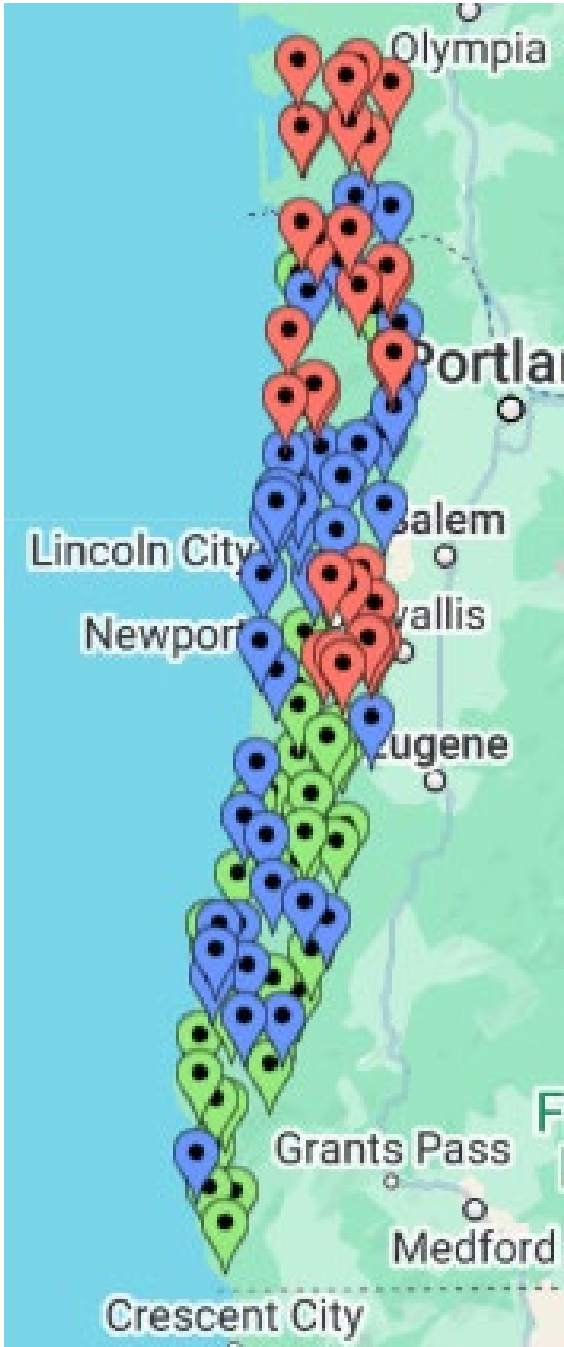
Swiss needle cast growth analysis, 2023

November 30, 2023

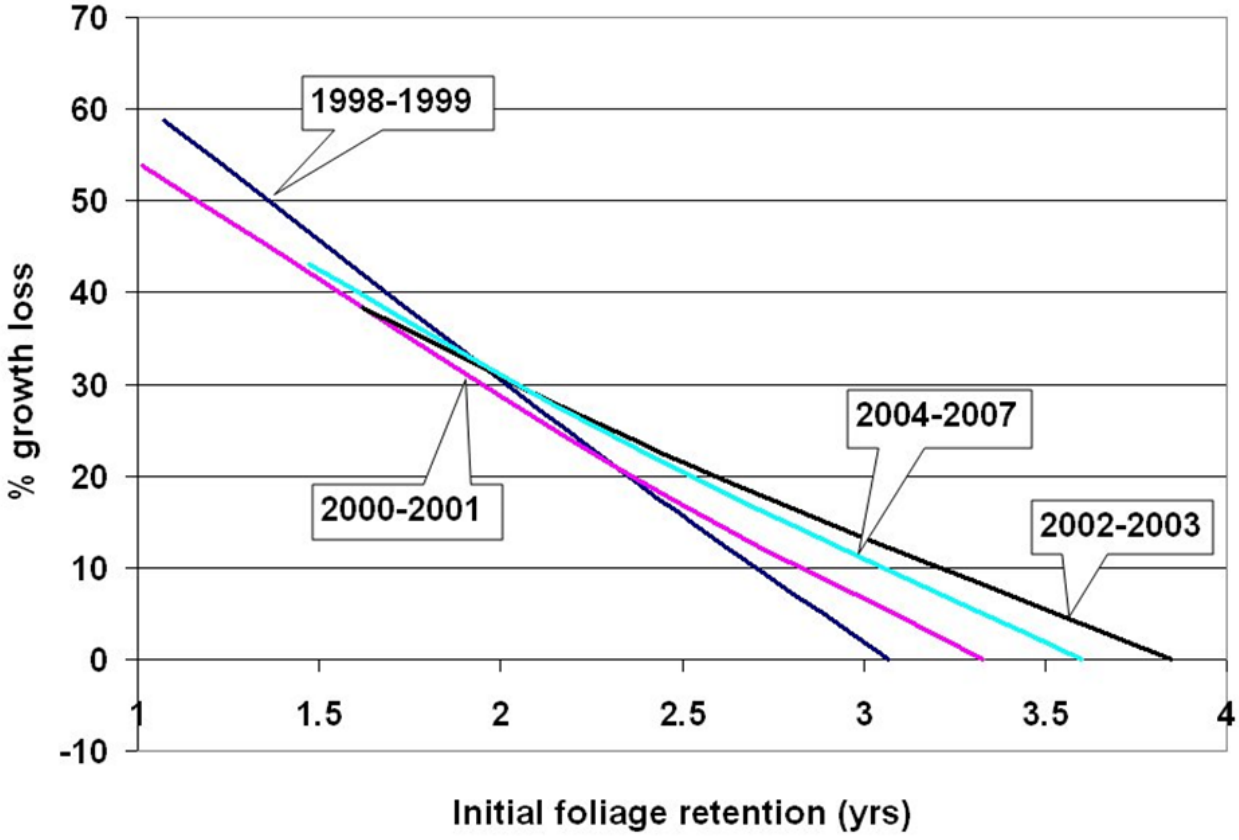
SNCC Research Plot Network

- New effort uses 102 plots from new SNCC plot network (installed 2013-2015)
  - Has greater geographic range (than GIS)
  - Indicative of current stands
  - Doesn't include stunted stands that will never become merchantable
  - Group1: 10-year remeasurement of 30% of network (in red)
  - Group2: 10-year remeasurement of 30% of network (in blue)
  - Group3: 10-year remeasurement of 30% of network (in green)

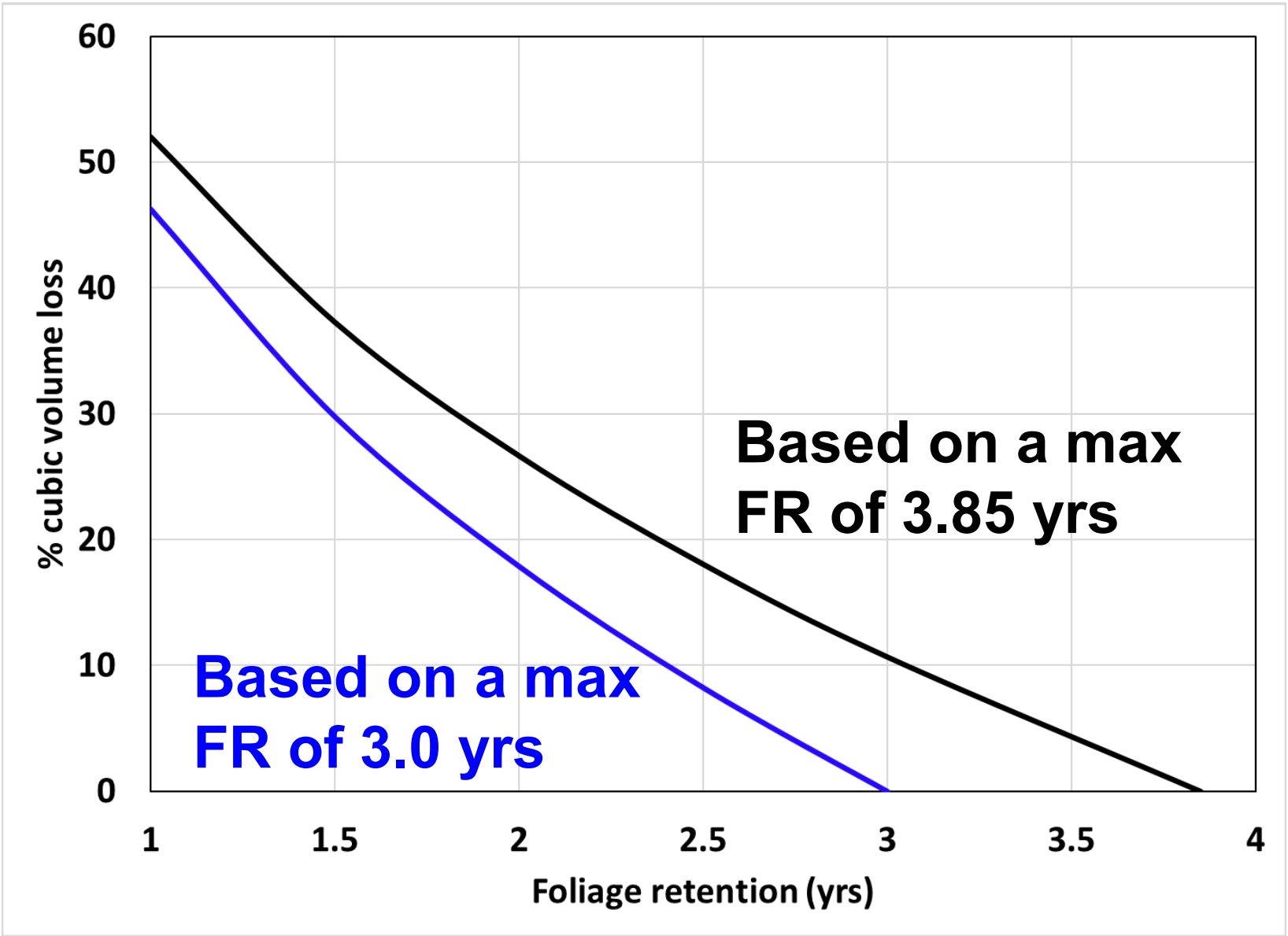


Stand level cubic volume growth loss, 1998-2008

- **Growth loss is expressed relative to maximum foliage retention of plots within each growth period**



Stand level cubic volume growth loss, 1998-2008 Combined, from 2011 publication



Stand level cubic volume growth, 2013-2019

$$CFV\_PAI = a \cdot (BA_{df}^{b}) \cdot \exp(c \cdot BA_{ndf}) \cdot SI_{adj}^{d} \cdot (1 - \exp(e + f \cdot FR^{3}))$$

CFV estimated using Bruce and Demars vol eqn.

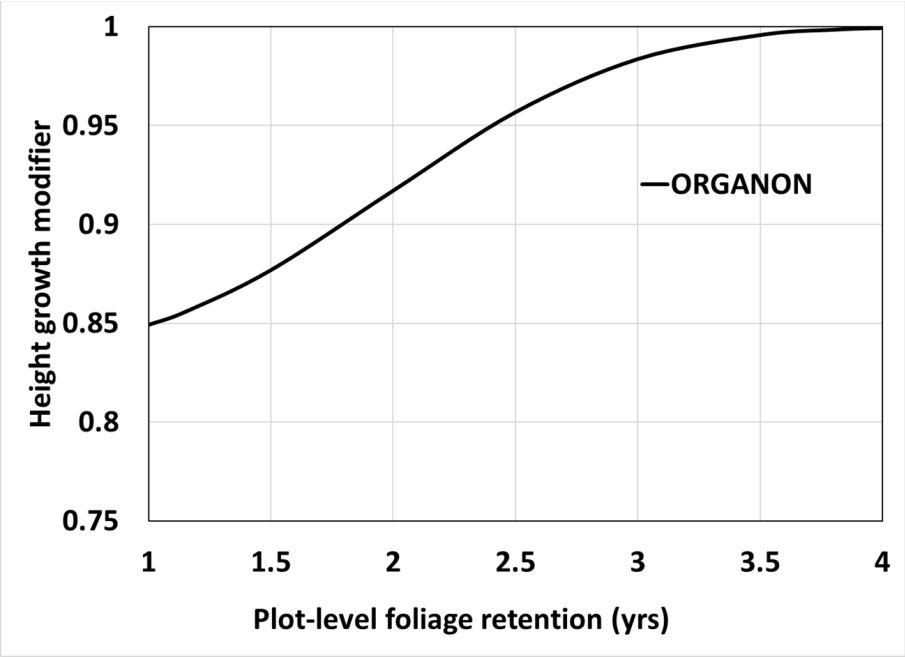
Periodic annual cubic volume growth dependent on:

- **initial DF basal area (+)**
- **basal area in other species (-)**
- **Douglas-fir site index (+)**
- **Douglas-fir foliage retention (+)**

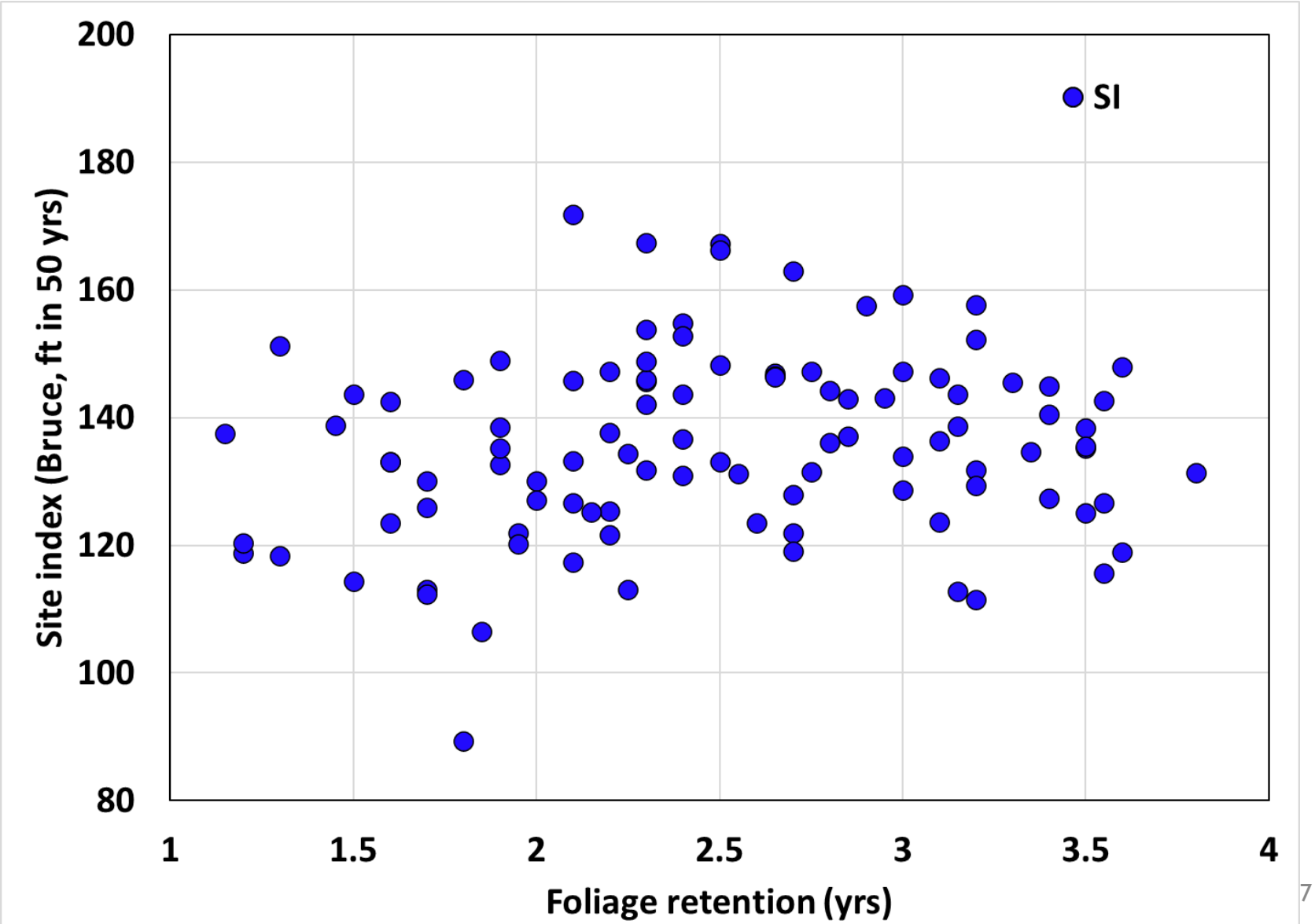
The site index problem

Dominant trees in infected stands have lost height increment due to SNC

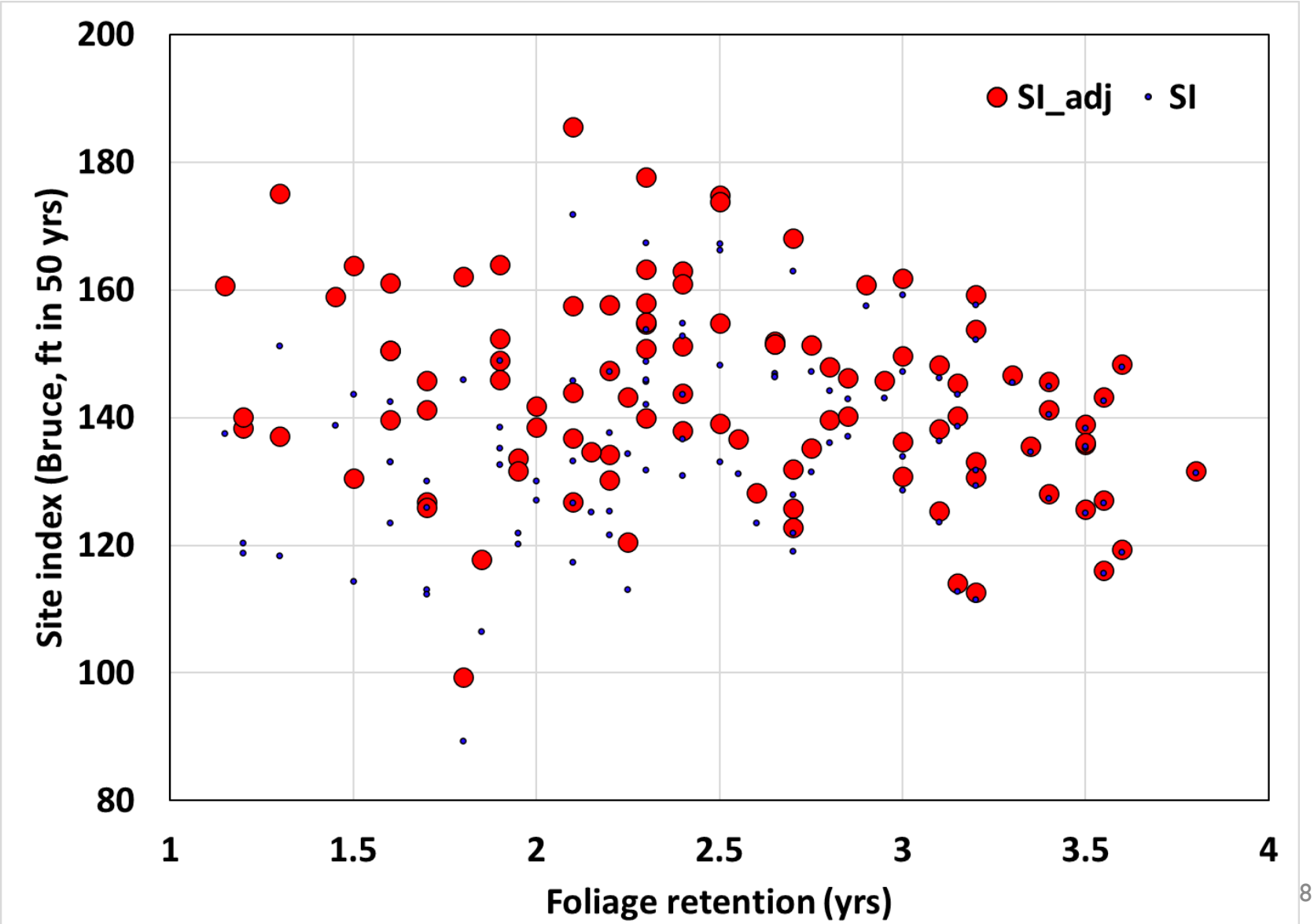
- Calculated the Bruce (1981) site index for each plot
  - SI= f(Ht_{40}, age)
- Adjusted the SI using the 2014 Hann SNC ORGANON height modifier
  - Adjusted SI =
  - SI_A= f(Ht_{40}/(SNC Htmod), age)
  - $SI_A = SI/(1-\exp(b_0+b_1 \cdot FR^3))$



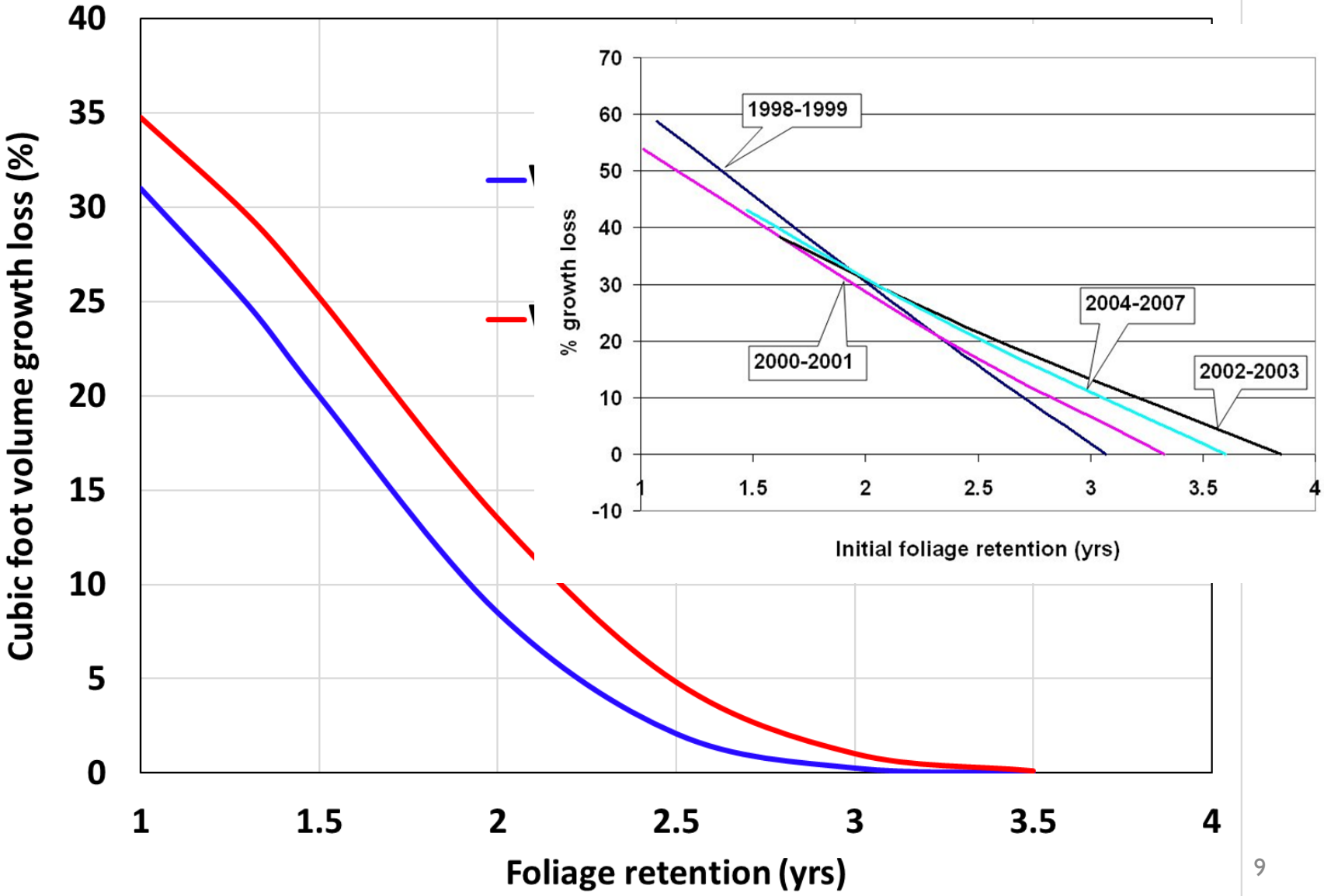
Site index (from height-age pairs) vs. FOLRET, new network



Site index (from height-age pairs) vs. Folret, new network, adjusted



Stand level cubic volume growth loss, 2013-2019



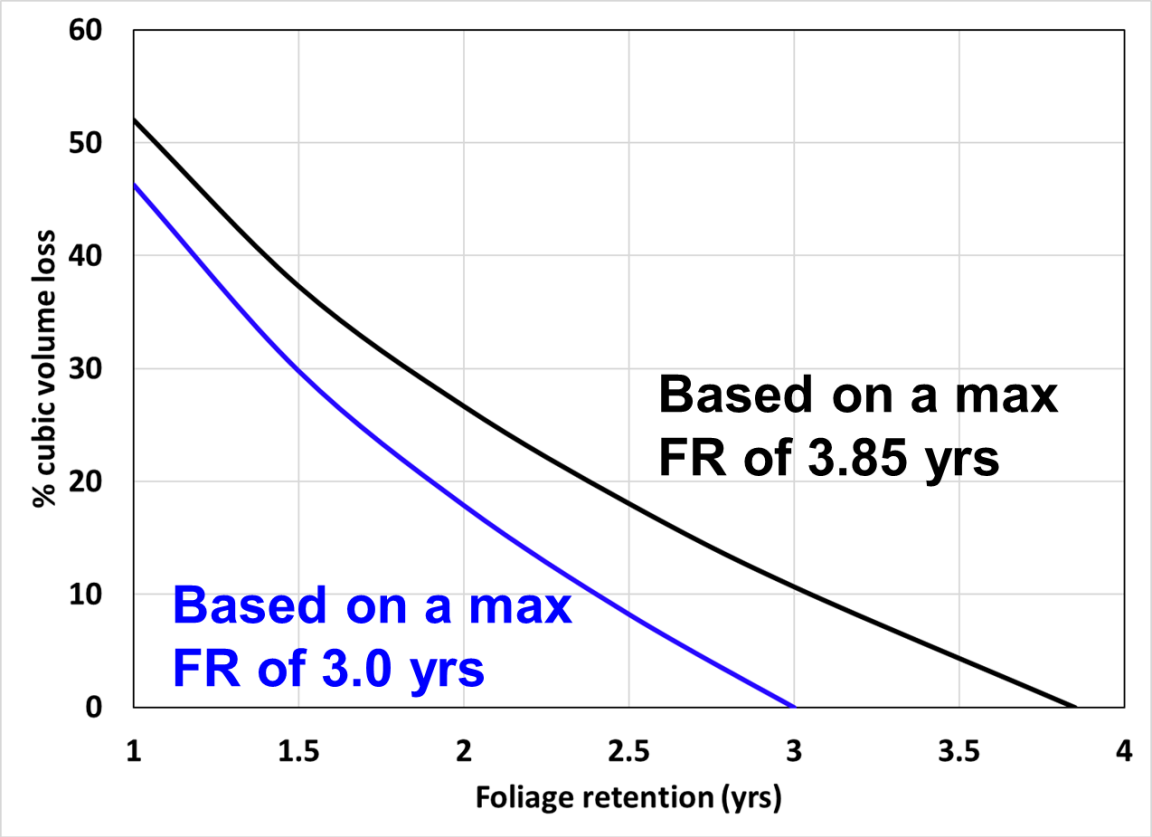
Why is the growth loss lower? The theory…

- GIS plot network represented the 1998 population.
- New plot network represents the current population
- Many of the worst stands that were sampled in 1998 are no longer present on the landscape. Those stands have been harvested and not replanted to Douglas-fir.
- Unaccounted for changes in foliage retention over long measurement period
- If zones where those plots existed were replanted to DF, growth loss estimates would likely go back up.

Second growth period

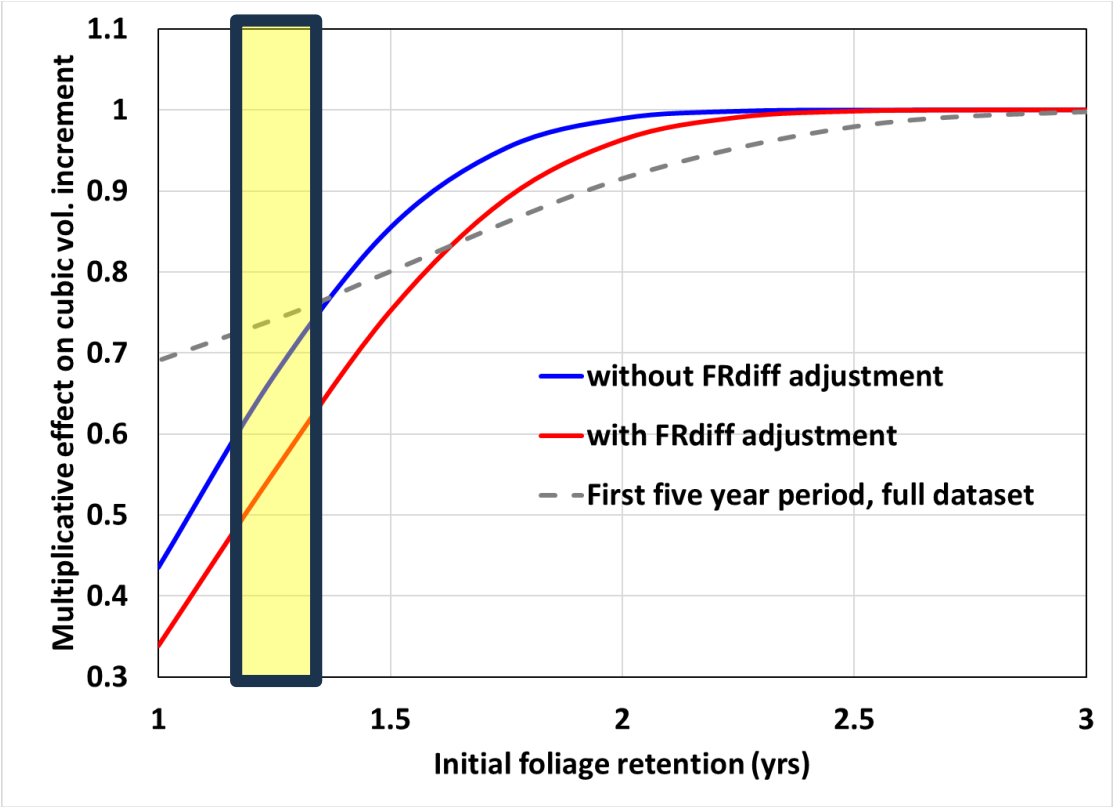
- Original (full) model
- $CFV\_PAI = a \cdot (BA_{df}^{b}) \cdot \exp(c \cdot BA_{ndf}) \cdot SI_{adj}^{d} \cdot (1 - \exp(e + f \cdot FR^{3}))$

- Reduced model for limited dataset
- $CFV\_PAI = a \cdot (BA_{df}^{b}) \cdot \exp(c \cdot BA_{ndf}) \cdot (1 - \exp(f \cdot FR^{3}))$



Second growth period, groups 1 and 2

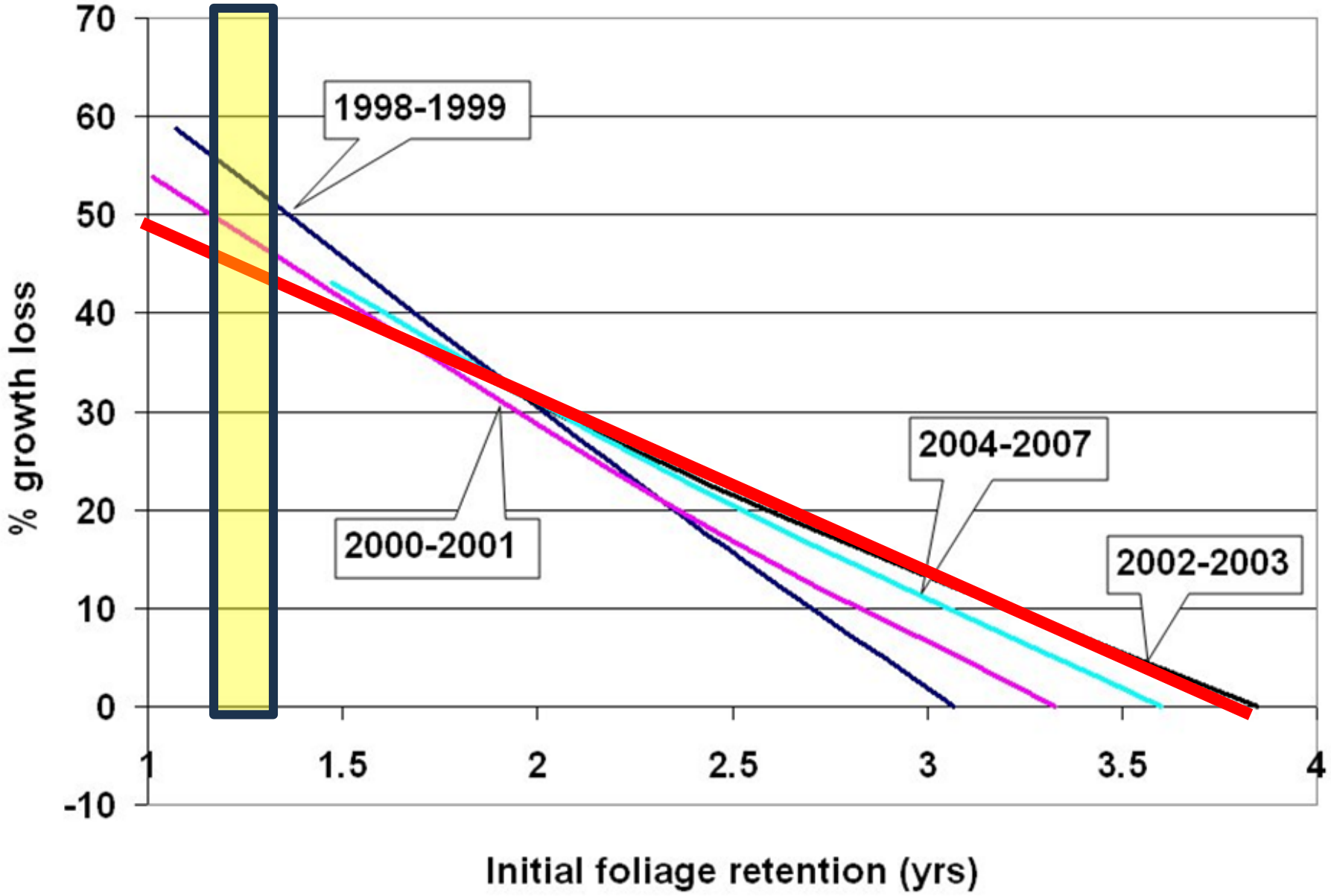
- Results imply that the growth losses are better for moderate FR, worse for low FR



- Sensitivity of response to FR term will be explored for full dataset

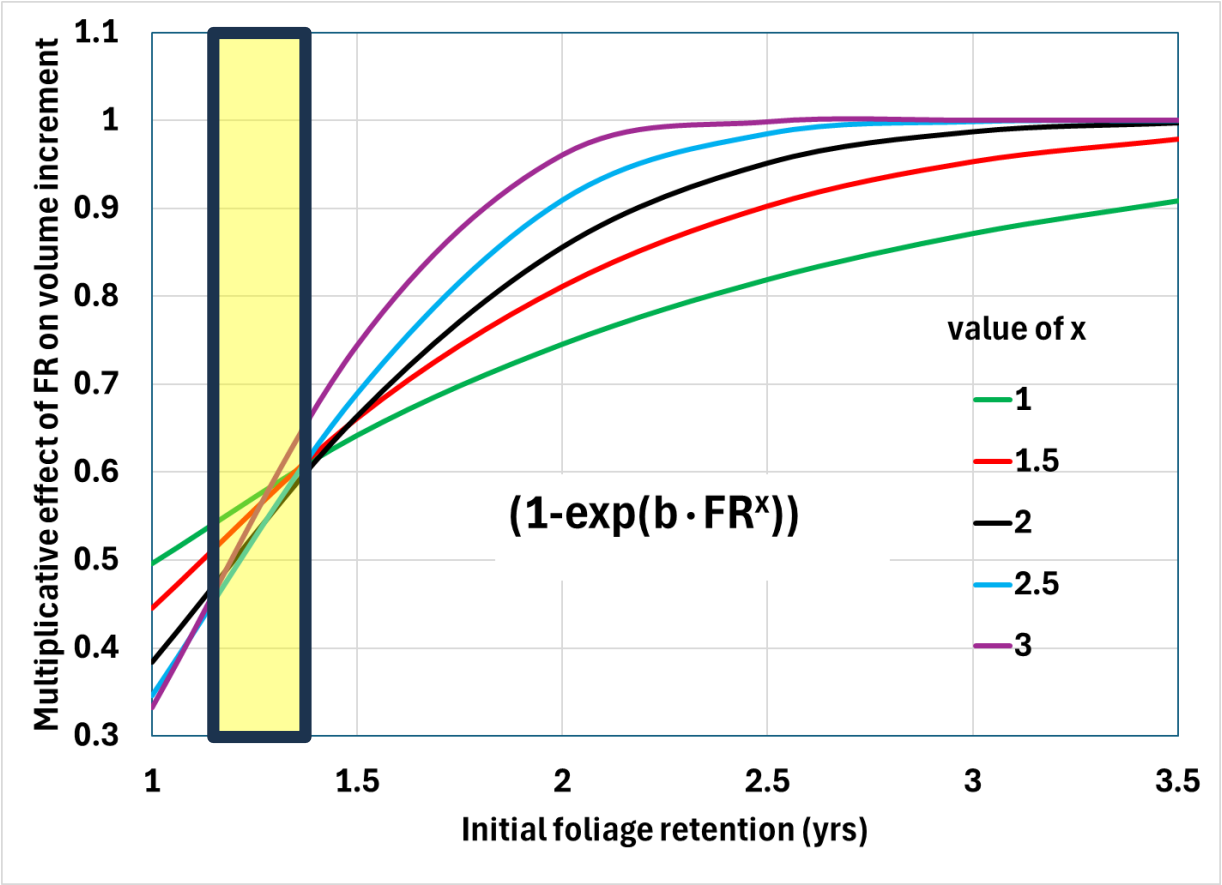
$$(1-\exp(a+b\cdot FR^3))$$

$$(1-\exp(b\cdot FR^3))$$


70
60
50
40
30
20
10
0
-10
% growth loss
1998-1999
2000-2001
2004-2007
2002-2003
1
1.5
2
2.5
3
3.5
4
Initial foliage retention (yrs)

Second growth period, groups 1 and 2

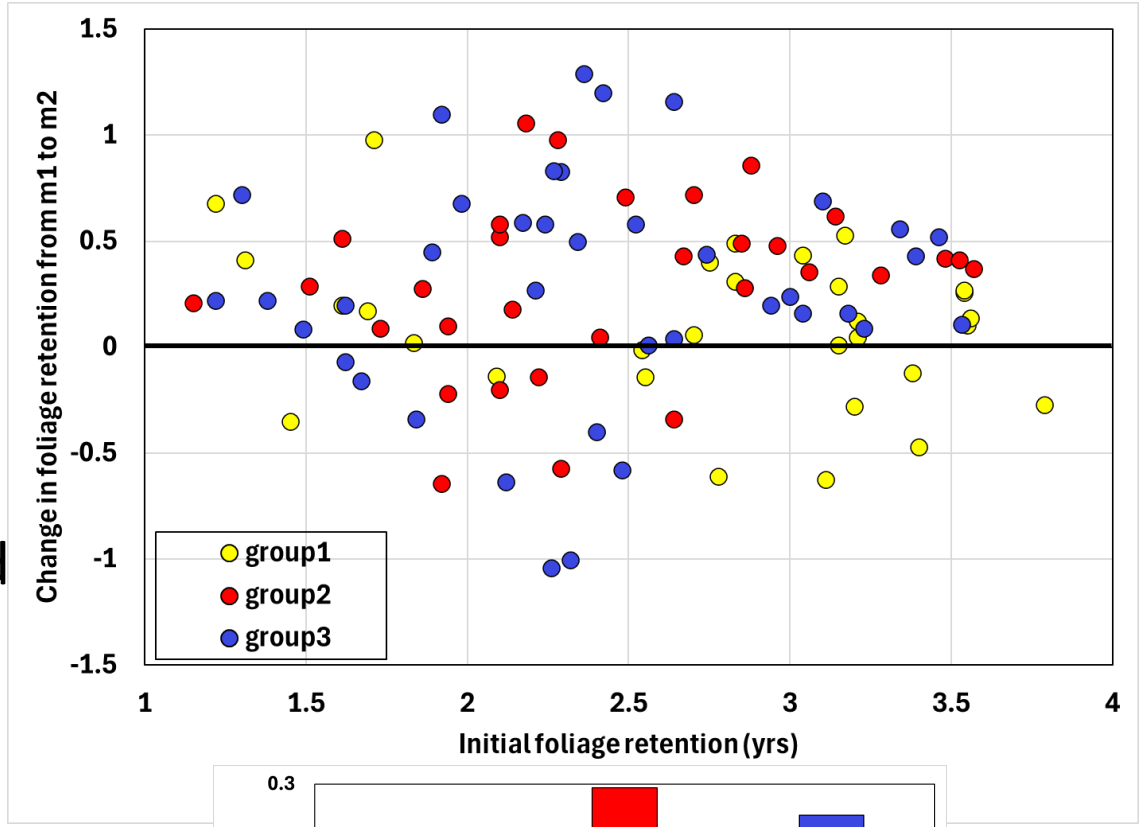
- Using different powers on FR, estimated growth loss for the most impacted plots is looking similar
- In the long term, what matters most are how well the "moderate" plots are performing

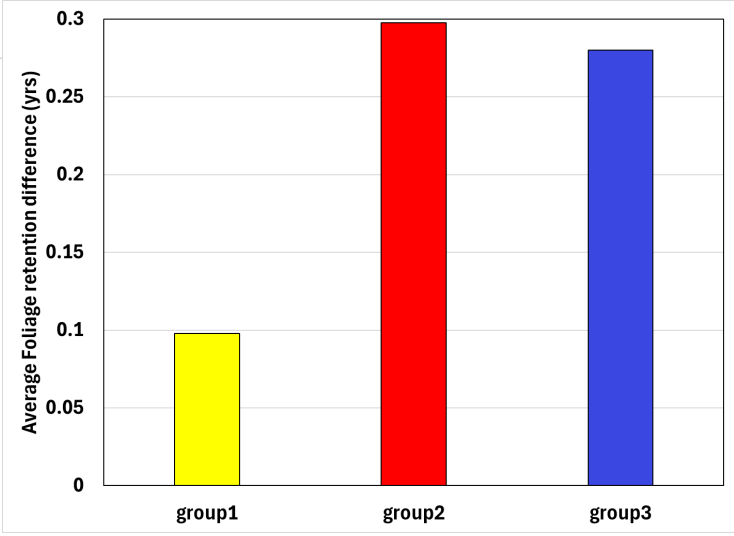


x	MSE
1	180.4
1.5	181.7
2	187.7
2.5	195.3
3	201.4

Change in FOLRET during first period

- Growth fit is based on initial SNC conditions
- Improved FOLRET over 5-yr period not accounted for
- Increase in FOLRET over period suggests improved conditions
- Analysis will need to account for FR at start and end of period…and perhaps use other means of interpolating estimated FR between measurements





What should be done for the finale?

- Given the long growing periods, the final analysis should wait for final spring 2026 foliar sampling to account for changes in foliage retention
- Rigorous testing and exploration of the FOLRET term
- Analysis will need to account for FR at start and end of period…and perhaps use other means of interpolating estimated FR between measurements
- Growth analysis should address cubic and Scribner volume losses, accounting for SNC-estimated changes in stem form


Questions?