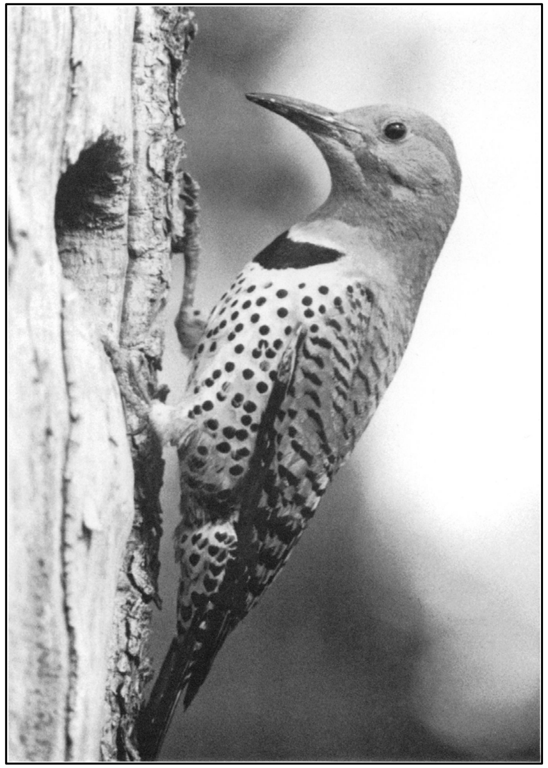
The Life Cycle of Dead Trees

Effectiveness
Monitoring
Committee

April 12, 2022

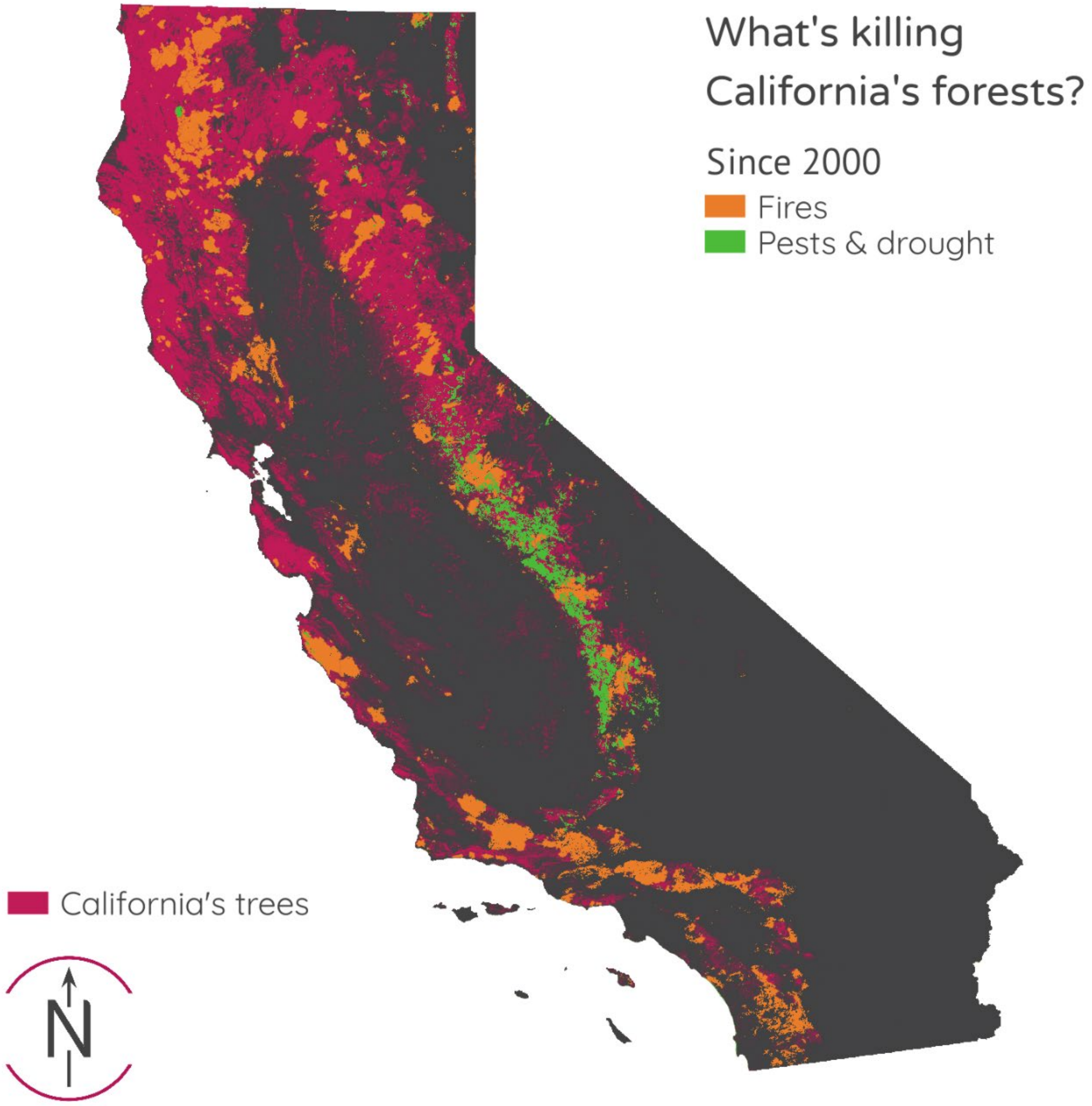
John J. Battles, Robert York, and Ariel Roughton

Snag Management in Forestry: Wildlife and Wildfire



Raphael and White. 1984. Use of snags by cavity-nesting birds in the Sierra Nevada. Wildlife Monograph 86:3-66.

Hot Drought = 147M Dead Trees



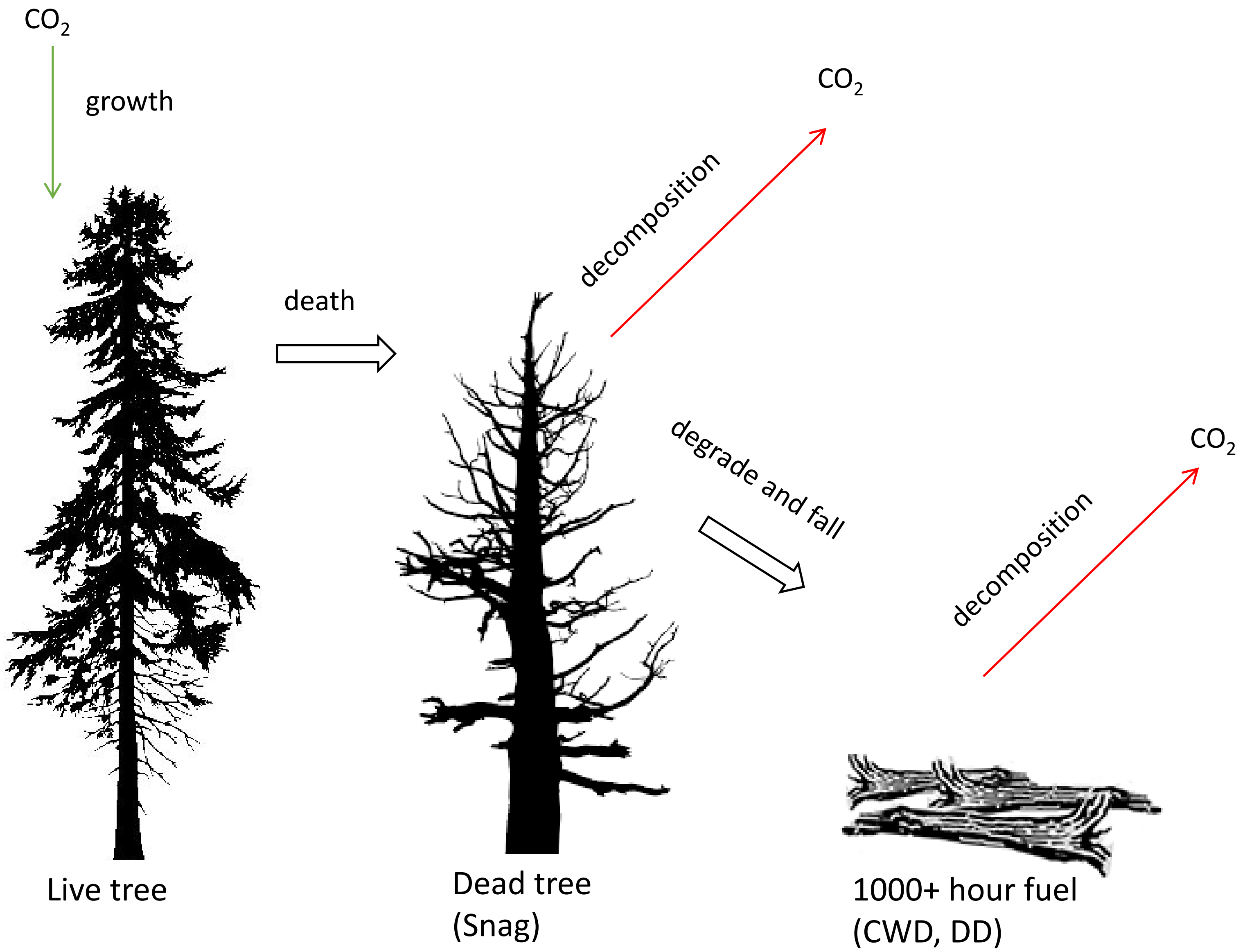
EMC Perspective

1. Habitat value of snags recognized and their retention stipulated in Forest Practice Rules.

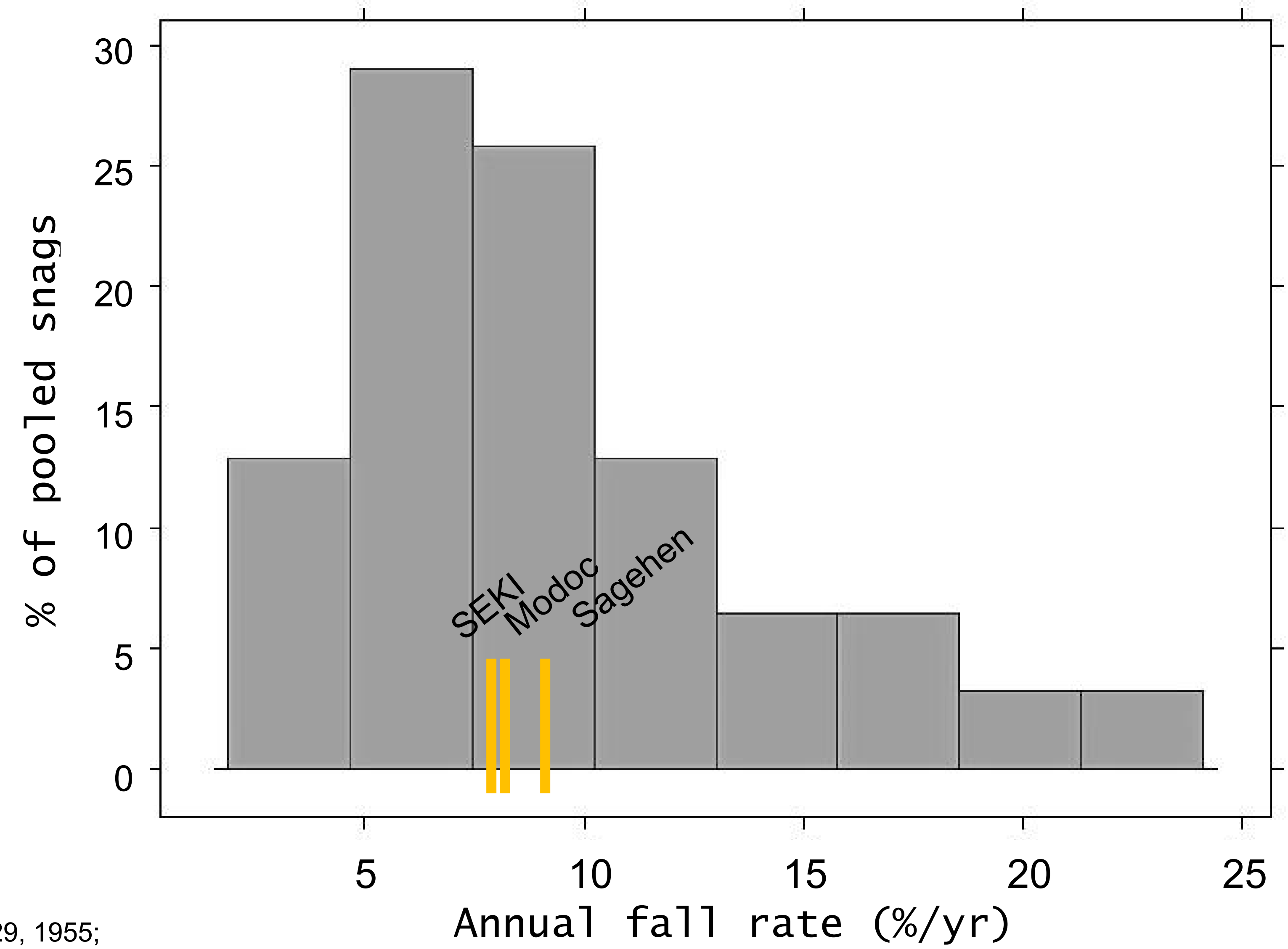
2. Snags present a risk to forest operations and wildfire hazard mitigation.

3. Need better understanding of dead wood cycle to inform forest management.

Dead wood cycle



Snags are ephemeral*



Keen 1929, 1955;
Raphael and Morrison 1987, 1993
Battles et al. 2015

*Histogram from Hilger et al. 2012

Decay rates are exponential

HARMON, M. E., CROMACK, K., JR., and SMITH, B. G. 1987. Coarse woody debris in mixed-conifer forests, Sequoia National Park, California. Can. J. For. Res. 17: 1265–1272.

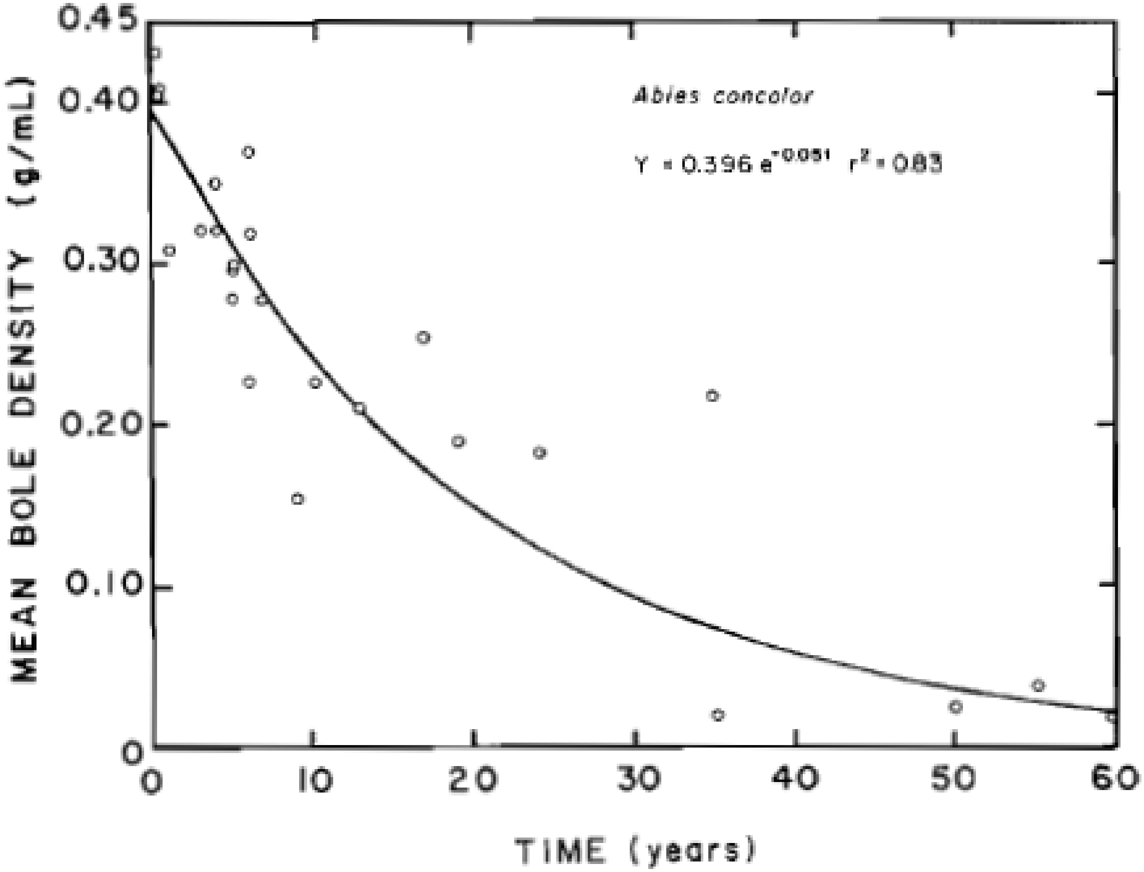


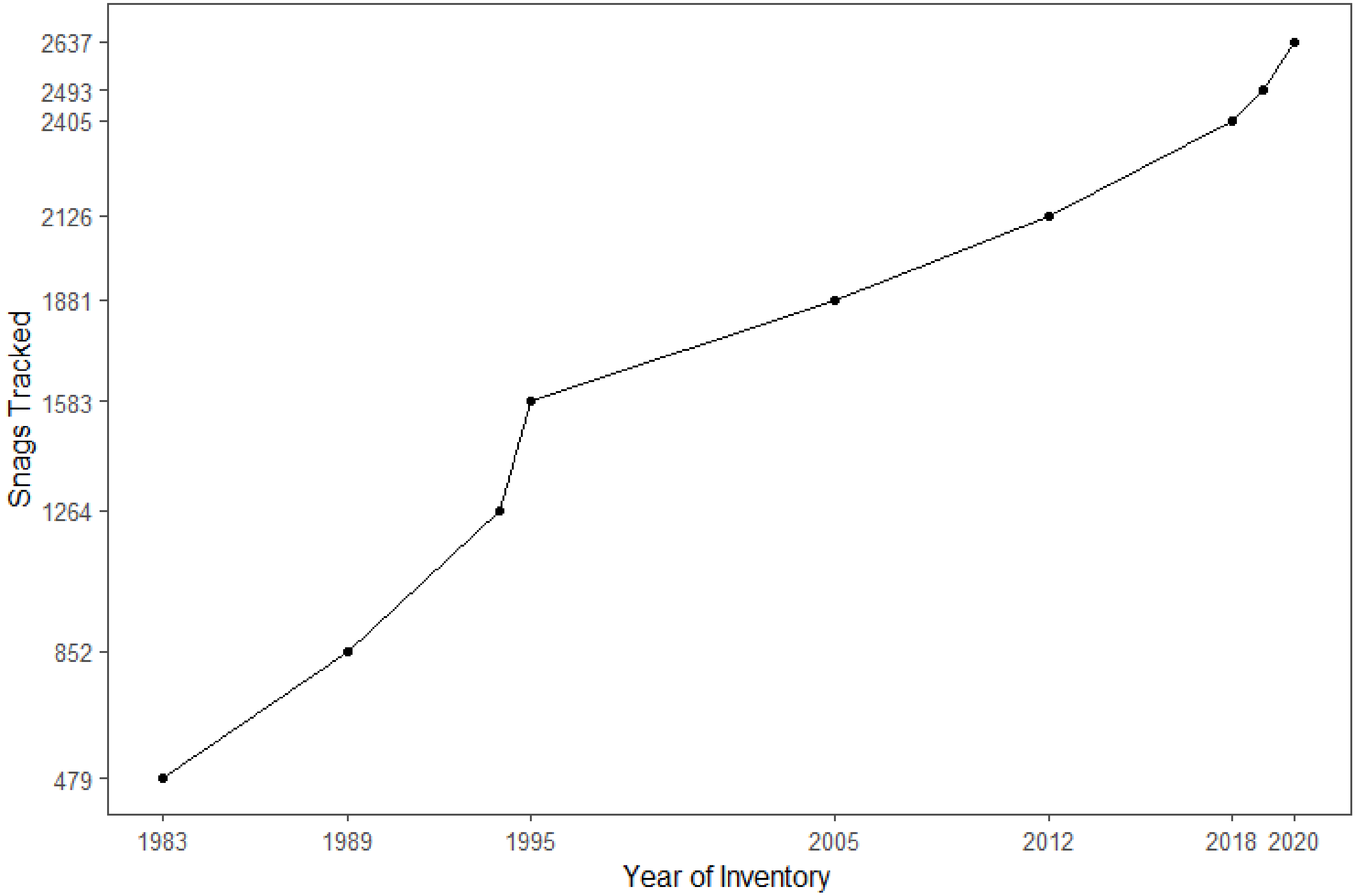
FIG. 1. Mean density of *Abies concolor* boles as a function of time since falling. The density of boles on the ground for more than 24 years was adjusted to reflect volume losses.

Blodgett Forest Research Station

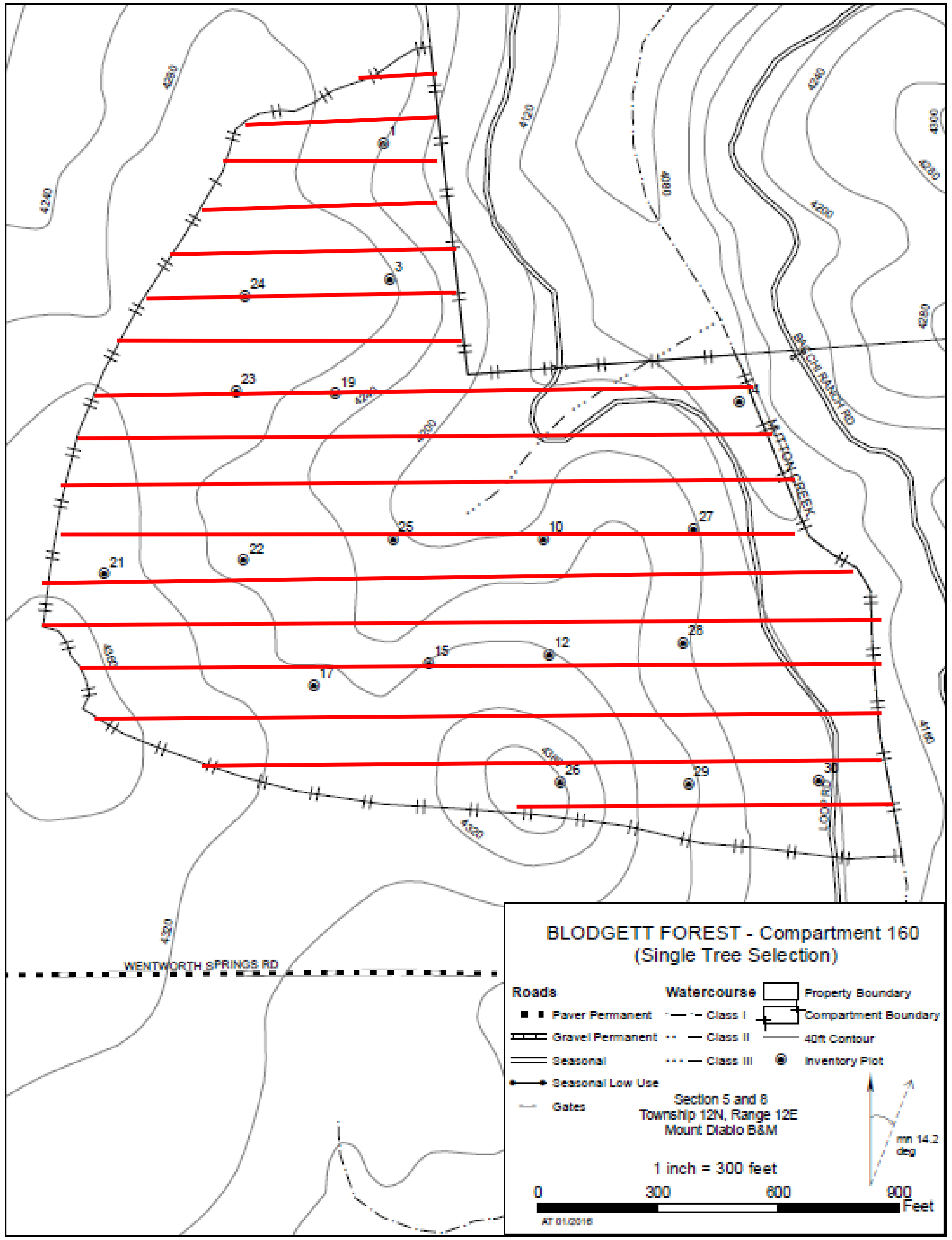
Blodgett Forest Managers

Percy Barr: 1934 – 1955
Rudy Grah: 1958 – 1960
Herb Sampert: 1960 – 1976
Bob Heald: 1976 – 2006
Frieder Schurr: 2006 - 2007
Robert York: 2007 – 2018
Ariel Roughton: 2019 –

Compartment 160: Snag demography study



Compartment 160: 2018-2020



Analytical approach

Strength: 2,600+ trees observed over 37 years

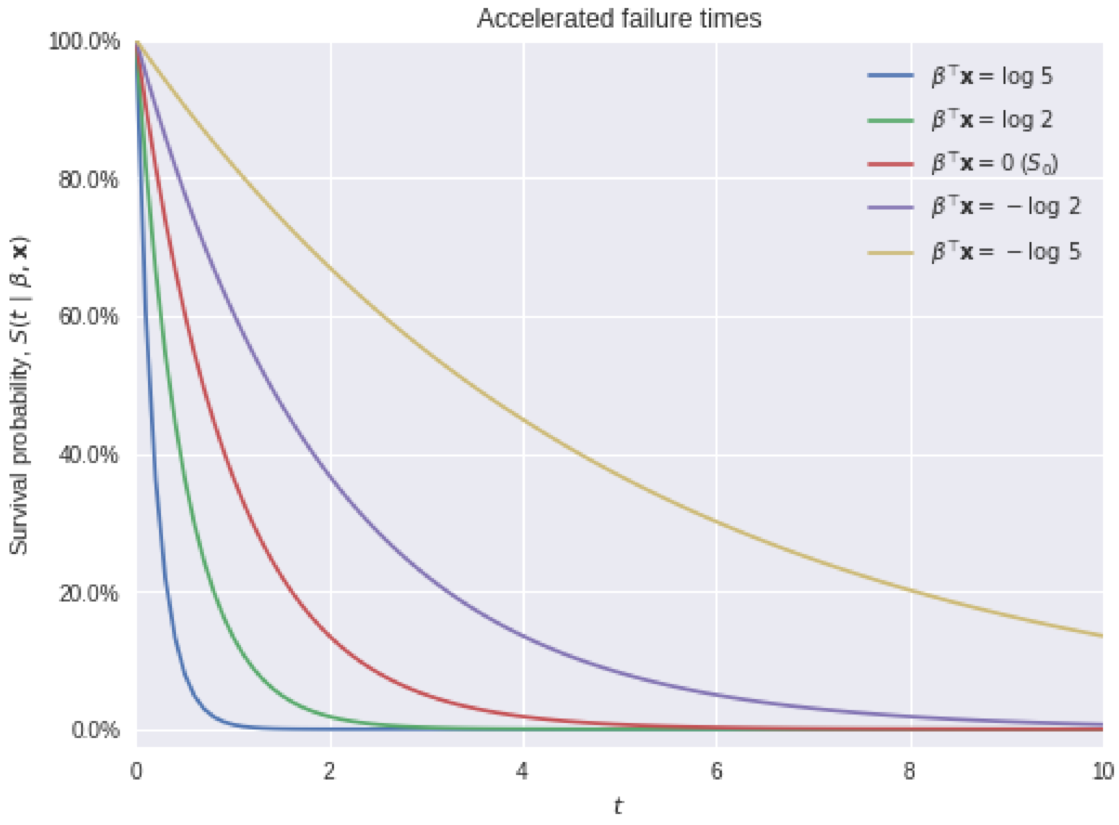
Weakness: Long intervals between inventories; interval censored data

Accelerated Failure Time (AFT) Model

- The effect of a fixed covariate Z is to act multiplicatively on the failure time T or additively on Y = logT.

$$Y = \log T = \alpha + \beta^T Z + \sigma\varepsilon$$

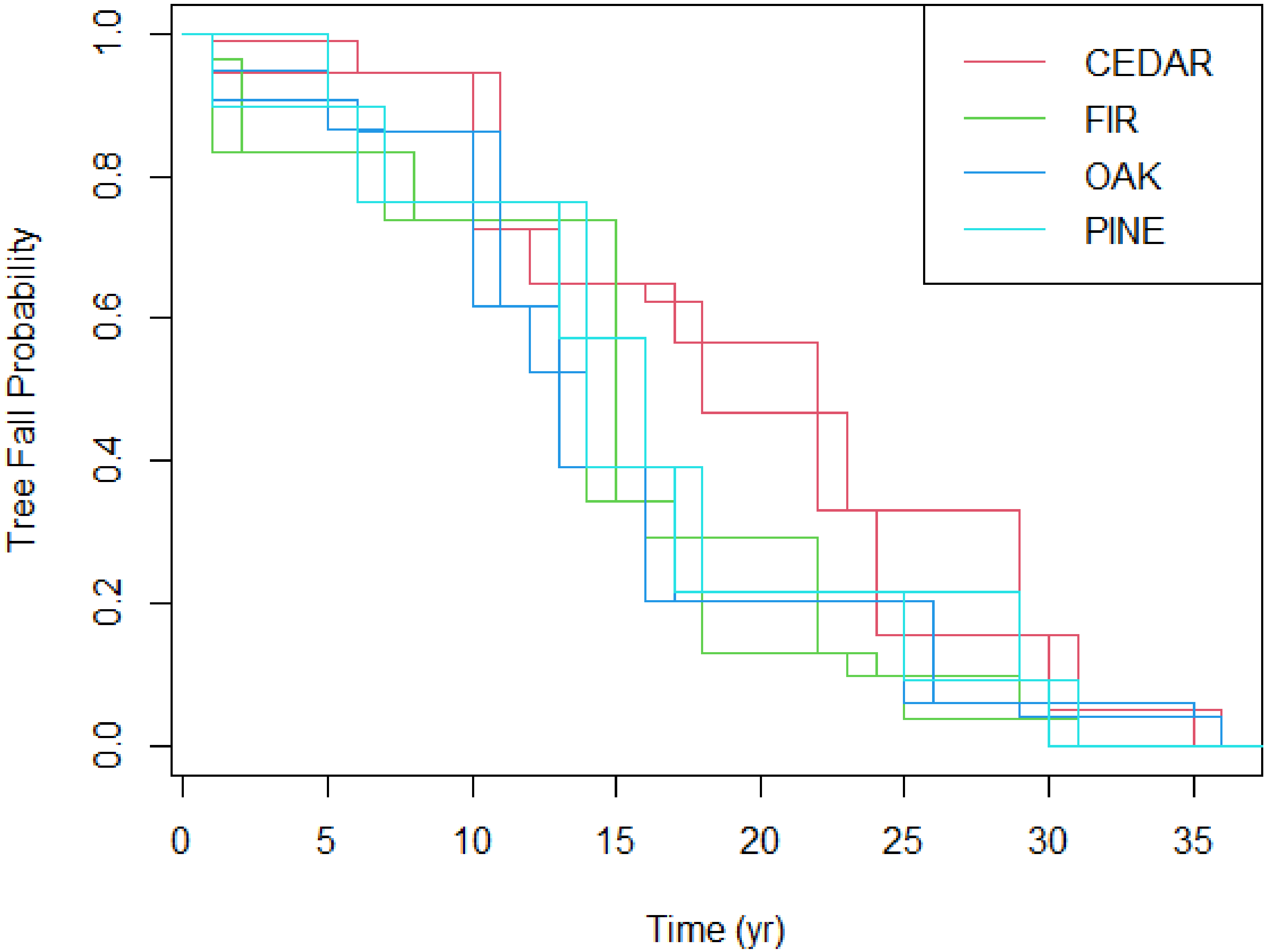
- exp(β): regression parameter which can be interpreted as the ratio of failure time per unit change in covariate.
- AFT model postulates a direct relationship between failure time and covariates.
- "Accelerated failure time model are in many ways more appealing because of their quite direct physical interpretation" – Sir David Cox.



Failure time analysis: Species group

1.Cedar remains standing longest

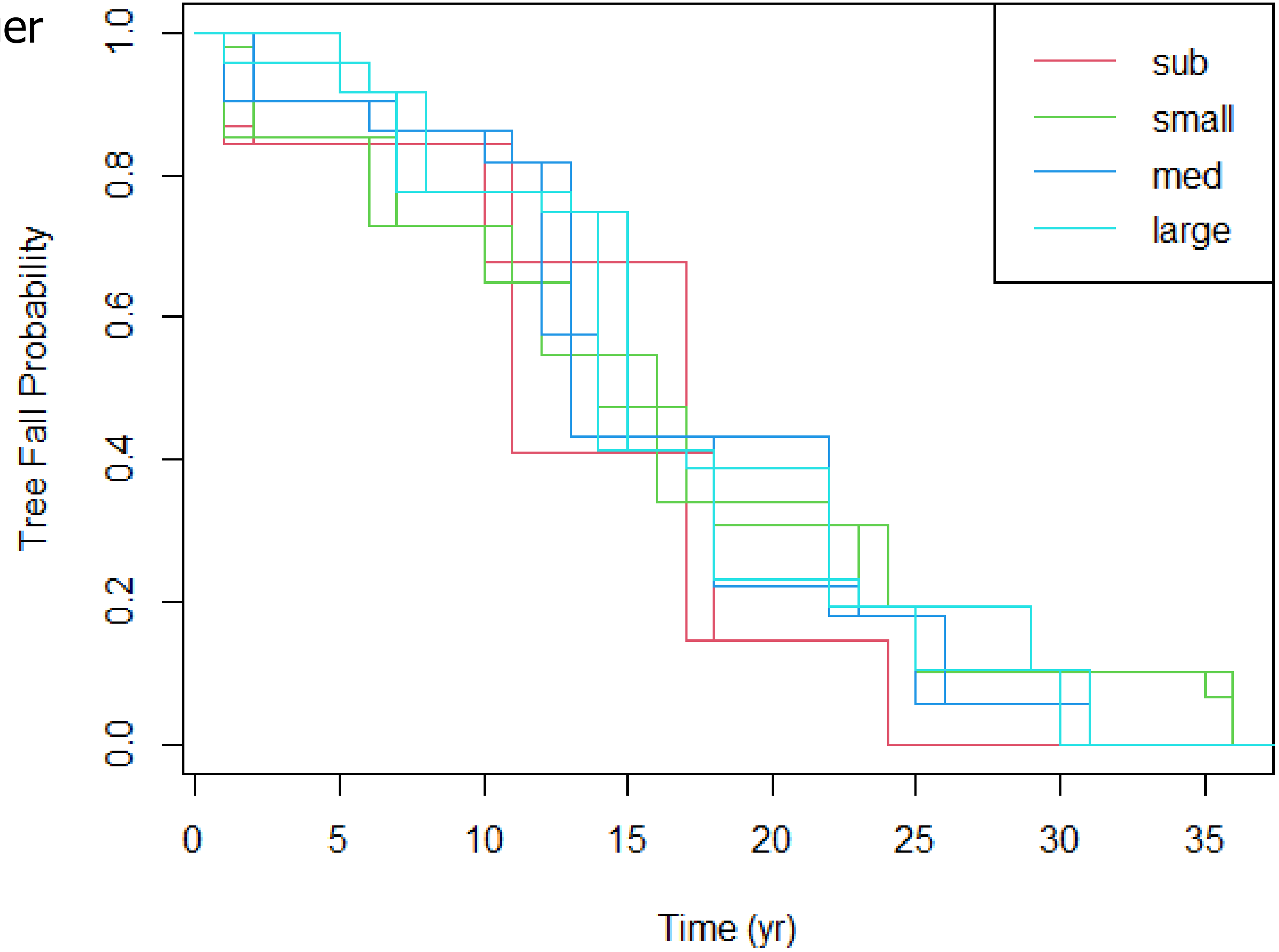
2. Fir falls the fastest



Failure time analysis: Tree size class

1. Larger trees remain standing longer

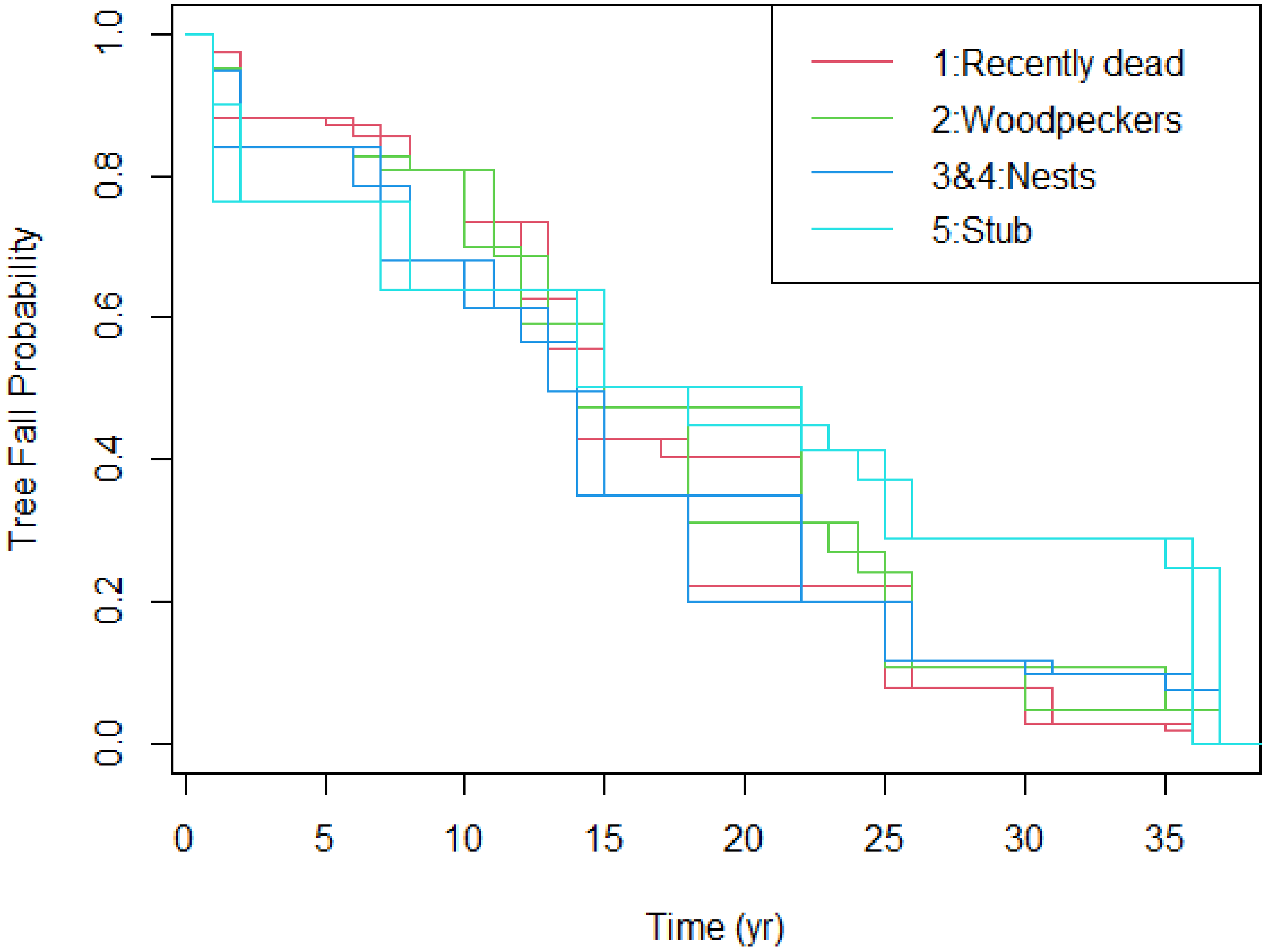
2. Smallest trees fall fastest
   (sub < 7.9 in DBH)



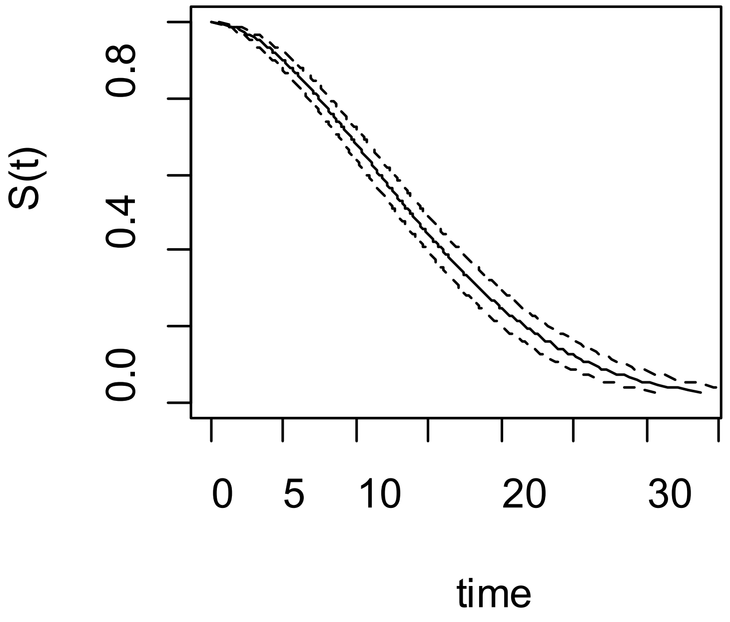
Failure time analysis: Decay class

Stubs remain standing a long time

Nest trees tend to fall the fastest



Median Fall Rates

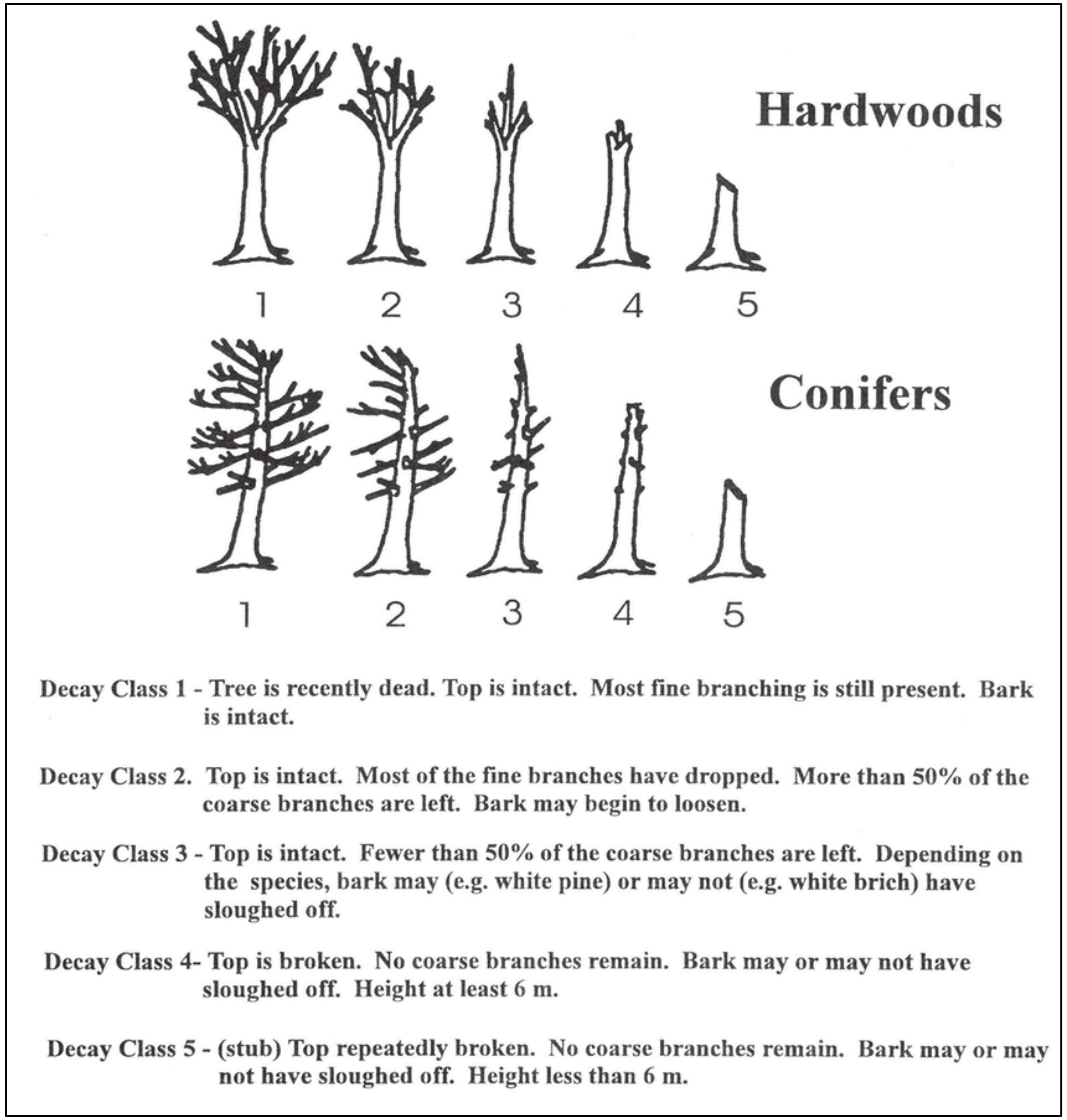


Weibull additive model with species group and size class was the best model

Species	DBH	Fall Times (years)		
		median	25th	75th
CEDAR	sub	17.9	11.1	26.0
CEDAR	small	19.1	11.9	27.8
CEDAR	med	18.4	11.4	26.7
CEDAR	large	17.2	10.7	24.9
PINE	sub	16.4	10.2	23.9
PINE	small	12.7	7.9	18.5
PINE	med	13.5	8.4	19.7
PINE	large	18.6	11.6	27.1
OAK	sub	1.1	0.7	1.7
OAK	small	14.8	9.2	21.5
OAK	med	14.2	8.8	20.7
OAK	large	15.5	9.6	22.5
FIR	sub	8.2	5.1	12.0
FIR	small	13.8	8.6	20.0
FIR	med	13.6	8.5	19.7
FIR	large	14.4	9.0	21.0

Decay progression
(wildlife snags only)

Decay Class	Longevity (years)	
	mean	se
1	2.0	1.4
2	2.1	1.3
3 & 4	6.8	4.8
5	9.3	6.2



EMC Application

Snags typically remain standing for 15 years.

Only 9 years of their 15 year median “lifetime” do snags provide critical wildlife habitat.

At Blodgett, it takes a minimum of 20 years to grow a tree big enough
to provide wildlife habitat.

Current snag retention guidelines do not consider longevity of existing snags.

Guidelines to not include provisions for snag recruitment in harvested stands.

Results suggest that one matching live tree should be retained for every snag retained to “recruit” replacements for snags that fall.

Decay rate of coarse woody debris

Log cemeteries established in 2018

Initial samples collected

Initial samples processed for wood density

2019: Monumented logs for the long-term

Department of Environmental Science, Policy, & Management

Retrospective Analysis of Wood Decay by Species in Sierran Mixed Conifer

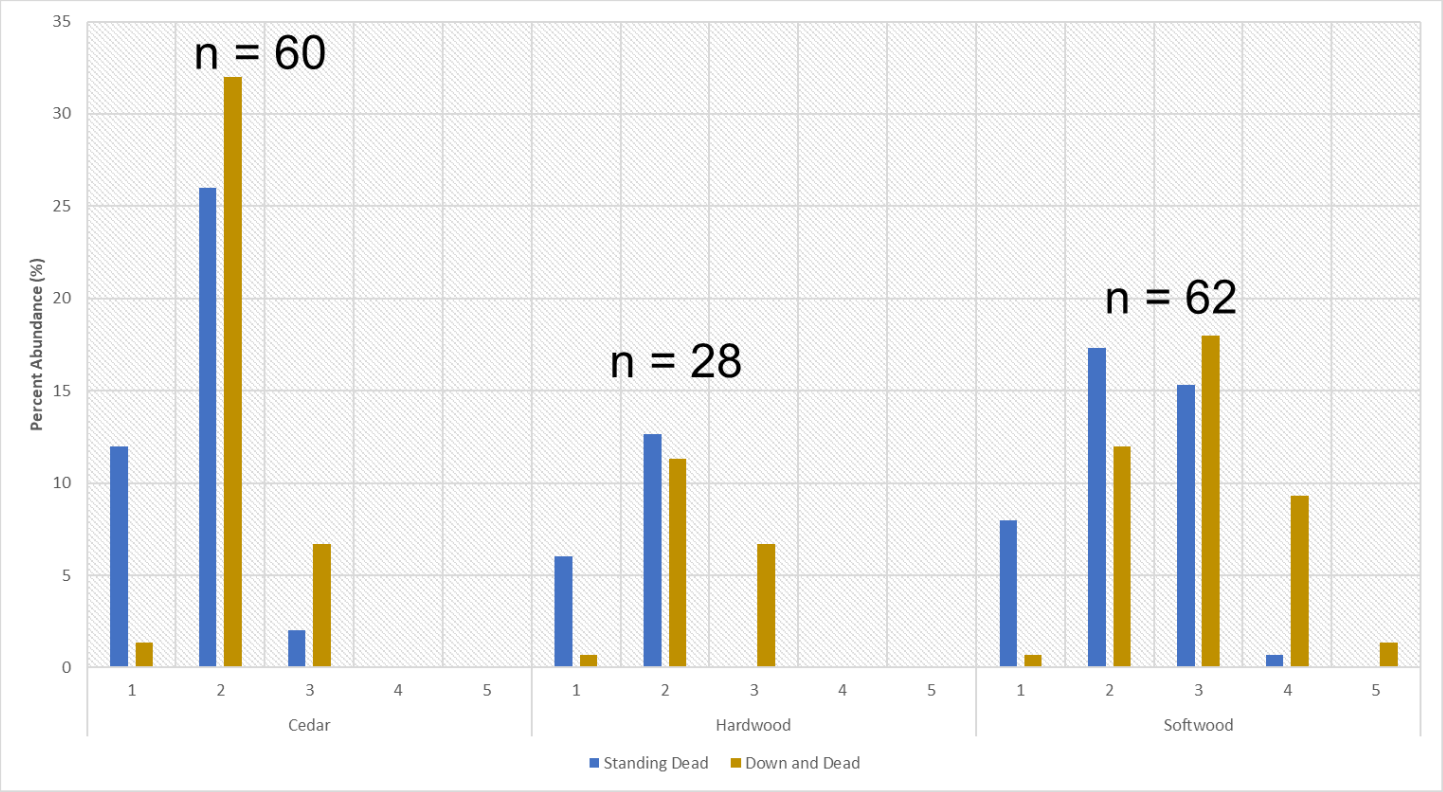
By Adam Sawicky
Mentor: Dr. John J. Battles

Approach

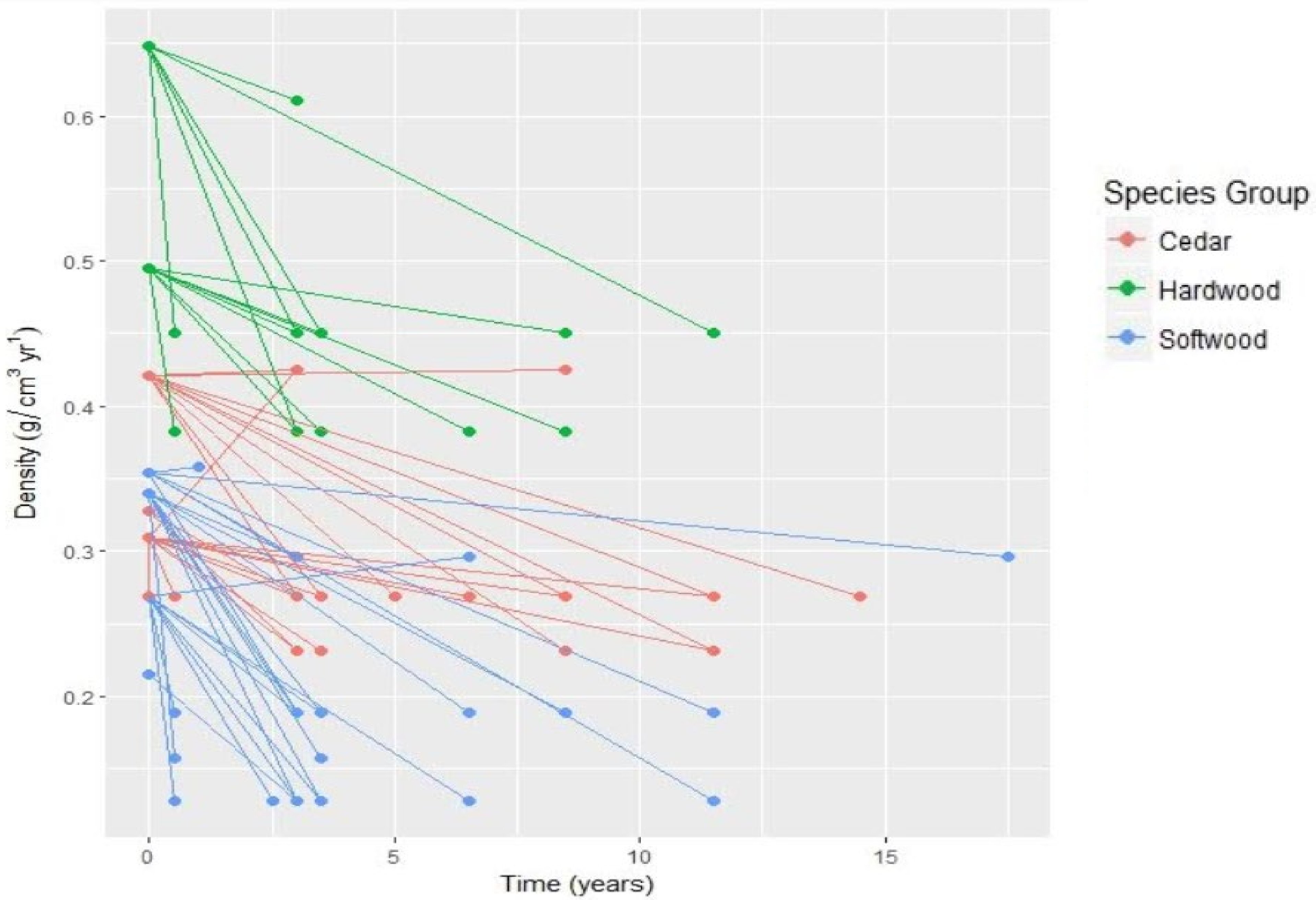
Conduct a field inventory of downed logs

Match records of fall; Evaluate current decay status

Use paired information to estimate decay rate

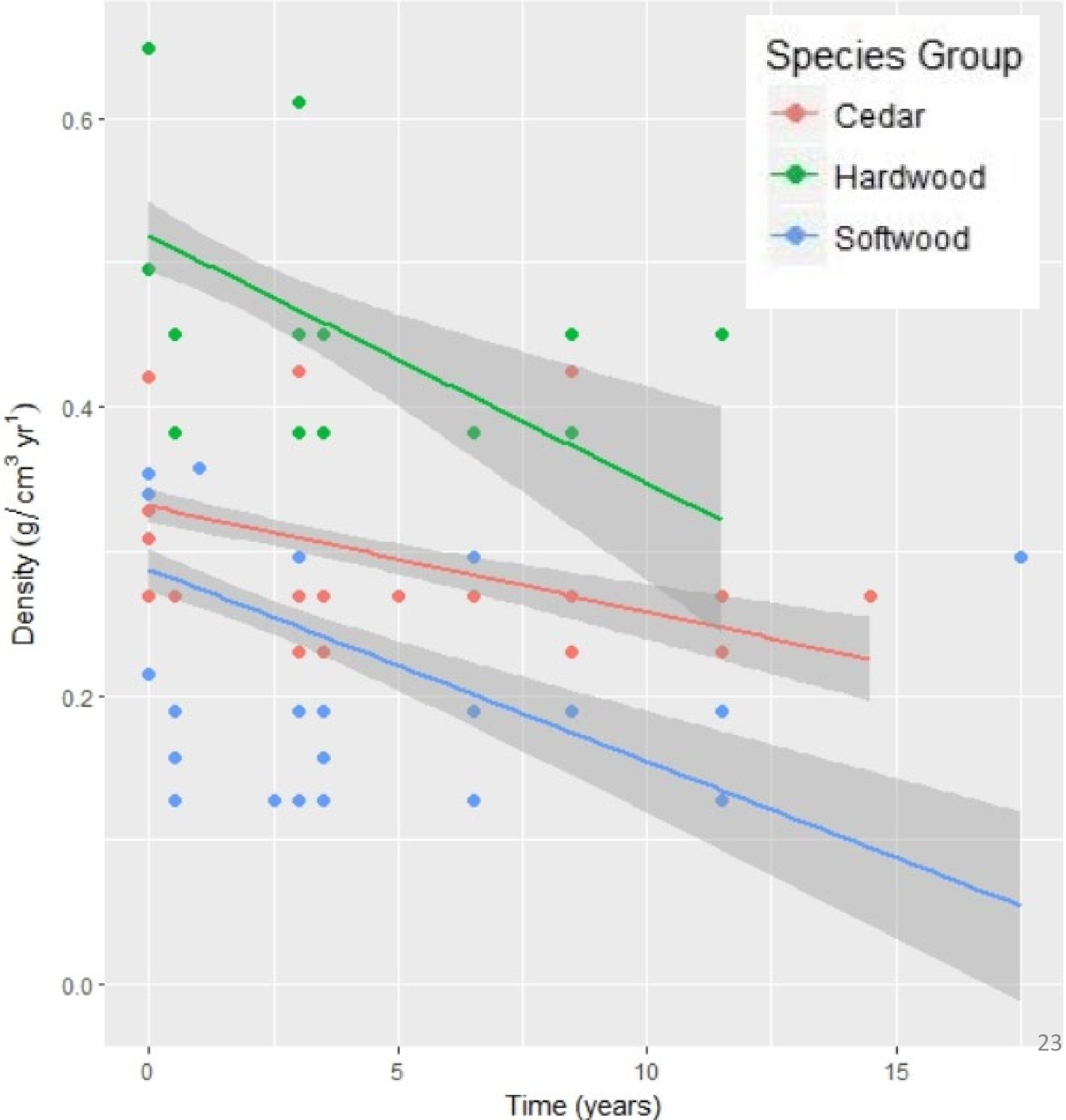


Paired observations

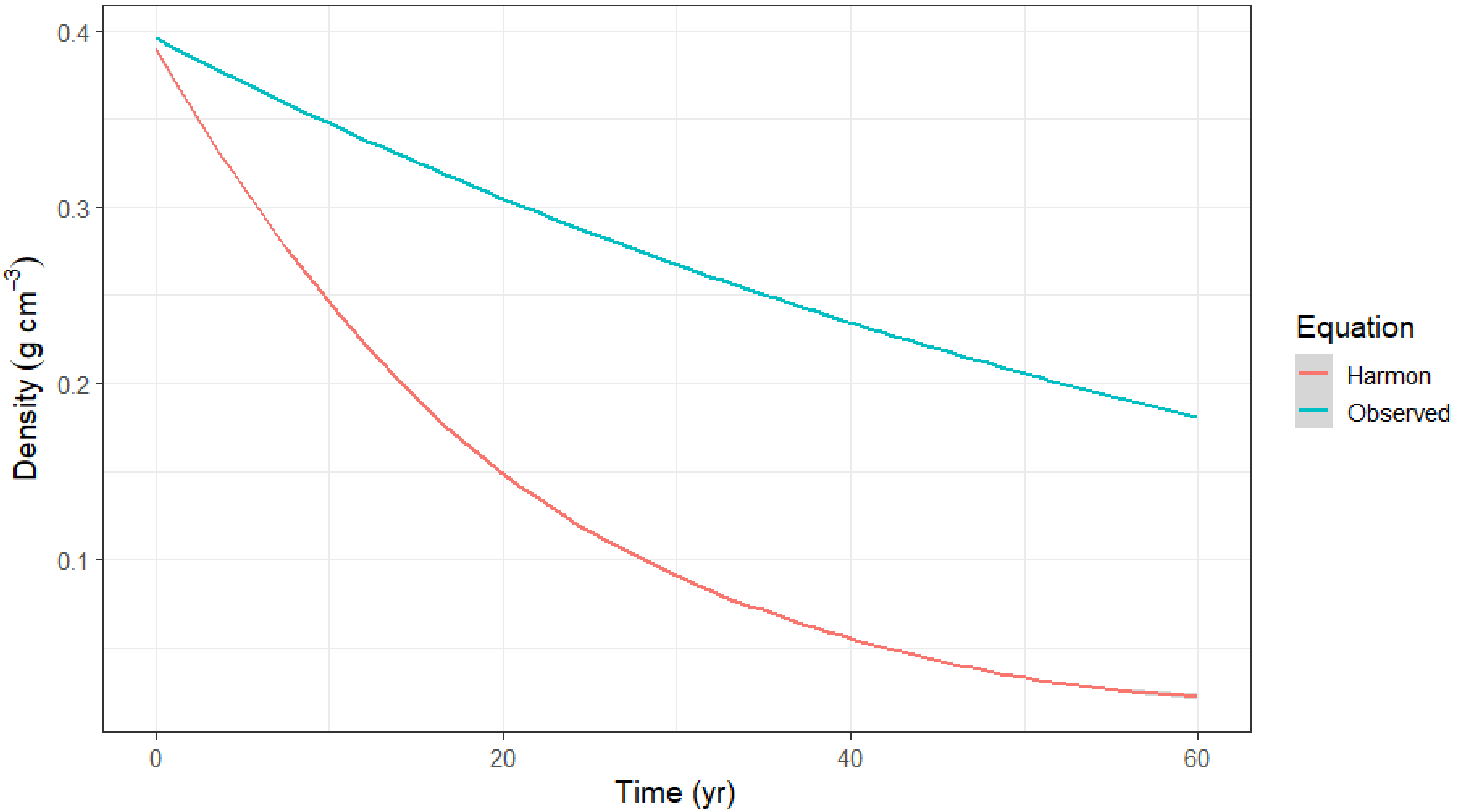


Rates of decay

Species Group	n	Decay Rate (g/cm^3 yr^1)
Softwood	62	0.013 (0.002)
Cedar	60	0.007 (0.002)
Hardwood	28	0.017 (0.004)



Decay rates at Blodgett: Slower than expected



Goal: Improve dead wood cycle in forest growth models

Existing models:

1. Underestimate snag fall rates

2. Overestimate CWD decay rates

Major Challenge: Generalize