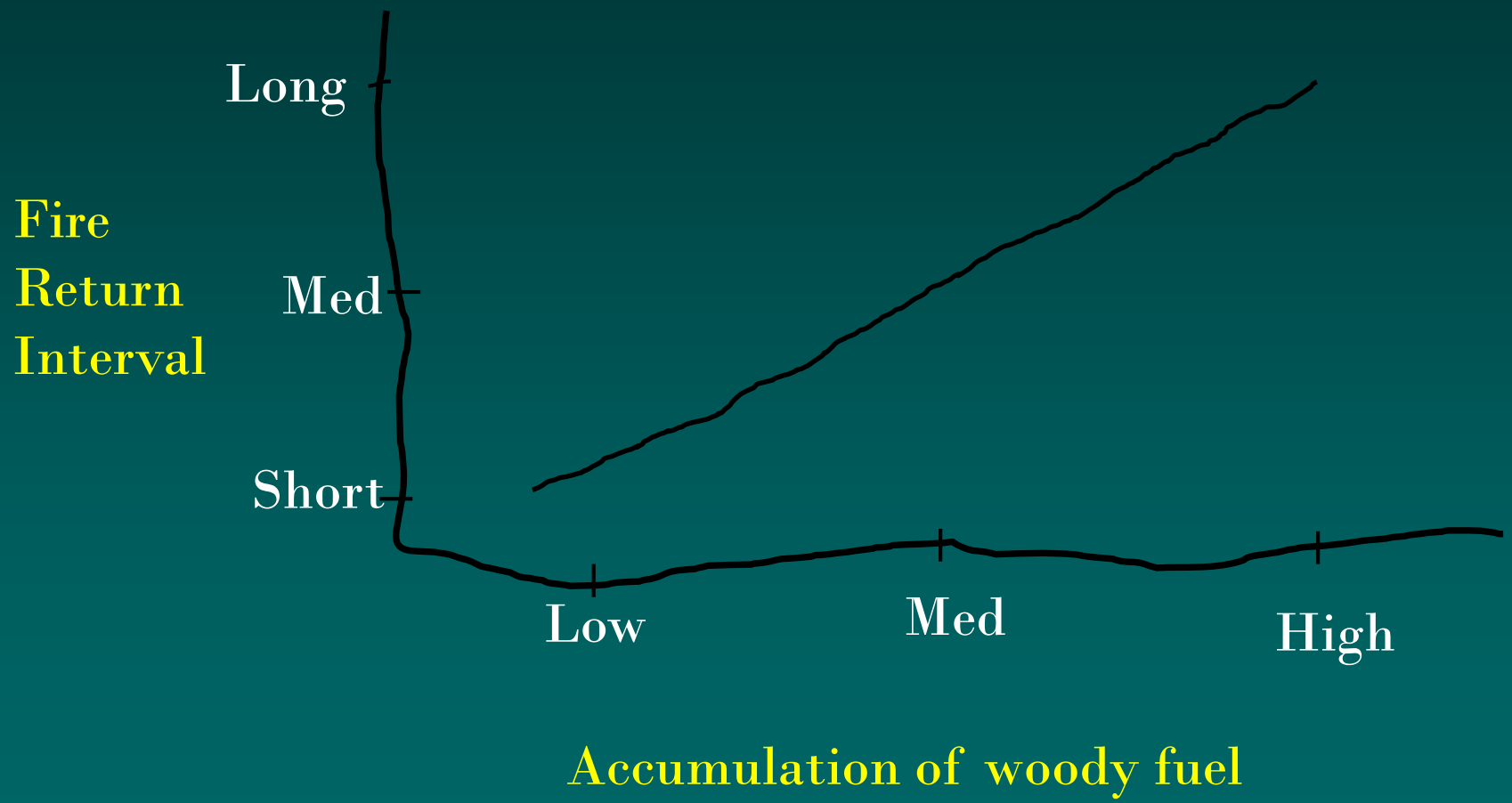


Other Studies:

Lopez, Stuart Island, Henry Island, Patos Island

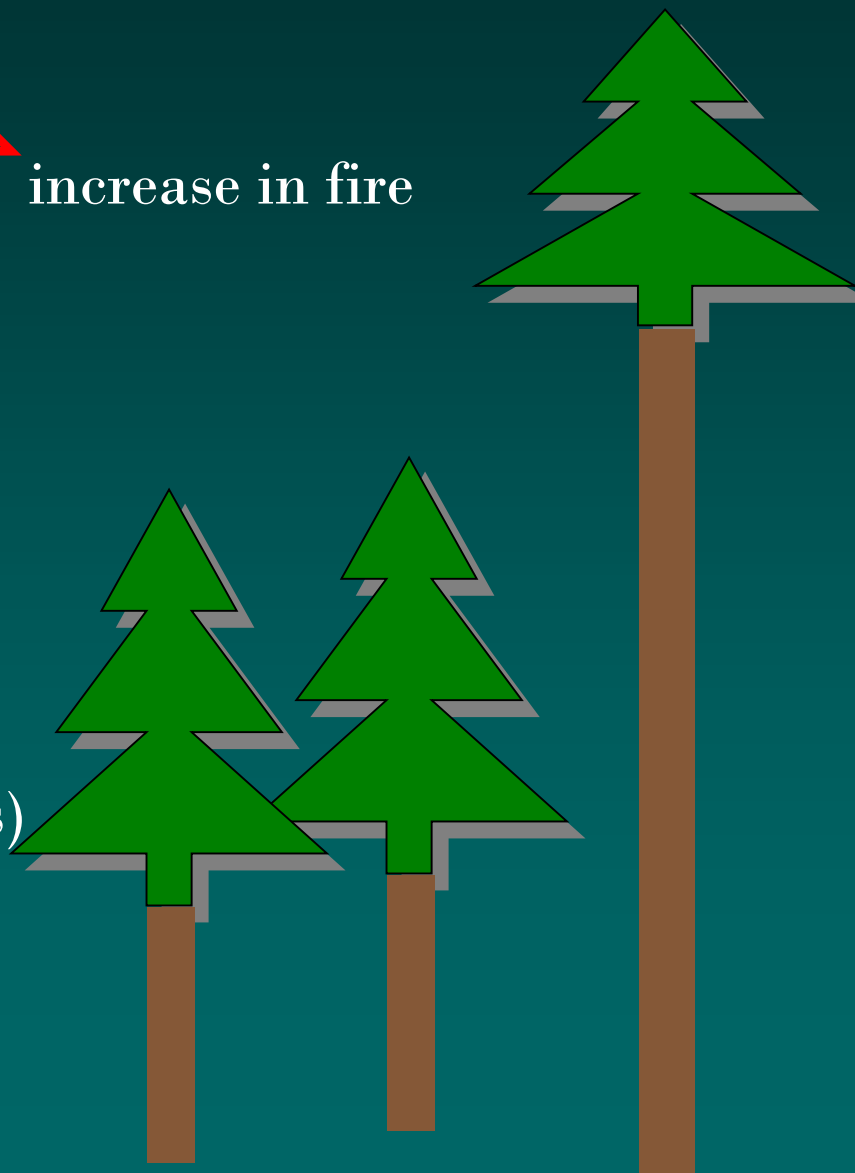
- *Most sites burned every 7-15 years.*
- *Fires low-intensity.*
- *Ignition source likely human.*
- *Burning stopped 100-150 yrs ago.*

Relationship of Fire Frequency to Fuels



Shift in Species Composition

- Longer Fire Return Interval = ⇧ increase in fire *intolerant* species.
  - Grand fir
  - Hemlock
  - Cedar
  - = ⇩ decrease in fire adapted species (oak, native grasses)



Management implications:

Current fire exclusion =

- Longest in last 500+ yrs.
- Structural and compositional changes
- Loss of woodlands and grasslands (encroachment)
- High fuel loads & increased risk of high severity fire

Management implications:

Current fire exclusion =

- Increase in overall forest cover
- Increase in overall tree density
- Greater susceptibility to drought
- …….insect & disease problems……

- …..and chances of Catastrophic fires!

Other Questions Related to Fire:

Other Questions Related to Fire:

Charcoal and its role in forest ecosystems.

- Important chemical connection between roots and mycorrhizae
- Functions as massive “hotel complex” for micro-organisms
- Stores carbon in soil (for centuries)
- Increases water holding capacity

Lack of new charcoal deposition may be contributing to declines in forest health

Other Questions Related to Fire:

Charcoal and its role in agricultural soils.

- Increases nutrient holding capacity (CEC)
- Improves tilth & micro-organism functions
- Stores carbon in soil (for centuries)
- Increases water holding capacity

C02 Release: Burn vs. Chip

C02 Release: Chip/ Burn vs. Charcoal

Low-tech charcoal production arrests conversion to atmospheric CO2 for centuries!


KUBOTA

Acknowledgements

Funding:

Center for the Study of Coast Salish Environments, UW College of Forest Resources

Field and Lab Help:

Sam Sprenger, Tillie Scruton, Mitchell Almaguer-Bay, Reed Wendel, Melanie Welch, Mike Tjoker, Mike Case, Jeremy Littell

Special Thanks:

Linda Brubaker, Jim Agee, Robert Gara


Yellow Island Burn, August 2004