FOR/FES-599

3-PG FOREST GROWTH MODEL

Dr. Richard H. Waring

Dr. Carlos A. Gonzalez-Benecke

Lecture 4

Modeling Thinning & Defoliation Response

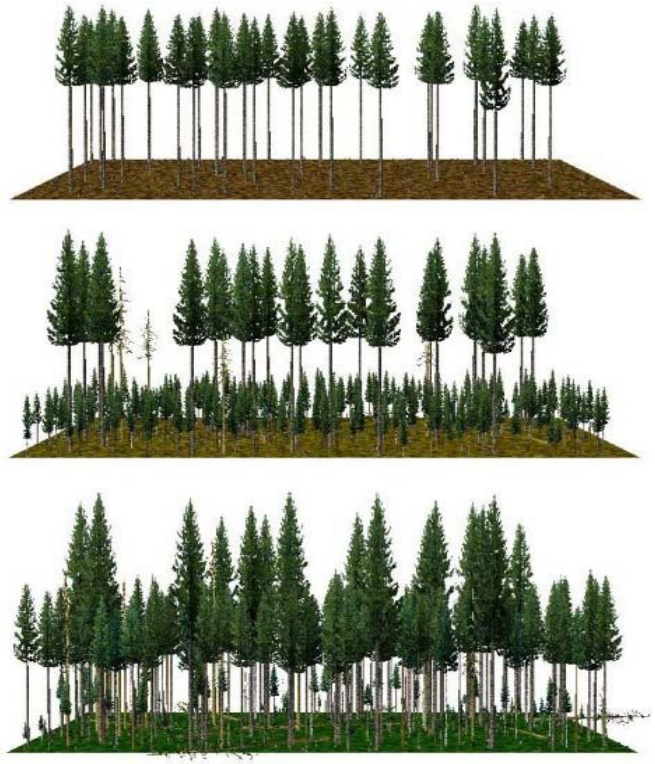
Landscape and Stand Visualization Models

- http://landscapemanagementsystem.org/ecosystem-management/landscpframe.html

- Landscape Management System (Univ. of Washington, College of Forest Res.) EnVision (http://envision.bioe.orst.edu/)

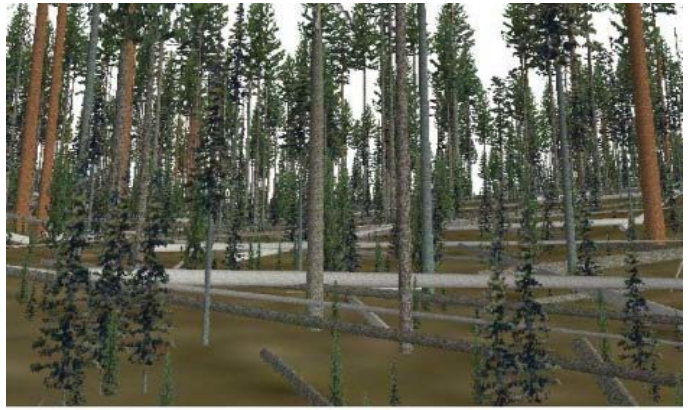
Landscape and Stand Visualization Models

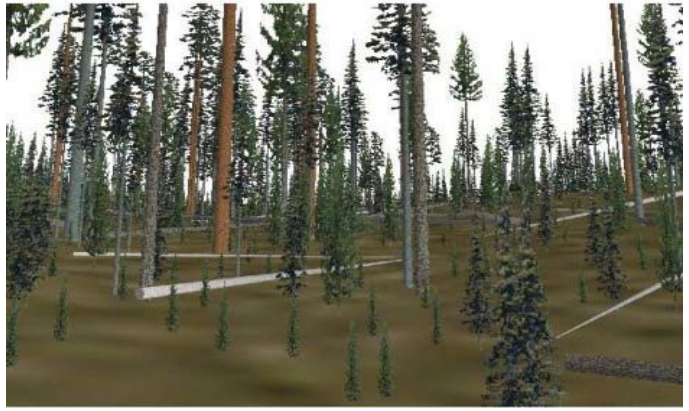
Can select type of tree and show changes over time in stand development



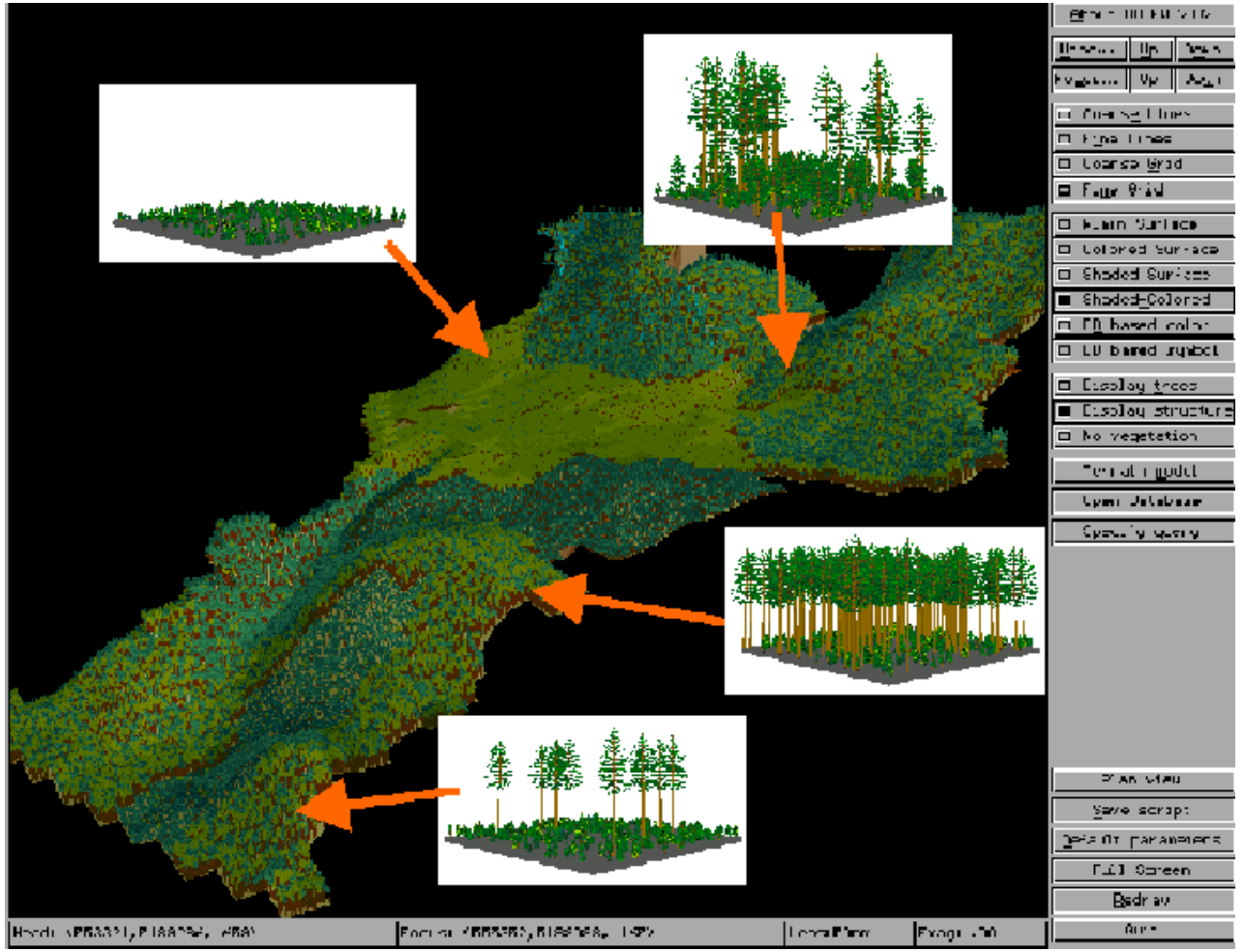
Landscape and Stand Visualization Models

Can simulate distribution of dead stems

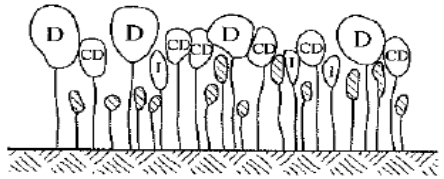




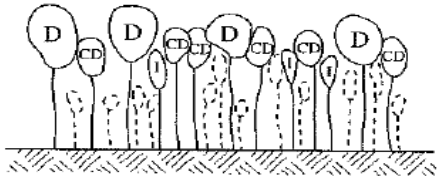
Landscape Visualization



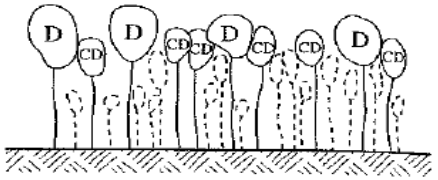
Thinning From Below



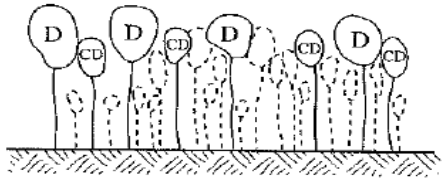
Unthinned



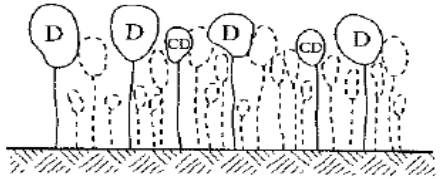
Grade A thinning from below
(Cut overtopped trees)
. . . A very light thinning



Grade B thinning from below
(Cut overtopped and intermediates)
. . . A light thinning



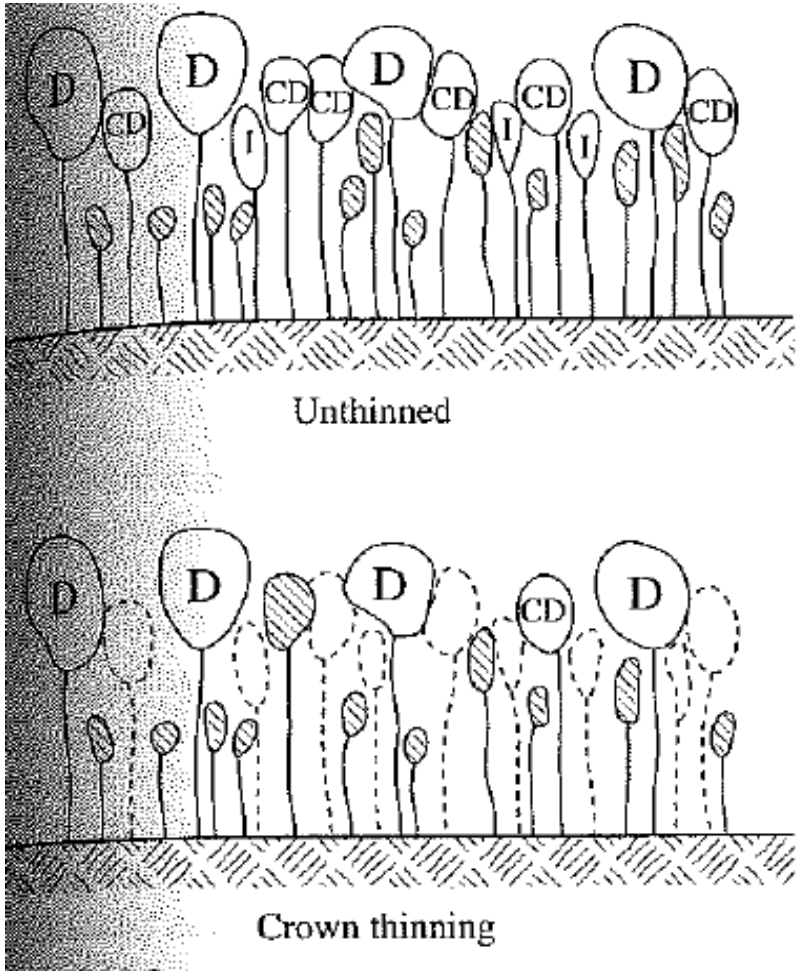
Grade C thinning from below
(Cut overtopped, intermediates,
and *some* codominants)
. . . A moderate thinning



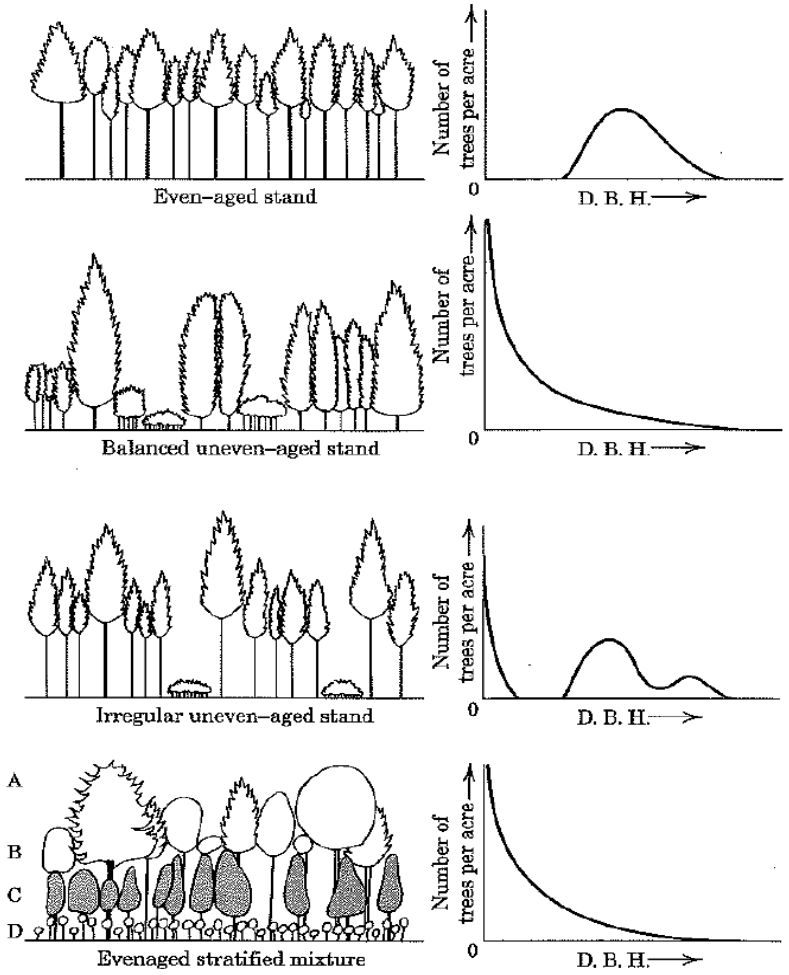
Grade D thinning from below
(Cut overtopped, intermediates,
and *most* codominants)
. . . A heavy thinning

FIGURE 18-1
Low thinning removes trees of subordinate crown positions to favor those of upper crown classes, with little effect on the main crown canopy for intensities of less than C-grade thinning from below.

Thinning From Above



Diameter Distributions

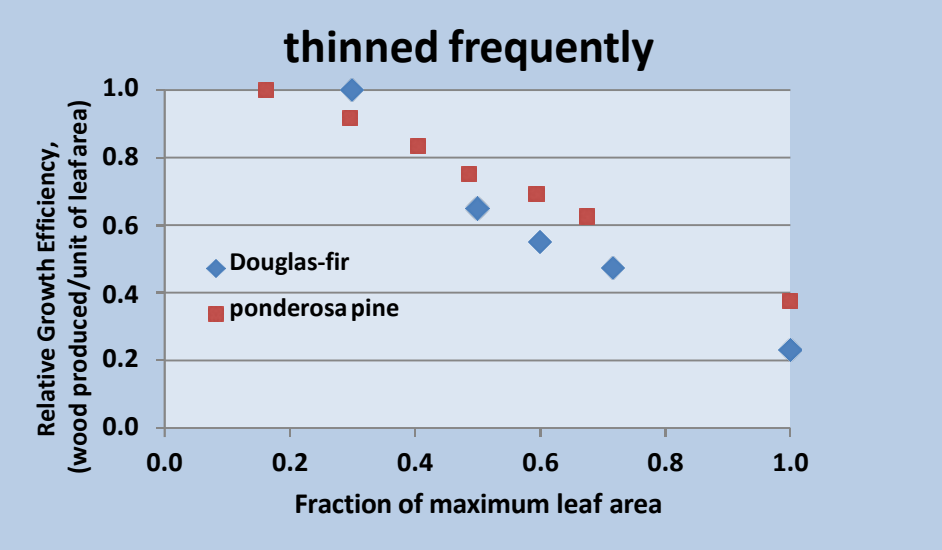


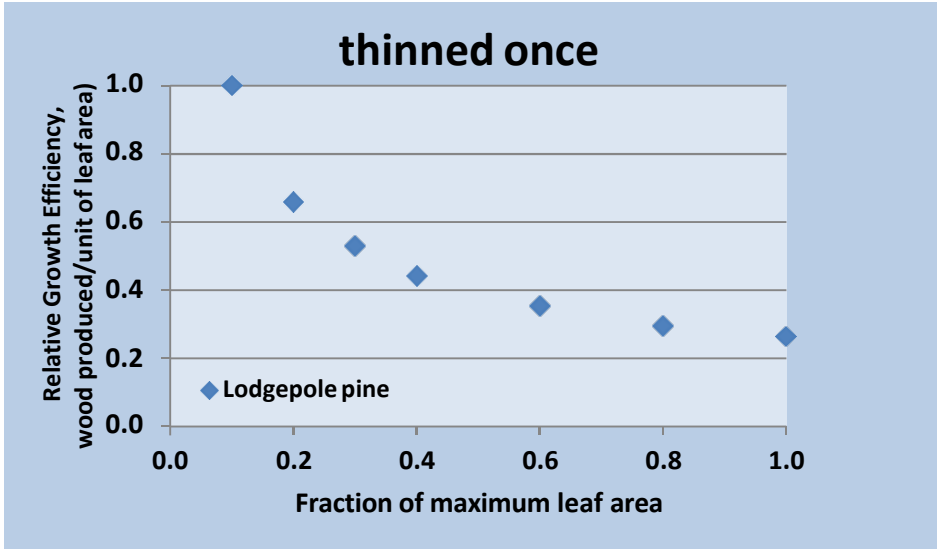
Unthinned Lodgepole Pine

Evenly Spaced Thinning

Modeling Thinning

Thinning improves tree growth per unit of leaf area (Growth Efficiency)





Annual Yield = Growth Efficiency X Leaf Area/hectare

At 50% of max leaf area, yields are ~ same as at 100%

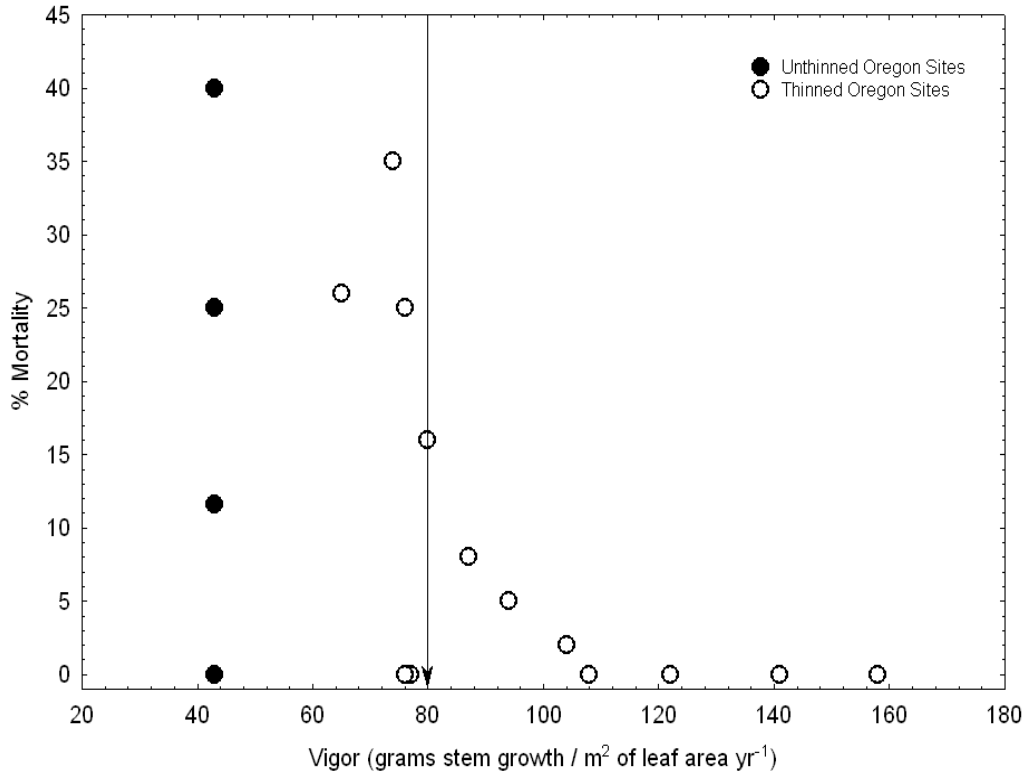
Waring et al. (1980) Forestry 54:129-137

Larsson et al. (1983) For. Sci. 29: 395-402

Coops et al. (2009) Rem. Sens. Env. 112:1058-1066

Modeling Thinning

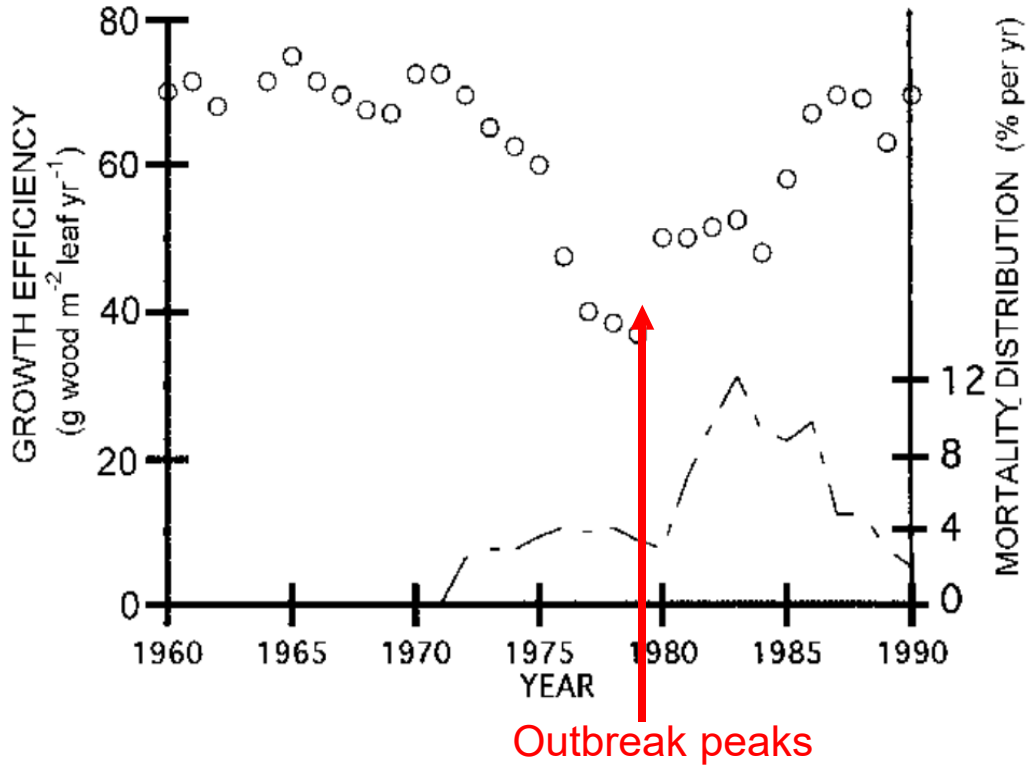
As the ratio of tree growth to leaf area increases, a threshold is reached, above which most trees are resistant to attack from bark beetles



[safe threshold equivalent to yearly growth of 5% of sapwood area] Coops et al. (2009) Remote Sensing of Env.12:1058-1066.

Defoliation Response

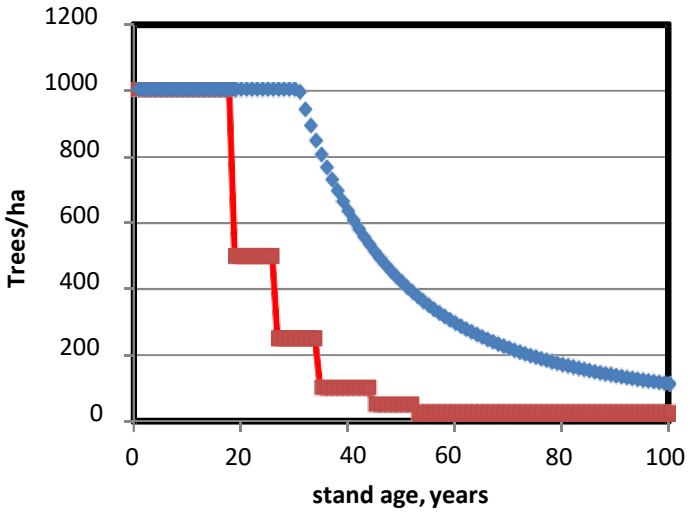
Periodic outbreaks of spruce budworm defoliate stands of balsam fir in eastern Canada. The death of some trees improves the vigor of those that survive



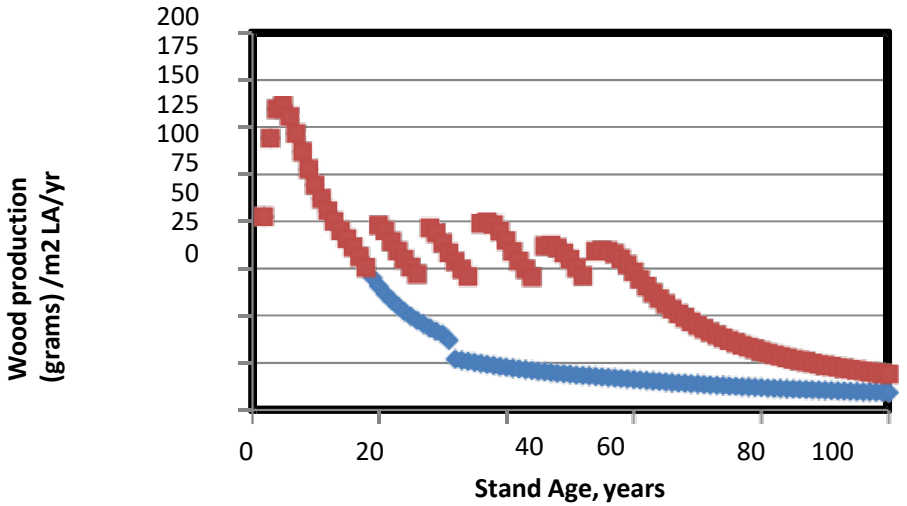
Coyea & Margolis (1994) Can. J. For.Res. 24:2208-2221

3-PG Comparison: Thinned and Unthinned Ponderonsa Pine

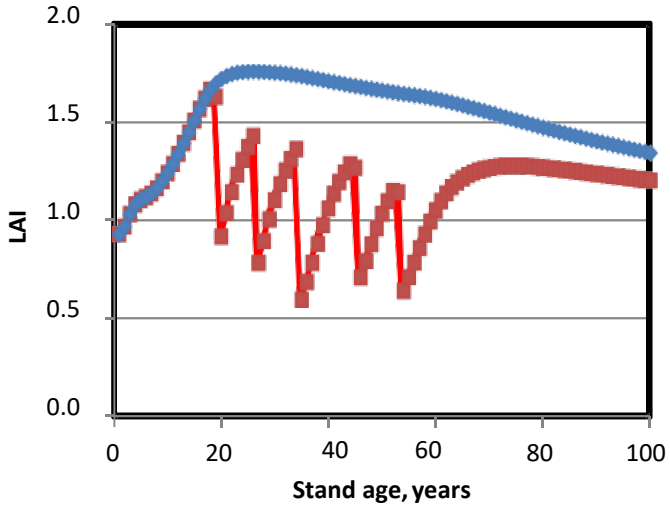
Tree stocking density



Tree vigor



Leaf Aera Index (LAI)



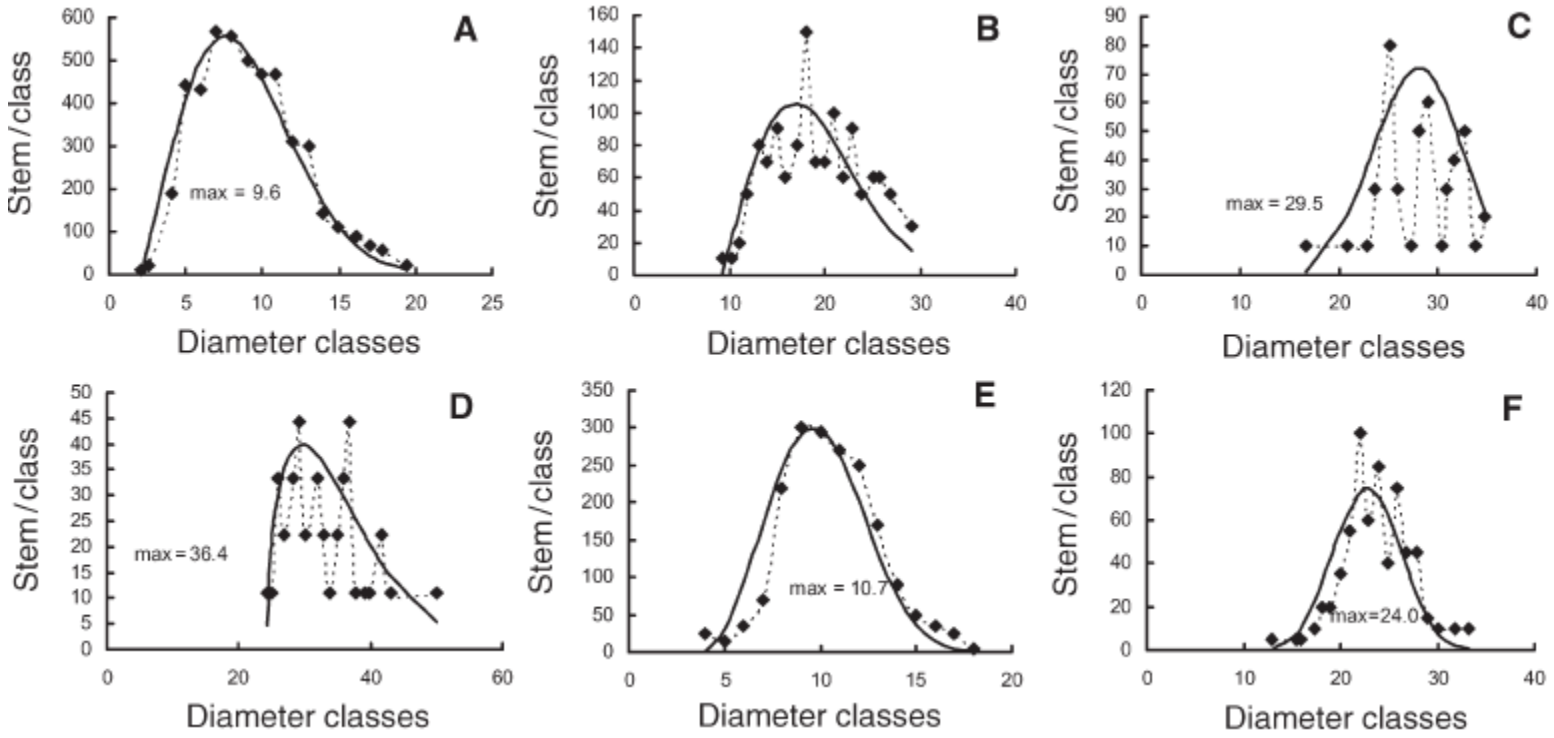
OSU Oregon State University College of Forestry

UBC

CSIRO

3PG

Decouple Stem From Foliage Allometrics and Fit to Weilbull Distribution



Landsberg et al. Tree Physiology 25: 781-792

Conclusion

- Thinning for different objectives, but all result in a temporary reduction in LAI
- 3-PG basic model assumes even-aged stands with trees evenly spaced, and no variation in stem diameters
- 3-PG can simulate thinning from above or below, but the growth response may be overestimated.
- Mean tree vigor is much more variable in natural forests than in plantations.
- More sophisticated models and visualization tools
  are available; these can be coupled to 3-PG to account for variation in LAI in response to disturbance & climate

Landsberg et al. Tree Physiology 25: 781-792