Introduction to Ecological Forestry

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Extension Forestry & Natural Resources

Educational Assistance

Finding answers and solving problems by learning together.

- Help you learn what you need to know - to decide what is right for you
- Take action – DIY or hired services.
- Improvement – Prevention – Problem-solving
- **Depending on your situation and your objectives.**

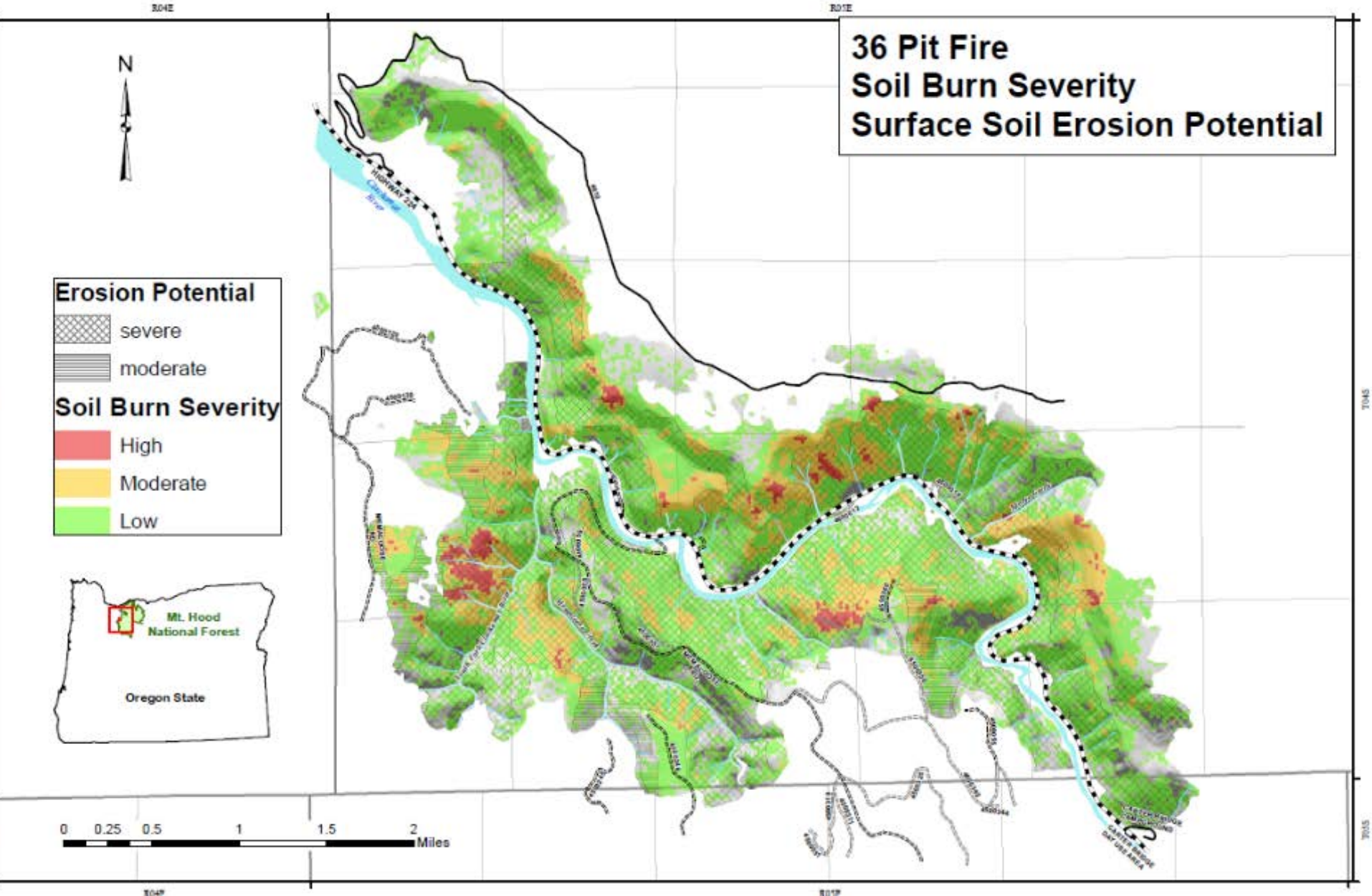
Elements of Ecological Forestry

- mimic natural forest processes
- maintain or increase ecological and financial capital
- native species diversity and forest structural diversity
- maintain or improve the soil
- enhance habitat and biodiversity.
- economic and ecological resilience
- diversified financial value - variety of merchantable timber products and non-timber forest products.

Ecological Forestry 101 Outline

- Ecology of Douglas-fir forests - natural forest development & forest stand dynamics
- Even-aged vs. uneven-aged forest management
- Ecological Forestry - managing for “continuous forest cover”
- Operational considerations in active management.
- Getting the help you need

Ecology of Douglas-fir - Fire is the major disturbance driver



Natural Fire Regimes of Major Forest Types

Forest Type	(frequency %) Fire Type	Fire Interval (years)
Oregon white oak woodland	(3%) Stand replacement (19%) Mixed severity (78%) Low surface fire	275 50 12
Douglas-fir (Willamette Valley foothills)	(18%) Stand replacement (29%) Mixed severity (53%) Low surface fire	150 90 50
Douglas-fir/western hemlock, dry	(25%) Stand replacement (75%) Mixed severity	300 100
Douglas-fir/western hemlock, wet	(71%) Stand replacement (29%) Mixed severity	400 >1,000

http://www.fs.fed.us/database/feis/fire_regime_table/PNVG_fire_regime_table.html#PacificNorthwest

Top 12 Trees in W. Oregon (by wood volume)

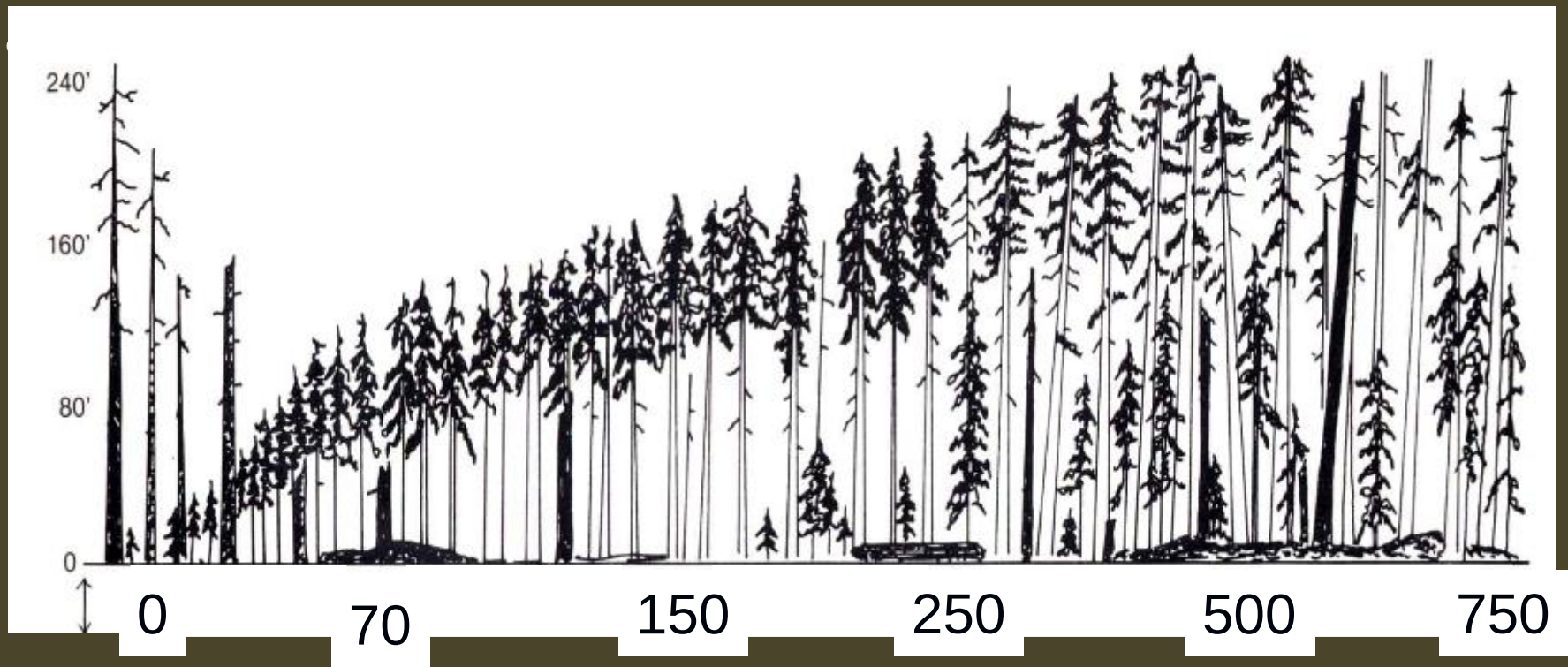
Source: USFS Forest Inventory and Analysis data 2000's

Douglas-fir	61.4%
Western hemlock	11.4%
Red alder	8.3%
Bigleaf maple	3.4%
Sitka spruce	2.7%
Grand fir	2.4%
Pacific madrone	1.8%
Oregon white oak	1.7%
Western redcedar	1.7%
Incense cedar	0.8%
White fir	0.6%
Ponderosa pine	0.5%

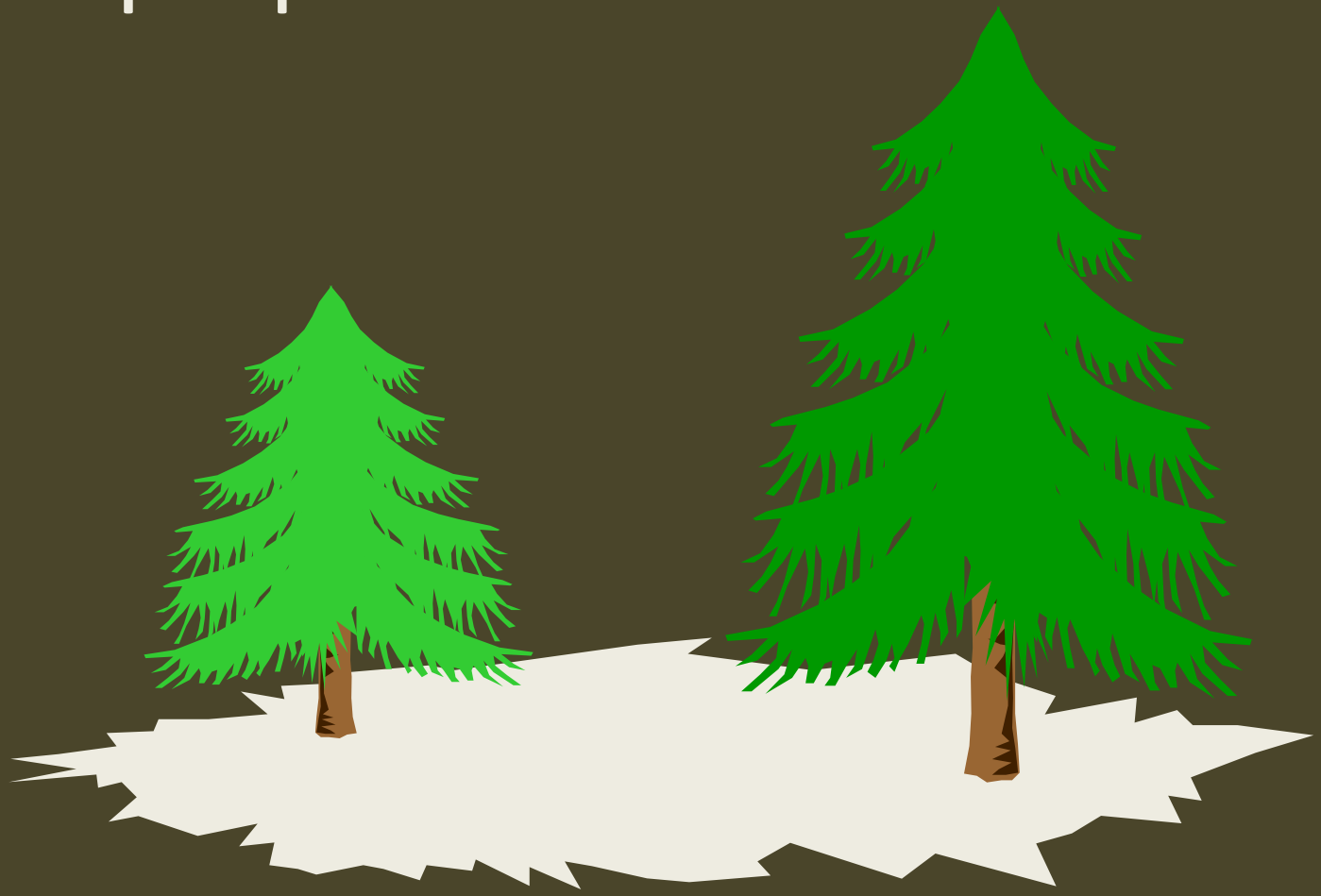
Forest Stand Dynamics - after disturbance

Stand development stages, disturbance dynamics, habitat

Chad Oliver 1981, Franklin and Van Pelt 2004



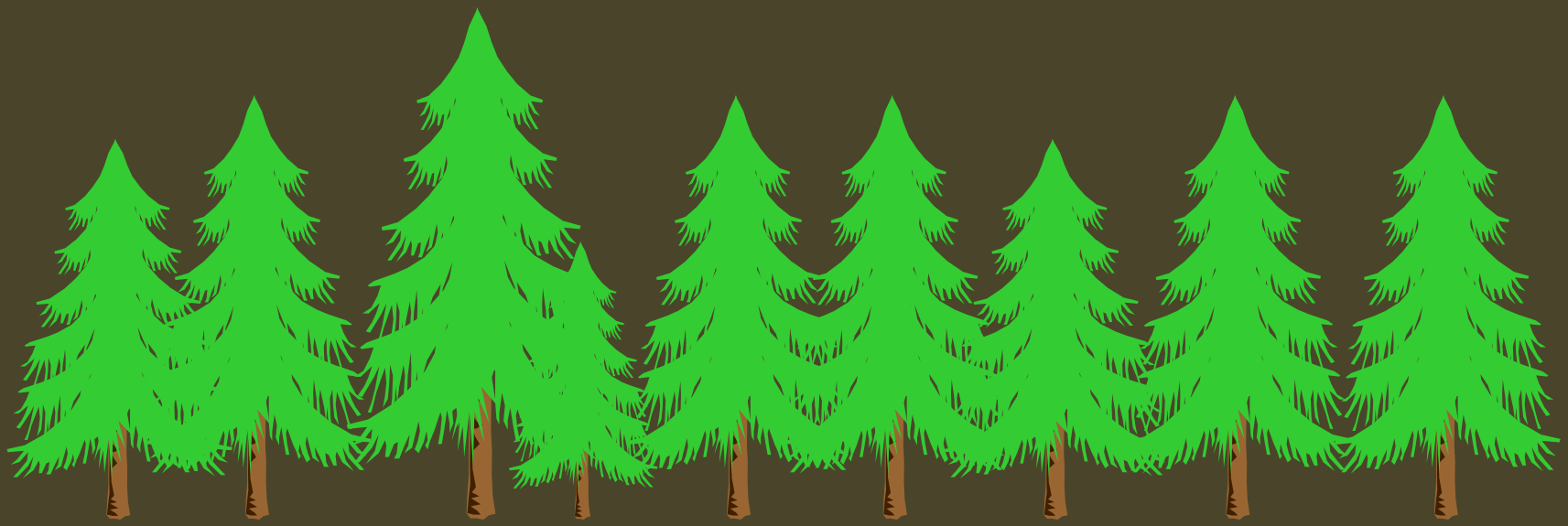
Resources required are proportional to tree size



Many Small = One Large

1: Seedling Stage

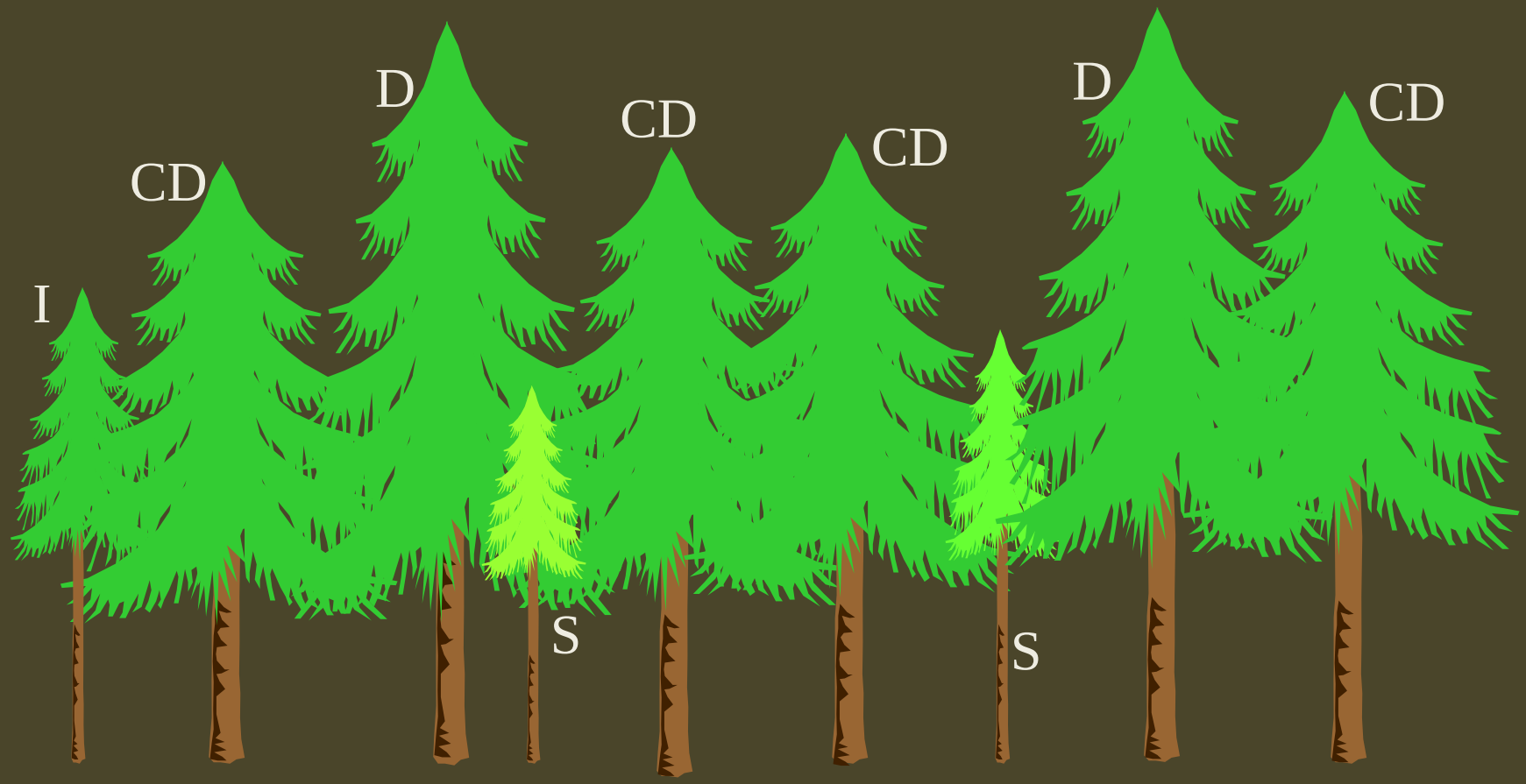
2: Crown Closure Stage



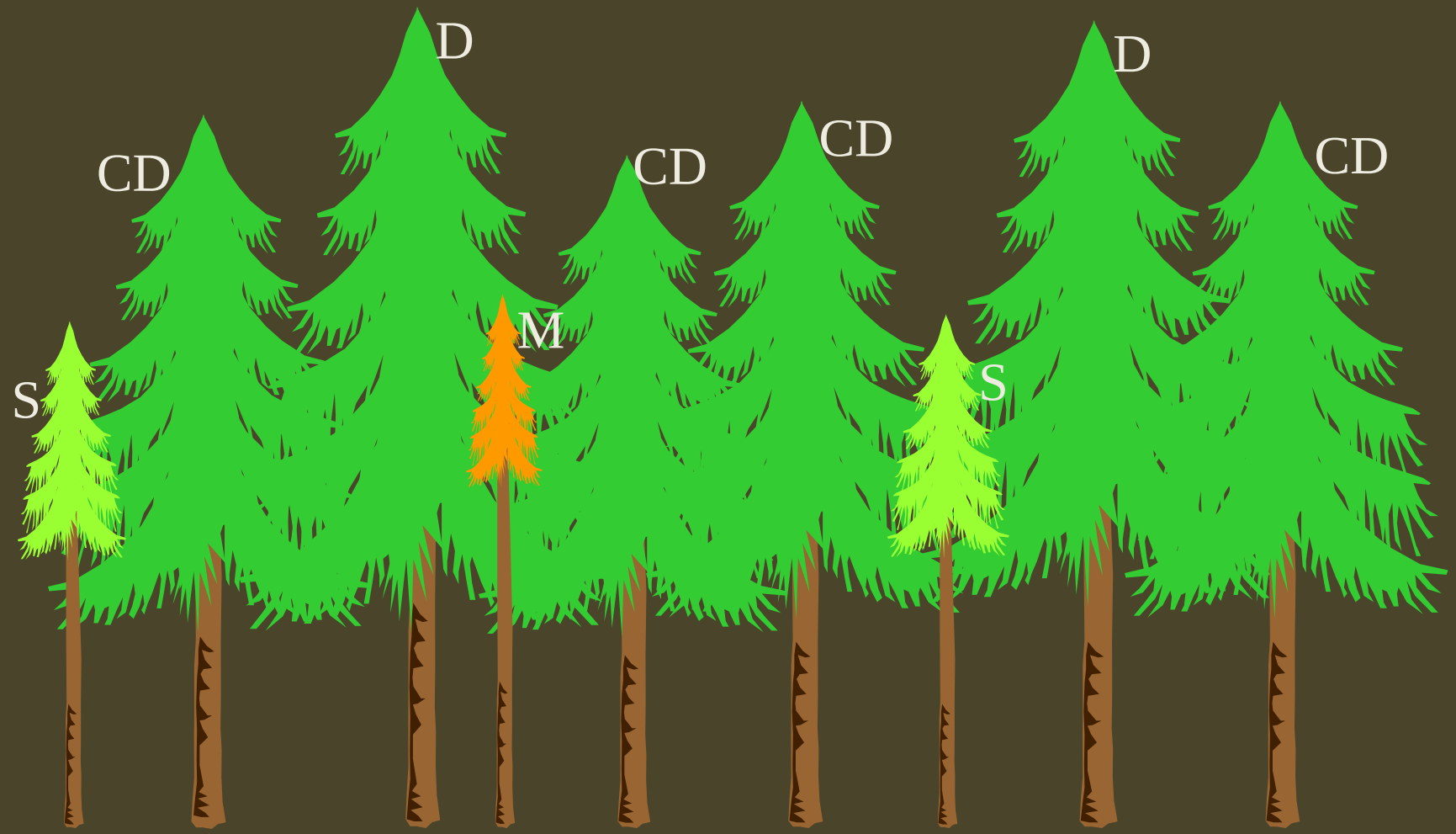
3. Crown Differentiation Stage

D = dominant CD = co-dominant

I = intermediate S = suppressed



4. Self-thinning Stage



Difference in size due to crown differentiation – All these Douglas-fir are 37-38 years old

Competitive vs. Agent Mortality

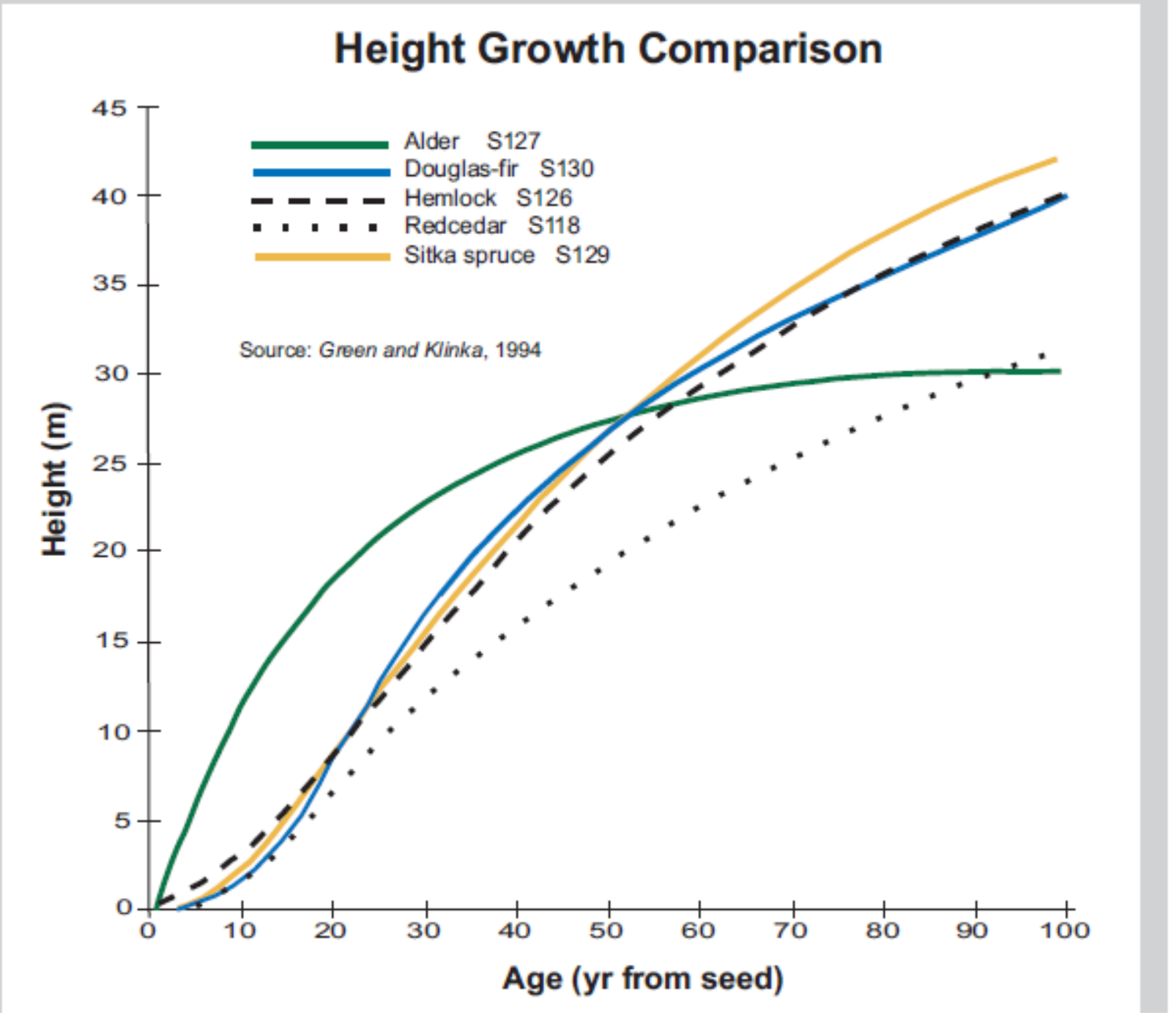
Natural Regeneration
- Understory Establishment Stage

- Seed Source
  - Species, seed year, predation
- Environment
  - Temp, water, light
- Seed bed
  - Soil, competition, mycorrhiza

Shade tolerance –
Ranking of western tree species (Daniel et al. 1979)

Very tolerant	Western hemlock	Pacific yew	Pacific silver fir Vine maple
Tolerant	Western redcedar	Grand fir	Sitka spruce
Intermediate	Big-leaf maple	Douglas-fir	Western white pine
Intolerant	Ponderosa pine	Lodgepole pine	Red alder
Very intolerant	Cottonwoods	Larch	

Mixed-species Forests



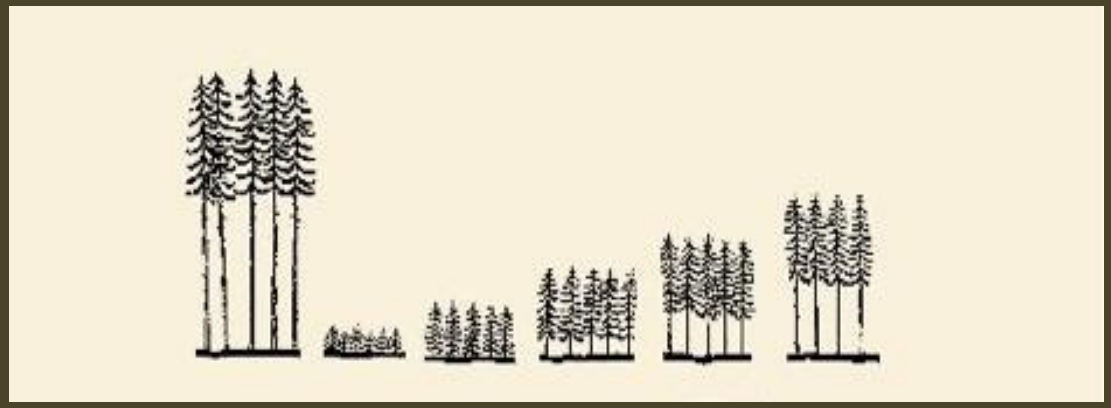
Red Alder: A state of knowledge, p. 45 http://www.fs.fed.us/pnw/publications/pnw_gtr669/

Maximum stand density varies by species

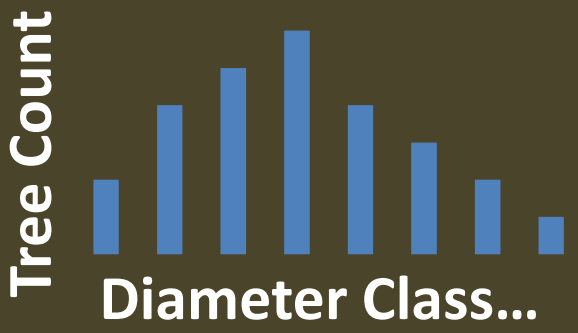
Species	Biological Max. Trees per acre at 10-inch dbh	Trees per acre at mortality threshold 10-inch dbh
Alder	450	246
Douglas-fir	595	329
W. hemlock	850	463

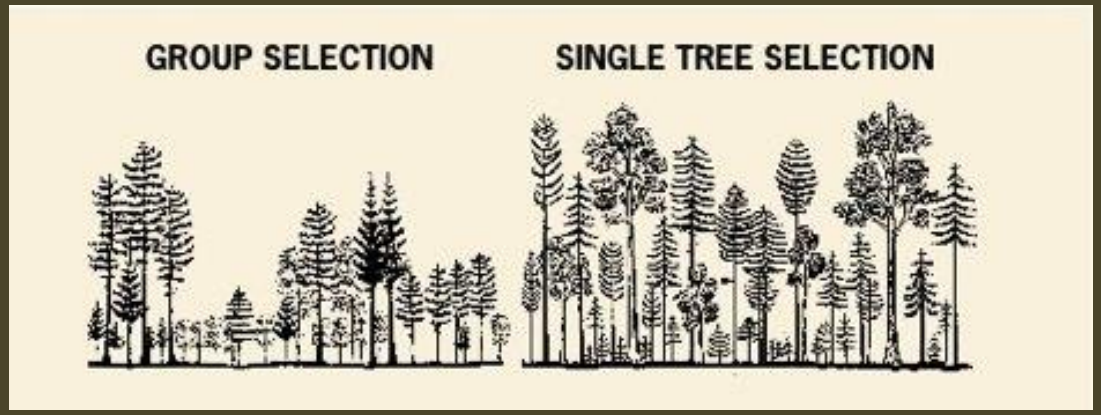
Based on Stand Density Index for each species

Even-aged vs. Uneven-aged Management

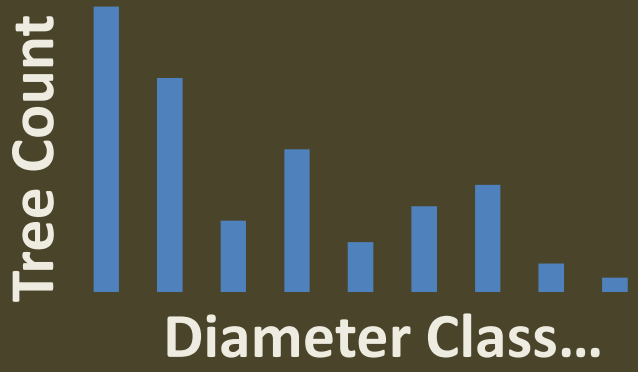


Even-aged “age-class” System





Uneven-aged Management System



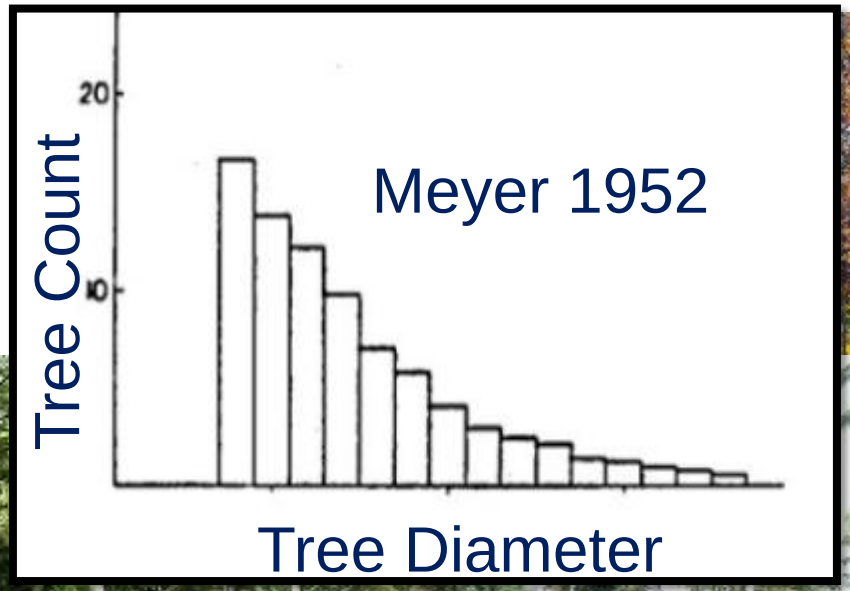
Even-aged Management

common practice with Douglas-fir and many other species

Ecological Basis for Uneven-aged Management

Many Types Worldwide

- "Inverse J" Diameter distribution of natural stands driven by small-scale disturbance



Uneven-aged Management - Long History
& much debate among foresters

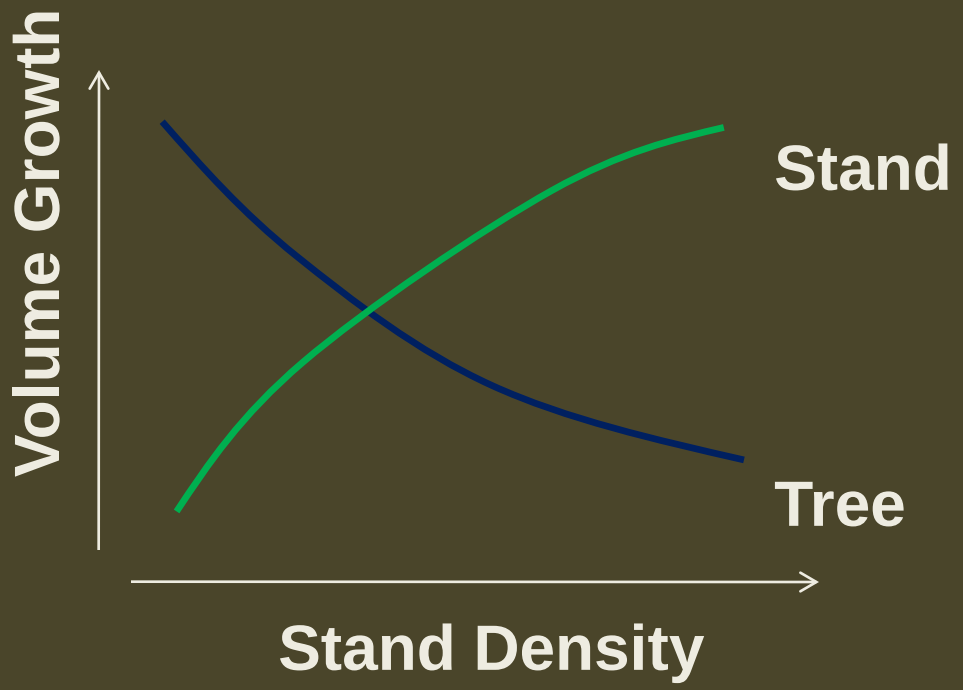
- Alfred Möller, 1922 “Dauerwald” in Germany
- Kirkland and Brandstrom, 1930’s USFS
- Continuous Forest Cover, Natural Forestry, Close-to Nature Silviculture

References:

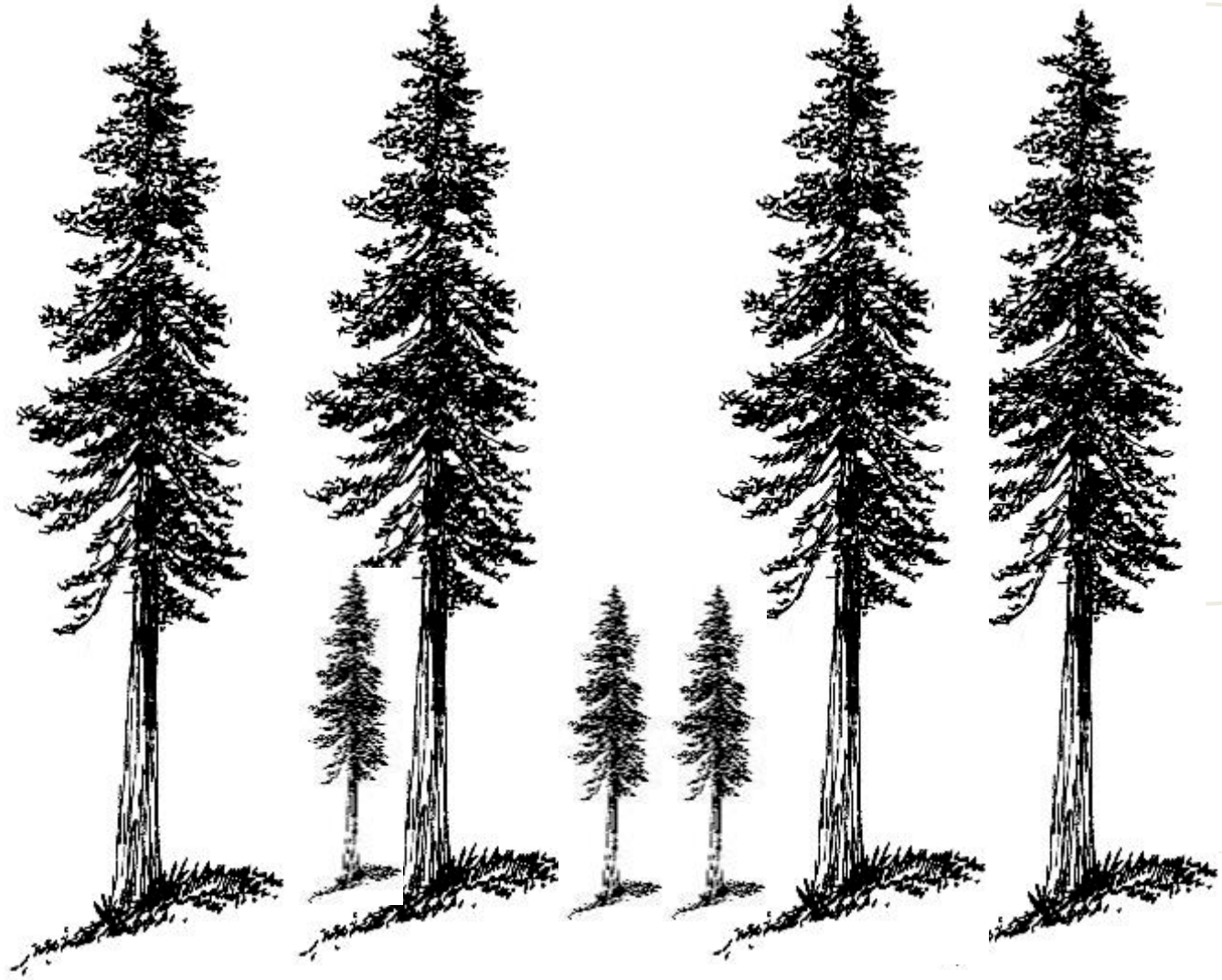
Controversy over clearcutting
http://www.foresthistory.org/ASPNET/Policy/Forest_Management/Clearcutting/timeline.aspx
Selective cutting in Douglas-fir: History Revisited
http://www.fs.fed.us/pnw/olympia/silv/publications/opt/418_Curtis1998b.pdf


Managing Multi-aged Stands


Growing Space Allocation – Trees versus Stands



Growing Space Allocation



80%
Growing Space
In Overstory

20%
Growing Space
In Understory

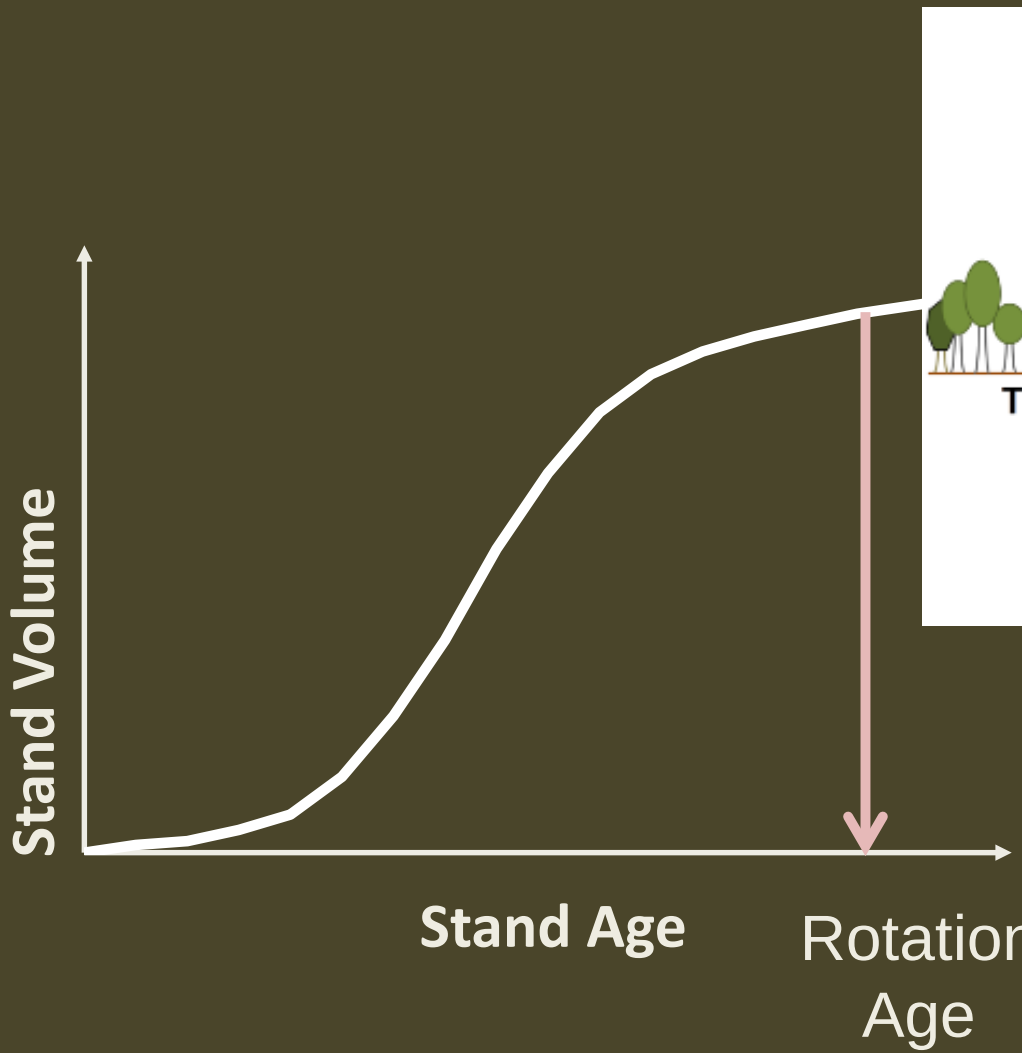
Managing Uneven-aged Stands

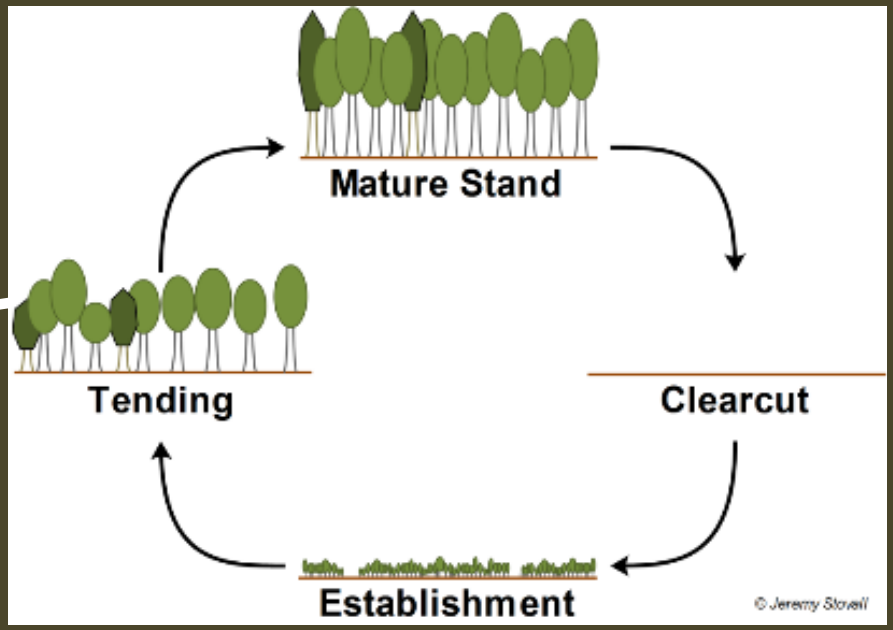
Manage stand density to:

1. Sustain growth of all stand components
2. Maintain stand structure
3. Replace tree mortality and harvest with regeneration

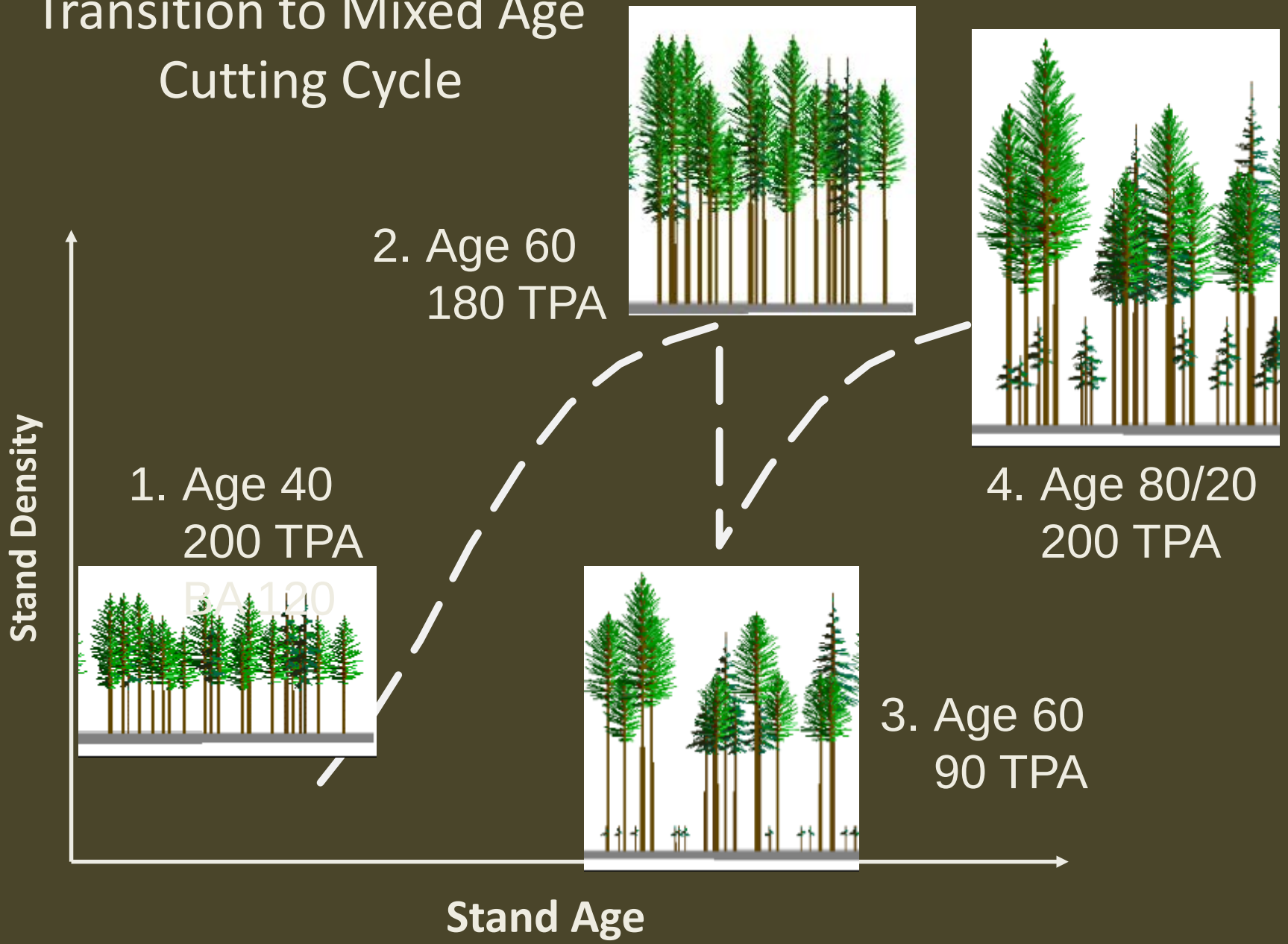
Transformation from even-aged to uneven-aged?

Stand Volume and Rotation in Even-aged System



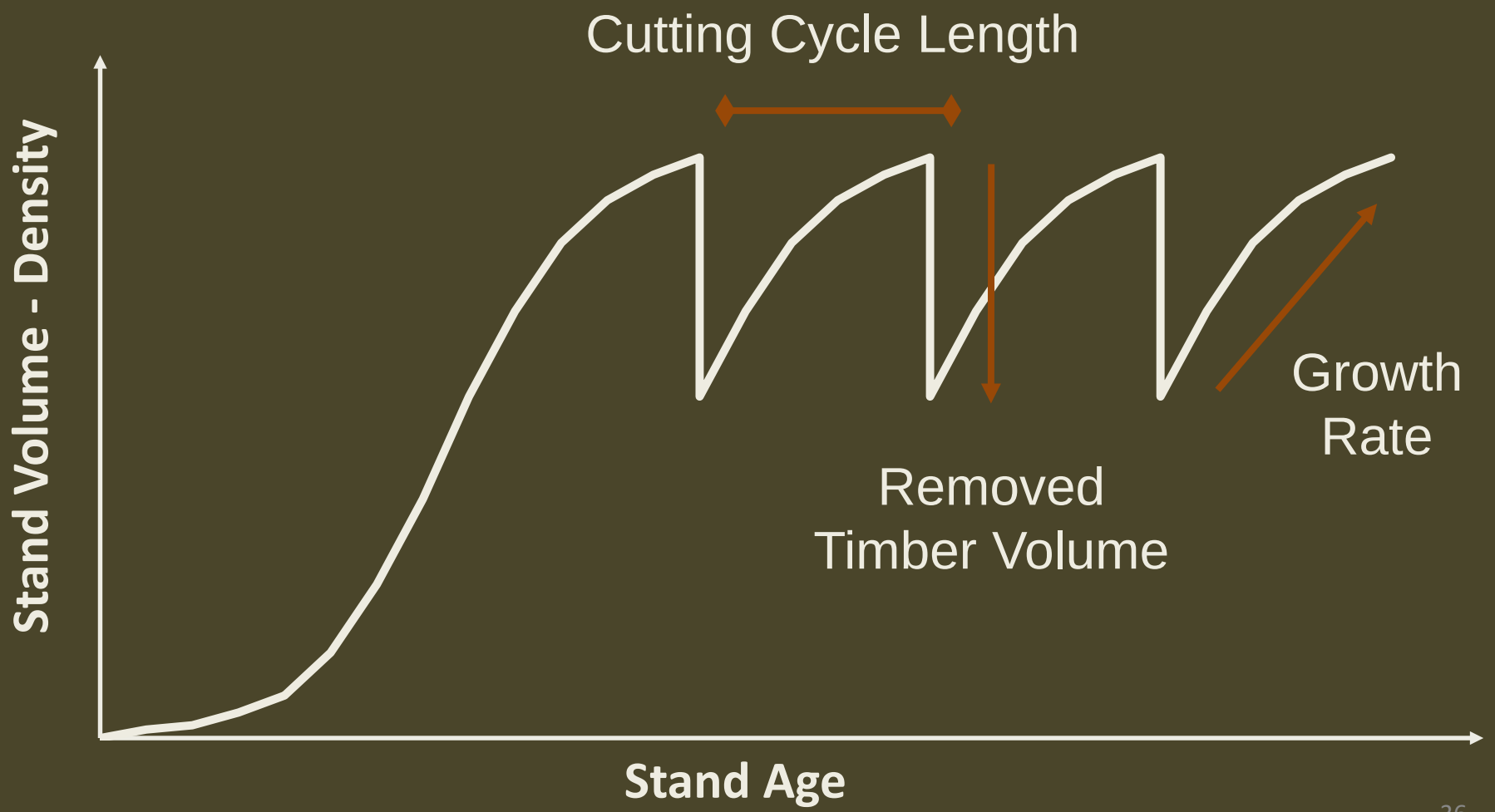


Transition to Mixed Age Cutting Cycle

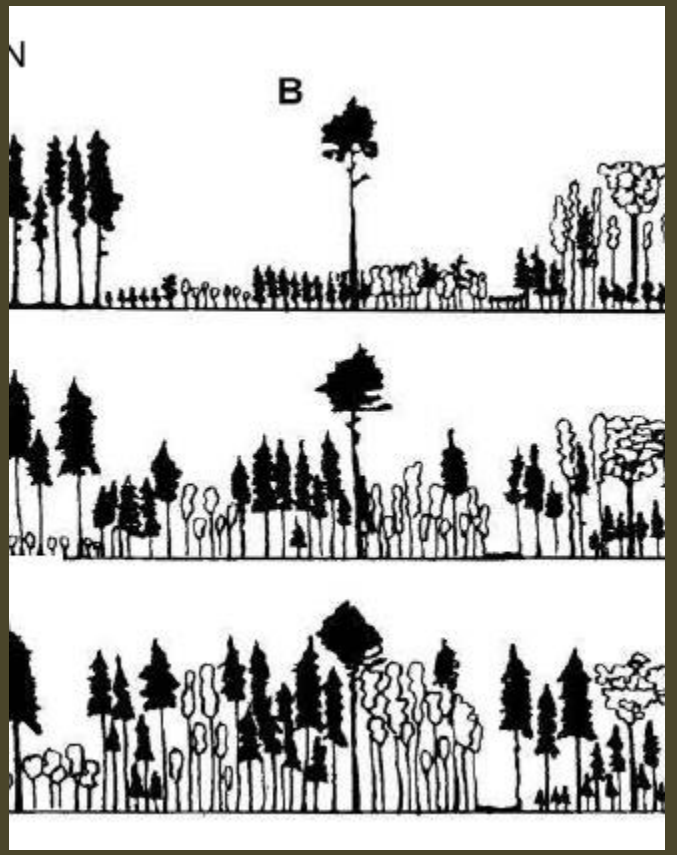


Cutting Cycle

– cutting cycle length depends on cutting intensity and growth rates

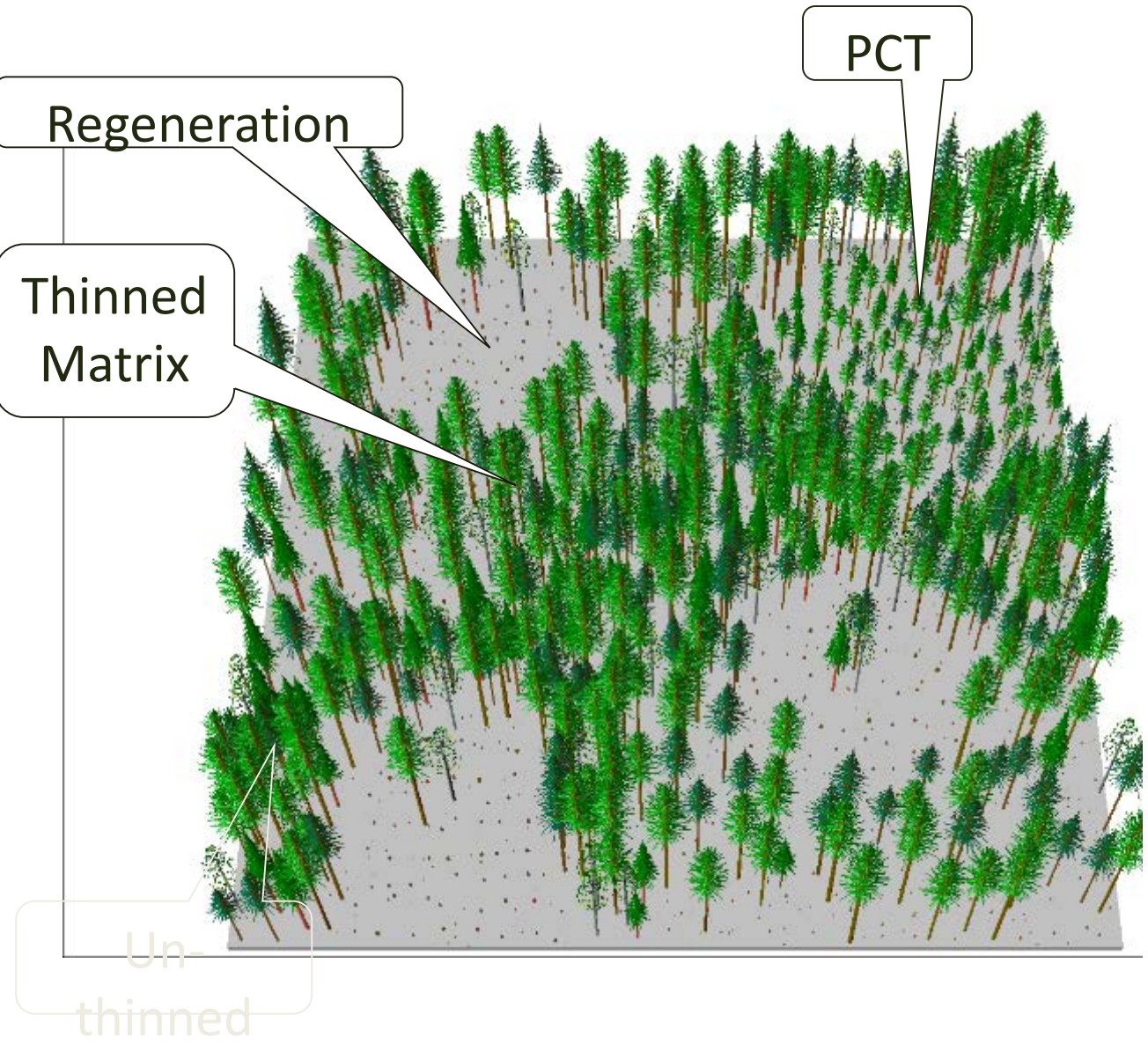


Group Selection System



Group Selection System

- Area Control Method of Uneven-aged Management



Activities:

Group-Selection Harvest

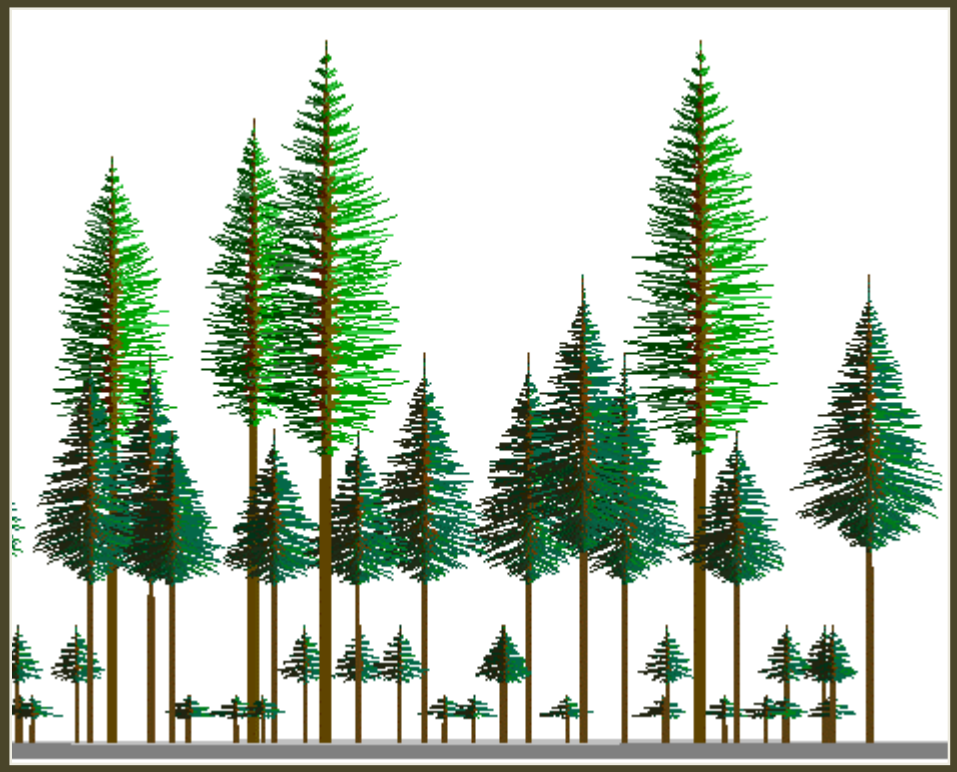
Natural Regeneration Planting

Pre-comm. Thinning

Commercial Thinning

Understory Thinning

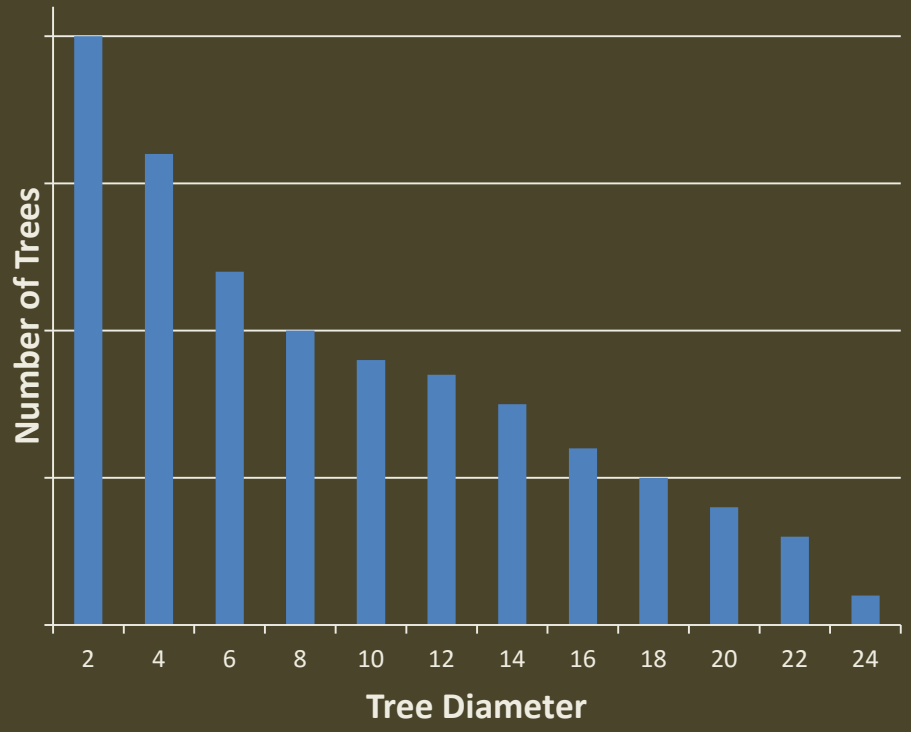
Single Tree Selection

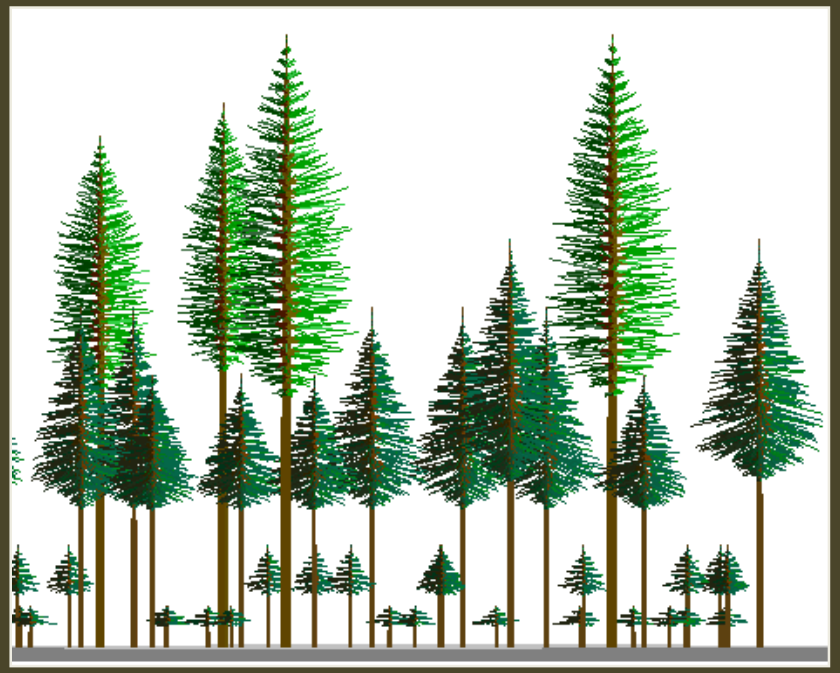


Single Tree Selection

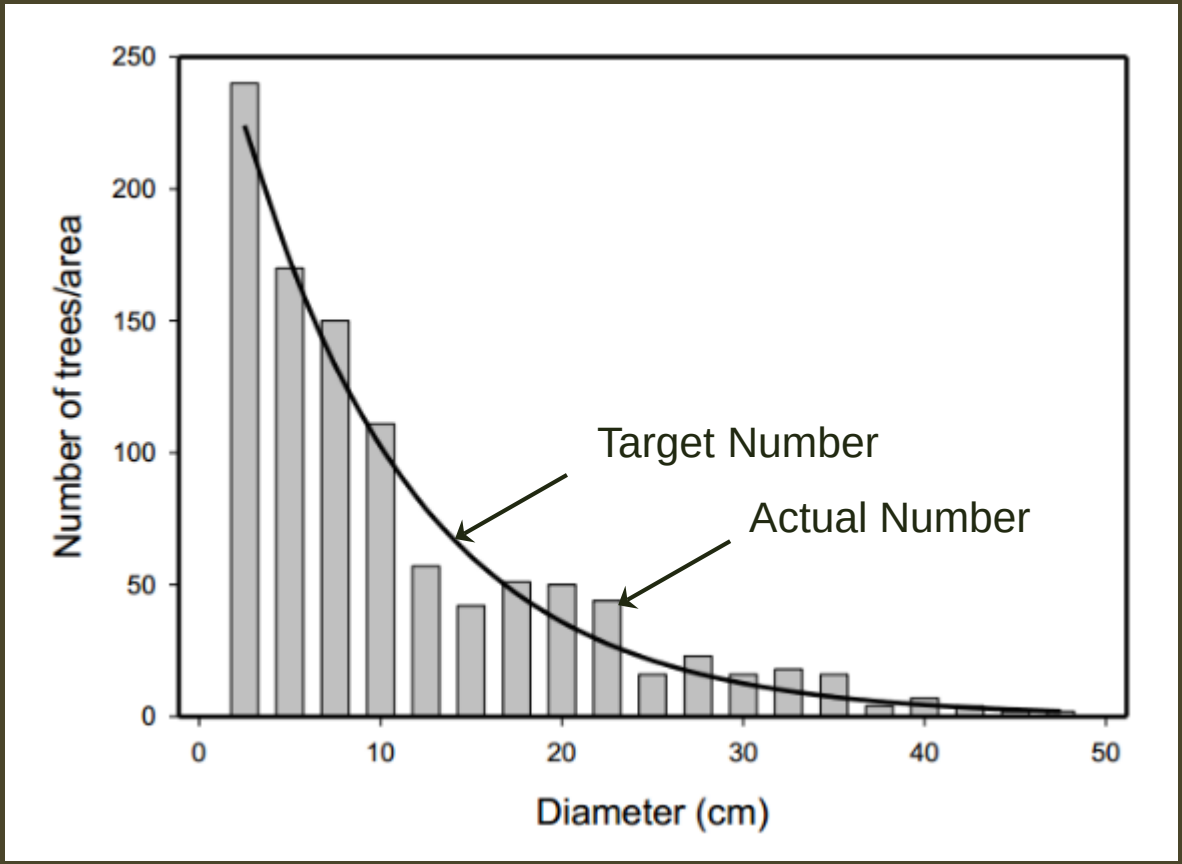
– developing a guide curve from tree count and diameter

Tree Tally by 2 inch Diameter Class



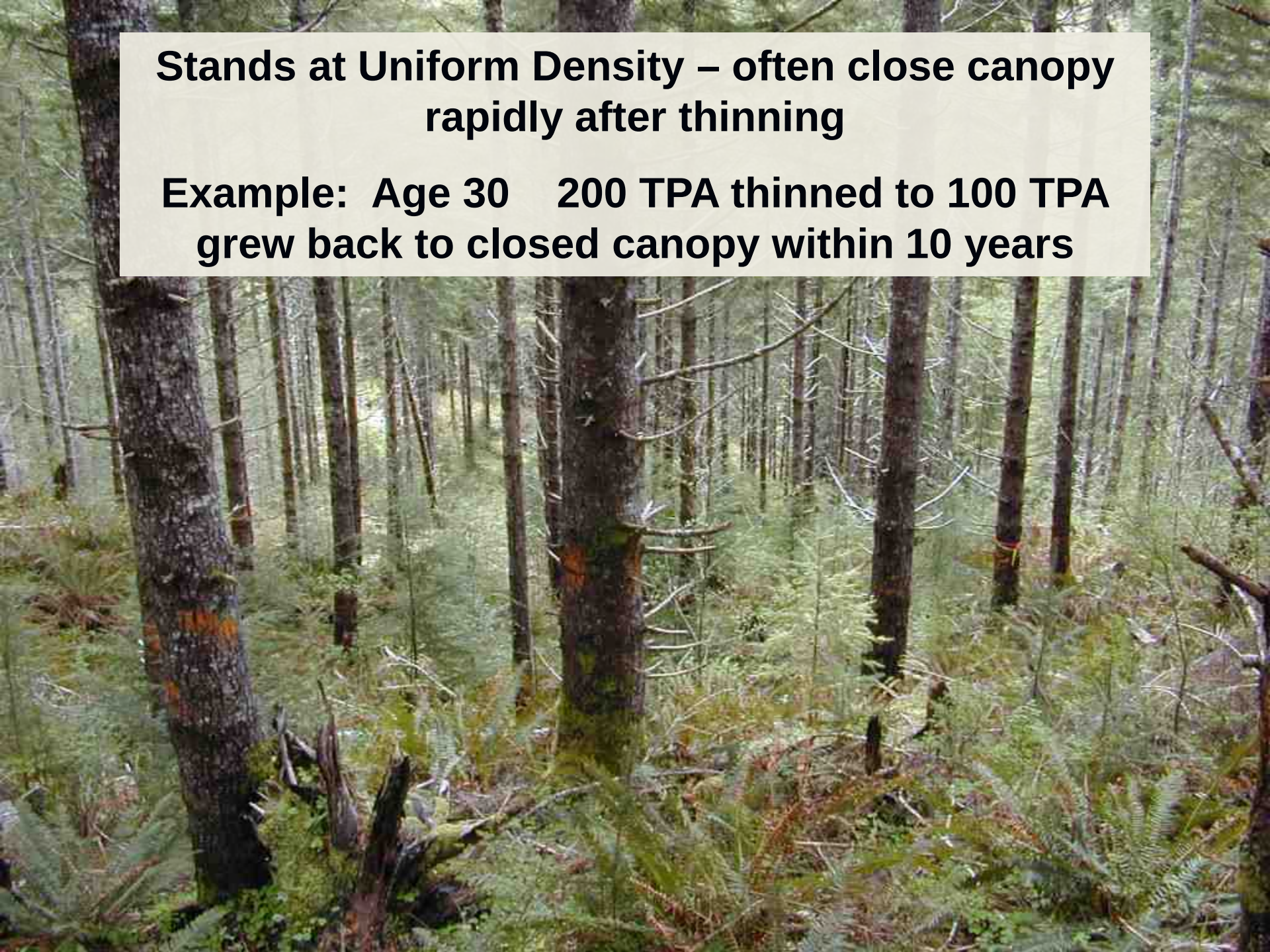


Single Tree Selection



Guide Curve:

At each cutting cycle we thin trees in classes that exceed the guide curve.



Stands at Uniform Density – often close canopy rapidly after thinning

Example: Age 30 200 TPA thinned to 100 TPA grew back to closed canopy within 10 years

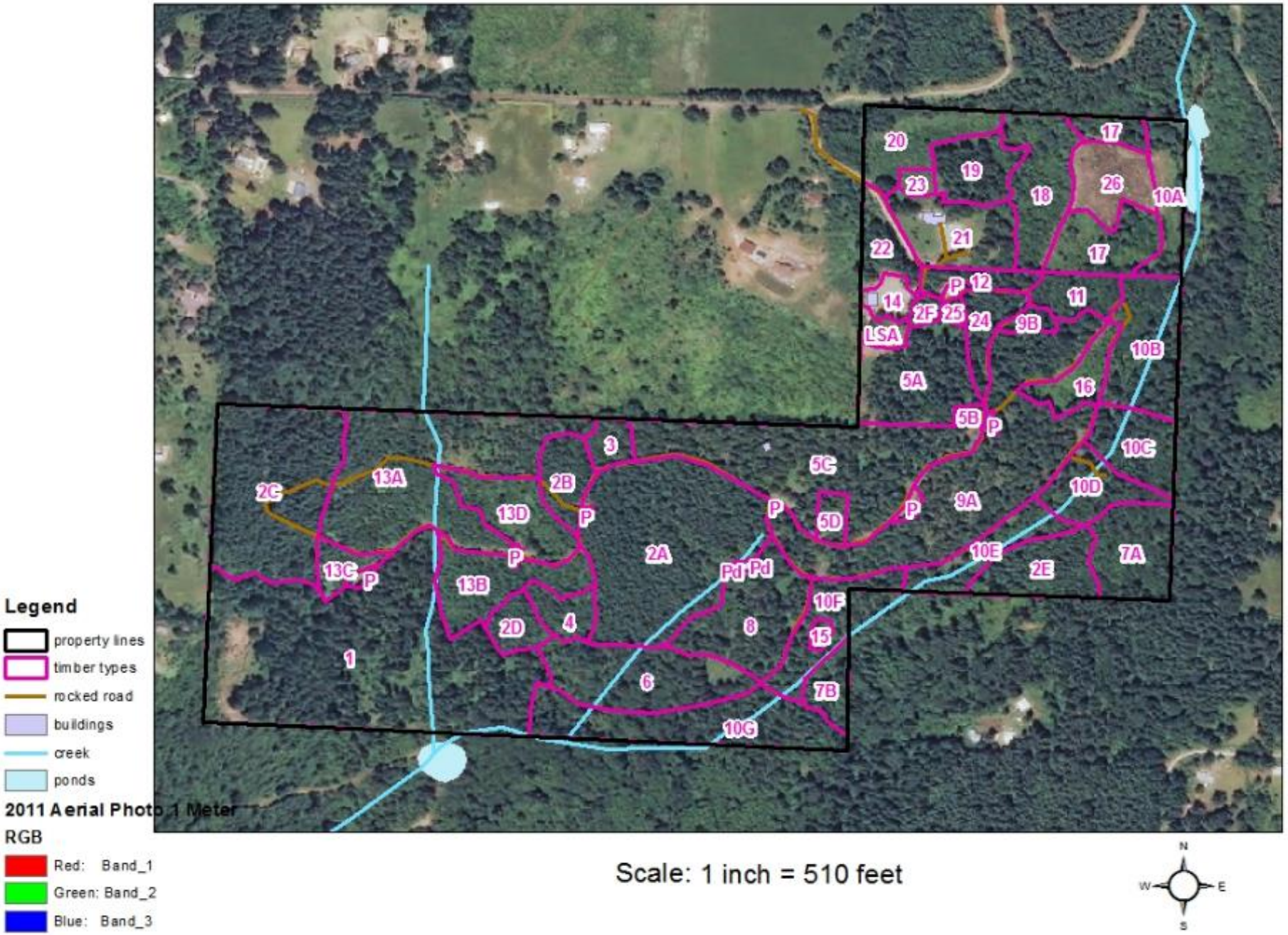
With uniform spacing / thinning:
dominant trees often close crowns rapidly, little room for intermediate trees or understory layers.

Patchy, variable density spacing / thinning can increase canopy diversity more and for a longer time.

Photos from: http://www.fs.fed.us/pnw/olympia/silv/selected-studies/variable/index.shtml

Hopkins Demonstration Forest

www.demonstrationforest.org



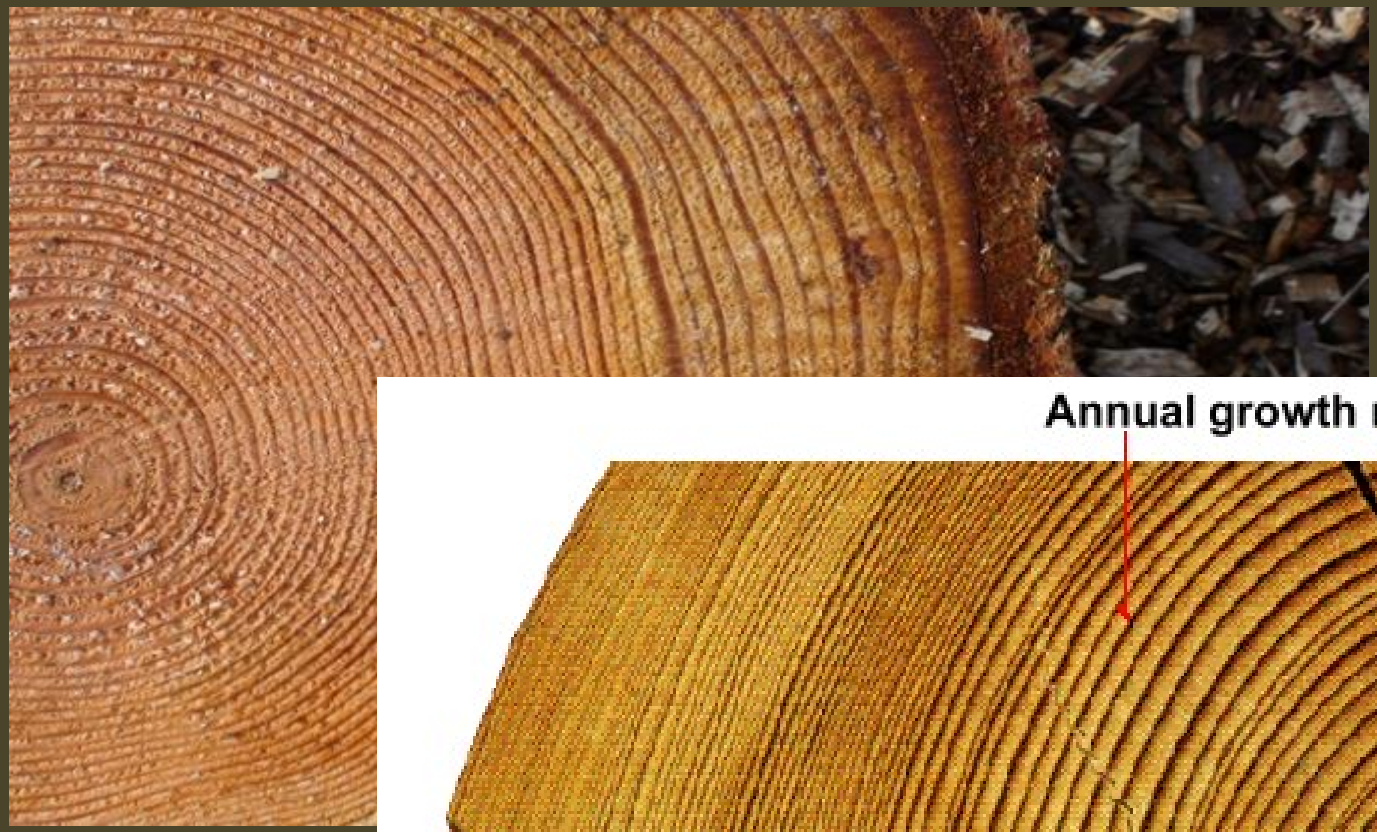
Variable Density Thinning in Even-aged Naturally Regenerated Second Growth

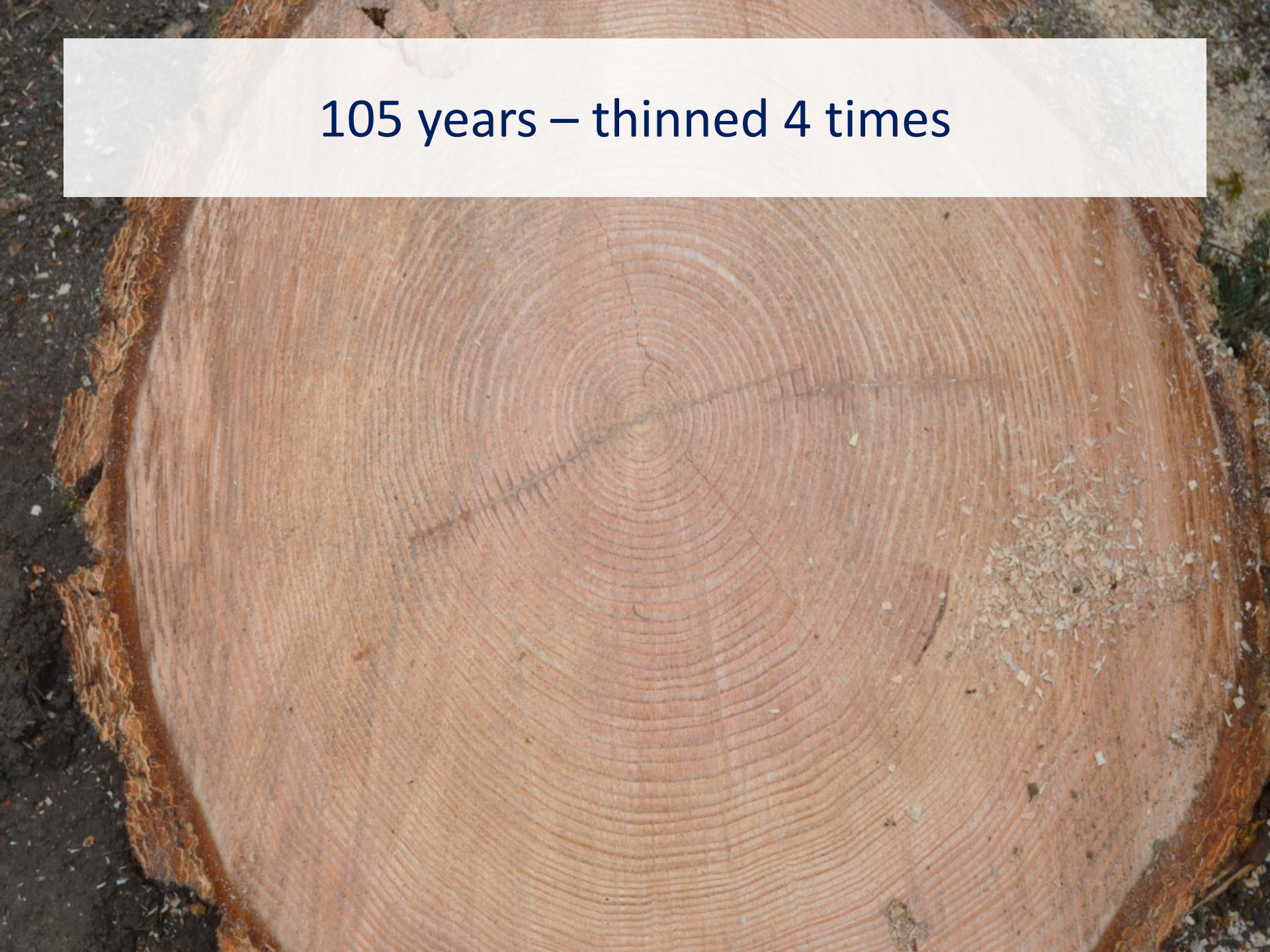
Uneven-aged Management in Naturally Regenerated Second Growth

Uneven-aged Management
Forest Products – Marketing Product Diversity

Assessing growth and control density of all tree sizes and species in the same stand

Assessment of Growth – Overstory diameter increment



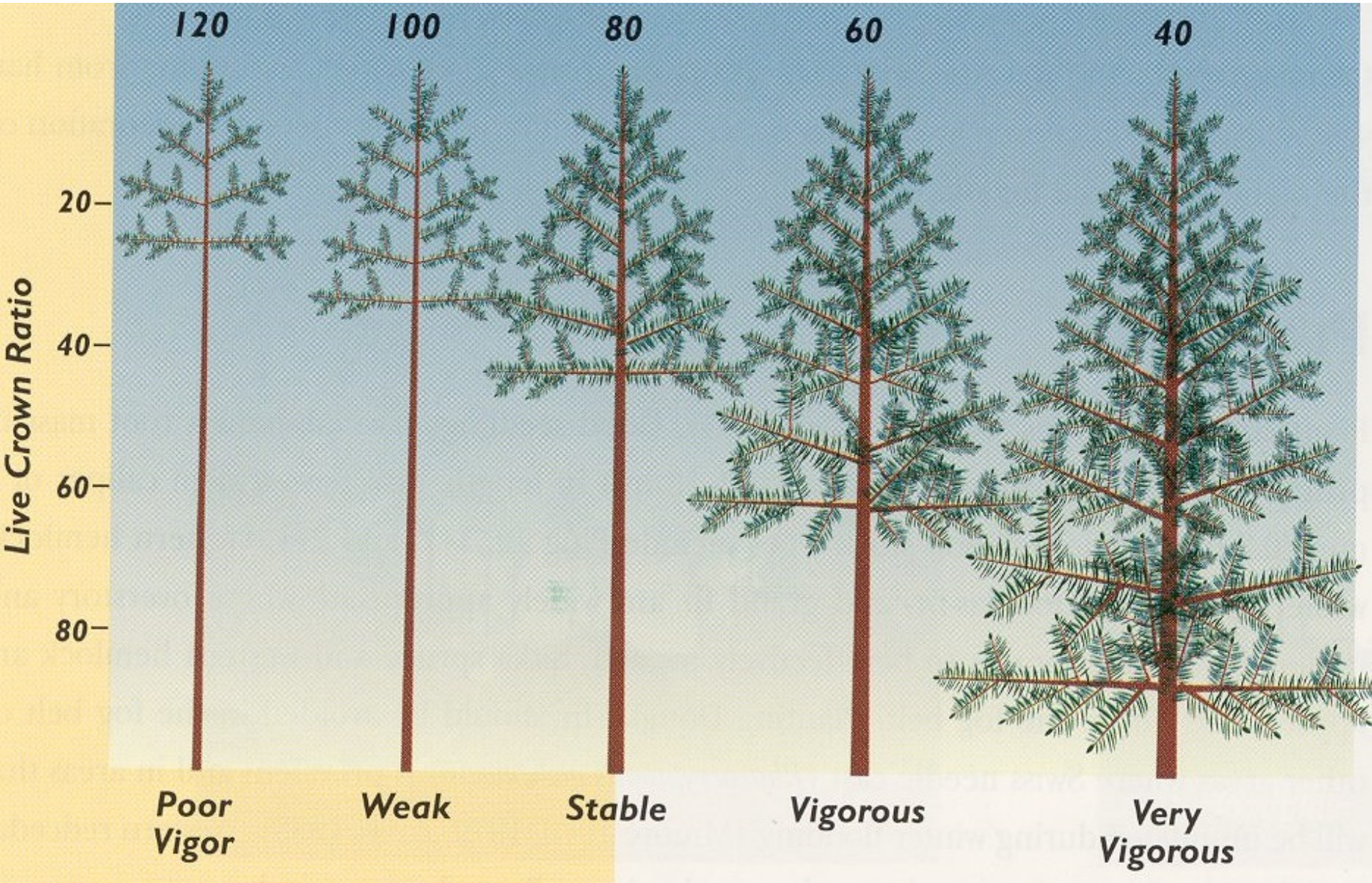

105 years – thinned 4 times

Assessment of Tree Growth, Vigor, and Stability

- Crown ratio
- Height-diameter ratio

Tree Vigor and Stability

Height : Diameter Ratio *(H and D in same units)*



Assessment of Growth – Understory trees

Growth of terminal shoot versus lateral branches - Douglas-fir

Large Gap >30% Light

Small Gap ~20% Light

Under Canopy >20% L

Understory Growth –
Morphological Plasticity


Noble fir


Pacific silver fir


Western hemlock

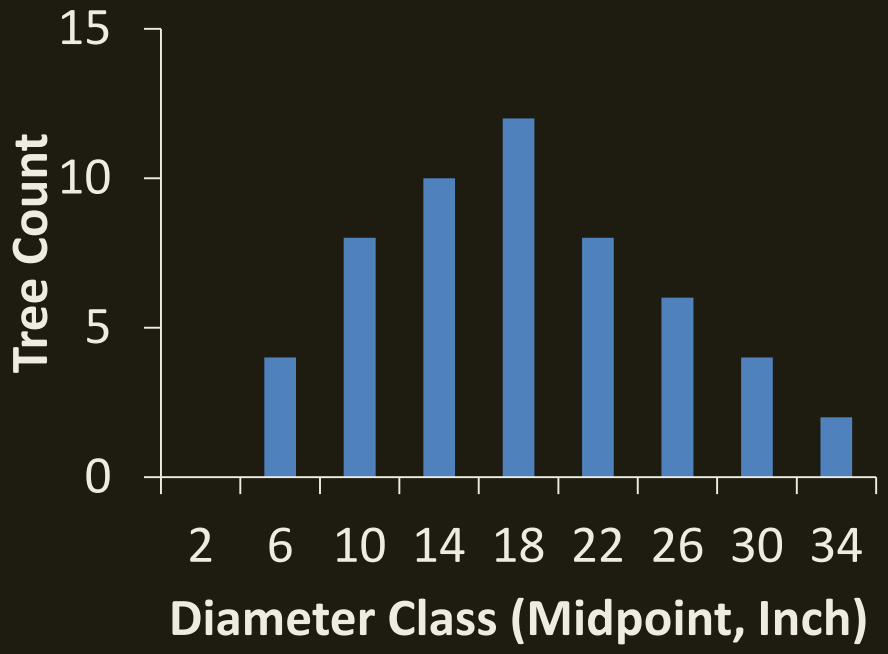
- Sun and shade foliage
- Terminal vs. lateral growth
- Apical dominance

Tools For Assessment – Diameter Distribution

Tree Diameter Tally Sheet				
DBH Class (Inches)	Plot 1 Count	Plot 2 Count	Plot 3 Count	Sum Tree Count
0-4	0	0	0	0
4-8	2	1	1	4
8-12	4	1	3	8
12-16	6	2	2	10
16-20	2	2	8	12
20-24		6	2	8
24-28		1	5	6
28-32	4			4
32-36	1	1		2

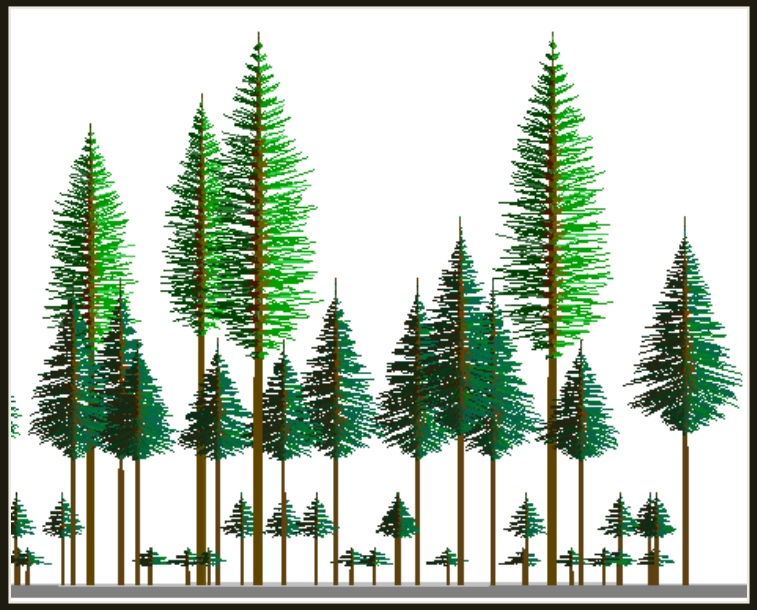
Tools For Assessment –

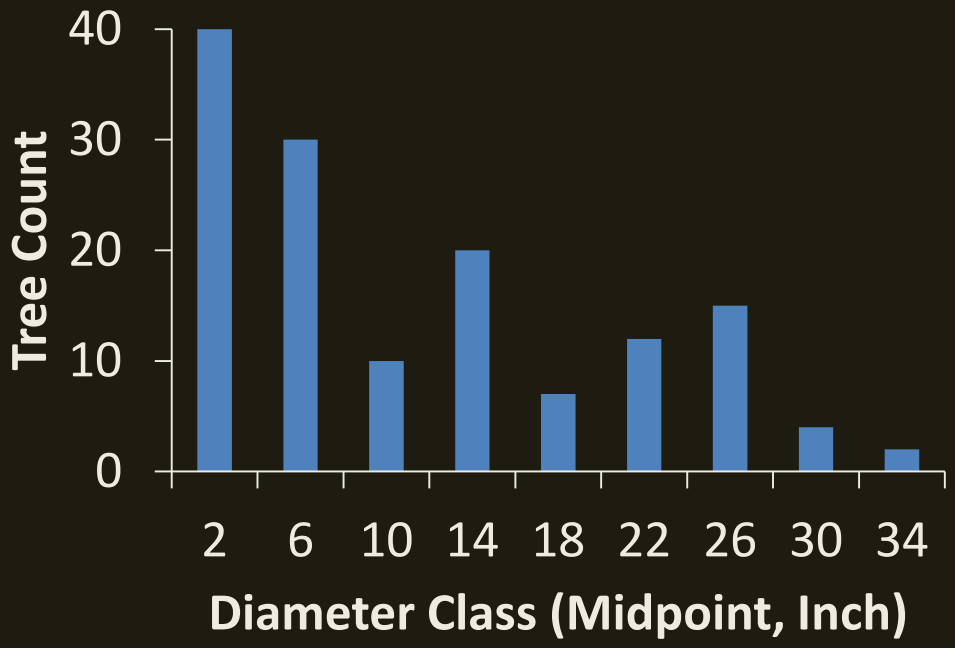
Diameter Distribution of Even-aged Stand



Growing Space Distribution

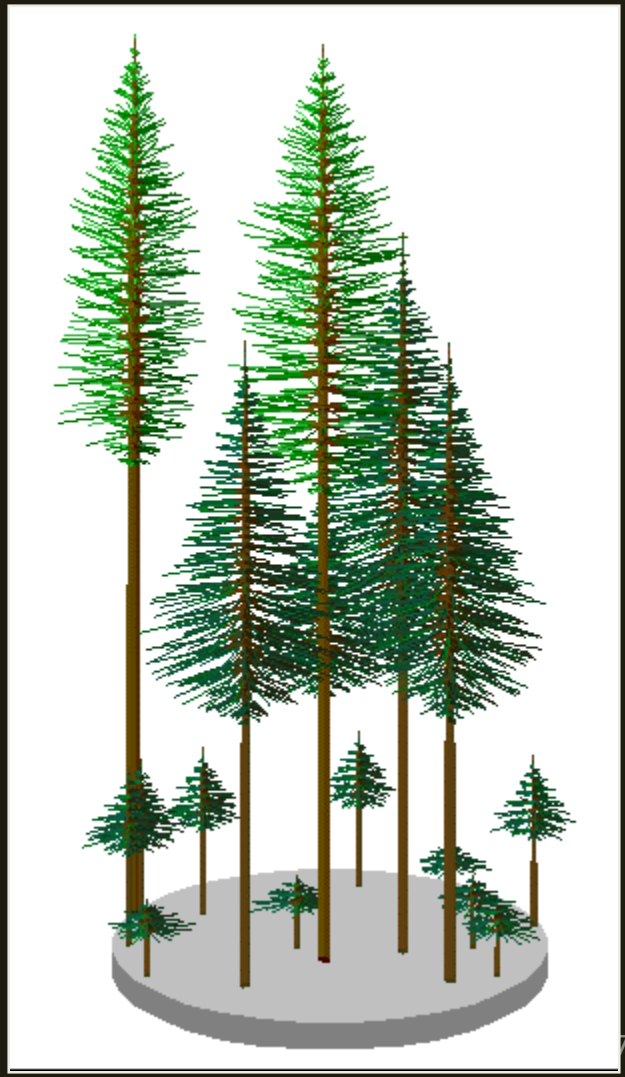
Diameter Distribution of Multi-aged Stand



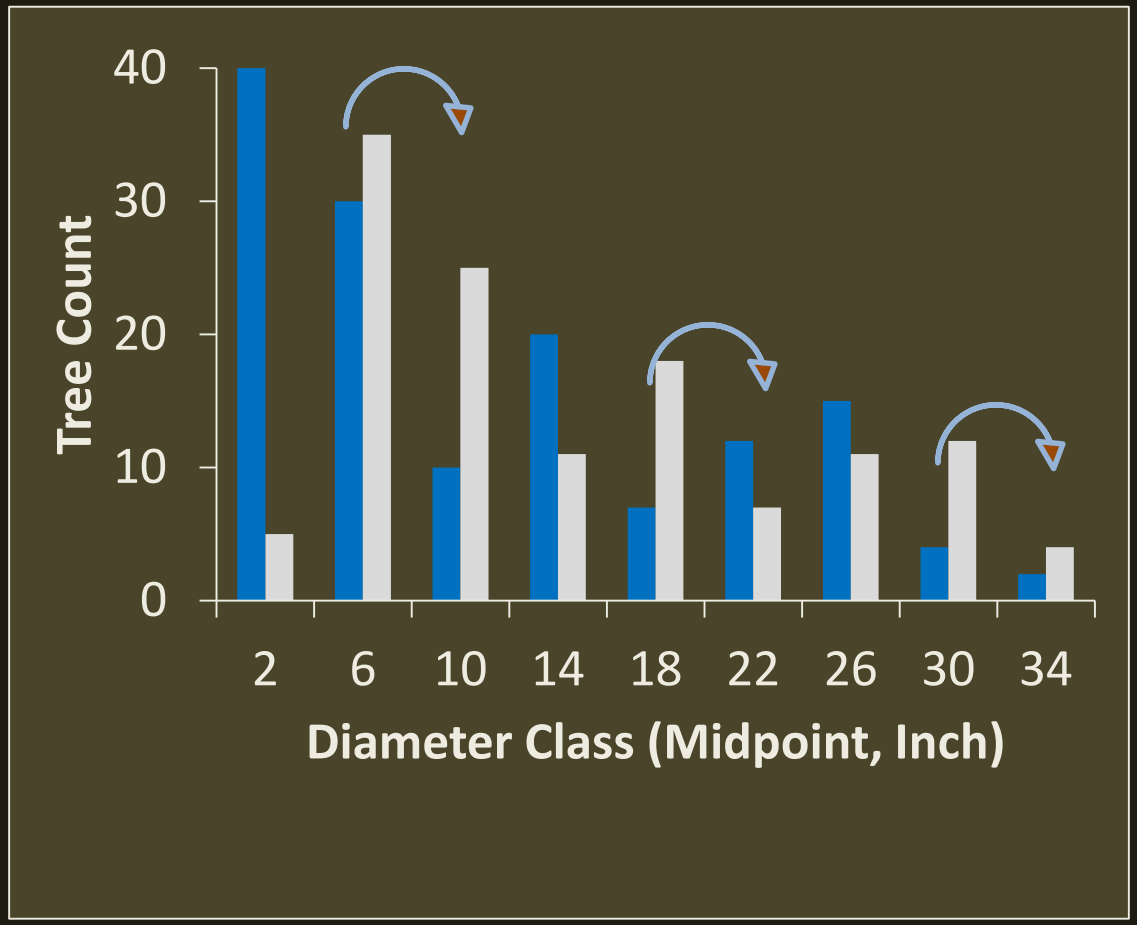


Permanent Sample Plots

- Species composition
- Size classes
- Stand volume
- Diameter growth
- Height growth
- Mortality
- Harvest



Permanent Sample Plots –
Diameter distribution and increment



Inventory Period 1:
Diameter distribution

Inventory Period 2:
Diameter distribution
Diameter class transition

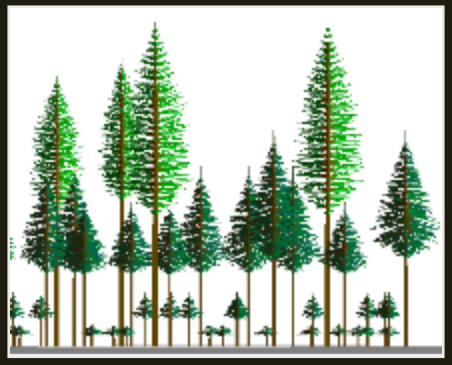
Thinning and Harvest

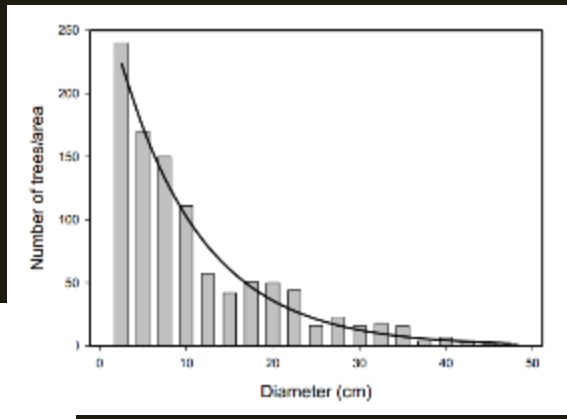
- Objectives
  - Stocking Control, Regeneration, and Timber
- Timing
  - Recovered previous harvest, market conditions
- Make a plan
  - Long-term plan as Guide not Rule
- Creating habitat
  - CWD, snags, canopy layers

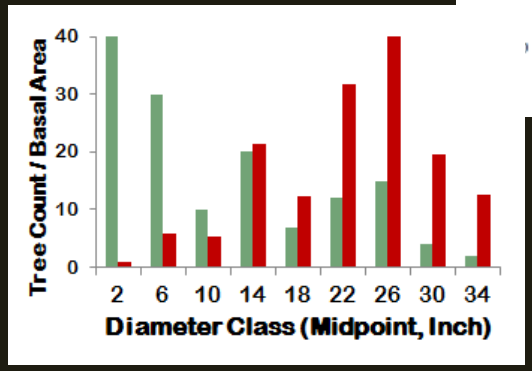
Tree Selection and Marking

- Creating growing space
- Selection guide
- Basal area
- Diameter distribution

- Mark your Trees





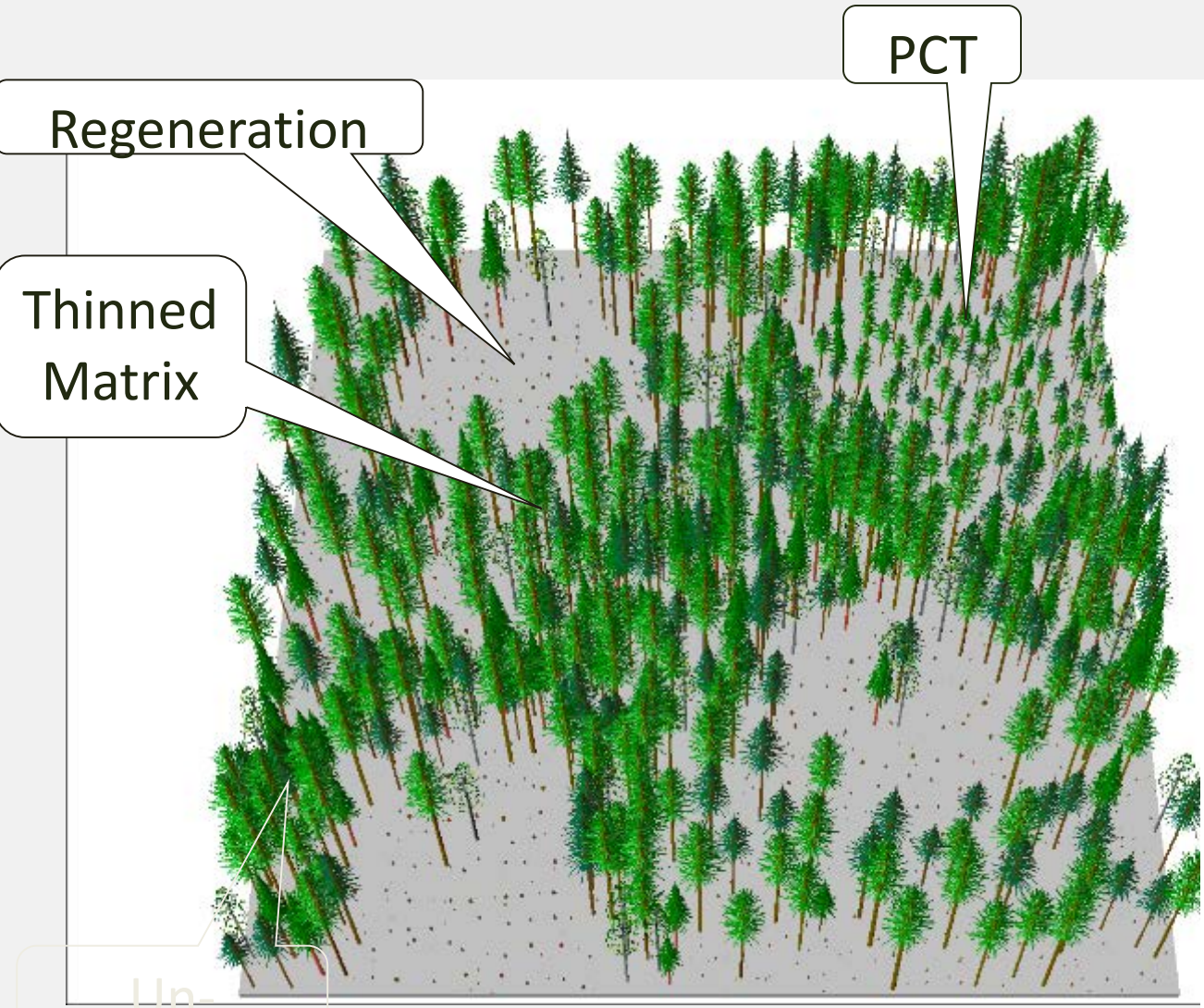


Harvest Layout

- Units and boundaries
  - Uneven-aged stands are more variable
- Forest Practices

- Roads and trails
  - Long-term planning and reuse
- Collaboration

Planning - Group Selection System



Activities:

Group-Selection Harvest

Natural Regeneration Planting

Pre-comm. Thinning

Commercial Thinning

Understory Thinning

Implementation


JOHN DEERE

Harvest Impacts

Summary – managing stand dynamics

- In the absence of disturbance (management) forest stands grow increasingly dense until they reach "carrying capacity" or "self-thinning" density.
- Unchecked competition results in "winners" and "losers" – within species and between species.
- Use assessment tools, judge growing space by looking at crown vigor, crown ratio, and height/diameter ratio.
- For successful management of mixed species and mixed age - give every tree enough growing space/distance from neighbors.

Summary – managing stand dynamics

- With uniform spacing and uniform thinning
  - dominant and co-dominant trees often close crowns rapidly
  - there is little room for intermediate trees or understory layers
- Patchy, variable density thinning can increase canopy diversity more and for a longer time.

Challenges with selective harvesting or partial cutting

- Need to avoid high-grading = removing the best trees and leaving damaged, diseased, genetically “inferior” stock.
- Need to avoid soil compaction, damage to roots, damage to stems and crowns of trees you want to leave for the future.
- Understory shrubs and herbs take over and inhibit understory trees.
- Understory trees are too numerous (too dense) and need to be thinned.
- Requires time, money, care, and dedication.

Keep learning and get the help you need

- You are part of an active and supportive forestry community - learn from each other.
- Field tours, workshops, classes abound
- Use assistance available from many agencies - OSU Extension, Soil & Water Conservation Districts, NRCS, NNRG, Oregon Department of Forestry, etc.
- Get good professional help when you need it – consultants, contractors.

Alternative Forest Management OSU Extension Publications

- Group Selection Cutting in Mature Douglas-fir Forests - EM 9106
- Two-Aged Stand Management in the Coast Range - EM 9082
- Individual Tree Selection (ITS) in a Northeast Oregon Mixed Conifer Forest - EM 9083
- Mixed Conifer and Hardwood Forest Management in Southwest Oregon - EM 9084

https://catalog.extension.oregonstate.edu/series2