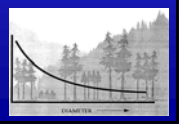
Application of Uneven-aged Management

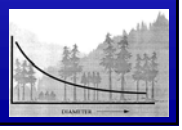
Important Terminology, Concepts & Methodology



Age Classes

- Uneven-age
- How ma an uneven-aged sta

This is the defining characteristic of an uneven-aged stand



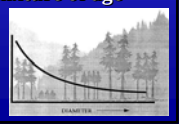
Uneven-aged Stands

2 Types

Balanced

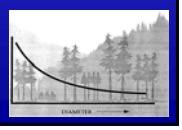
Irregular

Uneven-aged stand = Intimate mixture of age classes



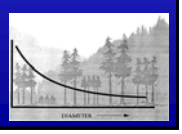
Balanced Uneven-aged Stands

- All-aged Forest
  - Every age class in the rotation is represented
  - Each age class represents approximately the same area
  - Regeneration of new trees would need to occur every year



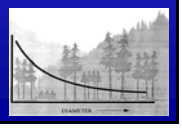
Balanced Uneven-aged Stands

- The perfect "All-aged" stand is theoretical, it mostly exists only in the imagination



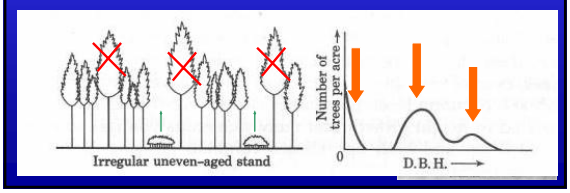
Balanced Uneven-aged Stands

- Even-spaced age class
  - More attainable
  - 3 or more age-classes evenly spaced over rotation (i.e., over a 5-year cutting cycle)



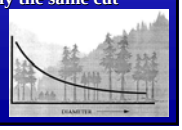
Irregular Uneven-aged Stands

- 3 or more age classes
- Stems are not evenly distributed throughout age classes



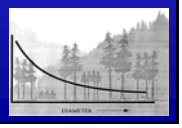
Some Terminology

- Silvicultural System
  - Process by which a forest is tended, harvested & regenerated to achieve management objectives
- Selection Method
  - Regeneration method or technique aimed at the creation and maintenance of uneven-aged stands
    - (i.e., Indiv. tree, Group, Patch)
- Sustained Yield
  - Even-flow, non-declining, i.e., roughly the same cut every year



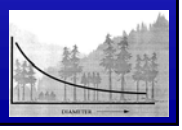
Sustained Yield Unit (SYU)

- Most commonly the SYU is the FOREST
- It is possible for the SYU to be the STAND
  - However, ABSOLUTELY NECESSARY to have a balanced distribution of age classes
  - You are harvesting the tail of the diameter distribution and creating conditions for progression of smaller size classes



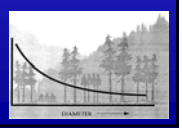
Regulation of the Cut

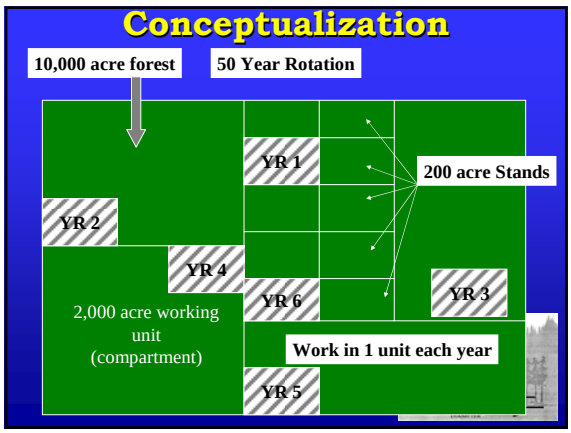
- Method by which the annual periodic cut is determined in order to attain a Sustained Yield
  - Two ways to look at this
    - *Area Regulation*
    - *Volume Regulation*

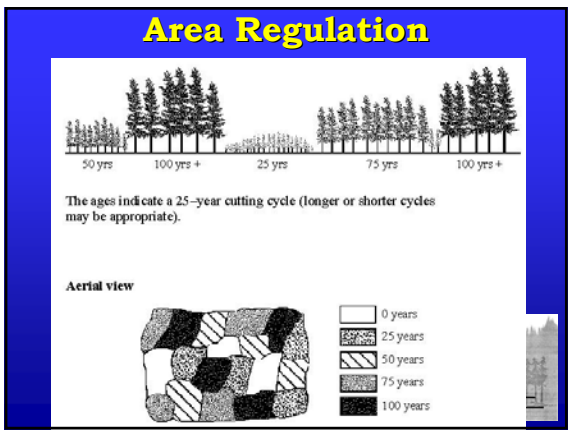


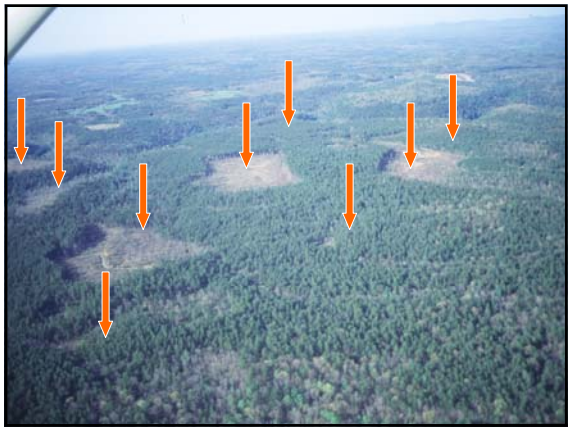
Area Regulation

- A management scheme to produce sustained yield at the forest level
  - NOT at the STAND level
- Does not create Uneven-Aged STANDS
  - Creates Uneven-aged FORESTS



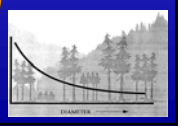

Conceptualization
10,000 acre forest
50 Year Rotation
YR 1
200 acre Stands
YR 2
YR 4
YR 3
YR 6
2,000 acre working unit (compartment)
Work in 1 unit each year
YR 5


Area Regulation
50 yrs
100 yrs +
25 yrs
75 yrs
100 yrs +
The ages indicate a 25–year cutting cycle (longer or shorter cycles may be appropriate).
Aerial view
0 years
25 years
50 years
75 years
100 years



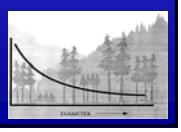
Volume Regulation

- Removal of Annual or Periodic Growth
- All age classes grow in an INTIMATE MIXTURE
- Mature stems (Rotation age) harvested each year
  - *Financially mature stems harvested*



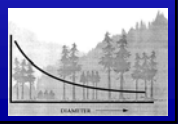
Financial Maturity

- Tree or stand can be seen as an investment
- When growth falls below an alternative rate the stand or tree is said to be <u>financially mature</u>

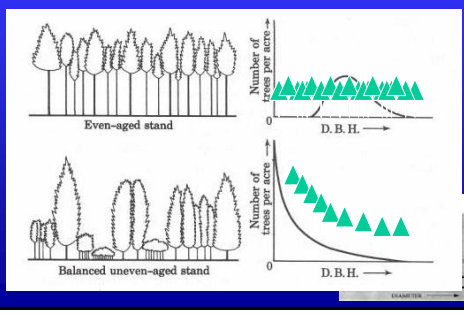


Uneven-aged management entails:

- Maintaining trees of different age classes in the same area
- Calls for more or less equal, periodic harvests
- Under this practice, trees are removed on an individual basis to leave a desired number of trees in each size class
- Variety of goals can be met
- Each harvest stimulates reproduction of new trees and enhances the growth and yield of older trees.

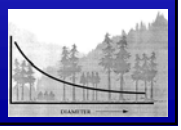


Diameter Distributions



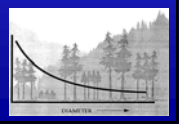
Regulation & Control

- Most straightforward & widely understood types of uneven-aged silviculture is single-tree selection
- Many early attempts failed b/c of inadequate regulation

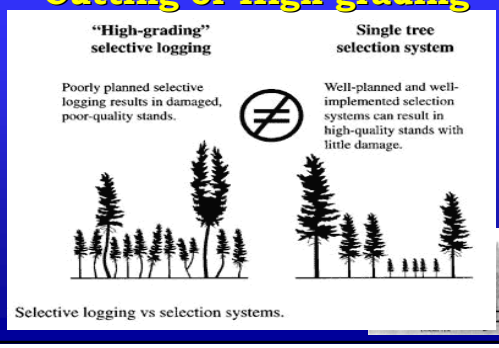


Regulation & Control

- Cutting was concentrated in large size classes w/ little thought given to developing and maintaining a balanced diameter distribution
- High-quality, mature timber was removed first – after repetition this reduced ingrowth into the sawtimber size classes



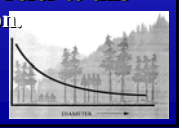
Result = Diameter-Limit Cutting or High-grading



Selective logging vs selection systems.

Diameter Limit Cut

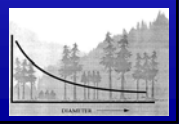
- Most common practice of harvesting hardwood forests of North America
- High grades the forests by taking only the largest and best trees at every harvest.
  - "Taking the BEST, Leaving the REST"
- Loggers and sawmillers often refer to this as select cutting or selection.
- It is poor forestry!



High-Grading

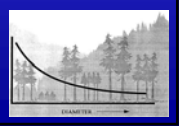
Definition

- Occurs when the residual stand has less value and potential value as the stand removed.
- Still widespread in Tennessee (Diameter-limit cutting)

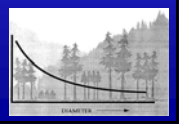


High-Grading

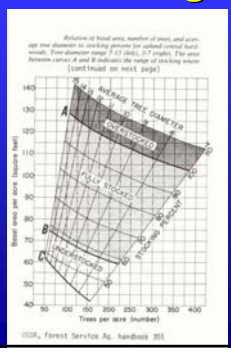
- What's the Harm?
- Most stands in Tennessee are Even-aged
- Favors shade-tolerant species
- Shade-tolerant spp. in the TN tend to be less valuable (economically and sometimes biologically)
- What would happen if Oak spp. were replaced?



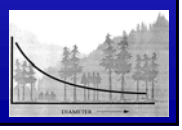
- **What we have learned is that regulation requires control over:**
  - **Diameter distribution**
  - **Growing stock levels**



Stocking Control

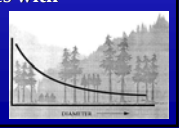


Stocking Chart



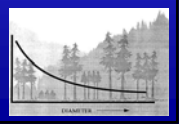
Stocking Control

- **What stocking levels should be retained after the cut?**
- **Gross growth varies only slightly over a moderate range of stocking levels**
  - **60 or 70% of full stocking enhances individual tree growth & stand growth**
  - **"Optimal" residual stocking varies with species & sizes of trees, diameter distribution, among others.**



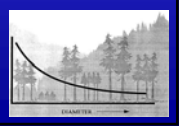
Control of Diameter Distribution

- Determining the desired number of trees or basal area to be retained in each diameter class
- "q" quotient



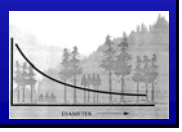
"q" quotient

- Expresses number of trees in successive diameter classes as a means of calculating a desired diameter distribution.
- Tends to be fairly constant in many undisturbed, uneven-aged stands.
- Represents the slope of the relationship (slope of the regression) between # of trees/ac and DBH.



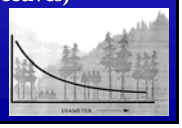
"q" quotient (example)

If you had 100 trees in the 6 inch class & a "q" of 1.3 you would have 130 trees in the 5 inch class, 169 trees in the 4 inch class and so on …



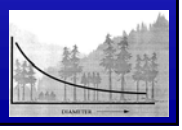
"q" quotient

- To set up a Diameter Distribution based on "q" you must decide upon three parameters:
  - Residual stocking
  - Maximum tree size (considering financial maturity and/or landowner objectives)
  - What "q" to use



What "q" to Use

- "q" normally varies between 1.3 and 2.0
- Small "q" tend to have higher proportions of the growing space devoted to larger trees (sawtimber)
- Stands managed with higher "q" values dominated by more trees in the smaller size classes (pulpwood, small product objectives)

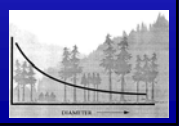


Comparison of Stand Attributes with Varying "q" - values

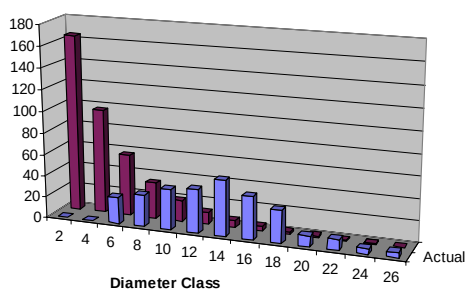
	Q = 1.2	*Q = 1.5*	*Q = 1.8*
Stems per Acre	low	Medium	High
Size of Stems	More sawtimber – less repro	Less sawtimber – more repro	Least sawtimber – more repro
Seedling / Mature tree ratio	Low	Medium	High
Wildlife Hiding Cover	Low	Medium	High
Landowner Goals	More to timber	Compromise between timber & aesthetics	Least timber

Residual Stand Structure Goals

- Once goals for stocking, max. tree size & "q" have been set, it is simple to calculate stand structure goals.
  - Assign 1 tree to largest DBH – then calculate successive smaller diameter classes with "q"
  - Calculate basal area of each DBH class & total basal area
  - Calculate for both target & actual, then compare

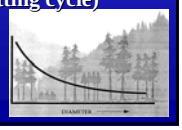


Target vs. Actual



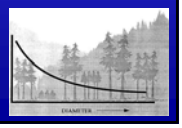
Creation & Maintenance of Balanced Uneven-aged Stands

- Creation from Even-aged stands
  - Can be done, but requires some loss of growth potential
  - Usually takes time (full rotation – removing a portion of the stand each cutting cycle)



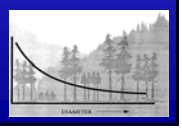
Creation from Even-aged stands

- 50-year rotation
- 10-year cutting cycle – enter stand once every 10 years
- Remove 1/5th of the stand each cutting cycle
  - If the decision was made when the stand was 80 yrs old – some 130 year old stems harvested



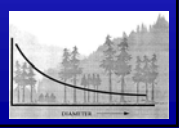
Creation from Even-aged stands

- If the stand was younger
  - Potentially harvesting immature stems early and overmature stems later in rotation
- In either case – would suffer a financial loss – loss in potential productivity
  - Losses may not be justified

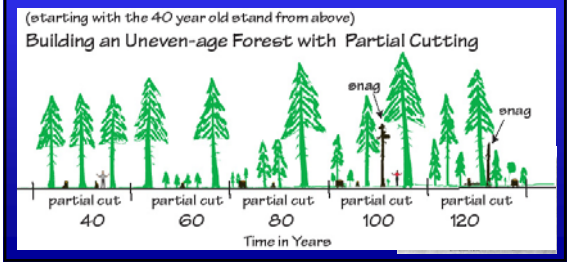


Creation from Irregular Uneven-aged stands

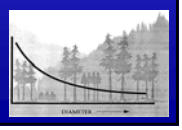
- Can be done much faster
- But potential losses remain a consideration
- Must remove or harvest from all age classes
- Remember "q"



Building an Uneven-aged Forest

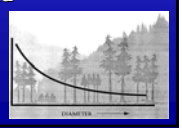


Manipulation of Stands



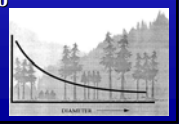
Harvest Cuts – Which trees are removed?

- Largest & usually oldest – either as individuals or small groups
- Harvested trees represent the annual or periodic growth
- Replaced by regenerating stems (reproduction) – this is repeated over time to create or maintain an uneven-aged stand
- Financial maturity – overriding factor



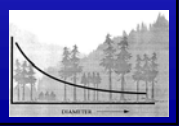
Other Considerations

- Trees at or above largest diameter – may not want to cut if still vigorous and healthy
- High-risk trees – not likely to make it to the next cycle – disease or insects
- Poor form – may want to remove poor genetic material or damaged stems
- Diameter distribution goals – cut more heavily or lightly in a diameter class to obtain proper diameter distribution



What about the Small Trees?

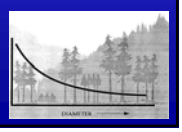
- Thinnings are required to regulate immature age or size classes
- Can not ignore – represent future
- Density needs to be controlled to foster ingrowth and continuous regeneration
  - If ignored – small stems will create a bump in the diameter distribution
  - Can cause loss in productivity & prohibit future regeneration
  - Pay attention to "q"



What Trees to Keep

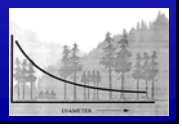
(among immature classes)

- Those of the best quality, soundness & vigor
- Offering best probability of survival & growth
- The desired spp.



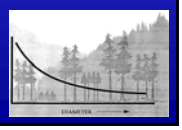
Modifications of the Selection Method

- Single Tree Selection
- Group Selection
- Strip Selection
- Dauerwald



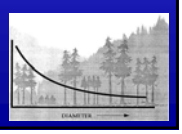
Single Tree Selection

- Managing Individual stems
- Create openings (removal of mature stems) to regenerate new stems in once occupied space
- Remove sufficient numbers of mature trees to cover area allocated to that age class



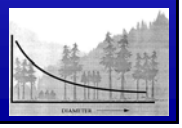
Single Tree Selection

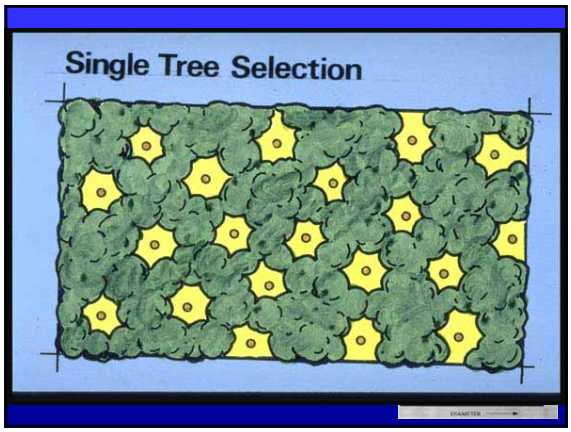
- Thin individual immature stems to balance the distribution
  - This redistributes proportional area among fewer stems
  - To optimize growth potential



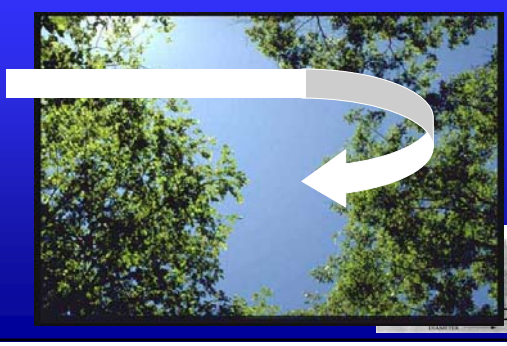
Single Tree Selection

- Some species adapted:
  - Sugar maple
  - Beech
  - Hemlock
  - Red spruce
  - Grand fir
  - Engelmann spruce





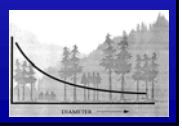
Single Tree Gap



Single Tree

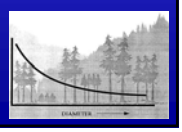
Single Tree Criticisms

- Inability to regenerate shade-intolerant spp.
- Unwillingness to invest in tending of immature stems
- Unwillingness to invest in inventory to determine diameter distribution & needs for tending



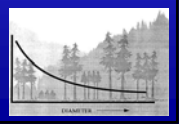
Single Tree Criticisms

- Can be difficult with clustering of mature stems
- Difficult to minimize damage to the residual stand



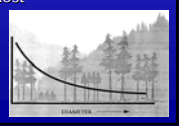
Group Selection System

- Stems cut in small groups rather than as individuals
- Identify family groups of mature and immature trees
  - Harvest mature groups to open the canopy for new regeneration
  - Thin the family groups of immature stems to maintain balance



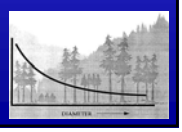
Group Selection

- Reasons to Use:
  - Species requirements
    - *Intolerants do not regenerate in small openings created by single tree selection*
    - *By modifying the size and arrangements of the group cuts – create a wider range of environments - Create conditions most favorable for a particular species*



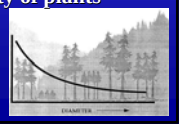
Group Selection

- Reasons to Use:
  - 1. Species requirements
    - *Reproduction – develops in small even-aged groups – gives better form*
    - *Able to track age class development easier (easier to see)*
    - *Edge effect – may be beneficial in establishment of some spp. – can cause growth reduction later.*
      - Not good for phototropic spp. i.e. hardwoods

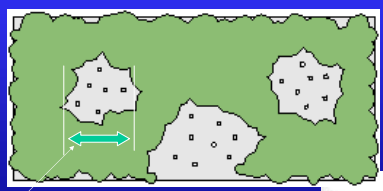


Group Selection

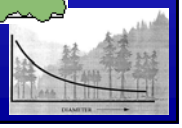
- 2. Economics of harvesting
  - More economical to harvest groups – less damage to residuals
- 3. Wildlife
  - More edge, more environmental conditions that produces a greater diversity of plants for cover, food source, etc…

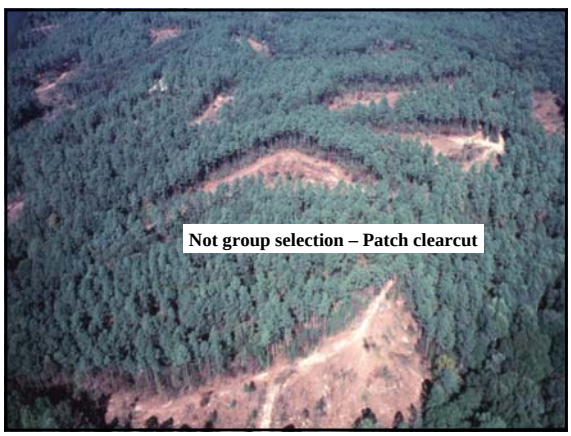


Group Selection System



Not greater than 1.5 to 2 times the height of average of the dominant canopy

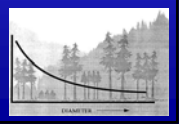




Not group selection – Patch clearcut

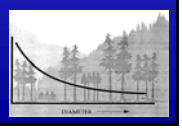
Group Selection Praise

- Can increase chances for regenerating shade-intolerant species
- Semantics – can turn into patch clearcutting if the size of the group is large – remember area management



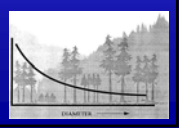
Group Selection Criticism

- Inventory ignores spatial distribution of family groups
- Unwillingness to tend immature groups
  - Failure to tend immature groups makes it a mere diameter-limit cut



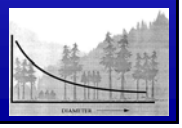
Strip Selection

- Each age class in the stand is concentrated in long narrow strips
- Harvested on a cutting cycle to include one strip each entry
- Seldom used in the U.S.
- Advantage – harvested material concentrated



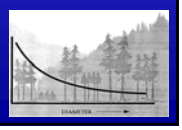
Strip Selection

- Advantage – less damage to reproduction
- Mostly used for montane watershed management – help increase snowpack
- Difficult to initiate, forces you to cut overmature & immature stems to set up the system



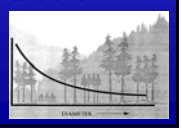
Dauerwald

- German – meaning continuous forest
- Each tree receives TLC
- Managing single trees instead of stands
- Used b/c of lack of land base in Europe
- Highly intensive management



Growth & Production

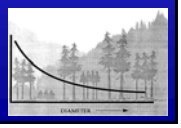
- Debate – uneven-aged stands are more efficient in production of volume and value
  - First, Value – may not be the case – species dependent – in the southeast the most valuable species are generally intolerant



Growth & Production

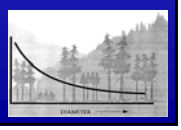
- Second, Volume – Reproduction occurs under mature harvestable trees
  - *Less time for harvestable turnover*
  - *Space for new cohort is not taken by mature stems*
  - *Better utilization of the site*
- Greater volume has not been conclusively demonstrated through scientific investigation

- Debate continues on……..



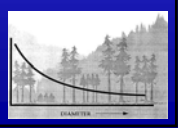
Economics of Uneven-aged Management

- Uneven-aged management may be appropriate for certain class of ownership
  - Small Private Landowners
    - *Some small landowners have a limited land base and wish to obtain periodic returns on investment*
    - *Especially if stand is already uneven-aged or two-aged – may be too costly to convert to even-age (time lag)*



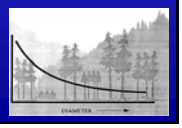
Small Landowner Example

- Situation – small landowner (200 acres), stand has been high-graded by diameter-limit cuts (so it is two-age)
- Alternatives:
  - No management – take what little stand produces
  - Convert to pine
  - Uneven-aged management – proper use



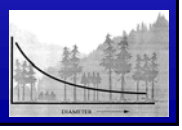
Small Landowner Example

- Landowner has a desire to actively manage – improve production of stand
- Assume a rotation of 30 years
  - Costs – site prep & planting (Even-aged), improvement cuts and added cost of harvesting (Uneven-aged)
  - Returns – value from clearcut (even-aged), value from yearly harvest (Uneven-aged)

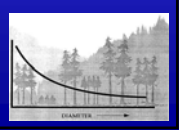


Small Landowner Example

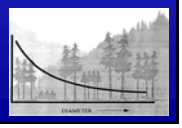
- Returns are more for plantation management
- Reasons why uneven-aged management might still be acceptable
  - Large initial investment in plantation
  - Multiple objectives – wildlife, aesthetics, timber



- In the past we have given landowners the alternative of even-aged or nothing
- Maybe we can encourage better tending of private land by promoting uneven-aged management
- Many simply not willing to employ even-aged or plantation management

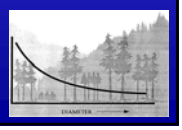


Other Partial Cuttings



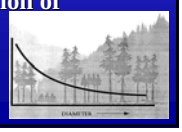
Non-harmful cuttings Do Not:

- Preclude regeneration
- Upset soils or expose them for long times
- Plug up natural drainages or change landforms



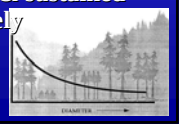
Cuttings outside this Silvicultural System:

- Give irregular yields of unpredictable amounts
- Take a chance on spp. composition of regeneration
- Accept non-uniform distribution of growing stock



Selective Cutting not Selection

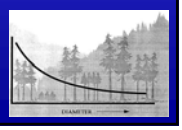
- Creaming, culling or high-grading
- Diameter-limit cutting
- Exploitation that removes certain trees of high value without regards to regeneration
- Known silvical requirements & sustained yield being wholly or largely ignored



Advantages & Disadvantages

as compared to even-aged management

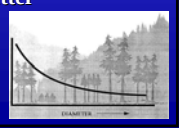
- Advantages
  - Seed source more assured
  - Better protection of site
  - Less danger of fire
  - Aesthetically more pleasing
  - Sawtimber quality could be better – debate
  - Less susceptible to insects or pathogens



Advantages & Disadvantages

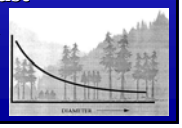
as compared to even-aged management

- Disadvantages
  - Harvesting is not concentrated – more costly
  - More supervision & expertise required
  - More damage to reproduction & residuals
  - Less chance for selecting for better genotypes
  - Difficult to manage & evaluate



Summary

- Favors tolerant spp. – equates to less valuable timber in TN
- Cost of operation is greater – larger area impacted for similar extraction
- Damage to residuals & reproduction
- For method to be effective, must be diligent in cutting in all size/age classes



Summary

- Markets for all materials are needed
- More expertise & time needed for proper implementation
- Danger of method degenerating to high-grading & diameter-limit cutting unless proper care is taken to promote all size/age classes