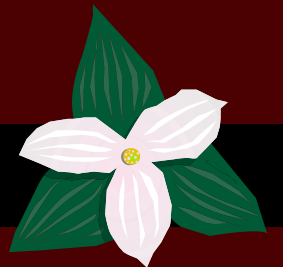


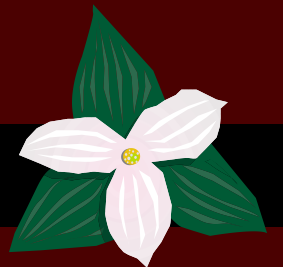
Conifer Plantation Management

**Another Landowner Workshop
In the Caring for Your Land Series.**



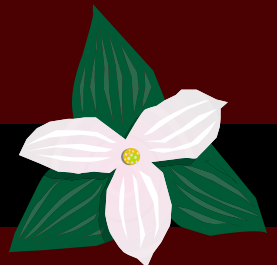
Why the workshop?

- ◆ **To give you**
 - ◆ **An opportunity to learn**
 - ◆ **Information to plan and implement**
 - ◆ **Tools to manage your conifer plantations**



What's in the Workshop?

- ◆ **An overview of conifer plantation management.**
- ◆ **Information on:** Species
Forest History
Planting
Management Planning
- ◆ **Modules on:** Crop Planning
Forest Operations
Timber sales and marketing
Biodiversity
Plantation problems

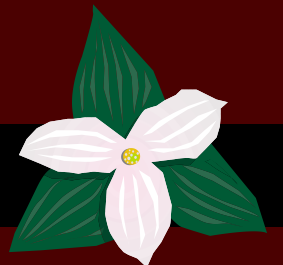


What Else?



- ◆ **Useful equipment**
- ◆ **Hints and advice**
- ◆ **Demonstration sites**

- ◆ **Reference material**
- ◆ **Interesting web sites**
- ◆ **Field trips**



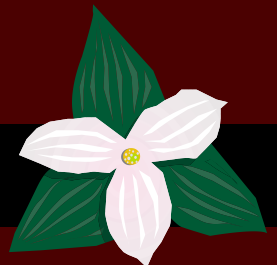
Conifer Plantations

Module #1 Introduction To Plantation Management



Forest history in Southern Ontario

- ◆ **Original great pine forests and hardwoods**
- ◆ **Early 1900s large tracts of land turned into empty wastelands**
- ◆ **Nutrients of soil depleted, topsoil lost**
- ◆ **Land lost ability to store water**
- ◆ **Droughts and floods**
- ◆ **Idle land in Eastern Ontario since 1940s**



The WIA Program



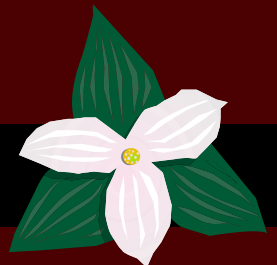
- ◆ **Started in 1967**
- ◆ **Put idle land back into forest**
- ◆ **Over 10,000 properties**
- ◆ **Most less than 10 hectares**



Why Plant Conifers?



- ◆ **Shorten the time to re-establish a forest**
- ◆ **Nurse crop for hardwoods**
- ◆ **Quality seedlings in nurseries**
- ◆ **Stabilize and rehabilitate soil**
- ◆ **Windbreak**
- ◆ **Investment**

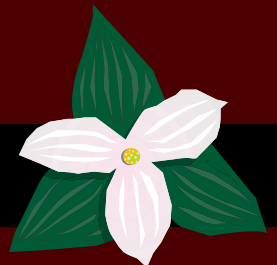


The Life Cycle of a Managed Plantation

◆ Usually 60-80 years total



◆ Managing takes time, money, effort and knowledge



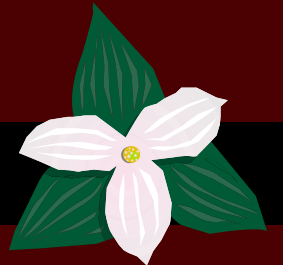
Meeting Your Objectives

- ◆ **Investment**
- ◆ **Site protection**
- ◆ **Recreation**
- ◆ **Conservation**
- ◆ **Wildlife**
- ◆ **Aesthetics**
- ◆ **Multiple use**



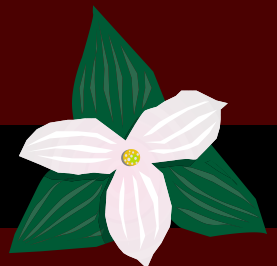
Plantation Role

- ◆ **Plantation ecosystem constantly evolving towards the desired natural forest after one rotation**
- ◆ **Nurse crop in the restoration of pre-settlement upland hardwood and pine forests**
- ◆ **Provide some wildlife habitat**



Conifers vs. Deciduous

- ◆ **Also called Gymnosperms, ever greens, needle-bearing trees and softwoods**
- ◆ **Most don't shed leaves in the fall**
- ◆ **Reproductive structures separate them from other (deciduous) trees**
 - ◆ **No true flowers**
 - ◆ **Seed bearing cones**
- ◆ **Wood composed of different type of cells than deciduous trees**
- ◆ **650 species worldwide**



Conifer Species of Ontario

Pines

- ♦ Red Pine
- ♦ White Pine
- ♦ Jack Pine
- ♦ Scots Pine



Spruces

- ♦ White Spruce
- ♦ Norway Spruce
- ♦ Black Spruce



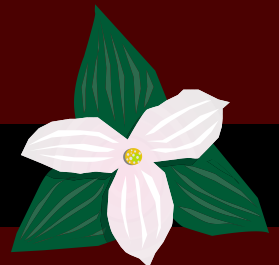
Cedars

- ♦ White Cedar



Larches

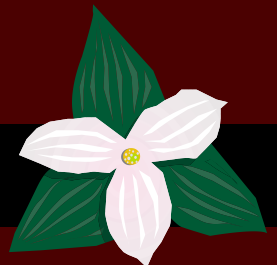
- ♦ European Larch
- ♦ Tamarack



Red Pine



- ◆ **Grows best on deep well-drained sands and sandy loams**
- ◆ **Nurse crop for development of hardwoods**
- ◆ **Usually not part of future forest**
- ◆ **Range of forest products**



White Pine

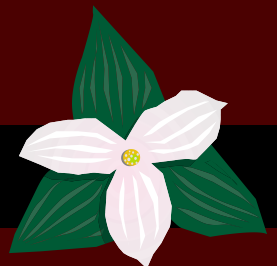


- ◆ **Moist, well-drained sandy loams, sands, clays**
- ◆ **Nurse crop for hardwoods**
- ◆ **Part of next forest**
- ◆ **High value forest products**



Jack Pine

- ◆ **Well-drained soils and dry sites**
- ◆ **Nurse crop for difficult sites for hardwoods**
- ◆ **Site protection and rehabilitation**
- ◆ **Little opportunity for forest products**
- ◆ **Not native to this part of Ontario**



White Spruce



- ◆ **Moist sands, sandy loams, clay loams and well-drained clays**
- ◆ **Will be a component of next stand**
- ◆ **Good markets for pulp and sawlogs**
- ◆ **Branches are tenacious**



White Cedar



- ◆ **Acid or alkaline soils, shallow soils**
- ◆ **Grows well on shallow soils over limestone**
- ◆ **Turns marginal land into a productive site**
- ◆ **Important wildlife habitat**



Other Species

In Eastern Ontario

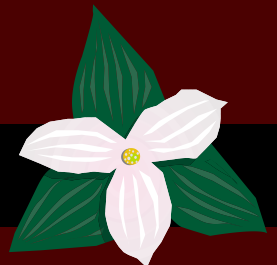
- ◆ **European larch** — well-drained loams, sandy loams
- ◆ **Tamarack** — moist sites, swamps, heavy clays, coarse sands

Elsewhere in Ontario

**Norway spruce
red oak
green ash
black locust**

**Scots pine
white ash
black walnut**

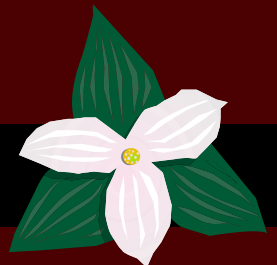
**black spruce
silver maple
poplars**



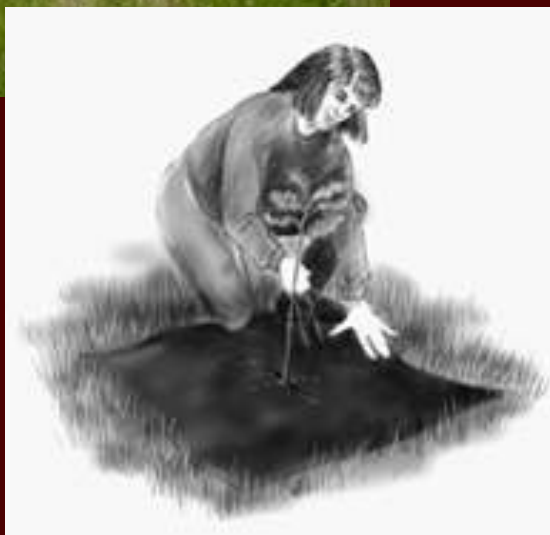
Designing the Plantation



- ◆ **Look at whole property**
- ◆ **Match species to site conditions**
- ◆ **Consider contours**
- ◆ **Establish spacing**
- ◆ **Rows at right angle to prevailing wind**
- ◆ **Think about harvest**
- ◆ **Planting course offered**



Preparing the Site



- ◆ **Control vegetation**
 - ◆ **Mechanical**
 - ◆ Mowing
 - ◆ Ploughing
 - ◆ Scalping
 - ◆ **Chemical**
 - ◆ Total site
 - ◆ Strip
 - ◆ Spot
 - ◆ **Manual**
 - ◆ mulch



Getting Ready to Plant

- ◆ **Ordering numbers to match spacing design**
- ◆ **Only get trees when ready to plant**
- ◆ **Water**
- ◆ **Types of stock**
 - ◆ **Bare root**
 - ◆ **Balled**
 - ◆ **Container**
- ◆ **Cool storage**



Planting Methods

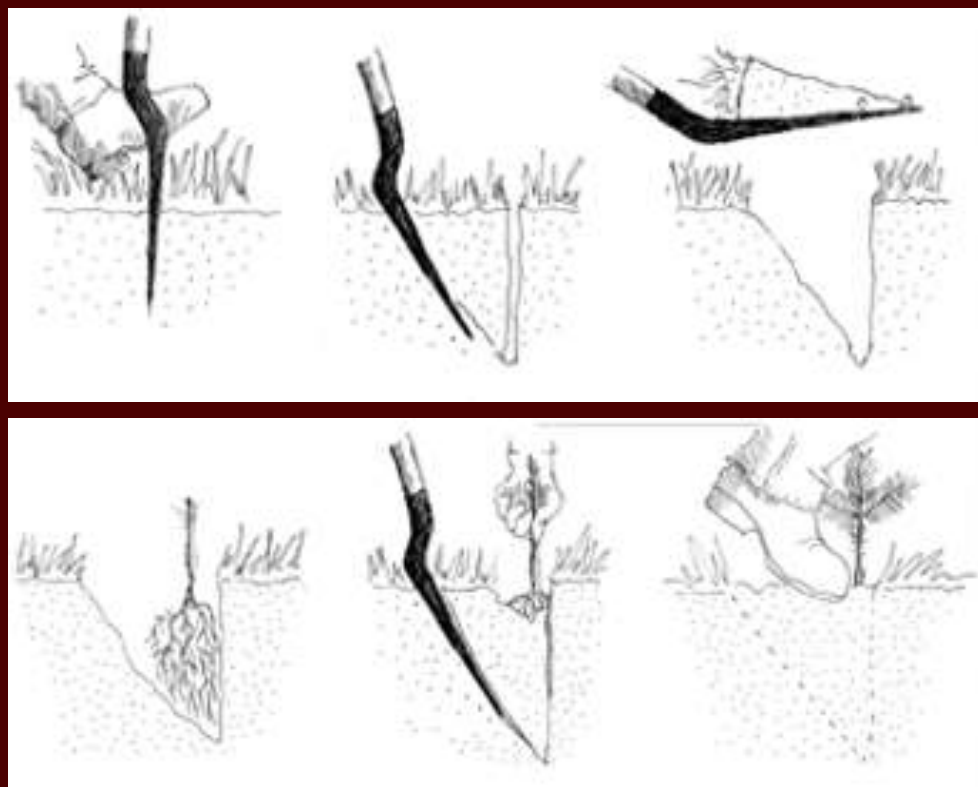


- ◆ **Machine Planting**
 - ◆ Larger areas
 - ◆ May be site prepared
 - ◆ Tractor access
- ◆ **Hand planting**
 - ◆ Smaller rougher areas
 - ◆ Irregular site
 - ◆ 500/day, physically fit



Hand Planting

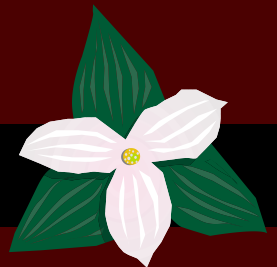
Wedge method



Tending

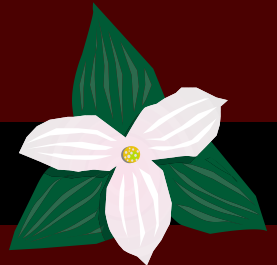


- ◆ **Must keep vegetation under control**
- ◆ **Tend until seedling is “free-to-grow”**
- ◆ **Methods include: spray, mulches, mats and mowing**



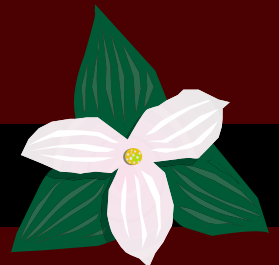
Assessment

- ◆ **Inspect plantation regularly**
- ◆ **Look for:**
 - ◆ **Dead trees**
 - ◆ **Dying trees**
 - ◆ **Needles being eaten**
 - ◆ **Yellowing**
- ◆ **Refill if required**



Plantation Dynamics

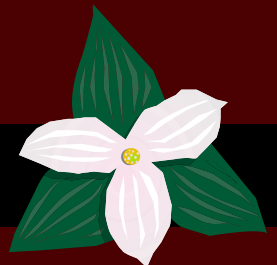
- ◆ **Trees will die if too crowded**
- ◆ **Branches will be too big if too few trees**
- ◆ **Need to maintain optimum growing space for trees as they mature**
- ◆ **Plant over 2,500 trees per hectare in order to have a final crop of 200-300 trees**
- ◆ **Thinning is important**



Understocked Plantations



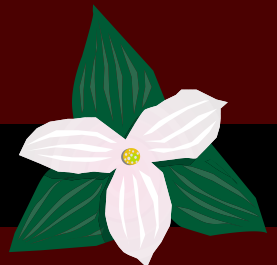
- ◆ **Too much open space**
- ◆ **Large crowns**
- ◆ **Large thick branches**
- ◆ **Space between trees under-utilized**
- ◆ **When is “wide” too wide?**



Overstocked Plantations



- ◆ **Small crowns**
- ◆ **Slow growing**
- ◆ **Susceptible to windthrow, insects, diseases**
- ◆ **Reduced product potential**
- ◆ **Limited management options**



Optimum Stocking



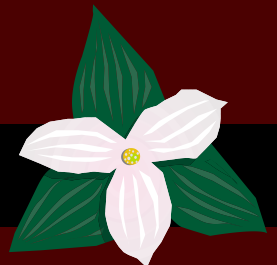
- ◆ **What you are aiming for**
- ◆ **Right number of trees varies with age and diameter**
- ◆ **Increase product potential**
- ◆ **Healthier plantation**
- ◆ **Growing vigoursly**
- ◆ **Better able to tolerate insect, disease and weather**



Managing Your Plantation



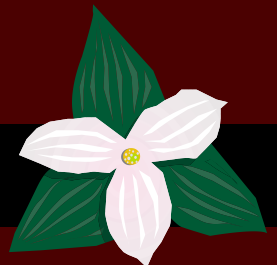
- ◆ **Management is important**
- ◆ **Managing involves periodic thinnings**
- ◆ **Management may include pruning disease and insect control**
- ◆ **You should have a management plan**
 - ◆ **Possible property tax reduction with MFTIP**
 - ◆ **Possible significant income tax benefits if managed as a business**



First Thinning Scenario



- ◆ **First thinning**
 - ◆ **25-30 years**
 - ◆ **15-20 cm average diameter (Dbh)**
 - ◆ **up to 33% of the original stand**
 - ◆ **Usually every 4th row plus 1 tree out of 5-6 on other rows**



Subsequent Thinnings



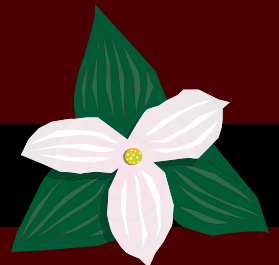
- ◆ **8-10 years apart**
- ◆ **Remove the poorest and leave the best**
- ◆ **Release your best**
- ◆ **Promote and protect regeneration**
- ◆ **Maintain health and vigour**



Equipment Used in Plantations



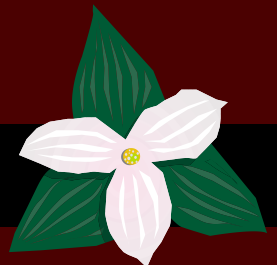
- ◆ **Harvesters**
- ◆ **Forwarders**
- ◆ **Trucks**
- ◆ **Skidders**
- ◆ **Horses**



Sales and Marketing



- ◆ **Why a formal contract?**
 - ◆ **Honest**
 - ◆ **Clarifies roles and responsibilities for both parties**
 - ◆ **Legally binding**
 - ◆ **Payments and schedules**
 - ◆ **Performance**
 - ◆ **“Good fences make good neighbours. Good contracts keep good friends.”**



The New Forest



- ◆ **Regeneration appears as you thin**
- ◆ **Supplement with seedlings**
- ◆ **Protect as you harvest**





Some \$ Value for Thinning

◆ Potential Revenue with Thinning Program

Product Type	Commercial Thinning		Final Harvest	Total Net Revenue
	Year '36	Year '49	Year '64	
Pulpwood Sawlogs	\$1,112	\$1,220 \$517	\$3,540 \$15,510	\$5,872 \$16,027
Total/hc	\$1,112	\$1,737	\$19,050	\$21,899

◆ Potential Revenue with no Thinning Program

Product Type	Final Harvest Year '60
Pulpwood Sawlogs	\$4,180 \$4,230
Total/hc	\$8,410

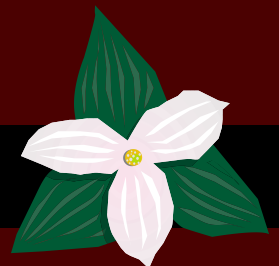
- ◆ 22 thousand per hectare compared to 8 thousand!!!
- ◆ Management pays



Summary



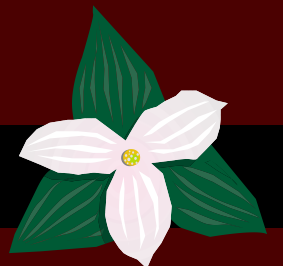
- ◆ **Determining your objectives**
- ◆ **Designing**
- ◆ **Preparing**
- ◆ **Planting**
- ◆ **Tending**
- ◆ **Thinning**
- ◆ **Regenerating**
- ◆ **Harvesting**
- ◆ **New Forest**



Conifer Plantation Management Workshops

- ◆ **Have been funded by:**
 - ◆ **Ministry of Natural Resources
and**
 - ◆ **Eastern Ontario Model Forest
through**
 - ◆ **The Stewardship Program**

- ◆ **Prepared by Bill Hardy, Hardy Consulting**



Module #2

Managing Your Plantation



Managing Your Plantation

Topics

- ◆ **Species and their roles**
- ◆ **Plantation dynamics**
- ◆ **Inventory**
- ◆ **Density Management**
- ◆ **Crop Planning**



Species & Their Roles



Typical plantations

Pure blocks

- ◆ **red pine**
- ◆ **white pine**
- ◆ **white spruce**
- ◆ **Norway spruce**
- ◆ **Jack pine**
- ◆ **white cedar**

Mixtures

- ◆ **red pine and white pine**
- ◆ **Jack pine and white pine**
- ◆ **other mixtures with hardwoods**

Species & Their Roles

Red Pine



- ◆ **Excellent variety of forest products**
- ◆ **Nurse crop**
- ◆ **Usually single rotation**
- ◆ **Thin to maintain vigour**

Species & Their Roles

White Pine



- ◆ **Excellent array of forest products**
- ◆ **Nurse crop**
- ◆ **Component of next stand**
- ◆ **Susceptible to insects and diseases**

Species & Their Roles

Jack Pine



- ◆ **Site protection and rehabilitation**
- ◆ **Nurse crop**
- ◆ **Subject to windthrow**
- ◆ **Limited product potential**
- ◆ **Not native to Southern Ontario**

Species & Their Roles

White Spruce



- ◆ **Good markets for pulp and sawlogs**
- ◆ **Will be part of the continuing forest**
- ◆ **Re-establish cover on wetter sites**
- ◆ **Limbs can be tenacious**

Species & Their Roles

White Cedar

- ◆ **Planted mainly for wildlife habitat**
- ◆ **Wide variety of products — cedar leaf oil, posts, grape stakes, sawlogs, pickets**



- ◆ **Good option for limestone sites**
- ◆ **Ability to capture site**

Plantation Dynamics



Important Concepts...

- ◆ **All forests change over time – growth, death, reproduction**
- ◆ **Land can support so much biomass**
- ◆ **Plantations tend to have trees that are similar in:**
 - ◆ **Species**
 - ◆ **Size (diameter/height)**
 - ◆ **Age**

Plantation Dynamics



- ◆ **Trees grow!**
- ◆ **What is the 'right' number of trees?**
 - ◆ **Do you have too many or too few?**
- ◆ **Stocking**
 - ◆ **Too many – Overstocked**
 - ◆ **Too few – Understocked**
 - ◆ **Just right – Optimal Stocking**

Plantation Dynamics



- ◆ **Trees will die if too crowded (OVERSTOCKED)**
- ◆ **Branches will be too big if too few trees (UNDERSTOCKED)**
- ◆ **Need to maintain optimum growing space for trees as they mature**
- ◆ **Thin for to maintain growth and vigour (IDEAL STOCKING)**
- ◆ **Properly managed forests produce the best forest products**

Plantation Dynamics



- ◆ **Initial spacing ~2,500 trees/hectare**
- ◆ **Final crop 200-300 trees/hectare**
- ◆ **Trees removed either by:**
 - ◆ **Mother Nature**
 - ◆ **You**

Forest Inventory

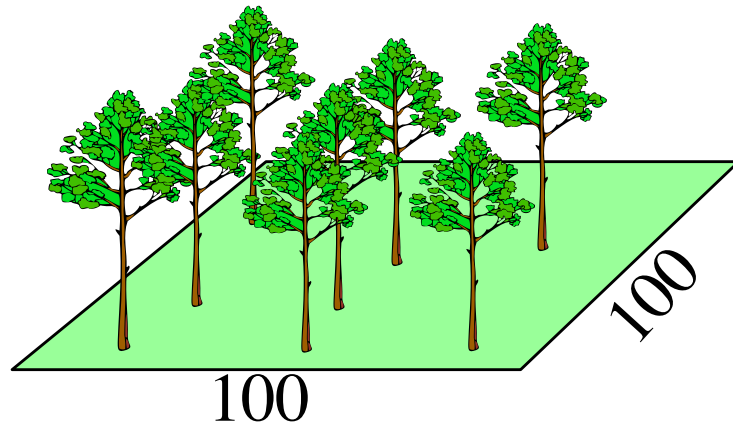


- ◆ You need to know how your forest is doing
- ◆ An inventory is a snapshot of your plantation at that time
- ◆ Use the inventory information to determine what to do
- ◆ Harvesting without an inventory is a **BIG** mistake

Forest Inventory

How do I inventory my plantation?

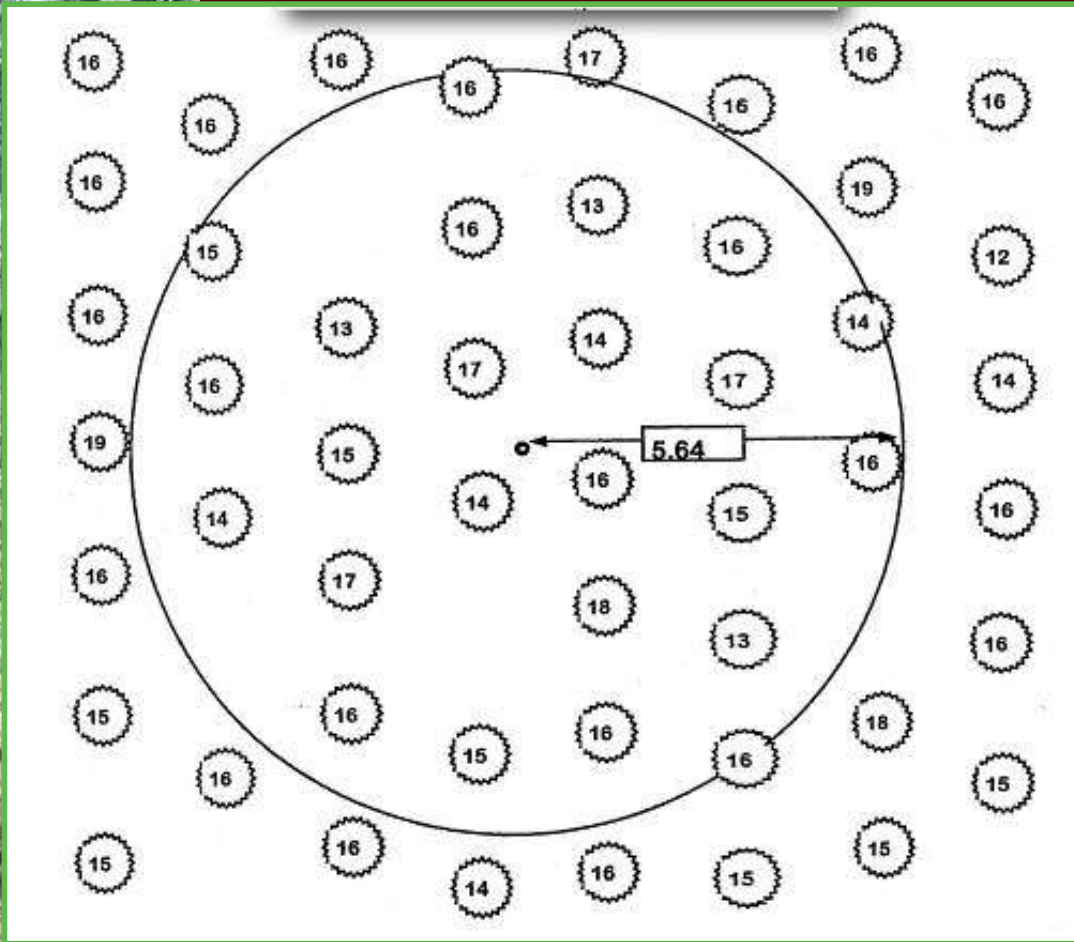
1 Hectare



- ◆ **All information is summarized on a per hectare basis**
- ◆ **A series of plots are established in the plantation**
- ◆ **Information on the trees within the plot is gathered**
- ◆ **Must do more than 1 plot (the more the better!)**
- ◆ **The results from each plot are averaged together**

Forest Inventory

How do I 'measure' my plantation?

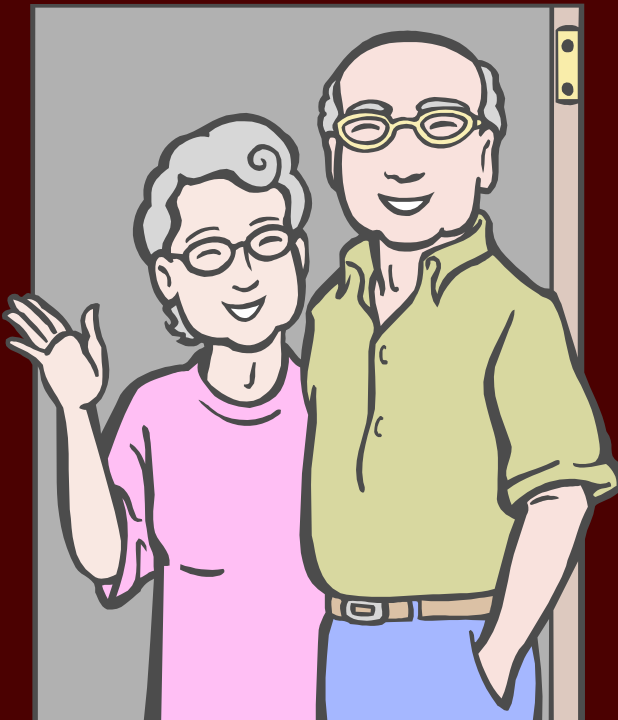


- ◆ **A circular plot of 5.64 meters radius is 1/100th of a hectare**
- ◆ **Two types of data collected**
 - ◆ **Plot Data**
 - ◆ The number of trees
 - ◆ The diameter of each tree
 - ◆ **Stand data**
 - ◆ The age of the plantation
 - ◆ The top or dominant height

Forest Inventory

An example....

**Mr. & Mrs. Smith own 10 ha
of property that was
planted 30 years ago with
25000 red pine seedlings**



- they put in 20 plots
- they counted and measured the diameter of each tree in the plots
- they measured the heights of 10 of the largest trees in the stand

Forest Inventory

An example....

Inventory Summary

Age = 30 years

Top Height = 15 meters

Average Diameter = 15.3 cm

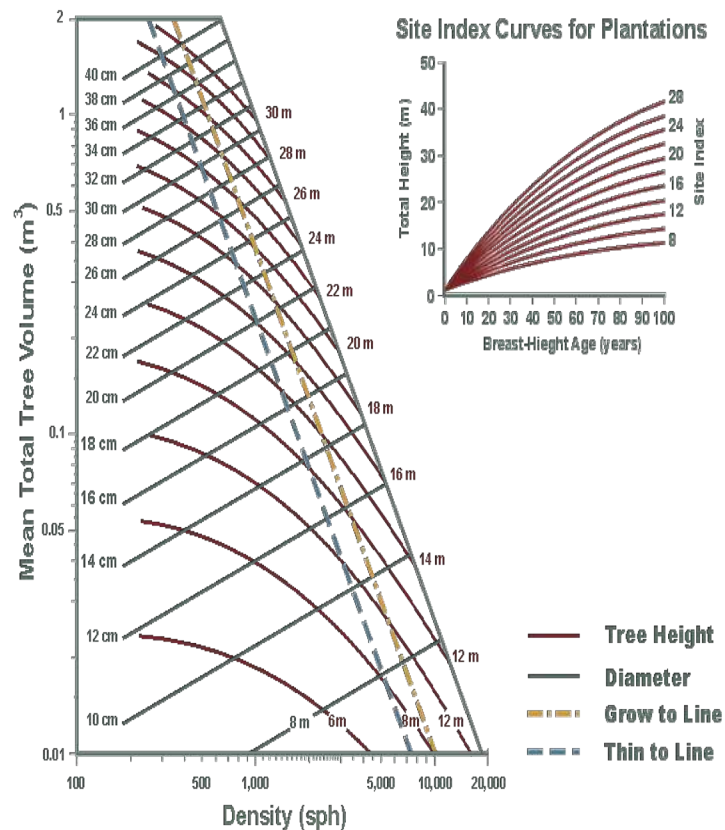
Average # trees/Ha = 2400

Species: 100% Red Pine

Density Management

The DMD (Density Management Diagram)

Density Management Diagram Red Pine Plantations

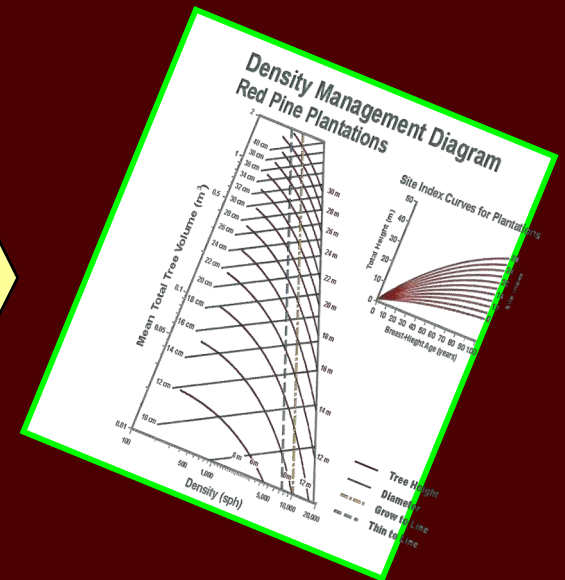
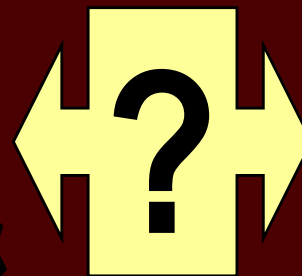


- ◆ relationship between tree numbers, height, diameter and volume
- ◆ a planning tool to adjust tree numbers
 - ◆ Optimum growth on each stem
 - ◆ Increase financial return
- ◆ when to thin
- ◆ how many trees to remove

Density Management

What you need to know about the DMD

- ◆ Made up of several parts
 - ◆ We will look at each one
- ◆ Need to use it systematically
- ◆ A lot of science has gone into it



Parts of the DMD... Number of Trees

Inventory Summary

Age = 30 years

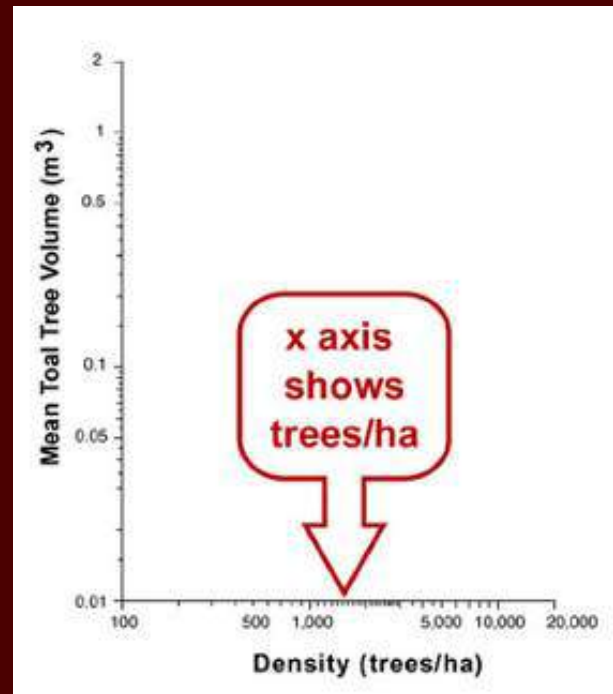
Top Height = 15 meters

Average Diameter = 15.3 cm

Average # trees/Ha = 2400

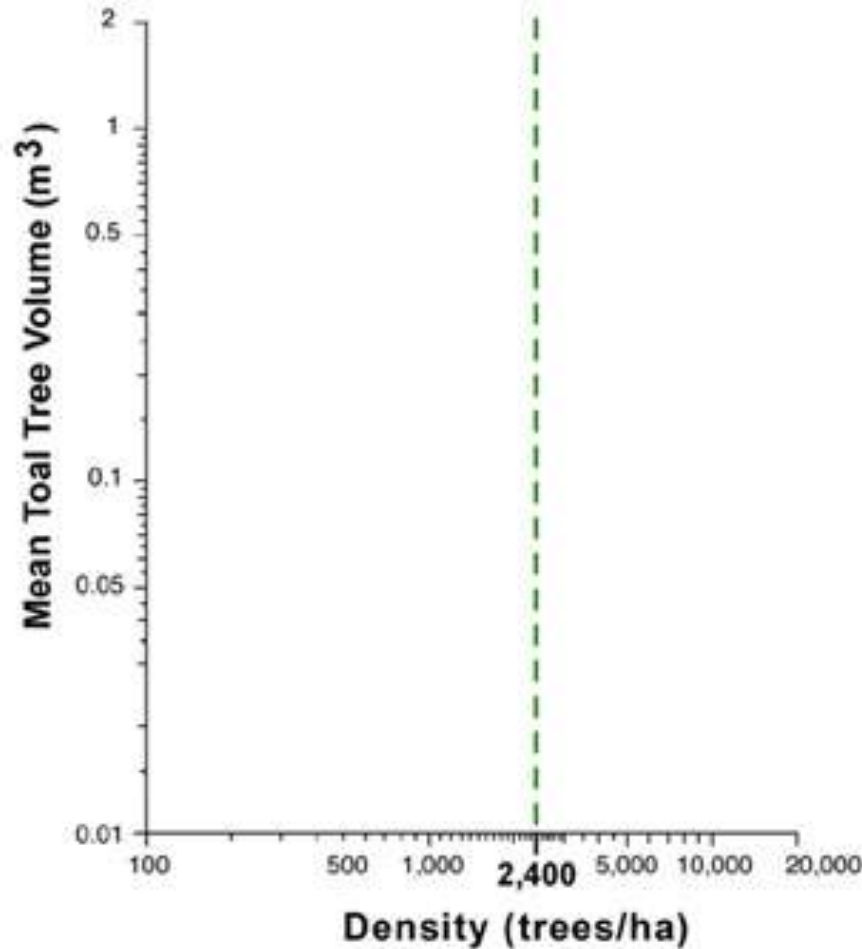
Species: 100% Red Pine

- ◆ **Keep in mind the inventory from the Smith Plantation**



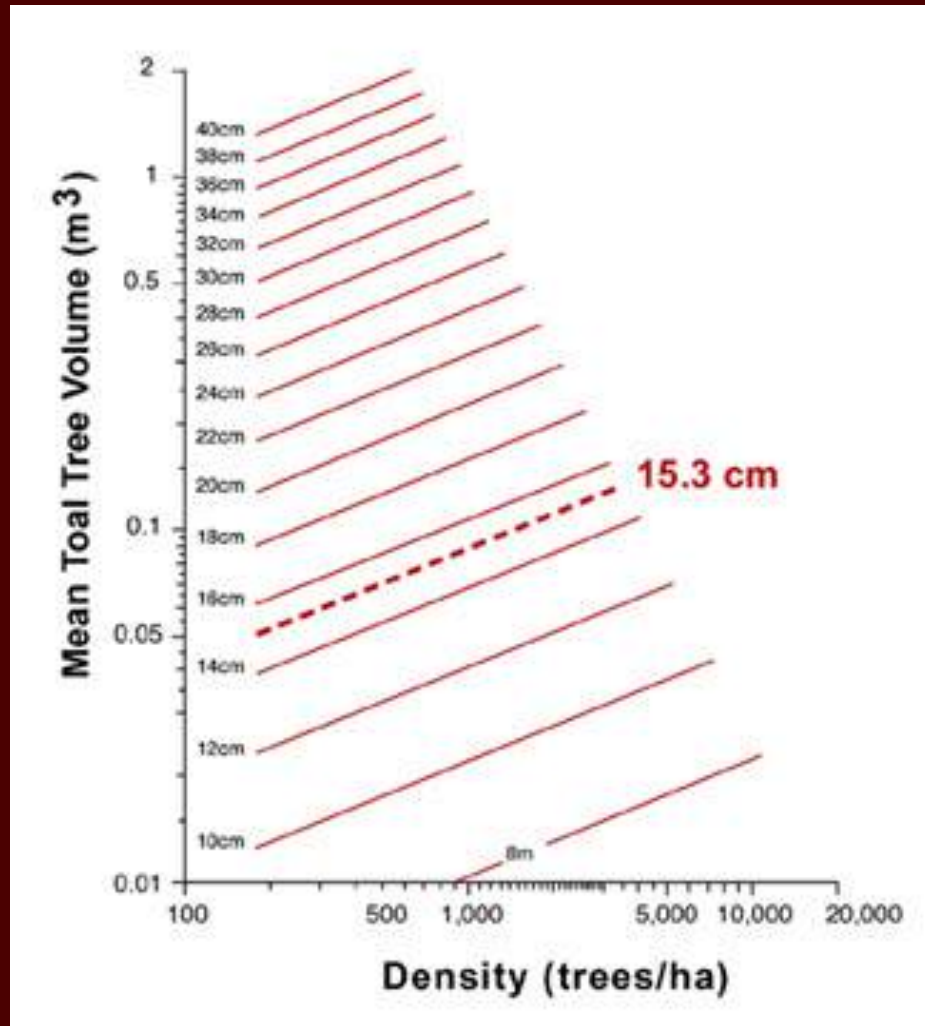
- ◆ **X-axis = trees per ha**
- ◆ **Logarithmic scale**

Parts of the DMD... Number of Trees



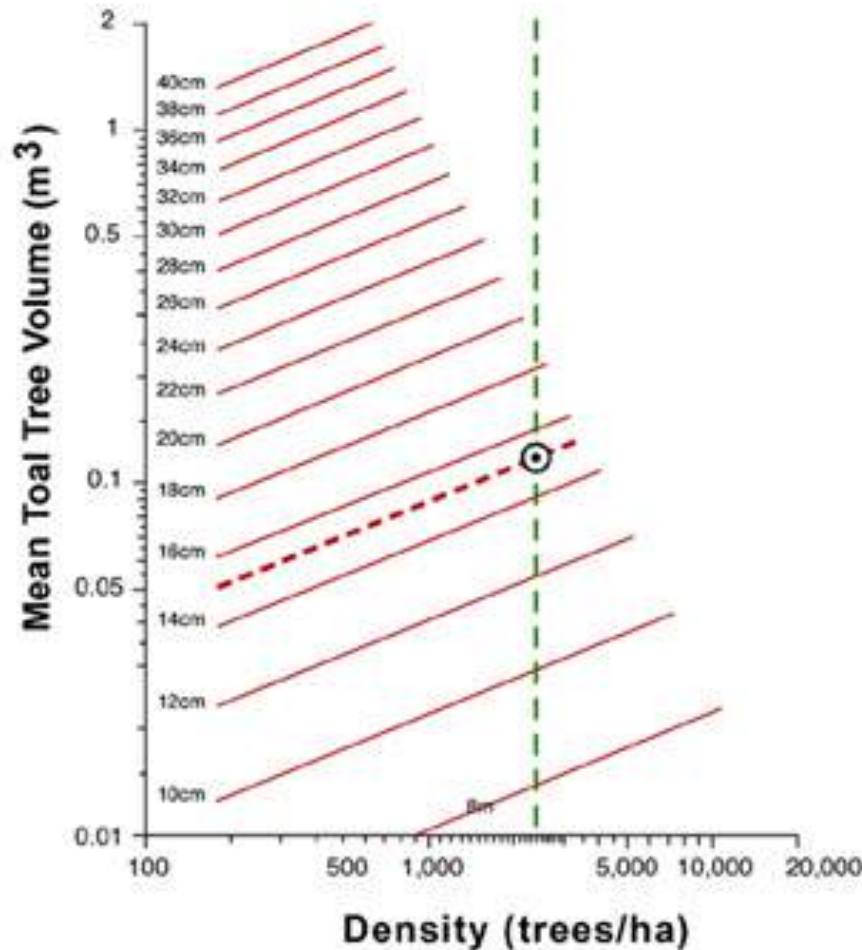
- ◆ **There were 2400 trees per hectare**
- ◆ **Originally planted at 2500**
- ◆ **some trees lost through mortality**

Parts of the DMD... Average Diameter



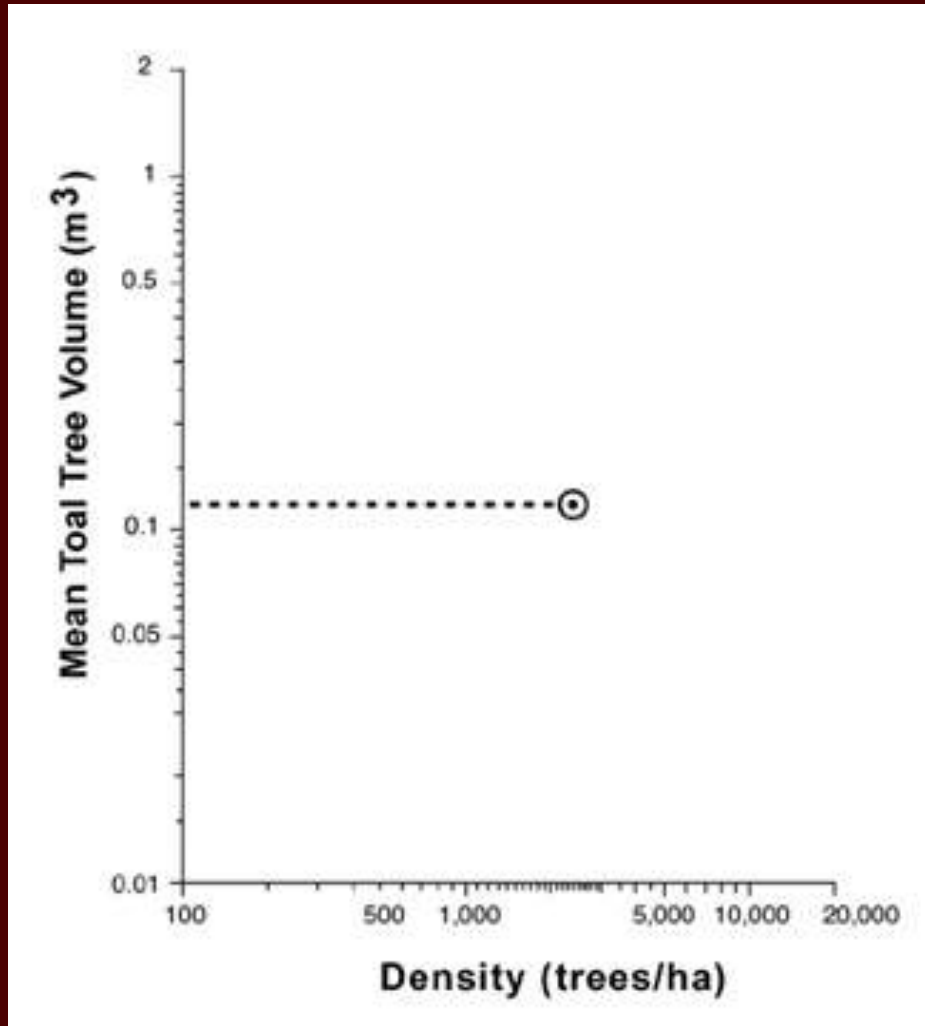
- ◆ **Average diameter represented by upward sloped lines**
- ◆ **2 cm intervals**
- ◆ **The dashed line represents the average diameter for the Smith Plantation**

Parts of the DMD... Density/Diameter Relationship



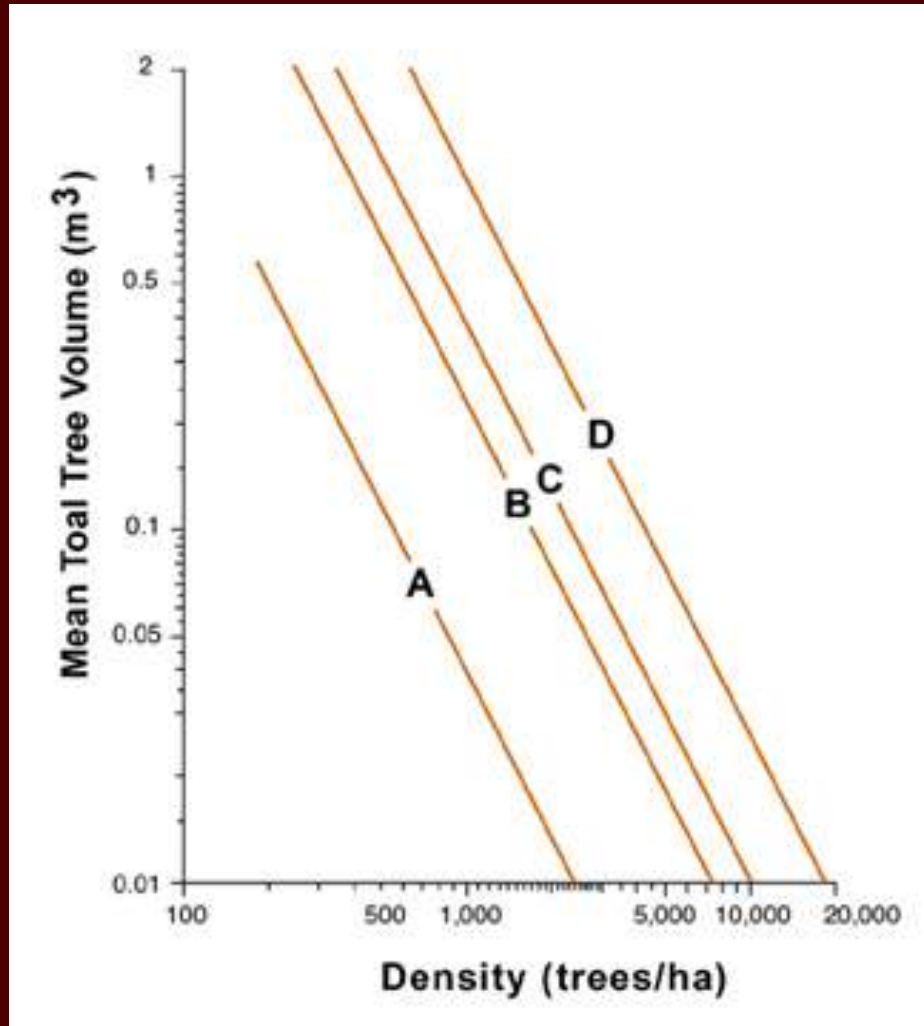
- ◆ Intersection point is important
- ◆ Can use this point to estimate the average tree volume, management options etc.

Parts of the DMD... Average Tree Volume



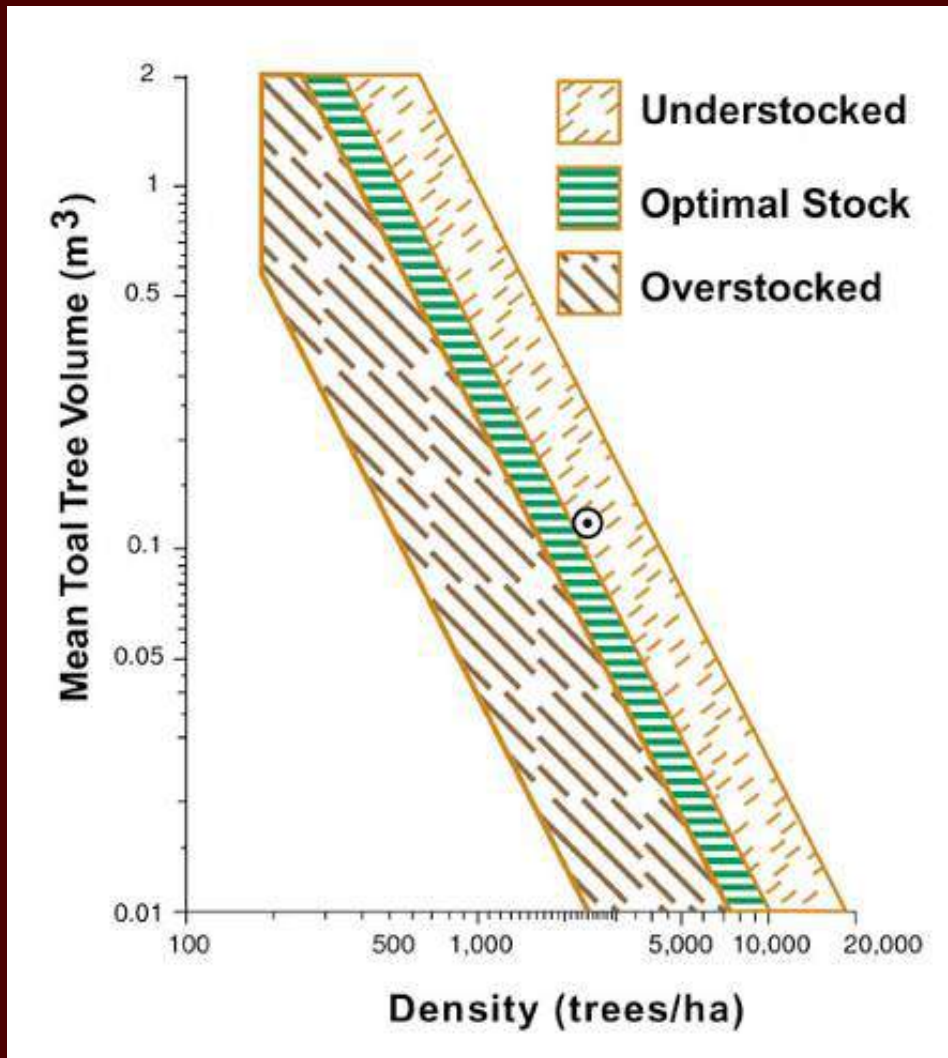
- ◆ Y-axis represents average tree volume
- ◆ In this example the average tree volume is .12 cubic meters
- ◆ What would the volume be per hectare?
- ◆ Total stand volume?

Parts of the DMD... Stand Growth Lines



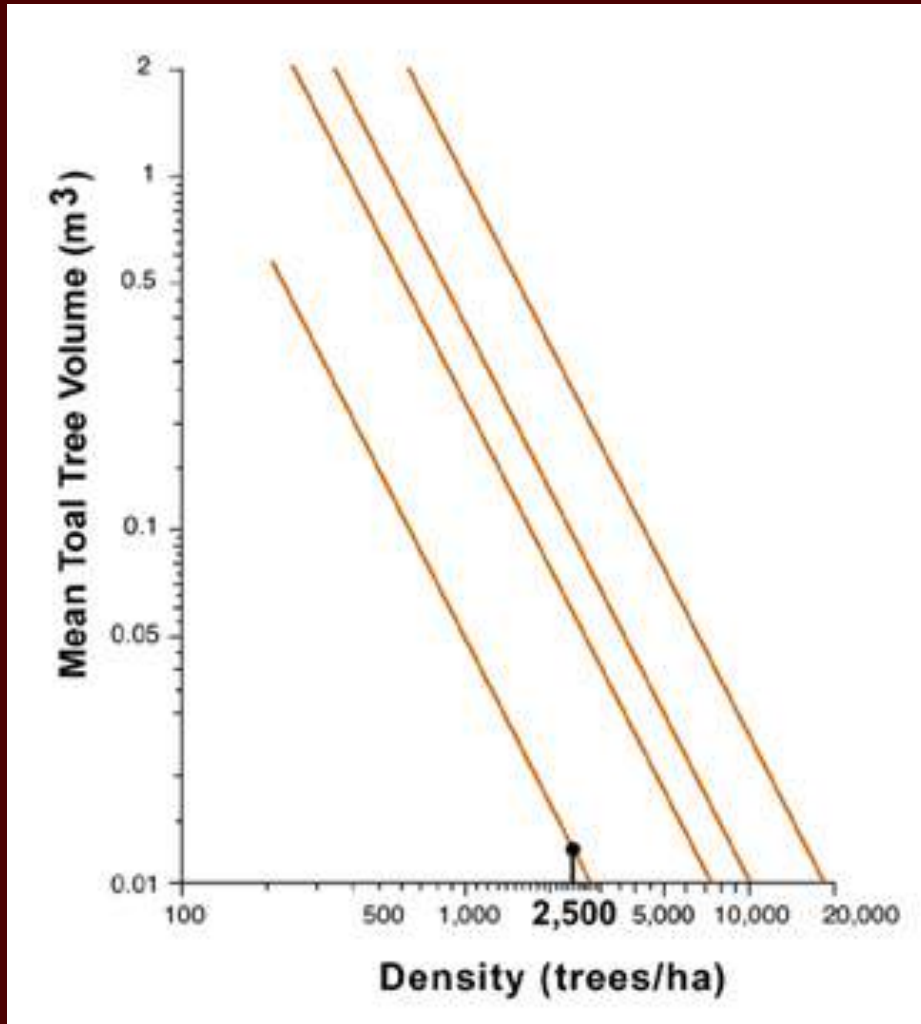
- A** Crown closure line
- B** Thin-to Line
- C** Grow-to Line
- D** Max. Density Line

Parts of the DMD... Stocking Zones



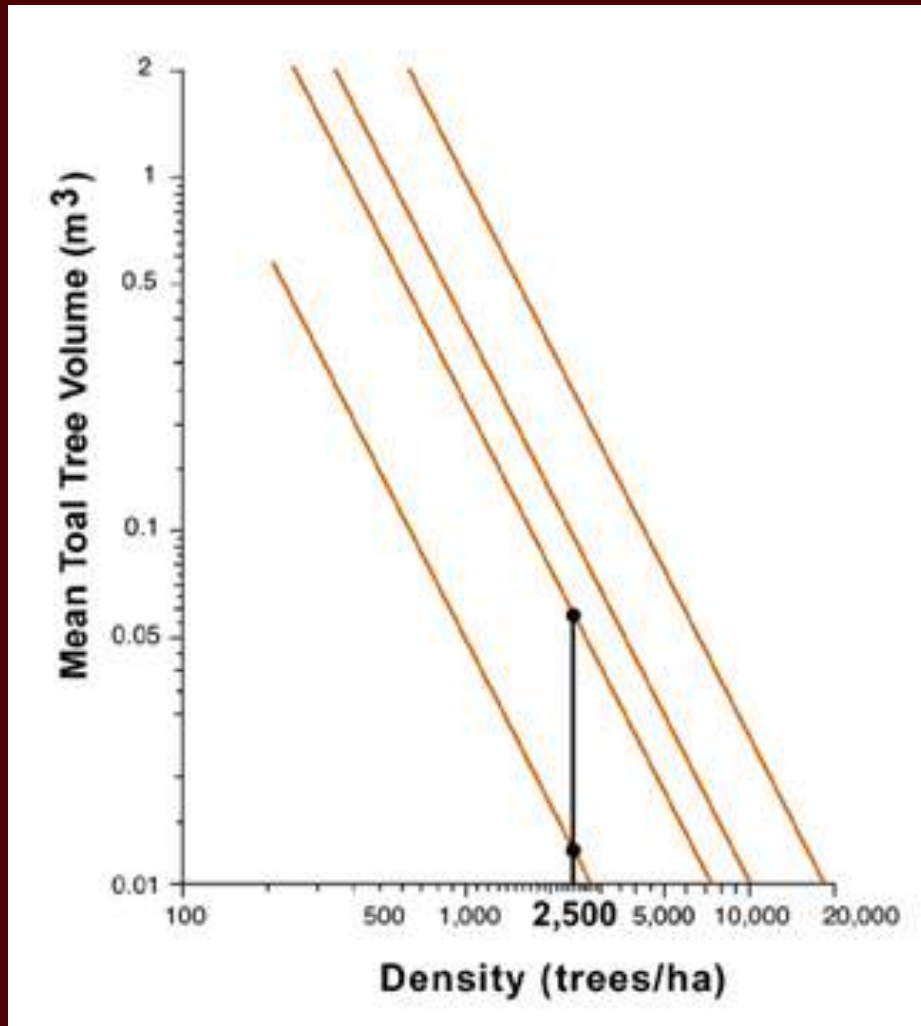
- ◆ **Three separate 'zones'**
- ◆ **Indicates relative stocking**
- ◆ **The Smith plantation is overstocked**

What happens to a stand over time



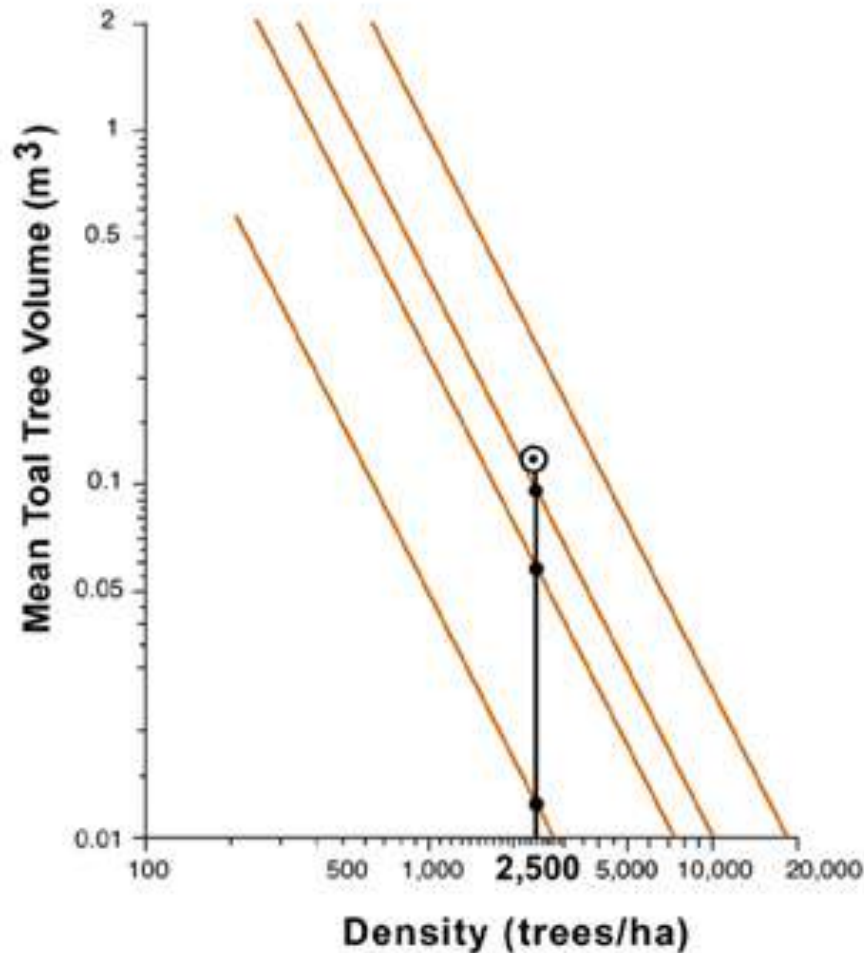
- ◆ Age is about 10 years
- ◆ Crowns begin to touch
- ◆ Site is fully occupied by trees
- ◆ Lots of room for growth
- ◆ Period of rapid growth begins

What happens to a stand over time



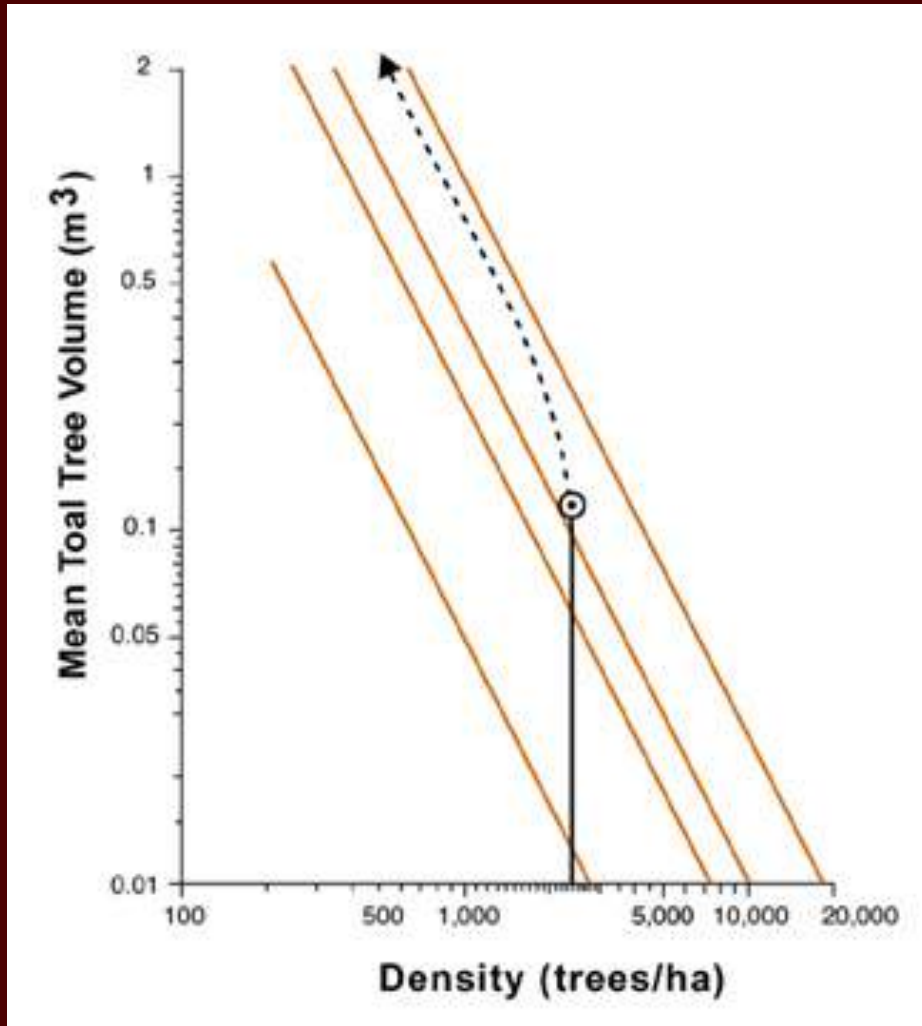
- ◆ Grows into the zone of optimum stocking
- ◆ 'best' growth rate

What happens to a stand over time



- ◆ Trees start to out grow the site
- ◆ Growth slows dramatically
- ◆ Some trees are lost to stress

What happens to a stand over time



- ◆ If left as is, this trend would continue
- ◆ The 'Mother Nature' management approach



Understocked Stands



- ◆ **Open space**
- ◆ **Large crowns**
- ◆ **Large thick branches**
- ◆ **Space between trees under-utilized**
- ◆ **When is “wide” too wide**

Overstocked Stands



- ◆ **Small crowns**
- ◆ **Susceptible to windthrow, insects, diseases**
- ◆ **Reduced product potential**
- ◆ **Limited management options**

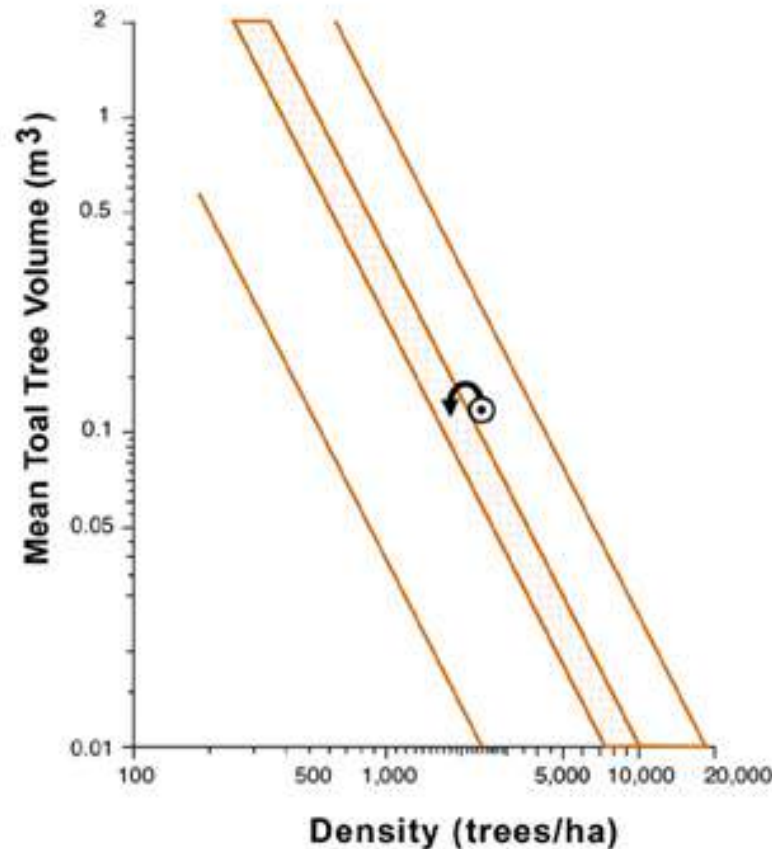
Optimally Stocked Stands



- ◆ **Larger diameters on fewer trees**
- ◆ **Increased product potential**
- ◆ **Healthy woodlot**
 - ◆ **vigorous**
 - ◆ **fights off insects and diseases**
 - ◆ **minimizes ice storm damage**

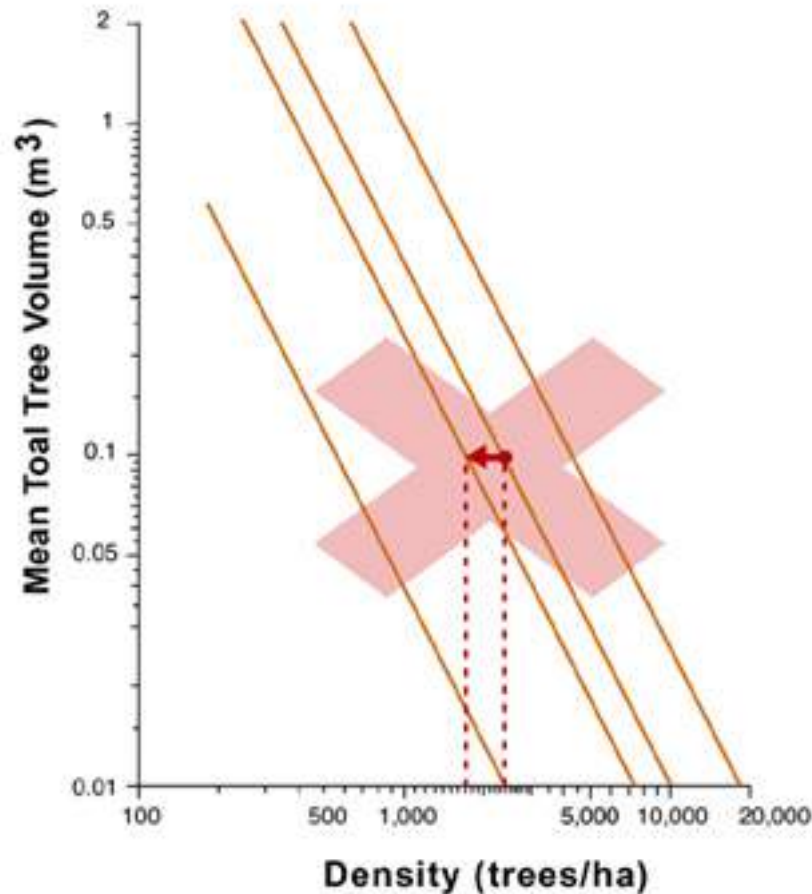
Developing a Management Prescription

How Many Trees Need to Come Out??????



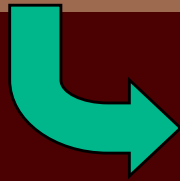
- ◆ **Need to reduce the number of trees/ha**
- ◆ **Shooting for optimal stocking; i.e. between the Thin-to and Grow-to lines**
- ◆ **Ideal number is on the Thin-to line**
- ◆ **Maximizes the number of years between thinning**

Developing a Management Prescription

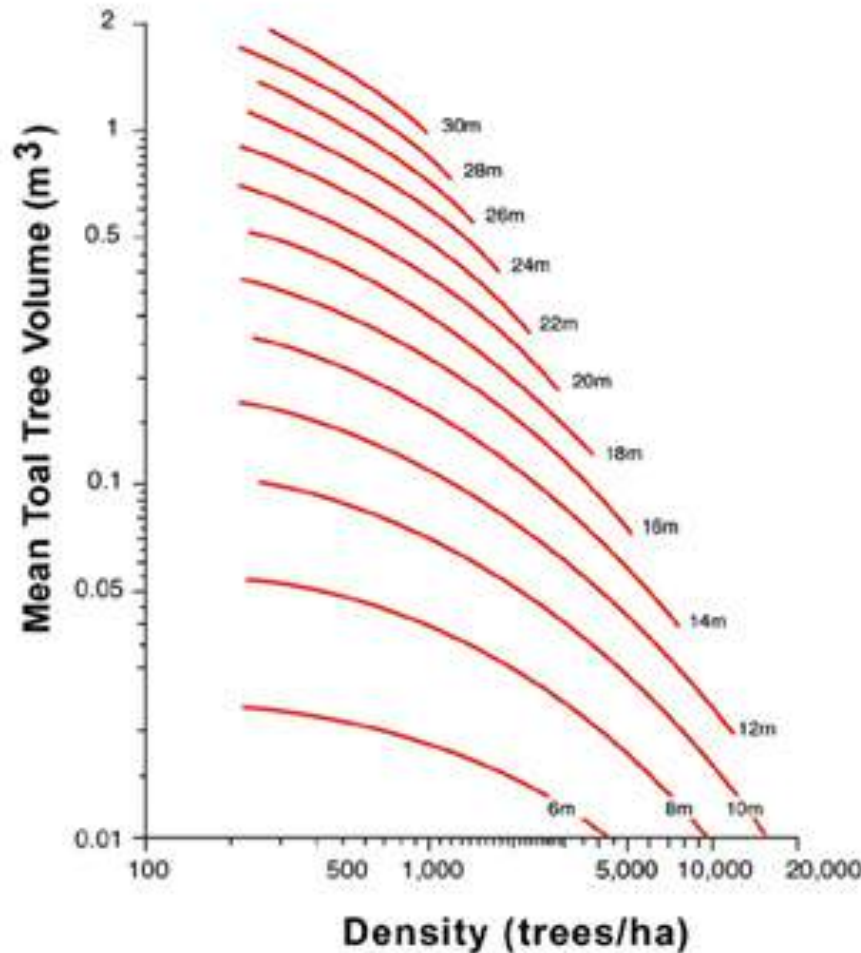


- ◆ **Can't draw a straight line across to the Thin-to line**
- ◆ **Thinning tends to increase average diameter**
- ◆ **Thinning does not increase dominant or top height**

Developing a Management Prescription

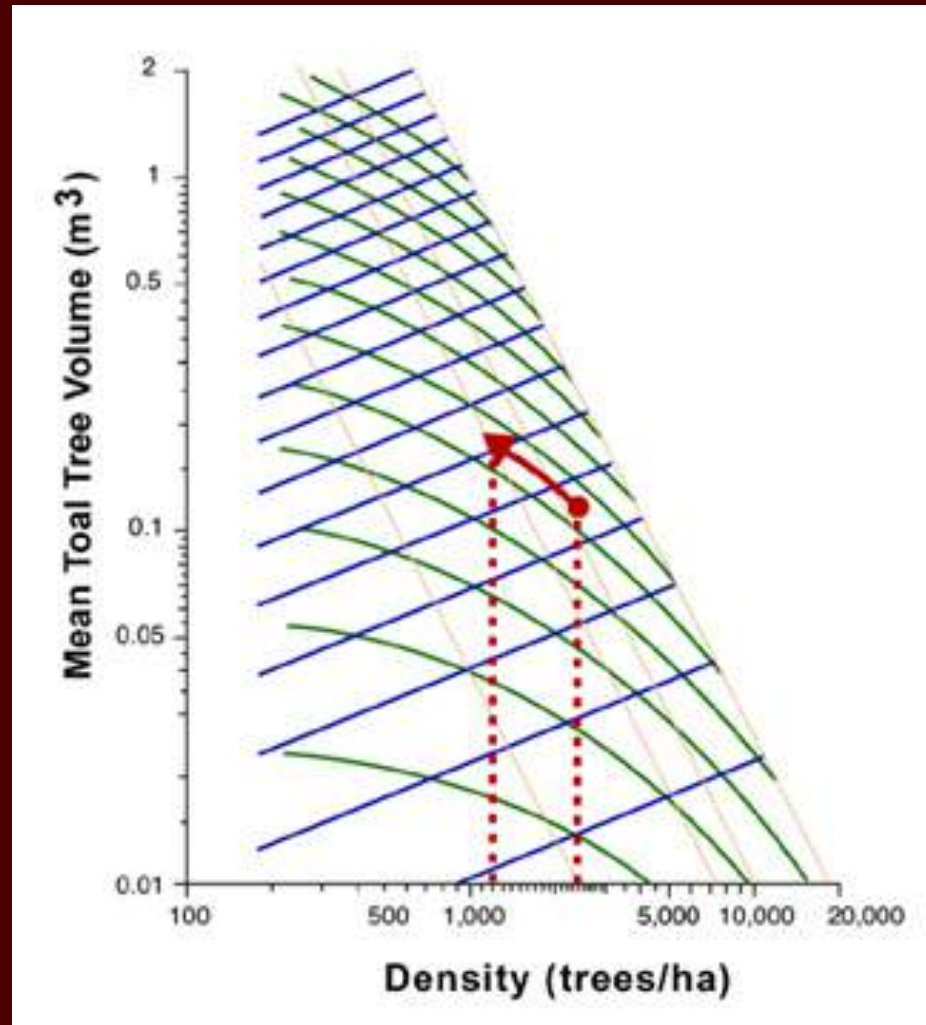


Parts of the DMD... Height Curves



- ◆ Height lines are curved
- ◆ Many stands won't have the height listed in the DMD
- ◆ It is the curve (trend) that is important

Developing a Management Prescription



- ◆ Follow the height line back to the Thin-to line
- ◆ Project a line down to the X-axis (density)
- ◆ In this example the number of trees to be removed is about 1200 per hectare

Developing a Management Prescription

**Should Mr. Smith
thin 1200 stems/ha?**



Rule of 1/3

- ◆ If the stand is well overstocked, never cut more than 1/3 at any one time
- ◆ If the stand is near to, or at the Grow-to line, you can harvest more than 1/3

Developing a Management Prescription

**Should Mr. Smith
thin 1200 stems/ha?**



- ◆ **In this case the stand is well overstocked so Mr. Smith should only harvest 1/3 of the total # of stems**
- ◆ **$1/3=800$ stems/ha**

The prescription.... Harvest 800 stems/ha

Developing a Management Prescription

What does 800 trees/ha mean??

We know...

- ◆ Trees are planted in rows
- ◆ We want to harvest 33% (1/3) of the stand

So...

- ◆ Cutting every 4th row would be 25%
- ◆ That is about 600 trees/ha
- ◆ Still need another 200 trees/ha
- ◆ 200 trees is about 11% of the remaining trees ($200/(2400-600)$)
- ◆ This equals about 1 out of every 9



Developing a Management Prescription

The Final Prescription...

Mark for harvest every 4th row and approximately 1 out of every 6 trees in the remaining rows.

- ◆ **Select smaller, damaged, poorer quality trees from within the rows**



Developing a Management Prescription

How much volume....

- ◆ Volume per tree was $.12 \text{ m}^3$
- ◆ Harvest prescription = 800 stems/ha
- ◆ Estimated harvest volume/ha ...

$$800 * .12 = 96 \text{ cubic meters}$$

- ◆ There are 10 ha
- ◆ Estimated Total Harvest Volume...

$$10 * 96 = 960 \text{ m}^3$$



Developing a Management Prescription

How much is it worth....

- ◆ Harvested logs are worth something
- ◆ Prices and markets vary considerably
- ◆ Most first thinnings are paid for by tonnage not number of stems



- ◆ Currently... 1 tonne is worth ~\$5 which is about \$4.25 per m3
- ◆ Mr. Smith's harvested trees are worth
\$4,590

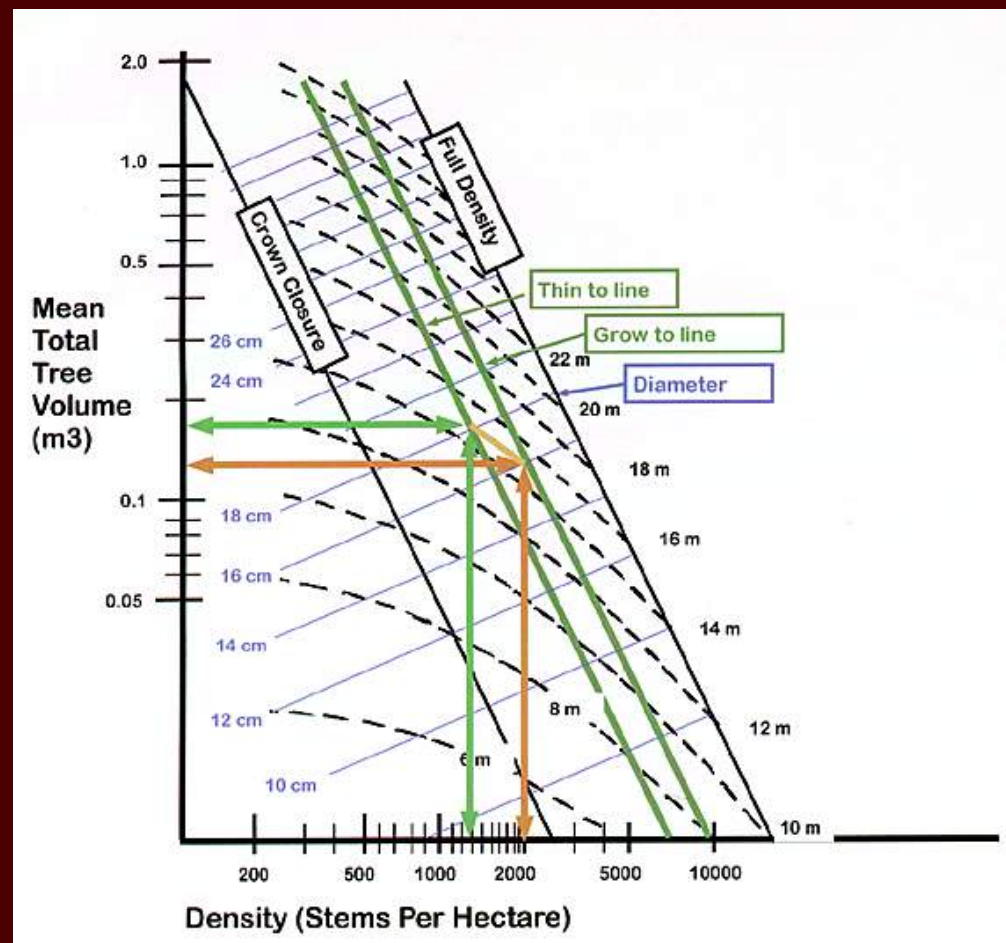
Some thoughts

- ◆ **Options limited by plantation design**
- ◆ **Take the worst and leave the best**
- ◆ **Adjust to circumstances**
- ◆ **Always refer to and update plan**
- ◆ **Remove enough to allow stand to maintain vigour**
- ◆ **First thinning must allow for future access — row thinning**

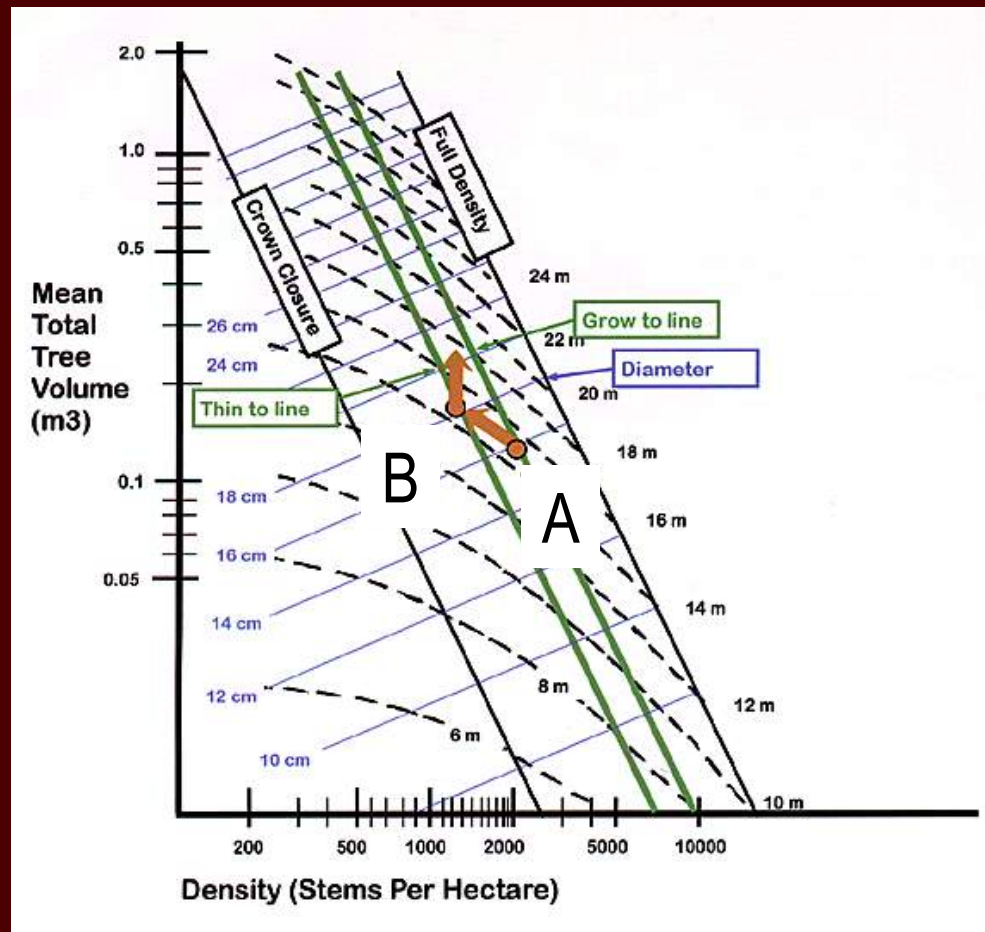


Some thoughts

- ◆ **Thinning increases average tree volume of remaining stems**

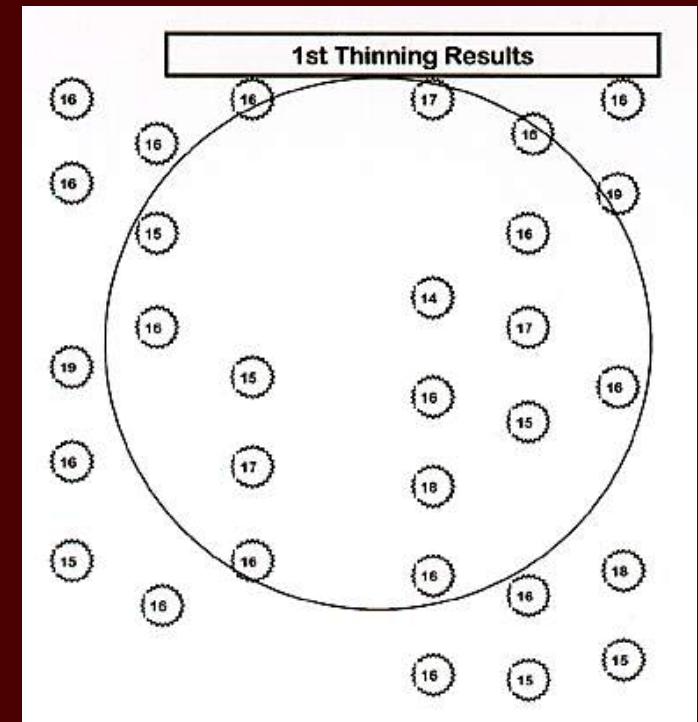


First Thinning Summary



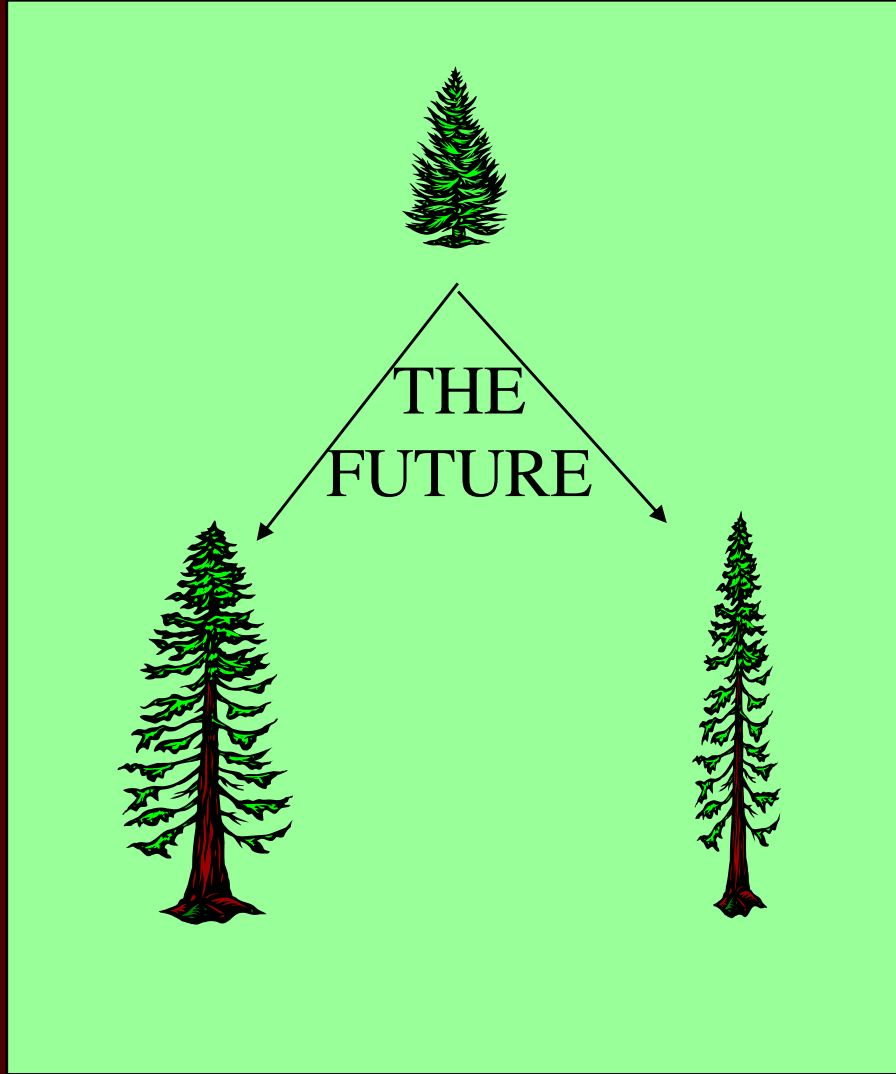
- ◆ **First thinning**
 - ◆ ~25-30 years
 - ◆ 15-20 cm average diameter (Dbh)
 - ◆ up to 1/3 of the original stand
 - ◆ every fourth row plus 1 tree out of 5-6 on other rows

First Thinning Summary



- ◆ **Mechanical row harvesting**
- ◆ **1 row in 4 removed**
- ◆ **Trees/rows marked**

Crop Planning



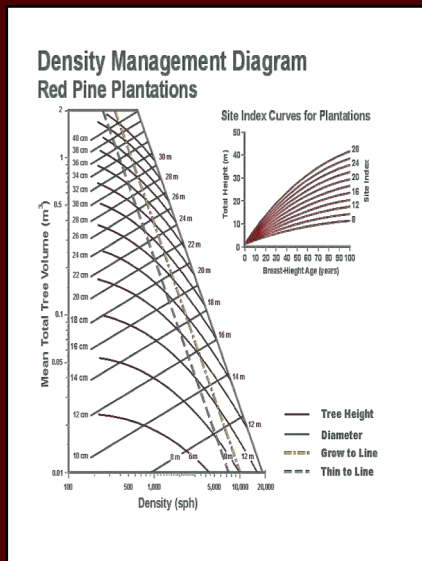
- ◆ We know what we have Now
- ◆ What will happen later?

Crop Planning

Second Thinning

Second INVENTORY

- ◆ Age ~ 40
- ◆ Trees/ha= 1600
- ◆ Average Diameter = 18cm

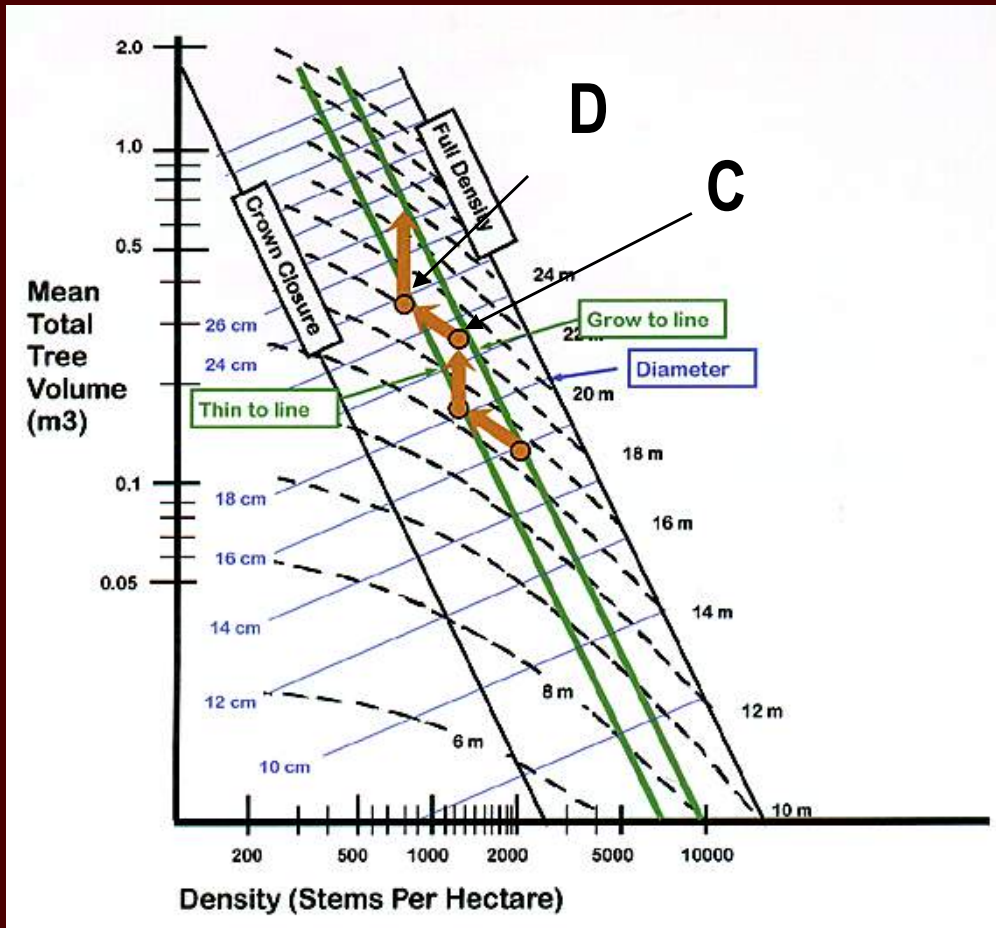


- ◆ Plot point on DMD to see where the stand 'sits'
- ◆ Is it time to harvest?



Crop Planning

Second Thinning



- ◆ selection system
- ◆ remove poorer quality stems
- ◆ release crop trees
- ◆ pulpwood, sawlogs
- ◆ may promote hardwood regeneration
- ◆ maintain health and vigour

Crop Planning

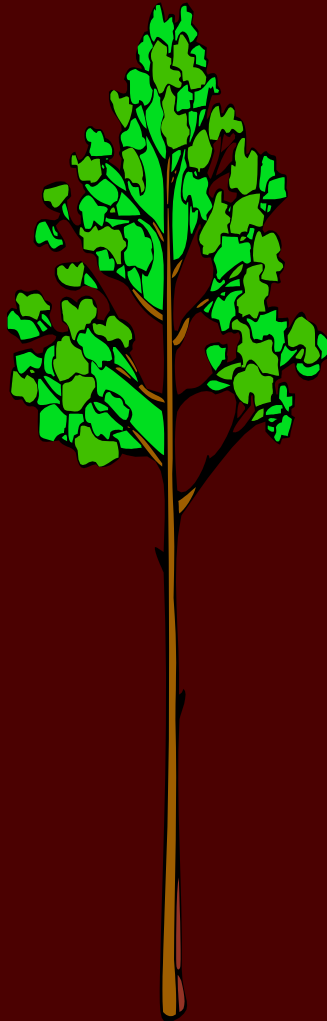
Second Thinning – What Trees?



- ◆ **Choose the smaller trees**
- ◆ **Identify future crop trees**
- ◆ **Estimated volume per tree = .250**
- ◆ **Harvest 600 trees per hectare**
- ◆ **Estimated Harvest=**
 $.250 * 600 * 10 = 1500\text{m}^3$

Crop Planning

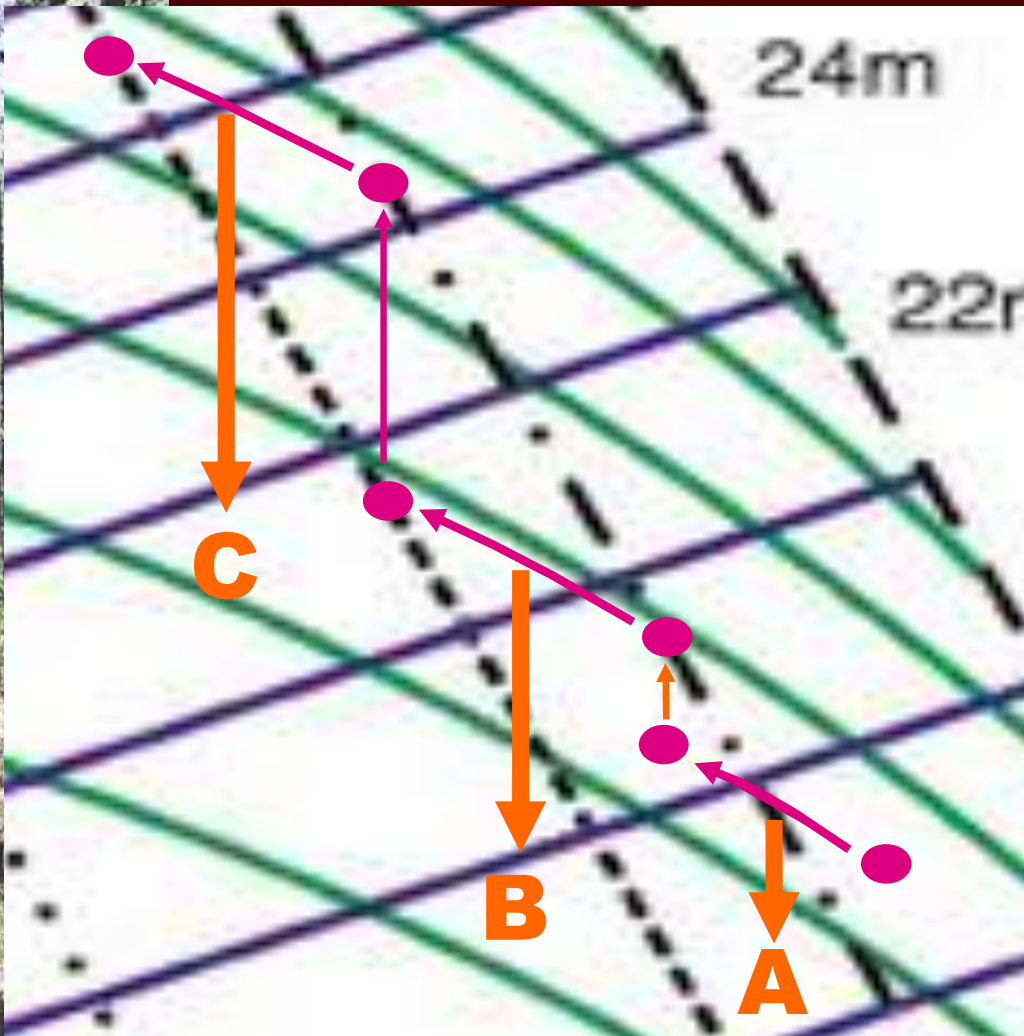
After the 2nd thinning



- ◆ Access roads, trails and landings established
- ◆ All or most poor quality trees removed
- ◆ High quality trees left with room to grow
- ◆ Easy felling for remaining trees

Crop Planning

Subsequent Thinnings



- ◆ Use the DMD to tell you how many to harvest
- ◆ Every 8 – 10 years
- ◆ Selectively thin - choose poorest quality trees first
- ◆ Can identify final crop trees

Harvests

A = 2400 to 1600

B = 1600 to 1000

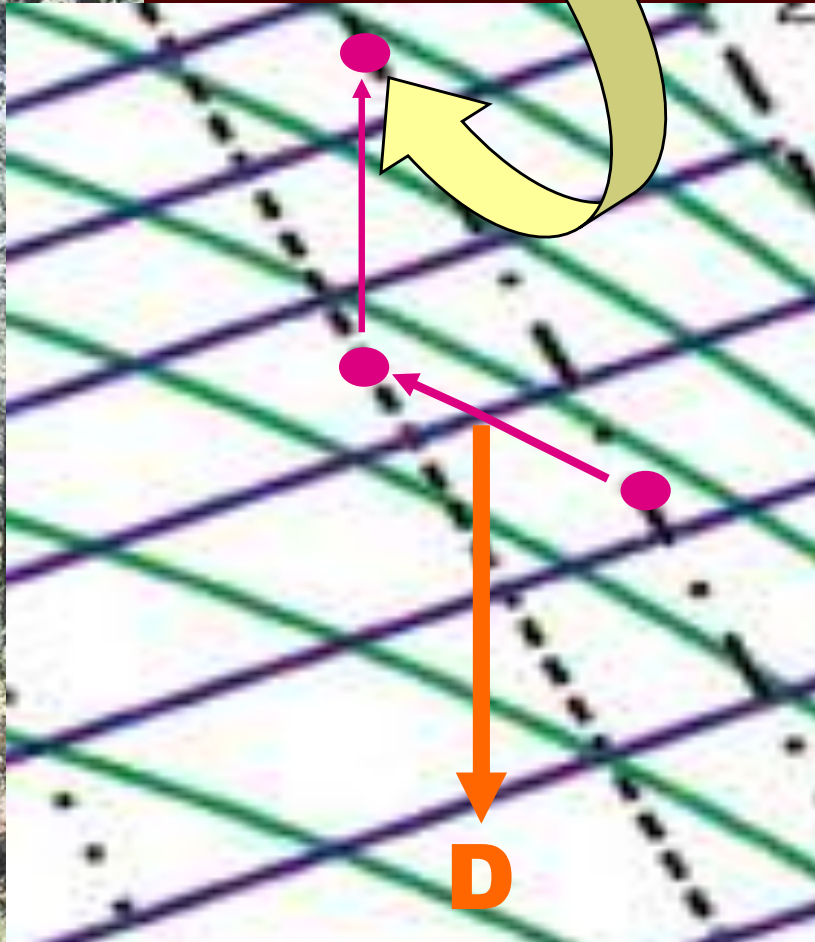
C = 1000 to 600

D = 600 to 375

Crop Planning

\$

The Final Harvest



- ◆ **D was 4th thinning - 600 to 375 trees per hectare**
- ◆ **375 trees per hectare is the final harvest**
- ◆ **Need to wait for:**
 - ◆ **Stand hits grow-to line**
 - ◆ **A good market presents itself**
- ◆ **Protect new forest during final harvest(s)**
- ◆ **Advanced saplings and polewood present**
- ◆ **Use skid trails already established**

Crop Planning

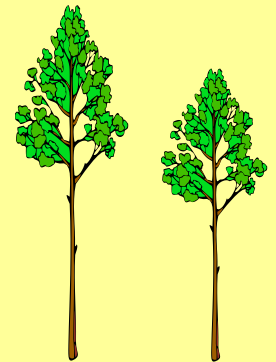
When will my plantation need thinning?

- ◆ **DMD is a tool that can be used to predict when you need to harvest**
- ◆ **Keep in mind...**
 - ◆ **Tree height is even across the stand**
 - ◆ **Height growth is related to the quality of the site**
 - ◆ **Height is related to age of the tree**

Both trees are the same age.

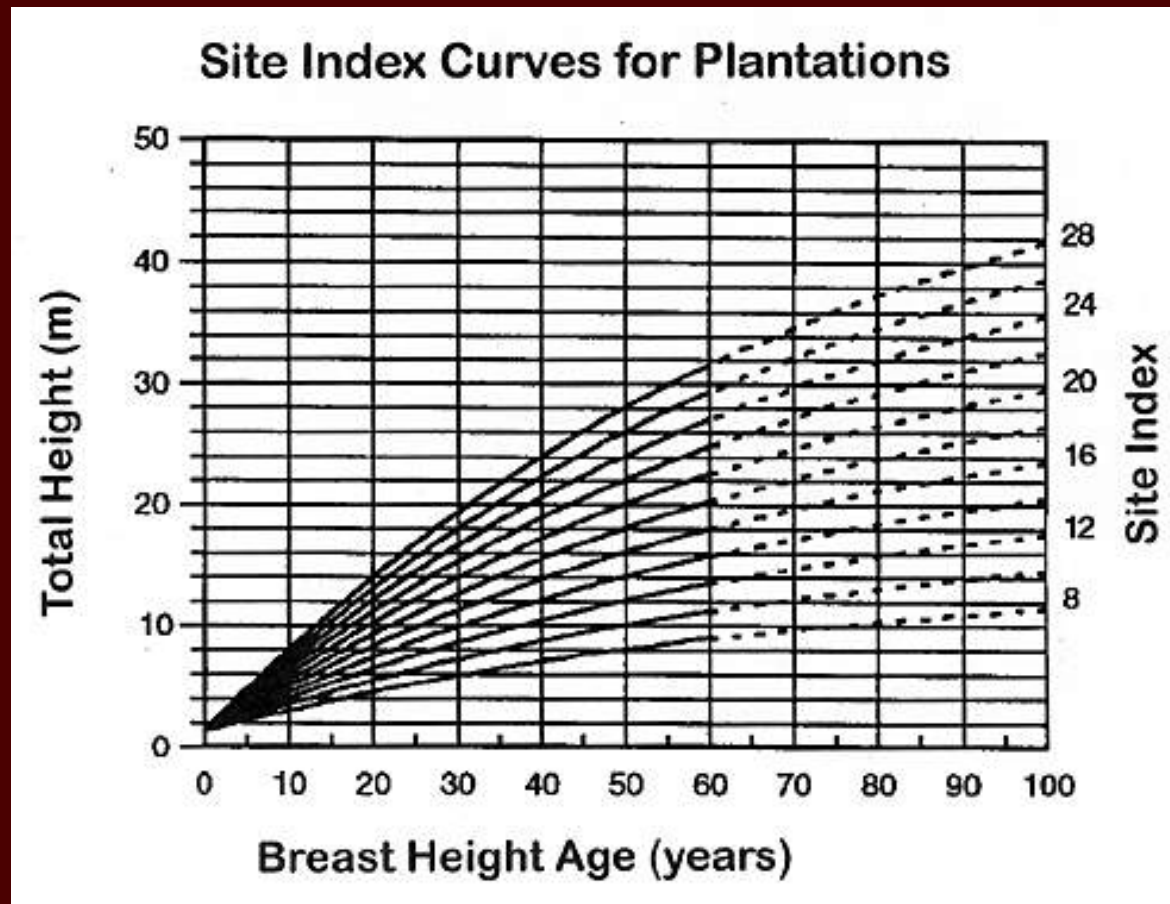
Which one came from the better site?

Which one has the larger diameter?



Crop Planning

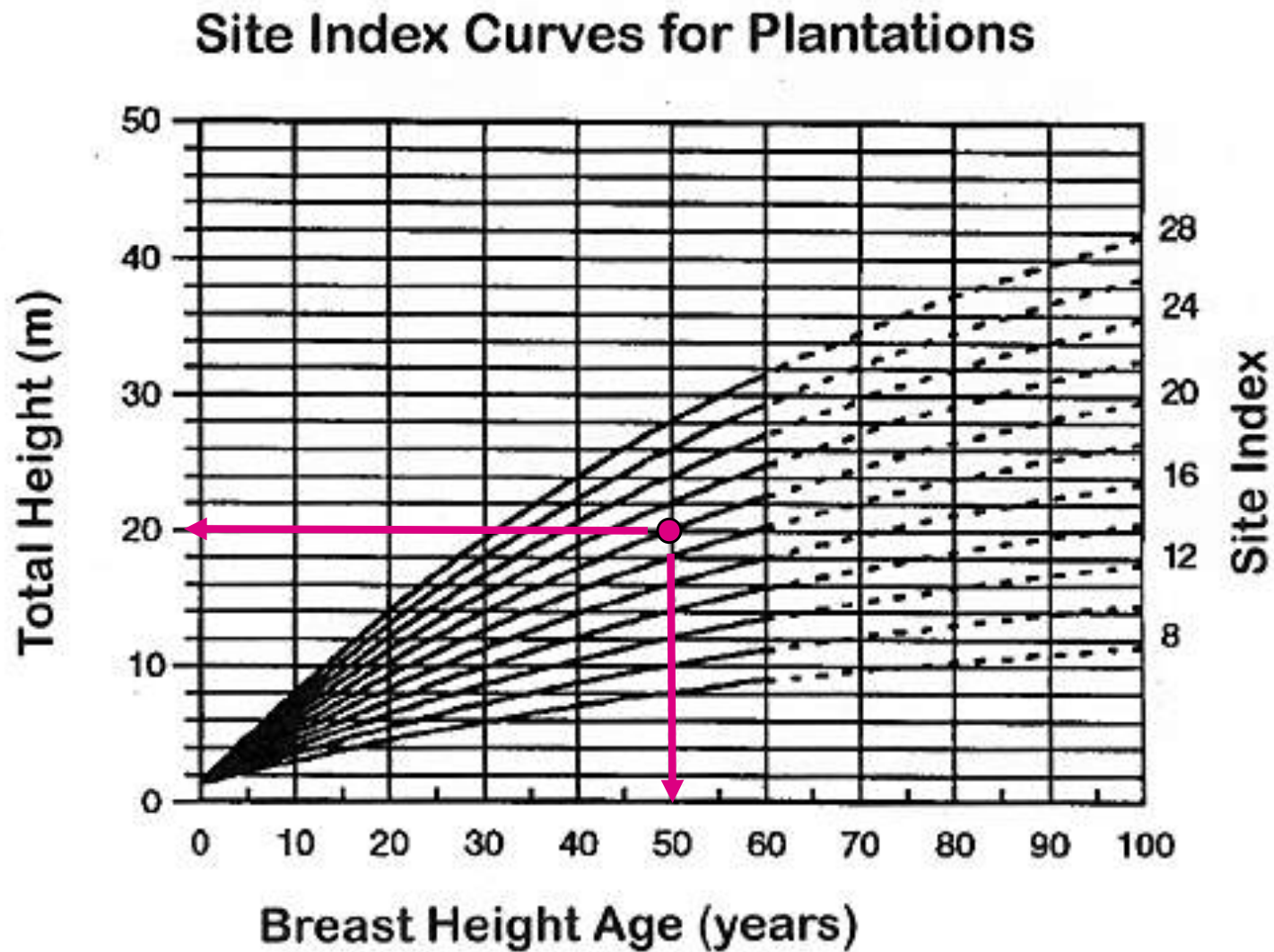
The Height Factor



- ◆ Need to look at Site Index (SI) curves
- ◆ SI is a measure of the height to age relationship
- ◆ Better sites have taller trees

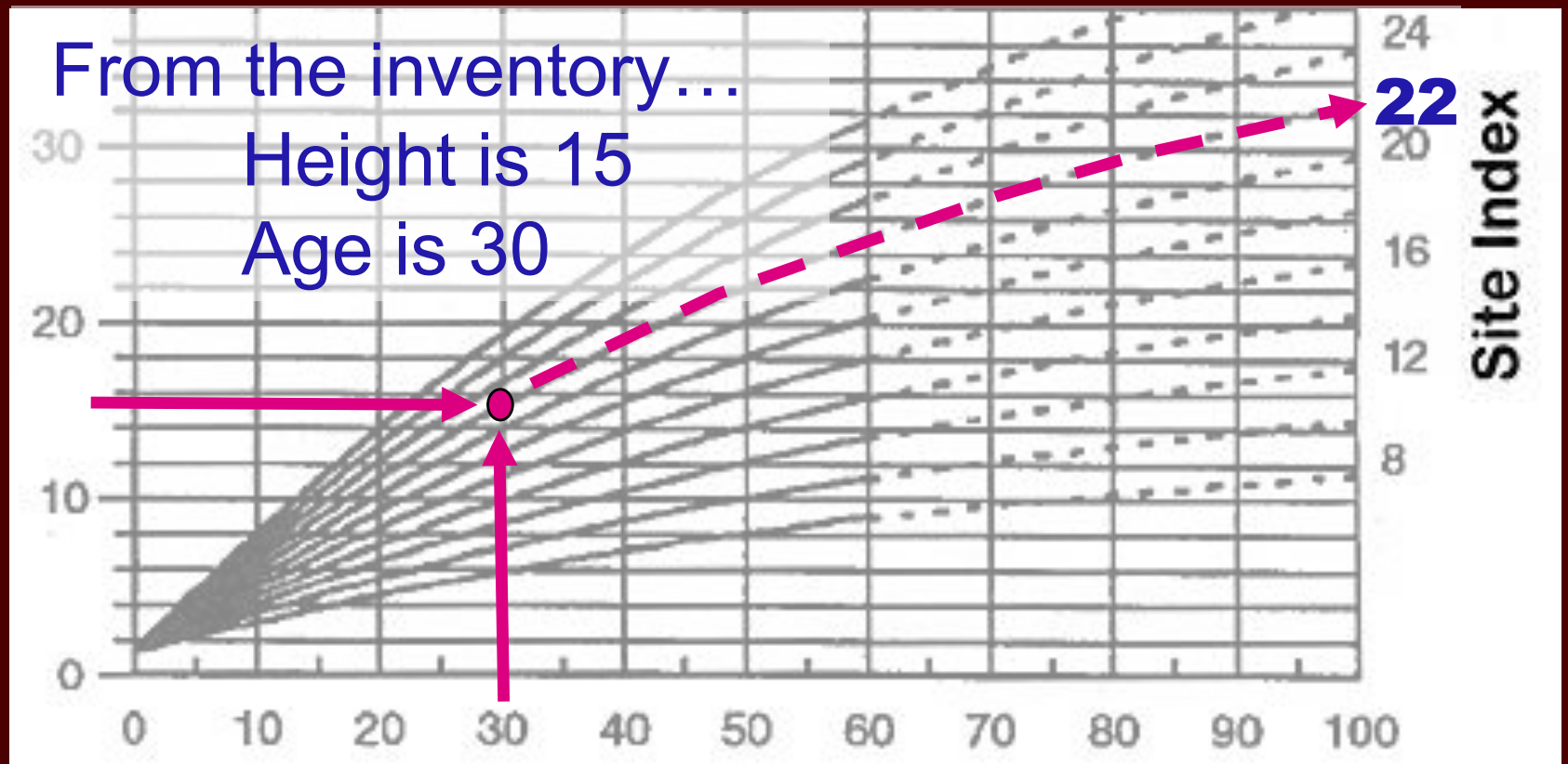
Crop Planning

What does SI mean?



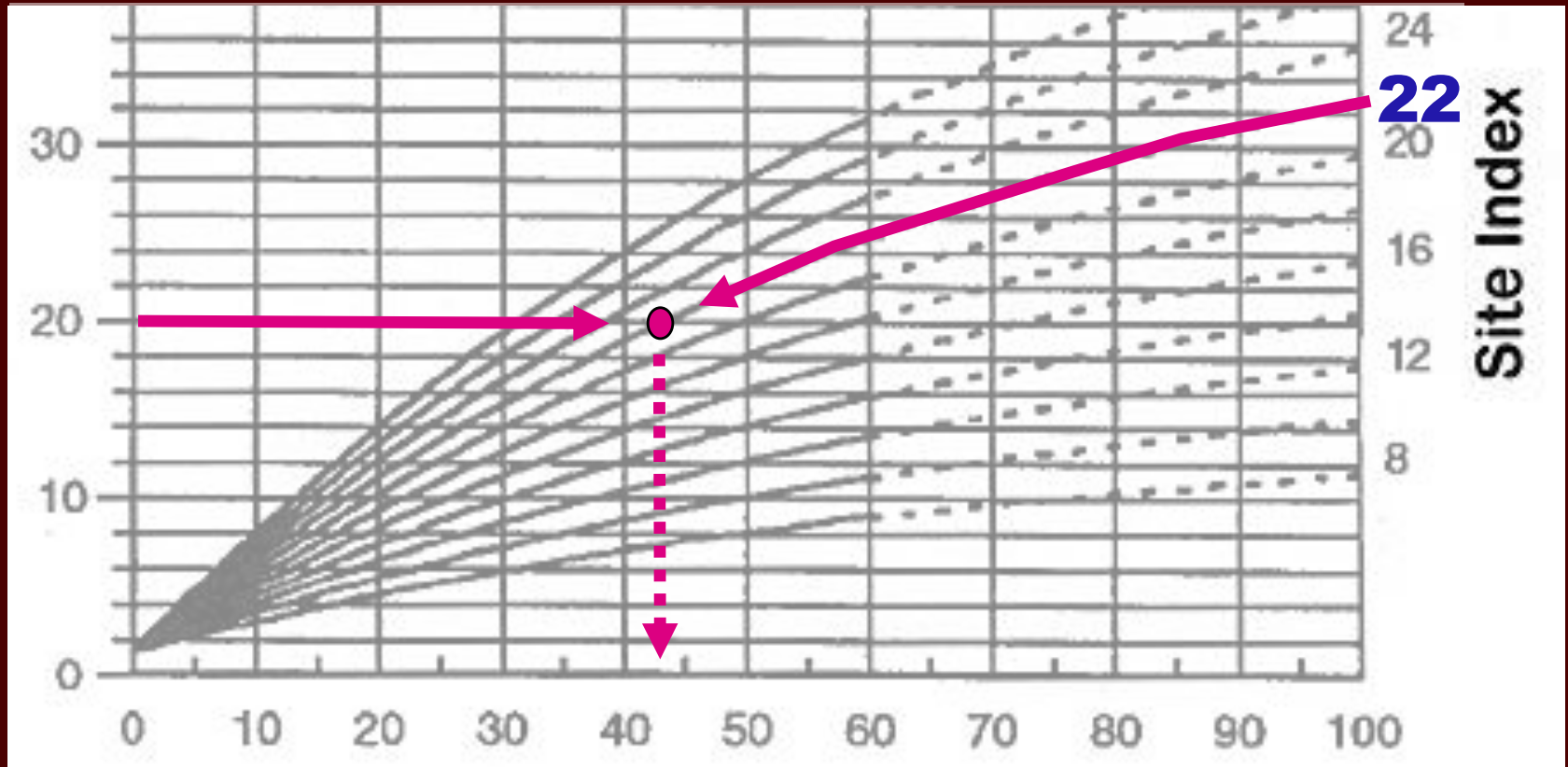
Crop Planning

What SI is the Smith Plantation?



Crop Planning

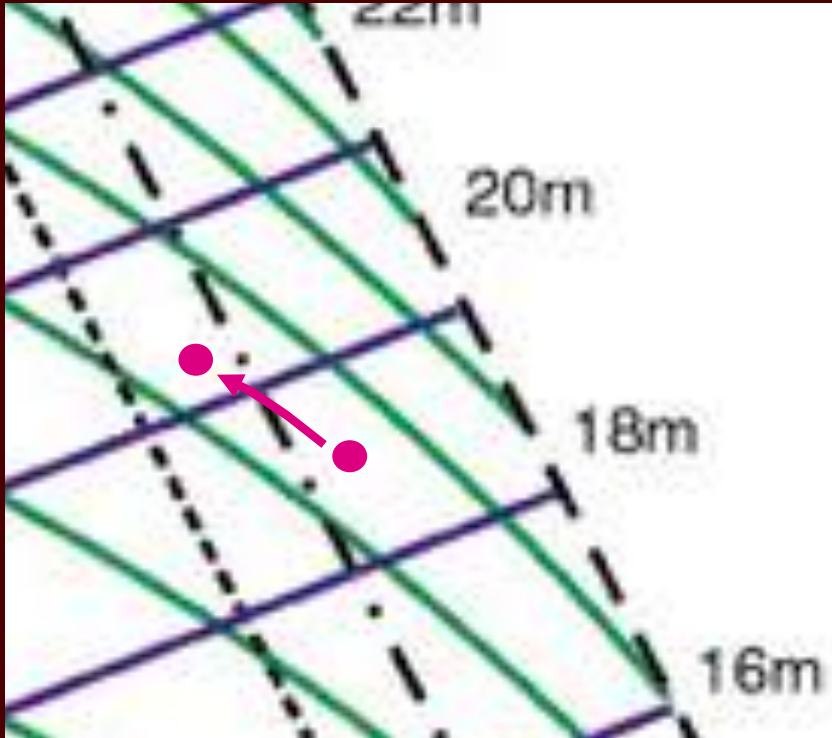
When will the Smith Plantation be 20 m tall?



- ◆ **SI=22, Height=20**
- ◆ **Interpret from SI that age would be ~ 43**
- ◆ **The Smith plantation will be 20 meters tall in about 13 years**

Crop Planning

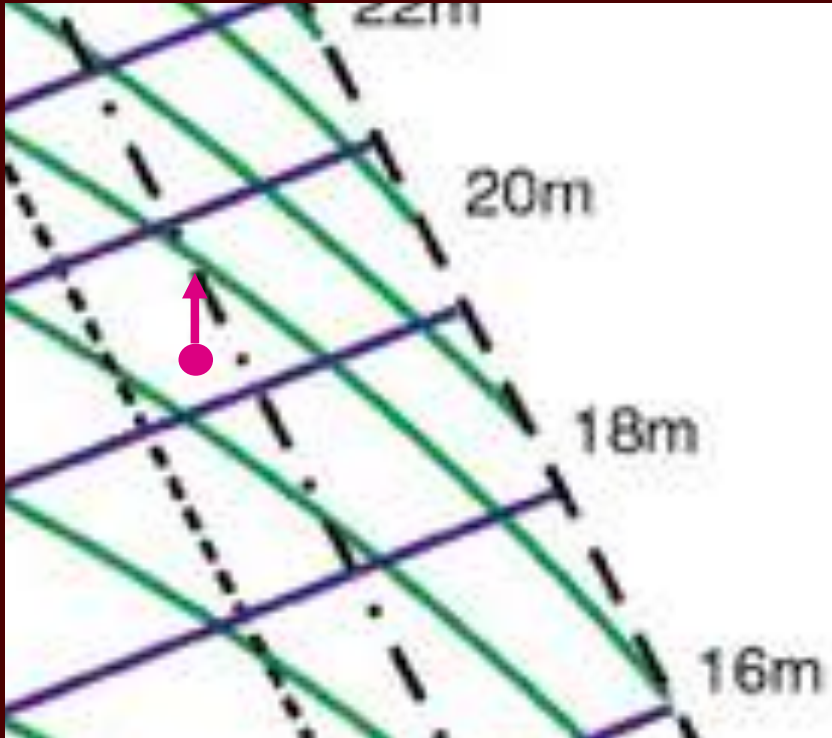
How many years to the next thinning?



- ◆ **Starting at 2400 stems/ha**
- ◆ **Harvesting to 1600**
- ◆ **Not at thin-to line (yet)**
- ◆ **Trees grow in diameter and height**
- ◆ **Harvesting does not change stand height**

Crop Planning

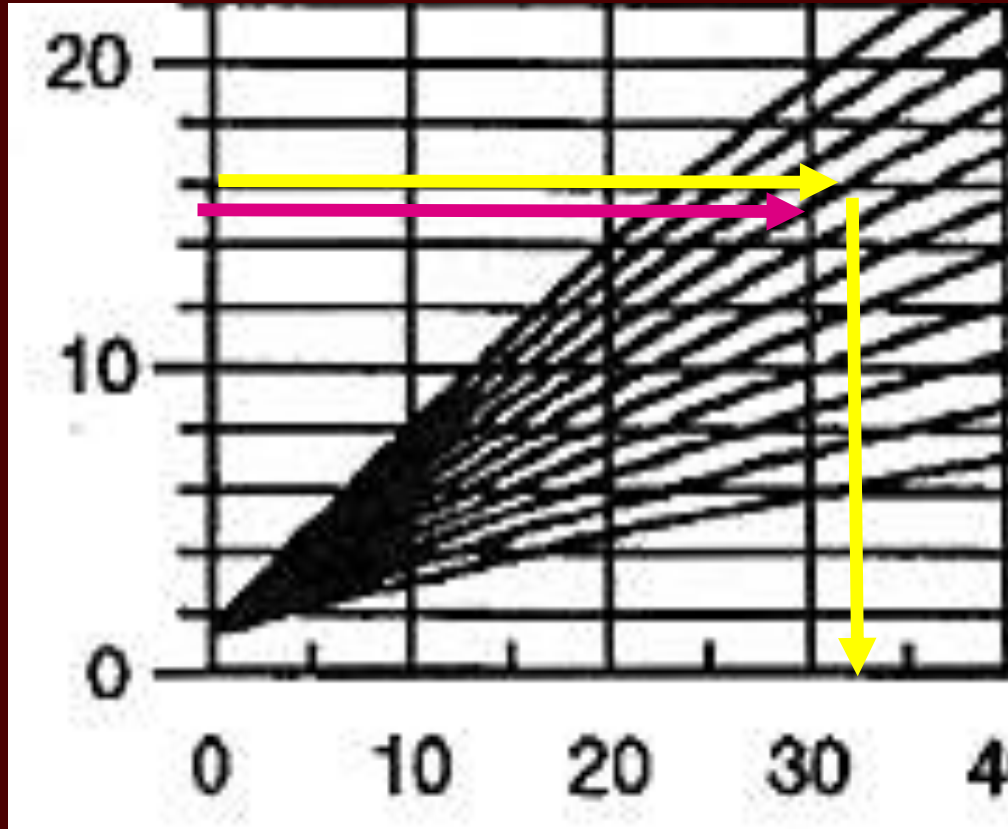
How many years to the next thinning?



- ◆ **The remaining trees grow in height and diameter**
- ◆ **Next harvest should occur when the stand hits the Grow-to Line**
- ◆ **Use the DMD to estimate the height at the time of harvest**
- ◆ **In this case it would be about 16m**

Crop Planning

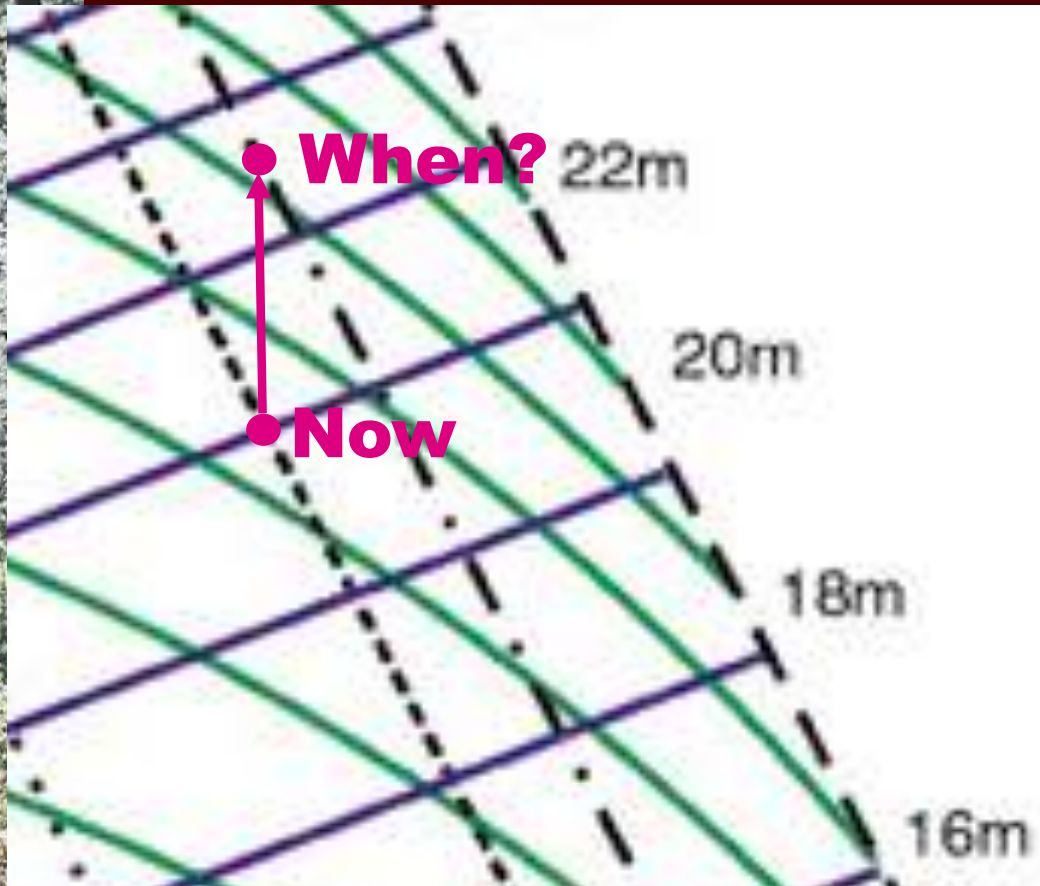
How many years to the next thinning?



- ◆ The next harvest will occur at stand height=16
- ◆ The SI will tell us how long this will be
- ◆ In this case, the next harvest should be in about 2 or 3 years!

Crop Planning

Another example...

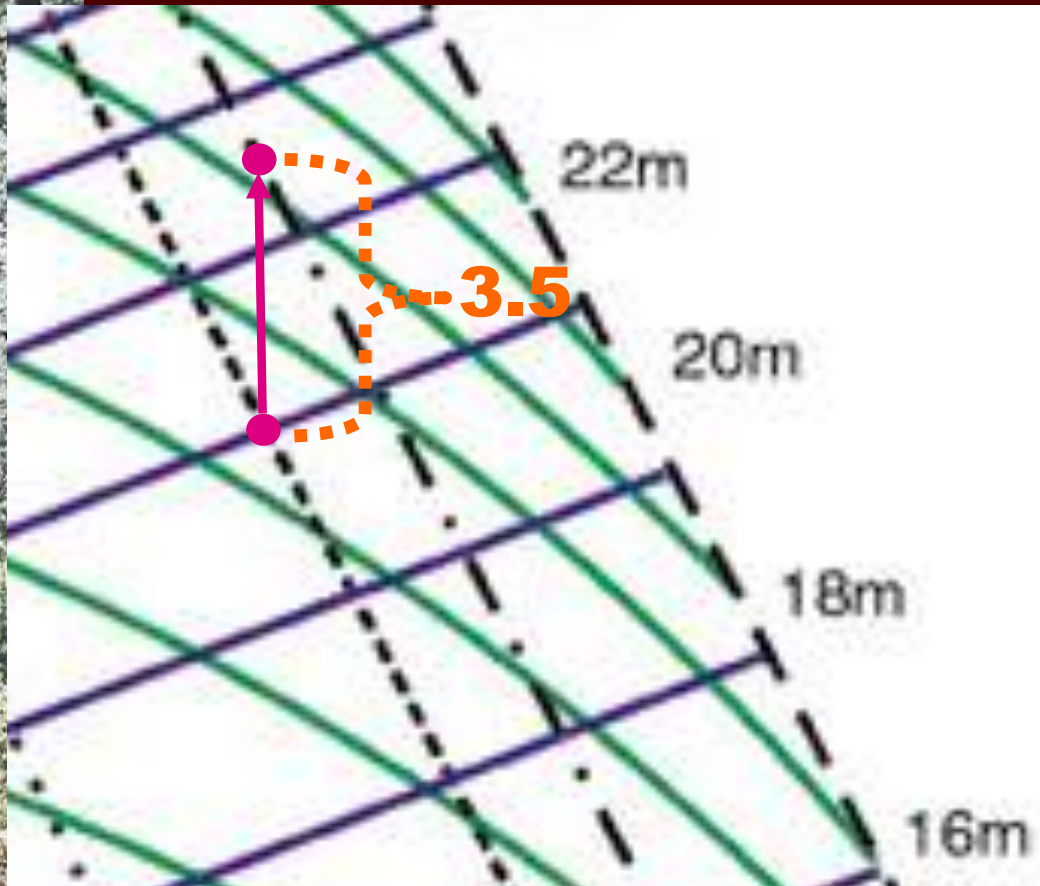


- ◆ Height= 12.4m
- ◆ SI=16

What's wrong with this picture?

Crop Planning

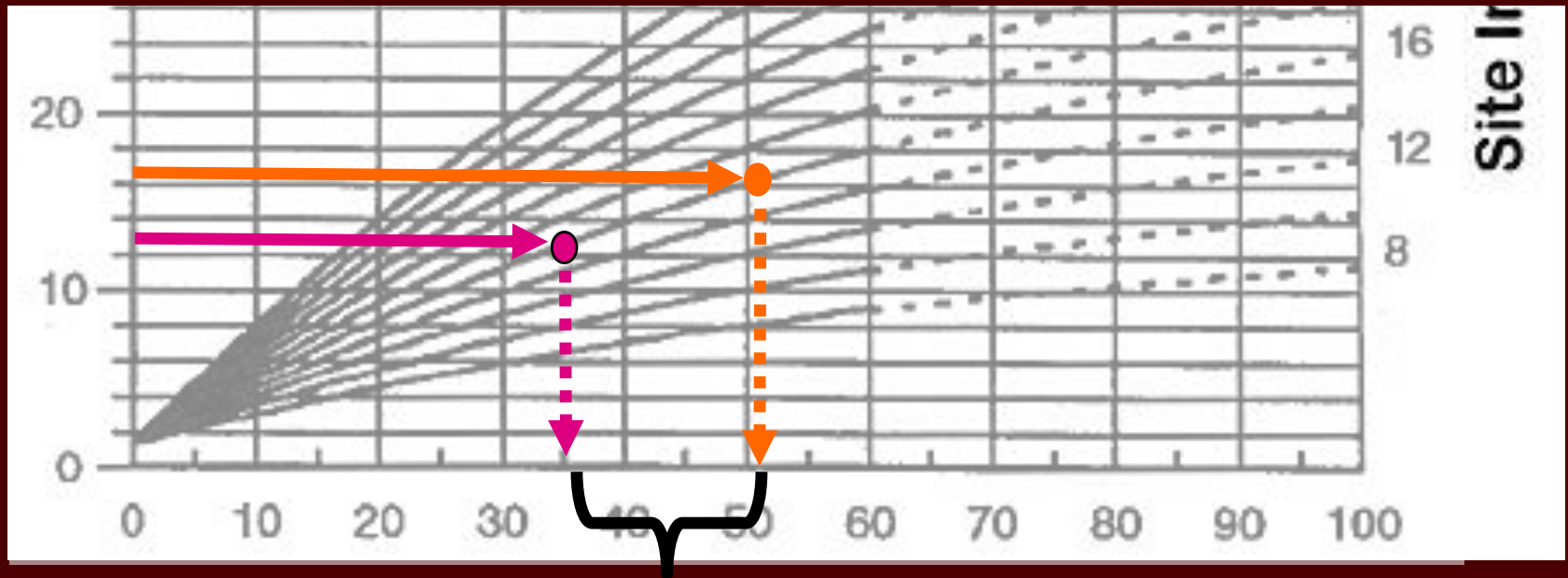
Another example (continued)...



- ◆ **Height= 12.8m**
- ◆ **Plots on DMD at 14.4 m**
- ◆ **The height growth is what is important**
- ◆ **Here it is about 3.5 m**

Crop Planning

Another example (continued)...



- ◆ It would take... **$53 - 35 = 18$ years**
- ◆ If the SI were 20 it would take 14 years
- ◆ If the SI were 28 it would take 7.25 years

Crop Planning

Crop Tree Selection



- ◆ **Trees that are selected to grow until the final harvest**
 - ◆ **location**
 - ◆ **growth rate**
 - ◆ **species**
 - ◆ **straightness**

Crop Planning

Crop Tree Pruning



- ◆ **Don't need to prune every tree**
- ◆ **Must prune Red & White Pine crop trees**
 - ◆ **Increases value**
 - ◆ **Reduces disease**

Crop Planning

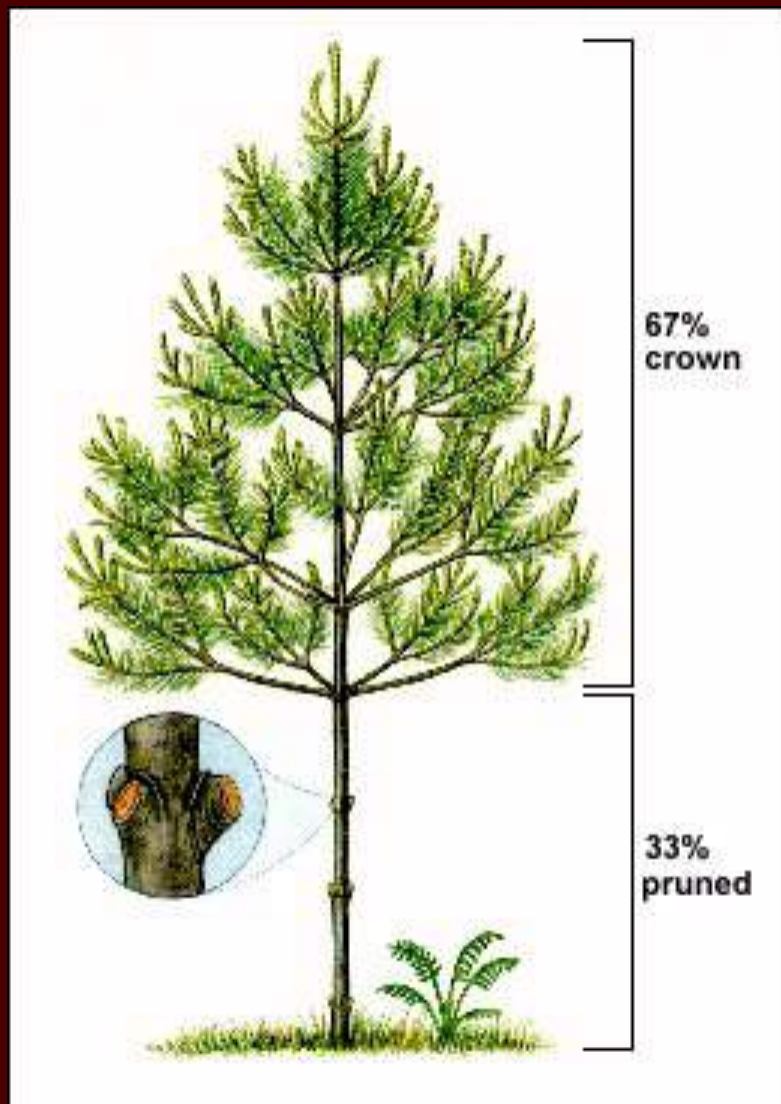


Figure 2. Combination pole saw pruner



Crop Planning

Thinned vs. unthinned A volume case study

Unthinned Plantation

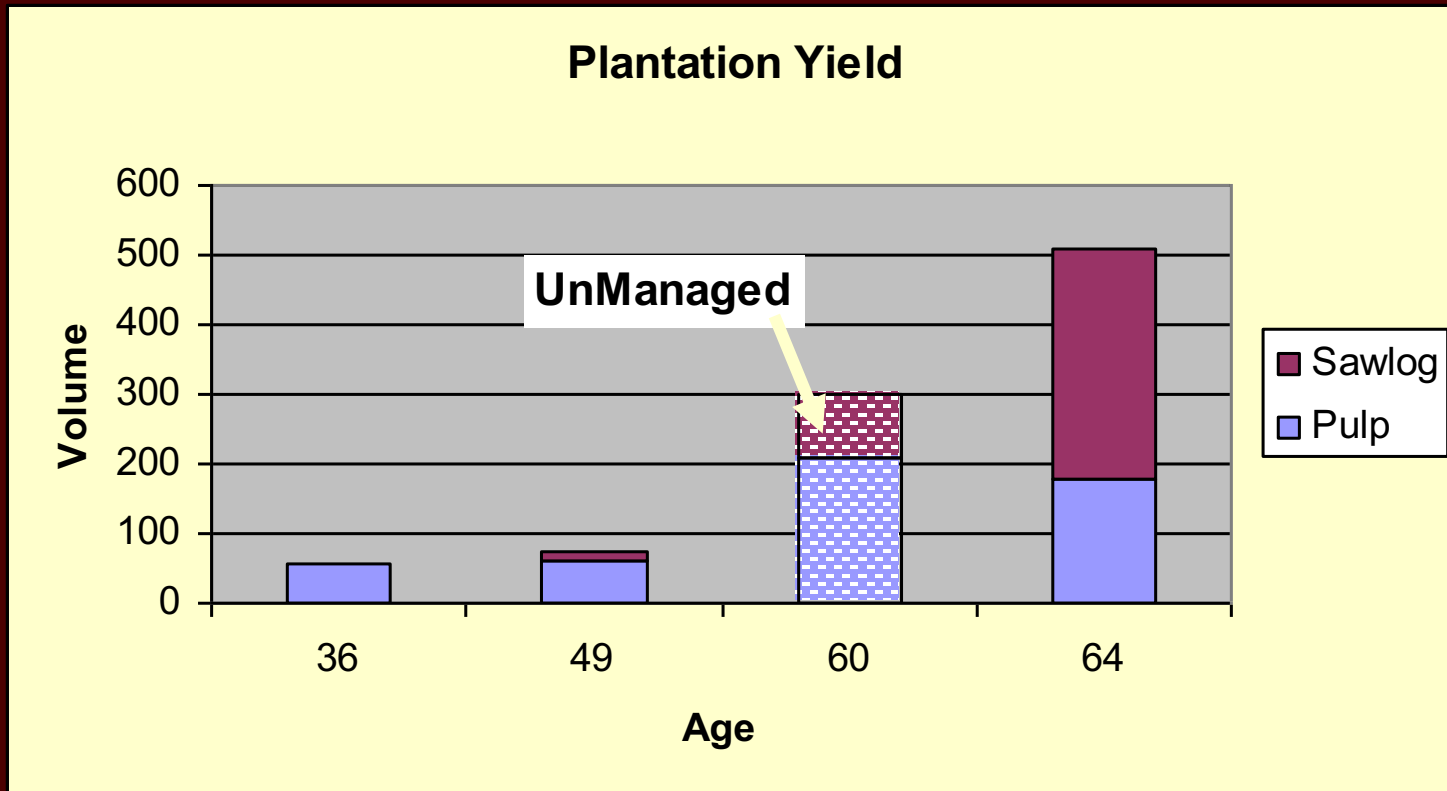
Activity	Pulpwood yield Cu. metres/ha.	Sawlog yield Cu. metres/ha
Harvest at age 60	209	90

Thinned Plantation

Activity	Age	Pulpwood yield Cu. metres/ha	Sawlog yield Cu. metres/ha
Thinning #1	36	55.6	—
Thinning #2	49	61.0	11
Thinning #3	64	177.0	330
	totals	293.60	341

Crop Planning

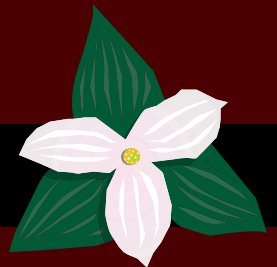
Thinned vs. Unthinned A volume case study



- ◆ **UnManaged Total Yield/Ha = 300 m3**
- ◆ **Managed Total Yield/Ha = 634 m3**

Conifer Plantations

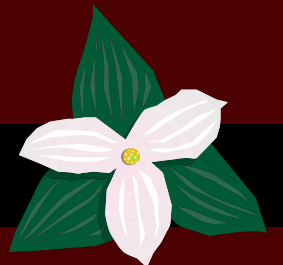
Module #3 Forest Operations





To Be Covered

- ◆ **Do-it-yourself vs Consultant vs Contractor**
- ◆ **Planning for the products**
- ◆ **Pruning and clipping — equipment**
- ◆ **Safety**
 - ◆ **safety practices**
 - ◆ **using equipment safely**
- ◆ **First thinning equipment**
- ◆ **Second thinning and others**



Are you taking on too much?

- ◆ **Do you:**
 - ◆ **have the time?**
 - ◆ **have the equipment?**
 - ◆ **know who has the best equipment?**
 - ◆ **know what bylaws apply?**
 - ◆ **know who gives the best prices?**
 - ◆ **know who has the best reputation?**
 - ◆ **need the help of a Consultant?**



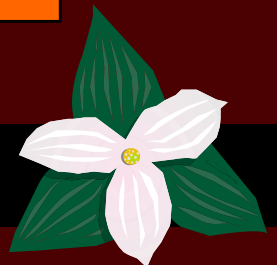
Forest Consultant vs. Harvesting Contractor

The Consultant will:

- ◆ **Check bylaws**
- ◆ **Mark trees or arrange for their marking**
- ◆ **Find the right contractor to do the job you want**
- ◆ **Prepare for the operations**

The right contractor will:

- ◆ **Have the right equipment**
- ◆ **Give you the best prices**
- ◆ **Have a good reputation**



Contractor Tidbits

- ◆ **Some contractors/mills will not buy without an approved plan**
- ◆ **Some contractors will write prescriptions and mark your trees (act as both consultant and contractor)**
- ◆ **Some contractors will thin other pines along with the red pine — don't miss an opportunity**
- ◆ **Always sign a contract and agree to prices before beginning**



Knowing Your Products



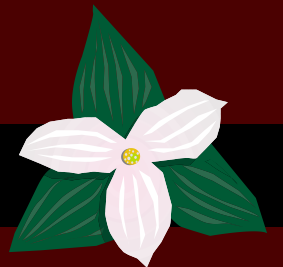
- ◆ **What makes a pole**
 - ◆ watch for spike knots
- ◆ **Logs for log homes**
- ◆ **Smallest commercial material**
- ◆ **Sawlogs**
- ◆ **Boughs for wreaths**
- ◆ **Pickets, posts**

**Get in touch with a buyer or mill
for up-to-date specs**

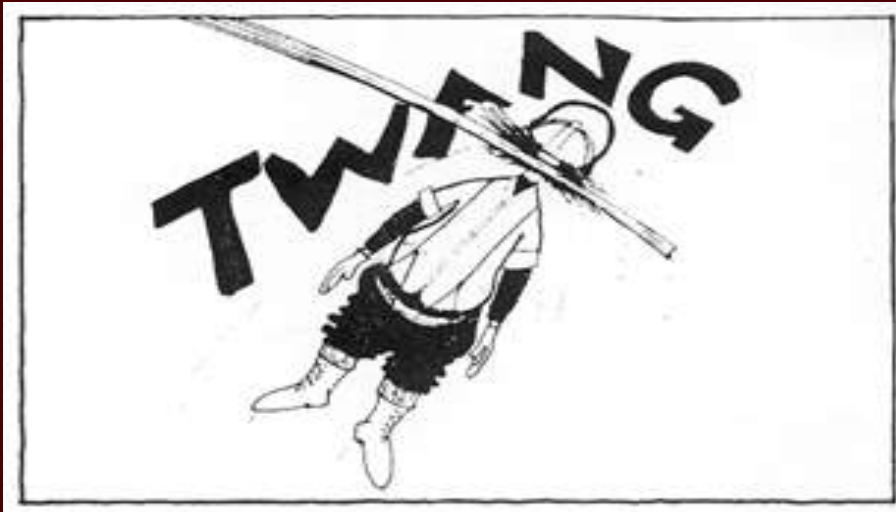


Safety Practices

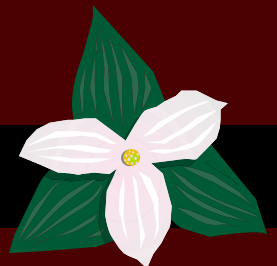
- ◆ **Using a Contractor:**
 - ◆ **right to inspect**
 - ◆ **let him know when on site and when leaving**
 - ◆ **wear safety gear**
 - ◆ **stay well clear of tree fellers, forwarders and loaders**



Using Equipment Safety



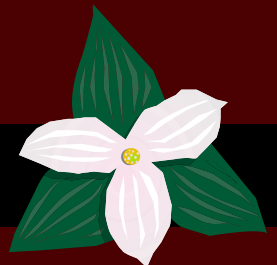
- ◆ **Contractors must be certified in chainsaw use — are you?**
 - ◆ **Attend a training seminar**
- ◆ **Always have a competent partner**
- ◆ **Have the right equipment to do the job**
- ◆ **Clean and sharpen frequently**



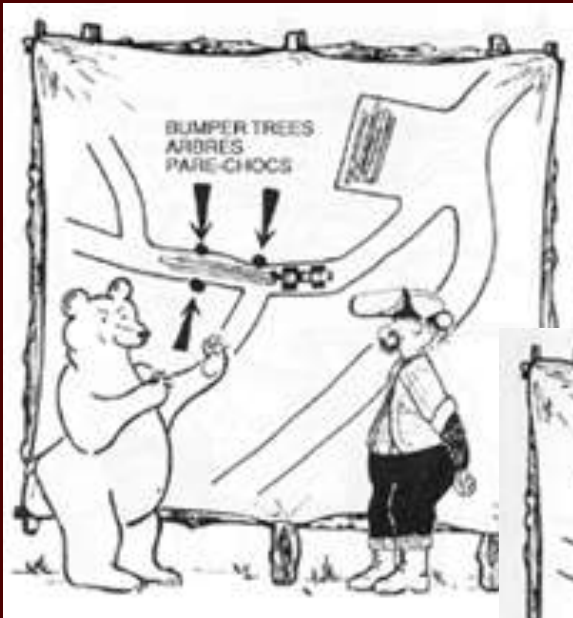
How Safe are you in your Plantation?



- ◆ **If you are working in your plantation:**
 - ◆ **never work in the woodlot alone!**
 - ◆ **rest when tired**
 - ◆ **follow same rules a contractor would**



Develop an Operating Plan



- ◆ Rows to be removed
- ◆ Locate and maintain roads
- ◆ Locate and maintain landings
- ◆ When to operate
- ◆ Plan for tree length



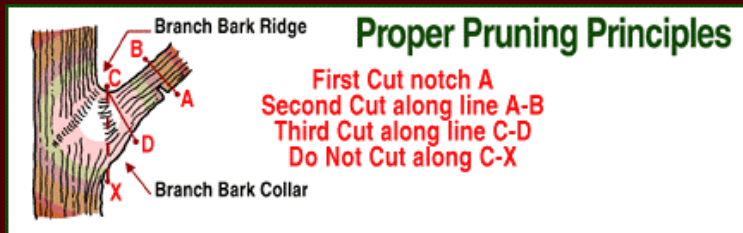
Pruning/Clipping



- ◆ **Clipping multiple leaders**
- ◆ **Pruning your trees**
 - ◆ **improve log quality**
 - ◆ **reduce disease**



How to Prune



Before



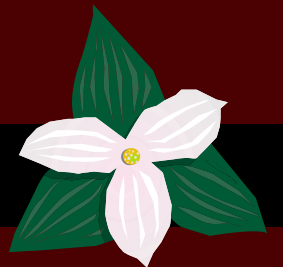
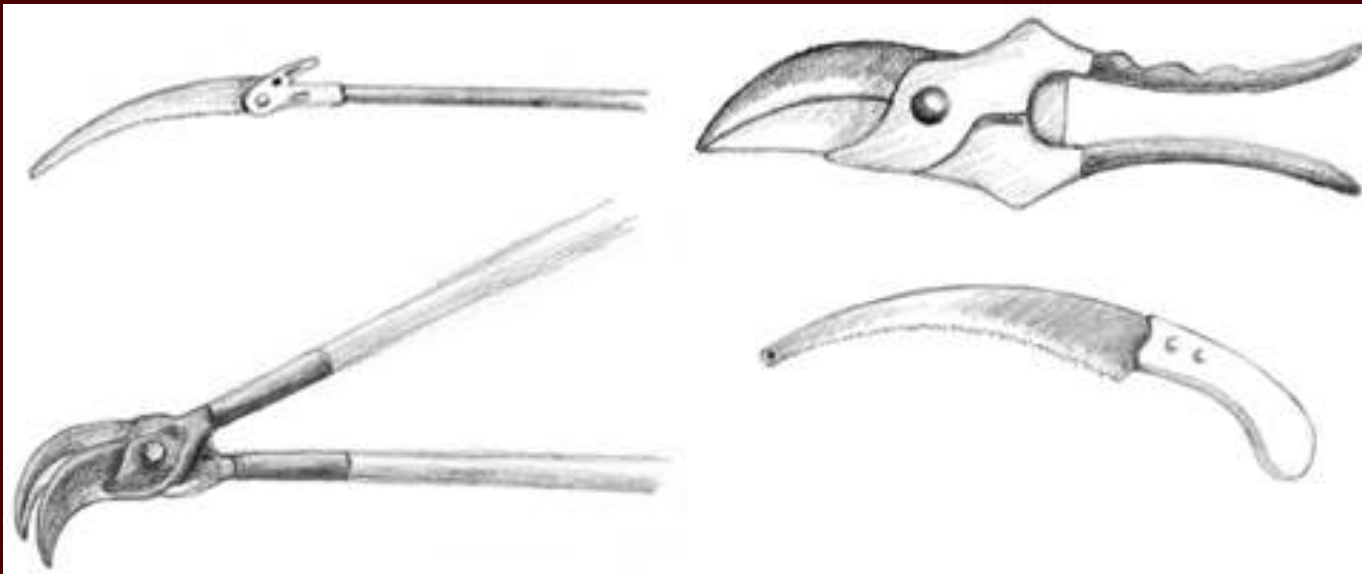
After

- ◆ Generally applies to larger branches
- ◆ Small branches can be pruned
- ◆ Watch the branch collar
- ◆ Leave 2/3 of live crown



Pruning Equipment

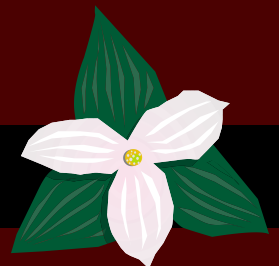
- ◆ **Use proper tools**
- ◆ **Clean regularly**
- ◆ **Keep sharp**
- ◆ **Pole saws — extensions to 5 metres**
- ◆ **Shears (can have extensions)**



Thinning



◆ **Can be done
by chainsaw
and horse**



Thinning

- ◆ **Always mark trees for removal**
- ◆ **Deal with the slash**
- ◆ **Prune limbs along skidding trail**
- ◆ **Pick out trees in adjacent rows as you go**
- ◆ **Buck material in landing**
- ◆ **Use a tape measure for lengths**



Harvesters and Forwarders



New Harvesters

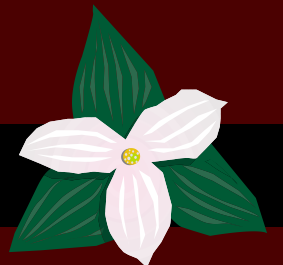


- ◆ **Technology is changing all the time.**



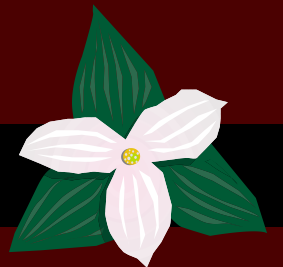
Mechanical Harvester

- ◆ **Can harvest up to 35 tonnes per day**
- ◆ **Minimum of 4 hectares**
- ◆ **Better if more properties**
- ◆ **Needs 70% of trees to have product**



Summary

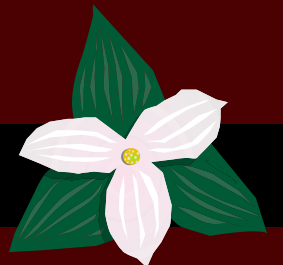
- ◆ **Do you need a consultant?**
- ◆ **Do you need a contractor?**
- ◆ **Safety in the plantation**
- ◆ **Operating plan**
- ◆ **Pruning**
- ◆ **Thinnings**
- ◆ **Equipment**
- ◆ **Horses to harvesters**



Conifer Plantation Management Workshops

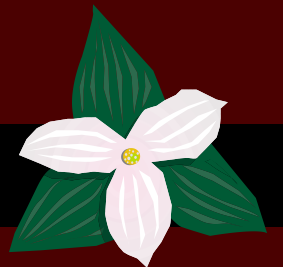
- ◆ **Have been funded by:**
 - ◆ **Ministry of Natural Resources
and**
 - ◆ **Eastern Ontario Model Forest
through**
 - ◆ **The Stewardship Program**

- ◆ **Prepared by Bill Hardy, Hardy Consulting**



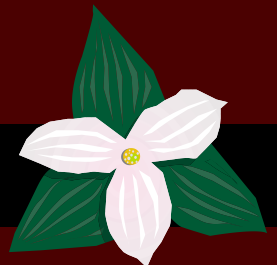
Conifer Plantations

Module #4 Timber Sales and Marketing



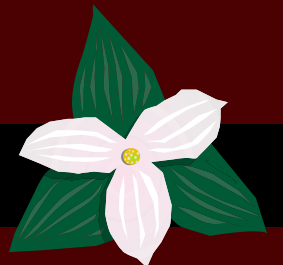
Overview

- ◆ **Things to Think About**
- ◆ **Types of Sales**
- ◆ **Factors to Consider**
- ◆ **Crop Scenarios**
- ◆ **The Contract**
- ◆ **Safety**
- ◆ **Further Information**



Things to think about

- ◆ **Do you have the expertise?**
- ◆ **Do you have enough material?**
- ◆ **Where can you get help?**
- ◆ **Markets?**
- ◆ **Management options**



Types of sales

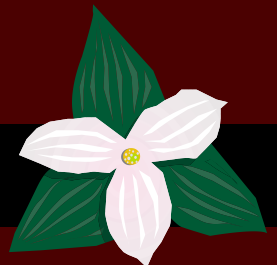
- ◆ **Timber selling arrangements**
 - ◆ **stumpage (trees standing)**
 - ◆ **roadside (trees cut and forwarded)**
 - ◆ **delivered at mill**
- ◆ **A sale is either lump sum or unit-priced**
- ◆ **Sale agreements on basis of**
 - ◆ **bids**
 - ◆ **negotiation**



Lump Sum Sales

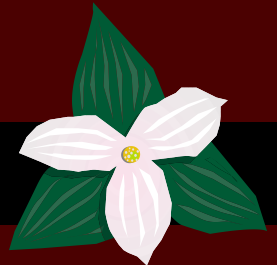


- ◆ **Recommended for most sales**
 - ◆ **marked trees**
 - ◆ **accurate inventory**
 - ◆ **effective with high value wood**
 - ◆ **buyers pay in advance**



Unit Priced Sales

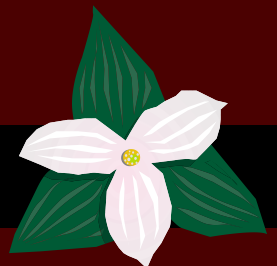
- ◆ **Require measurement for payment**
 - ◆ **Volumes at landing**
 - ◆ **Weight at mill**





Has this Happened to Someone you Know?

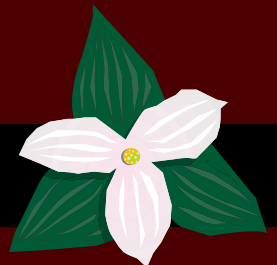
- ◆ **Operator interested in wood**
- ◆ **Is a friend of a friend of a . . .**
- ◆ **His word is as good as . . .**
- ◆ **No need to mark trees “I leave the best ones for the future”**
- ◆ **Offers a great price for everything he takes**
- ◆ **Would like to start right away**
- ◆ **No contract needed — he trusts you!**
- ◆ **Cheque is in the mail!**
- ◆ **No wood — no money — no woodlot**



Use a formal contract

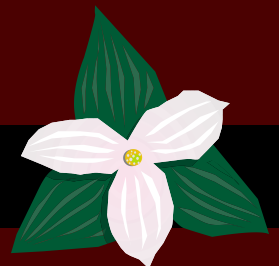
- ◆ **Honest**
- ◆ **Clarifies roles and responsibilities for both parties**
- ◆ **Legally binding**
- ◆ **Payments and schedules**
- ◆ **Performance**

“Good fences make good neighbours. Good contracts keep good friends.”



Check it Out!

- ◆ **Before signing contract**
 - ◆ references
 - ◆ visit sites, is landowner satisfied?
- ◆ **At logging sites**
 - ◆ does it meet your standards?
 - ◆ good utilization?
 - ◆ acceptable damage levels?





The Contract

- ◆ **Products and prices**
- ◆ **Method of payment**
- ◆ **Start and finish date**
- ◆ **Penalties**
- ◆ **Agent**

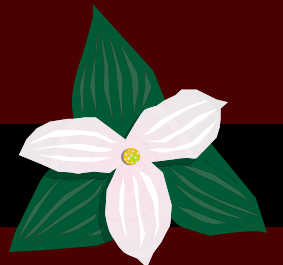
Contract for Sale of Standing Timber

**This contract entered into this 21st
day of November, 1995, between
John Doe of 4568 Third
Concession hereinafter called the
Seller, and Alfred Jones of
Brockville, hereinafter called the
Purchaser . . .**



The Contract

- ◆ **Areas or trees to be cut**
- ◆ **Responsibility for roads, fences and other improvements**
- ◆ **Precautions against fire**
- ◆ **Liability insurance**
- ◆ **Legislation, certification**
- ◆ **Legal advice**



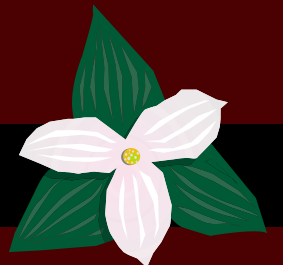
The Contract

- ◆ **Everything in a contract is negotiable**
- ◆ **Restrictions affect price**
- ◆ **Determine**
 - ◆ **What is essential?**
 - ◆ **What is negotiable?**
 - ◆ **What are the special provisions?**



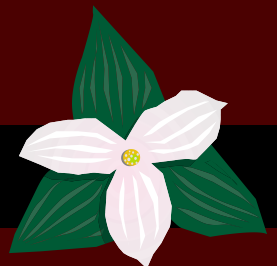
Value can Vary

- ◆ **How much do you have?**
- ◆ **Closeness to mill**
- ◆ **Access to plantation**
- ◆ **Is it the first or third thinning?**
- ◆ **Ask for help**



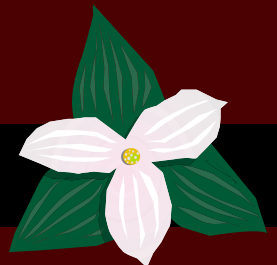
Typical Products From Red Pine

- ◆ **First and second thinnings**
 - ◆ **Pulpwood, sawlogs**
 - ◆ **Pickets, fence posts, landscape ties**
- ◆ **Subsequent thinnings and final harvest**
 - ◆ **sawlogs, poles, pulpwood**
 - ◆ **Larger, higher, value products**
- ◆ **Third thinning may be harvest final**



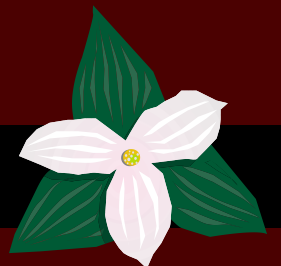
First Thinnings \$\$\$\$?

- ◆ **On the stump \$1-5 per tonne, 20-60 tonnes/ha**
- ◆ **Average diameter of 6 inches**
- ◆ **Price depends on many factors:**
 - ◆ **size,**
 - ◆ **volume,**
 - ◆ **access,**
 - ◆ **current market.**



Future Thinnings

- ◆ **Second thinnings worth \$4-10 per tonne**
- ◆ **Harvesters, skidders, forwarders**
- ◆ **After second thinning value of future thinning increases dramatically**
- ◆ **Harvesters, skidders — tree length (up to 60 feet long)**
- ◆ **Poles worth \$60-\$175 on landing**
 - ◆ **Straightness, circumference, height and taper**



Red Pine Crop Scenario

◆ What you may expect from a typical site

Activity	Average DBH (cm)	Total Age years	# Stems Removed	Pulpwood Yield (m3/ha)	Sawlog Yield(m3/ha)
Thinning #1	16.4	36	850	55.6	—
Thinning #2	23	49	400	61	11
Thinning #3	30	64	650	17.7	330





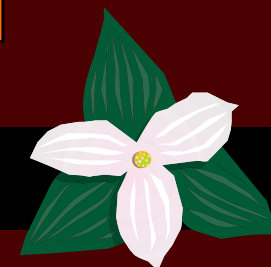
Net Revenue Scenarios

◆ Net Revenue with Thinning Program

Product Type	Commercial Thinning		Final Harvest	Total Net Revenue with thinning
	Year '36	Year '49	Year '64	
Boltwood Sawlogs	\$1,112	\$1,220 \$517	\$3,540 \$15,510	\$5,872 \$16,027
Total/ha	\$1,112	\$1,737	\$19,050	\$21,899

Product Type	Final Harvest Year '60	Total Net Revenue without thinning
Boltwood Sawlogs	\$4,180 \$4,230	\$4180 \$4230
Total/ha	\$8,410	\$8410

Your wood is valuable and is an investment to you!



How do you Find a Logger/Buyer

- ◆ **Forestry Consultant**
- ◆ **Forestry Associations**
- ◆ **Mills**
- ◆ **Other landowners**
- ◆ **Ministry of Natural Resources**
- ◆ **Stewardship Councils**
- ◆ **Eastern Ontario Model Forest**



Monitoring the Harvest

- ◆ **Operating plan being followed**
- ◆ **Only marked trees are being removed**
- ◆ **Safety**
- ◆ **Slash**
- ◆ **Minimal damage**



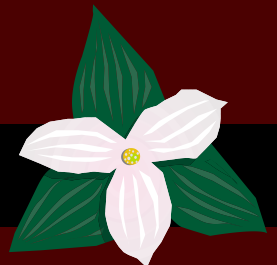
After the Harvest

- ◆ **Consider reinvesting earning back into property as required**
 - ◆ **Roads**
 - ◆ **Fences**
 - ◆ **Landings**
 - ◆ **Plan updates**



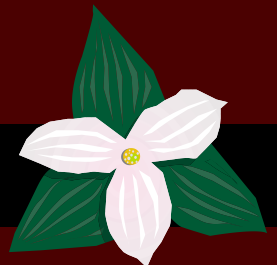
Summary

- ◆ **Planning to sell**
- ◆ **Inventory**
 - ◆ **Market research**
- ◆ **Making the deal**
 - ◆ **contract**
 - ◆ **reference checks**
 - ◆ **payment**
- ◆ **Monitoring**
- ◆ **Repairing the property afterward**
 - ◆ **re-investing**



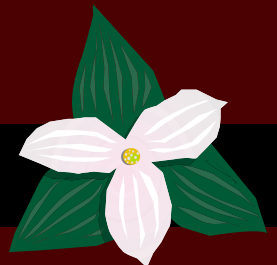
Websites

- ◆ **LandOwner Resource Centre**
www.lrconline.com
- ◆ **Ontario Woodlot Association**
www.ont-woodlot-assoc.org
- ◆ **University of West Virginia**
www.wvu.edu/users/exten/www/depts/af/ahc/timbsale.htm
- ◆ **University of Georgia**
www.forestry.uga.edu/abstracts/c0773.html
- ◆ **Ontario Forestry Association**
www.oforest.on.ca/index.html
- ◆ **Eastern Ontario Model Forest**
www.eomf.on.ca



Conifer Plantation Management Workshops

- ◆ **Have been funded by:**
 - ◆ **Ministry of Natural Resources
and**
 - ◆ **Eastern Ontario Model Forest**
 - ◆ **The Stewardship Program**

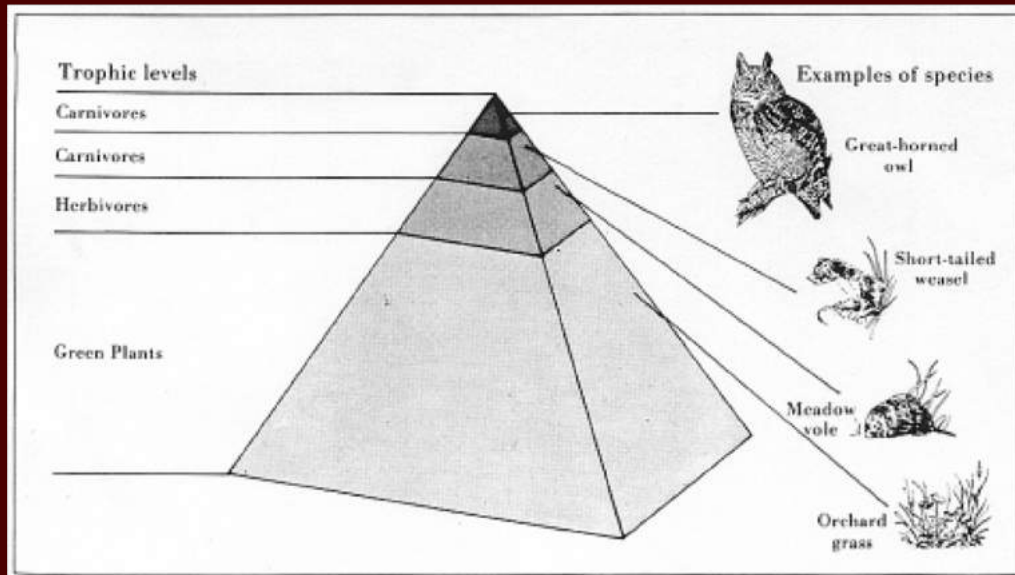


Conifer Plantations

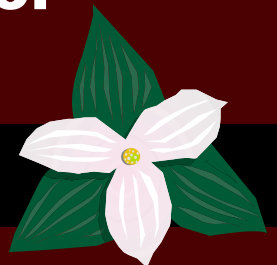
Module #5 Biodiversity and Wildlife Values



What's in the Module?



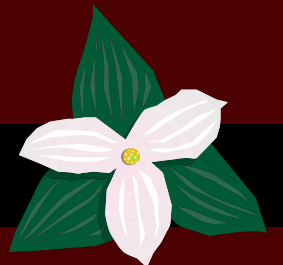
- ◆ **Biodiversity defined**
- ◆ **Importance**
- ◆ **Typical forest ecosystem**
- ◆ **Forest succession**
- ◆ **Your property**
- ◆ **Your plantation**
- ◆ **Plantation review**
- ◆ **Managing for birds**
- ◆ **Managing for animals**





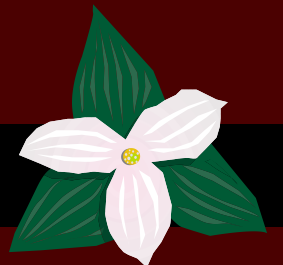
What is Biodiversity?

- ◆ **Biodiversity:** full variety of life in an area
- ◆ **Species diversity:** number and relative abundance
- ◆ **Genetic diversity:** genetic variation
- ◆ **Ecosystem diversity:** variety

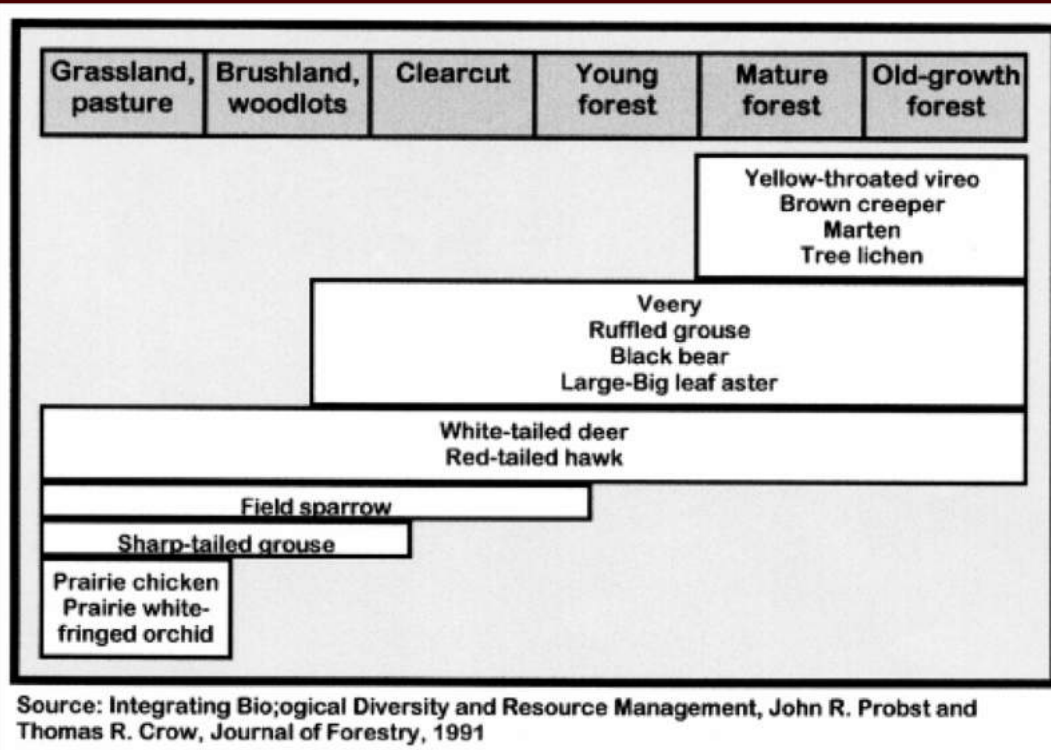


Diversity is Important

- ◆ **current extinction rates far exceed rates documented in geologic records**
- ◆ **manage for generalist organisms at the expense of habitat specialists**
- ◆ **Preserving single species has dominated**
- ◆ **More attention to whole ecosystems**
- ◆ **Diverse ecosystems better able to withstand stress and disturbance**



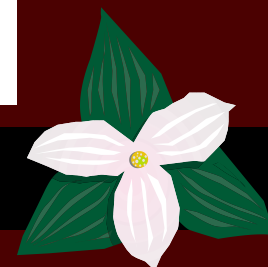
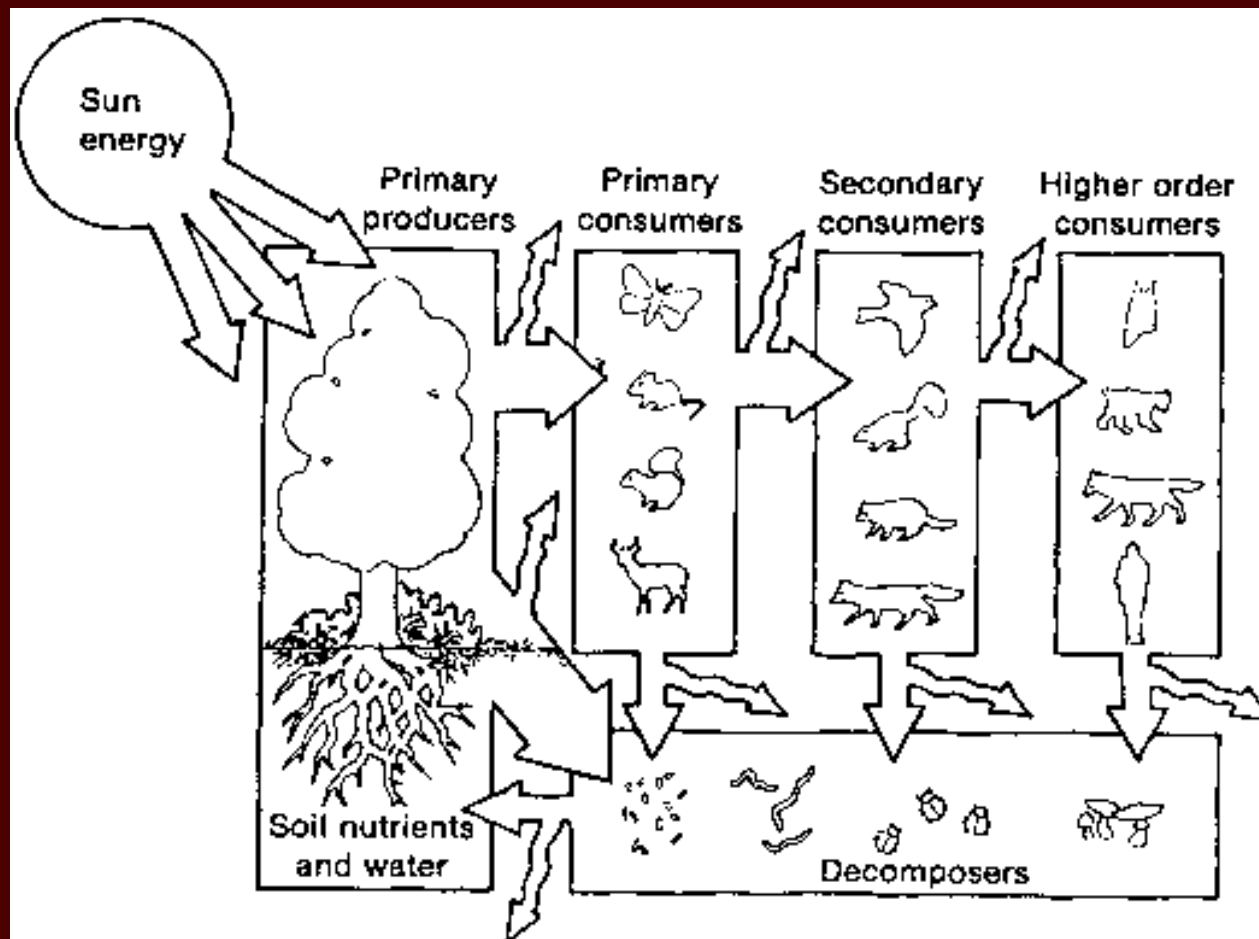
Generalists and Specialists



- ◆ **Generalists in a variety of ecosystems**
- ◆ **Specialists limited to only a few ecosystems**

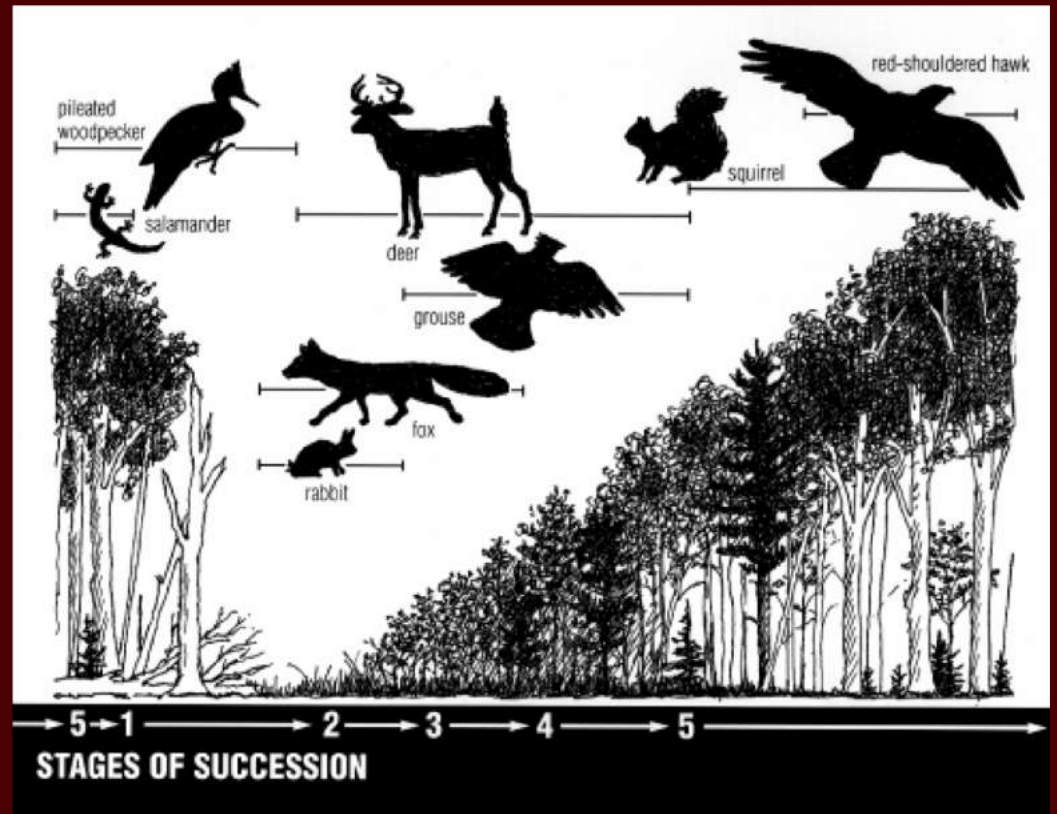


Forest Ecosystem



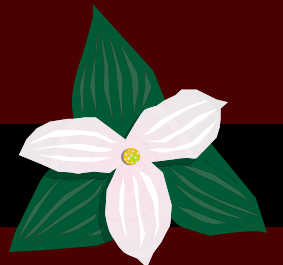
Succession

- ◆ **Natural process of change**
 - ◆ **pioneer species**
 - ◆ **climax forest**
- ◆ **Conifer plantations shorten the time span and provide economic return**



Where do you Start?

- ◆ **Inventory**
- ◆ **Identify ecosystems and their relationships**
- ◆ **Identify options to protect and enhance existing sites with linkages**
- ◆ **Create a Management Plan**



Plantation's Role on your Property

- ◆ **Nurse crop**
- ◆ **Adds diversity**
- ◆ **Links degraded and
fragmented forest patches**
- ◆ **Stabilizes eroded areas**
- ◆ **Protects waterways**
- ◆ **Meets your needs**



Plantations are not stable ecosystems

Continuous change from open areas

- ◆ **to young trees**
- ◆ **to crown closure**
- ◆ **to maintaining vigour**
- ◆ **to regeneration**
- ◆ **to renewal**

Continued management as plantation changes

- ◆ **site preparation**
- ◆ **planting**
- ◆ **early tending**
- ◆ **thinning for products**
- ◆ **thinning for regeneration**
- ◆ **harvesting and
conversion**

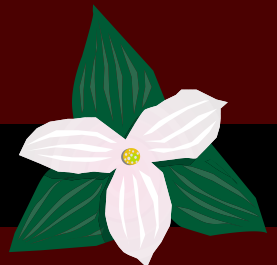
**Plantation ecosystem constantly evolving towards the
desired natural forest after one rotation**



Let's Look at Wildlife

◆ **Birds and animals**

- ◆ **cover**
- ◆ **food**
- ◆ **water**
- ◆ **space**

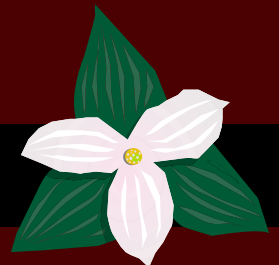


Birds in Your Plantation

- ◆ **Species composition changes as the plantation matures**
- ◆ **Hardwoods critical**



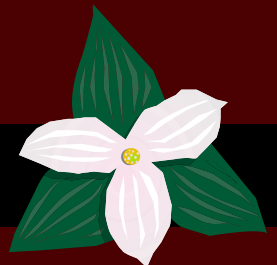
- ◆ **Species diversity increases with age**
 - ◆ **Without thinning, canopy closed and dramatic reduction in species present**



Helping our Feathered Friends

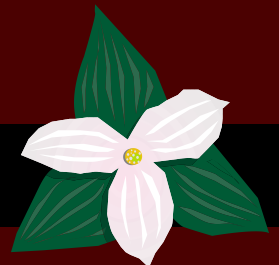


- ◆ **Restrict operations from April to July**
- ◆ **Thin plantations on schedule to promote hardwoods**
- ◆ **Thin plantations adjacent to hardwood seed sources first**
- ◆ **Plant mixtures e.g. Pr/Pj**



More Help

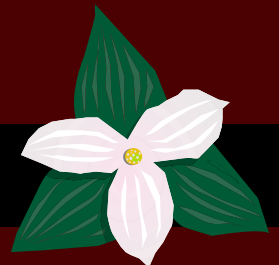
- ◆ **Direct seed or plant hardwoods where no seed source**
- ◆ **Promote and maintain snags and cavities**
- ◆ **Minimize edge habitat**



Animals in your Plantation



- ◆ **Animals tend to use edge**
- ◆ **Cover from the elements**
- ◆ **Cover from predators**
- ◆ **A limited source of food**
- ◆ **Older plantations provide opportunities for homes**



Helping the Animals



- ◆ **Preserve den trees**
- ◆ **Conifers to link woodlots**
- ◆ **Conifers as shelter**
- ◆ **Openings**
- ◆ **Retain hardwood patches**
- ◆ **Plant roads, trails, landings**



Other Ideas on Wildlife



- ◆ **Ecosystem diversity**

- ◆ **Recreation**

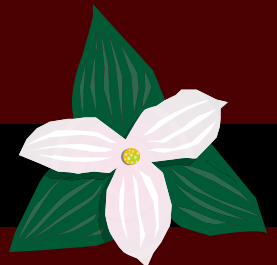
- ◆ **viewing**

- ◆ **hunting**

- ◆ **Eco-Tourism**

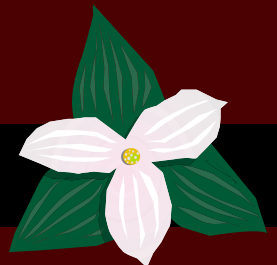
- ◆ **part of a variety of ecosystems**

- ◆ **part of a farm complex**



Your Plantation — Summary

- ◆ **Managing your plantation for biodiversity**
 - ◆ **When to operate**
 - ◆ **Watch that edge**
 - ◆ **Where are the hardwoods?**
 - ◆ **Linkages**
 - ◆ **Species mix**
 - ◆ **Thin, thin, thin**
 - ◆ **Don't forget the overall objectives!**



Conifer Plantations

Module #6

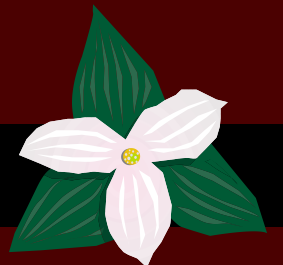
Plantation Problems



Plantation Problems

◆ Major Categories

- ◆ Insects**
- ◆ Diseases**
- ◆ Nuisance animals**
- ◆ Man**
- ◆ Disasters**



Insects

Leaf and Needle Feeders

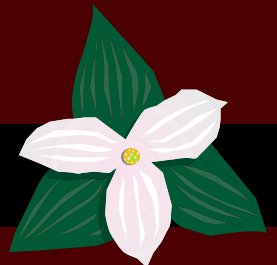
- ◆ Sawflies
- ◆ Webworm
- ◆ Gypsy moth

Stem or Twigs

- ◆ White pine weevil
- ◆ Pine shoot moth
- ◆ Wood borers
- ◆ Bark beetles

Root Feeders

- ◆ White grubs



Diseases



◆ Diseases in the Root

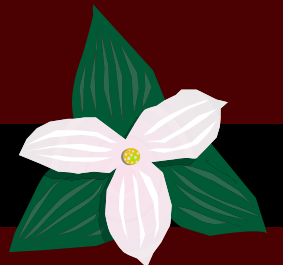
- ◆ Formes annosus
- ◆ Armellaria
- ◆ Scleroderis

◆ Cambium

- ◆ Blister rust

◆ Wood

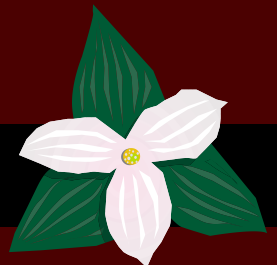
- ◆ Blue stain



Animals and Man



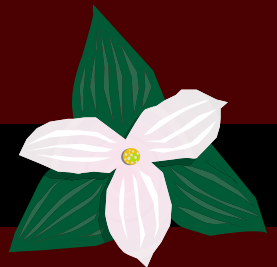
- ◆ Mice, rabbits, porcupines, cattle
- ◆ ATV's and snowmobiles can destroy young plantations



Disasters

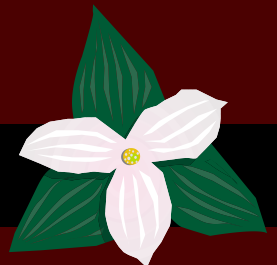


- ◆ **Storms**
 - ◆ ice/wind
- ◆ **Floods**
- ◆ **Drought**
- ◆ **Fire**



Some general thoughts

- ◆ **Plantations do provide an environment for the potential “explosion” of a pest**
- ◆ **Young plantations are very vulnerable**
- ◆ **Regular monitoring essential**
- ◆ **Quick response critical**





Kinds of Control

Mechanical/Physical

- ◆ **clipping**
- ◆ **removal**

Silvicultural

- ◆ **underplanting**

Biological

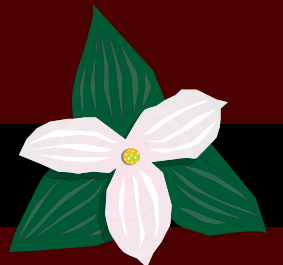
- ◆ **viruses**

Chemical

- ◆ **contact spray**
- ◆ **ingested**

Integrated Pest Management

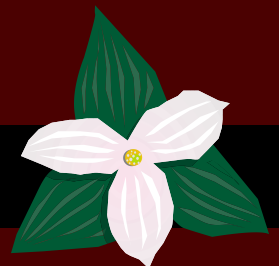
- ◆ **Combination of
any of the above**



Insects — Sawflies



- ◆ **Destructive pest in young plantations**
- ◆ **Attacks Pr, Pw, Pj, La, Ta, Sw**
- ◆ **May completely defoliate**
- ◆ **Monitor June and July**
- ◆ **Control physically, chemically or biologically**
- ◆ **Problem reduced with crown closure**



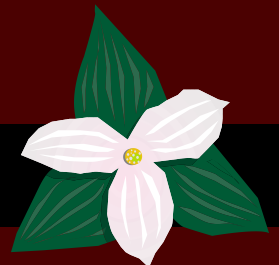
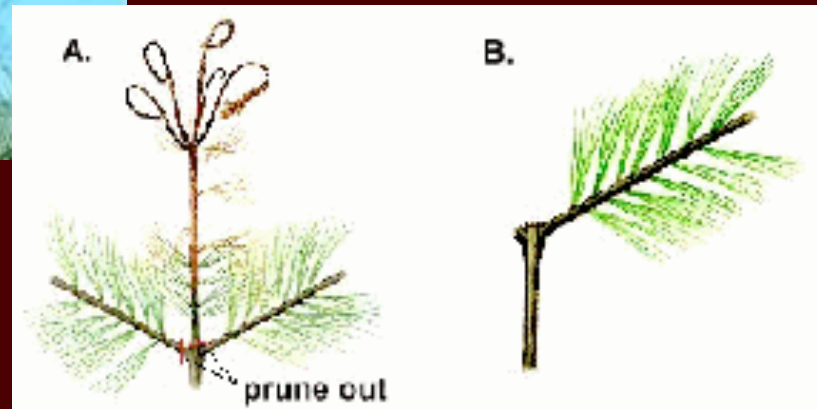
Insects — Red-headed Pine Sawfly



Insects — White Pine Weevil



- ◆ **Most prevalent pest**
- ◆ **Usually white pine**
 - ◆ **All pines and spruces**
- ◆ **Poorly stocked stands 1-10 metres**
- ◆ **Shoot withers mid-July**
- ◆ **Can render a tree commercially useless**
- ◆ **Clip, remove and destroy**
- ◆ **Underplant Pw**



Insects — White Pine Weevil



Insects — White Pine Weevil



Insects — Pine Shoot Borer



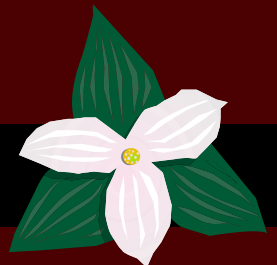
- ◆ **All species of pine**
- ◆ **Eggs laid in late April on new shoots, needles or buds**
- ◆ **Branch turns red, breaks off**
- ◆ **Reduced growth and distorted main stems**
- ◆ **Hand prune**



Insects — Pine False



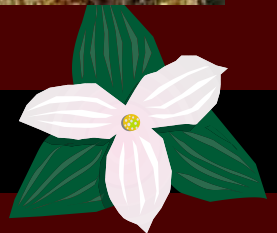
- ◆ **Introduced in 1950's**
- ◆ **Red, white, jack, Scots pines**
- ◆ **Started killing older pines in 1990's near Barrie**
- ◆ **Chemical insecticides**



Insects — Woodborers and Bark Beetles

Woodborers

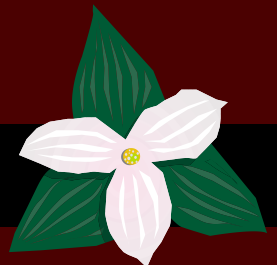
- ◆ **Attack dead or dying trees**
- ◆ **Logs cut but not removed**
- ◆ **Little consequence in healthy trees**
- ◆ **Control seldom warranted**
- ◆ **Feed for 2 years**



Insects — Woodborers and Bark Beetles

Bark Beetles

- ◆ **Breed in dead or dying material**
- ◆ **Various species for all the pines**
- ◆ **Feed under the bark**
- ◆ **Up to 2 generations each year**



Insects — White Grubs

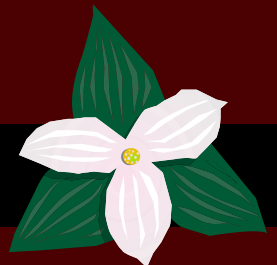
- ◆ Occur in patches of heavy grass on shallow soils
- ◆ Eat the fine roots causing death or retardation of growth in young trees
- ◆ 2–5 year cycles
- ◆ June beetles
- ◆ Treat roots with insecticide



Insects — Gypsy Moth

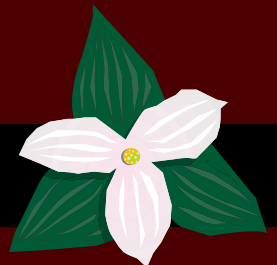


- ◆ **Known to attack over 400 species**
- ◆ **White pine is susceptible but prefers oaks, aspen, birch, maples (except red)**
- ◆ **Introduced pest**
- ◆ **Could be a problem when populations high throughout region**



Diseases — Some Thoughts

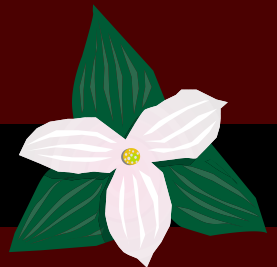
- ◆ **Vigorous trees are less susceptible**
- ◆ **Root rot in trees increases with age**
- ◆ **Some species are more prone**
- ◆ **Relationship between site characteristics and the incidence of root rot**
- ◆ **No known chemical treatments for root rot**



Diseases — *Fomes annosus*



- ◆ **Can be a serious problem**
- ◆ **Infection through freshly cut stumps**
- ◆ **Kills seedlings to mature trees**
- ◆ **Dead trees in circular patches**
- ◆ **Avoid damage to residual trees during thinning operations**

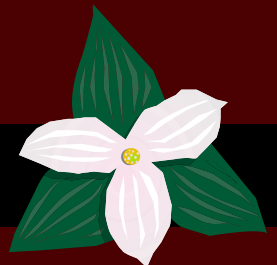


Diseases

White Pine Blister Rust



- ◆ **Symptoms**
 - ◆ **Red needled branch “flag”**
 - ◆ **Cankers depressed or swollen**
 - ◆ **Orange-yellow powdery masses of spores on canker**
- ◆ **Treatment/prevention**
 - ◆ **Prune lower branches**
 - ◆ **Remove branches with cankers 18” back from this infection**



Diseases

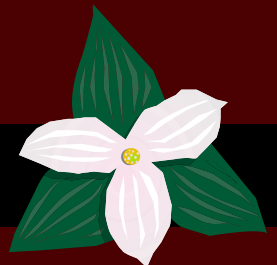
White Pine Blister Rust



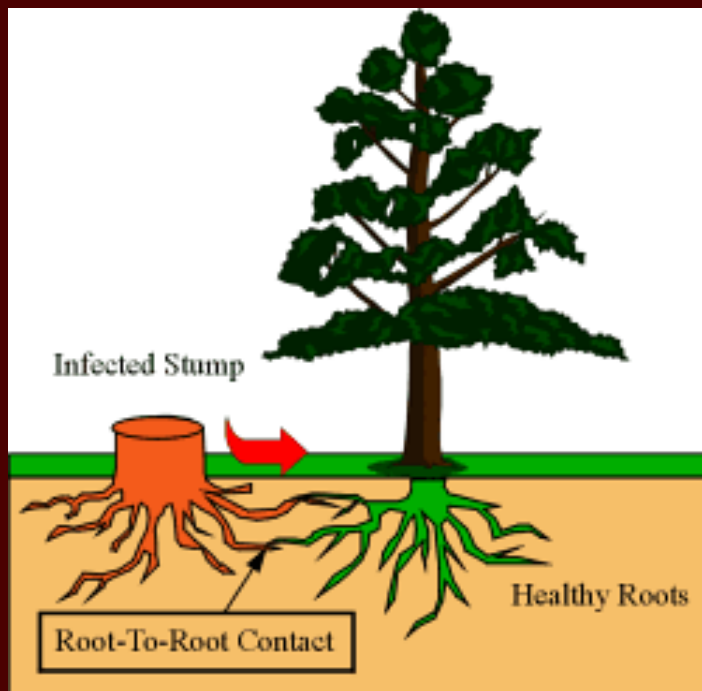
Diseases — Armillaria



- ◆ **Most common root rot in world**
- ◆ **General decline in vigour, discoloured foliage**
- ◆ **Thinning of the crown**
- ◆ **White mycelial fans and dark shoestring-like rhizomorphs under bark**
- ◆ **Usually spreads underground**
- ◆ **Trees die**



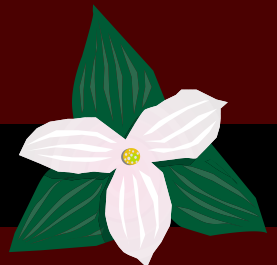
Diseases — Armillaria



Diseases — Scleroderris



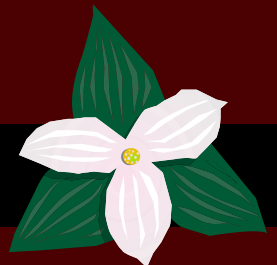
- ◆ **2 strains present in Ontario**
 - ◆ **North American strain rarely kills trees over 2 metres tall**
 - ◆ **European strain can kill larger trees**
- ◆ **Initially reddish-orange discolouration at the base of needles in May or June**
- ◆ **In summer needle and branch tips turn yellow to brown**
- ◆ **Forms canker on main stem and can kill tree**



Diseases — Blue Stain

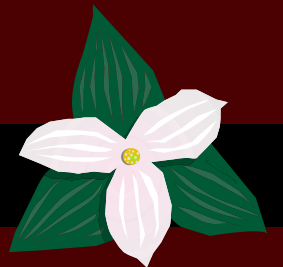


- ◆ **Logging injury**
- ◆ **Major destruction (ice storm '98) — broken trees**
- ◆ **Discolours wood**
- ◆ **Changes physical properties**
- ◆ **Renders wood valueless**



Pests — Cattle

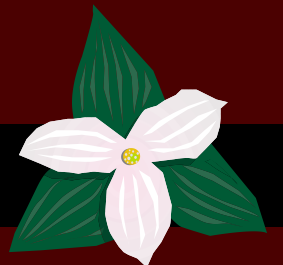
- ◆ **Cattle — keep them out!**
- ◆ **Damage roots and main stems**
- ◆ **Break branches**
- ◆ **Eat or crush seedlings**
- ◆ **Compact soil**



Pests — Mice

Mice

- ◆ **Feed on bark at base of tree under heavy snow**
 - ◆ **Need heavy grass cover**
- ◆ **Trees die slowly, can't assess until fall**
- ◆ **Good grass control should eliminate injury potential**
- ◆ **Populations vary**



Pests - Rabbits and Porcupines



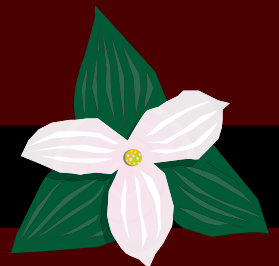
Rabbits

- ◆ **Feed on barks and buds in young plantations**
- ◆ **Damage evident mid to late summer when trees turn red**
- ◆ **High populations every 10-11 years**



Porcupines

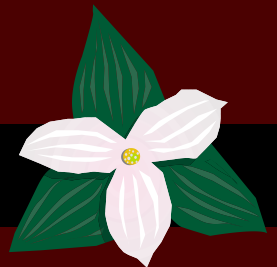
- ◆ **Feed high in trees, girdle tops**
- ◆ **Injury concentrated but sporadic**
- ◆ **Feed on bark when herbaceous material not present (winter)**



Man



- ◆ **ATV's and snowmobiles**
 - ◆ **Young trees vulnerable**
- ◆ **Signage and alternate trails**
- ◆ **Poor Management Practices!**

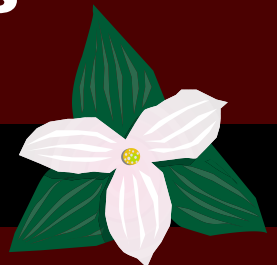


Disasters — Drought

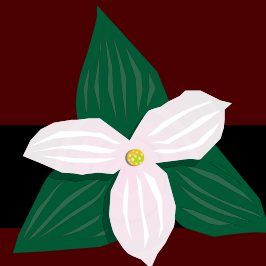
- ◆ **Thin soils over limestone very vulnerable until roots grow into cracks**
- ◆ **Plant drought resistant species e.g. Jack pine**



- ◆ **Reduce competition for moisture**
- ◆ **Mulch around trees**



Disasters — Drought



Disasters — Flooding

Storm floods

- ◆ **Usually short duration**
- ◆ **Minimal effect**
- ◆ **Rise in water table or beaver flood**

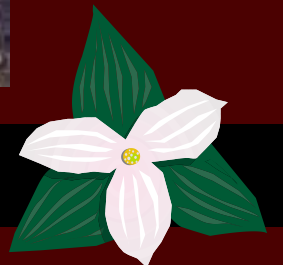
Long term flooding

- ◆ **Rise in water table or beaver flood**
- ◆ **Kills trees in open water**
- ◆ **Saturates land around drowning roots**



Disasters — Fire

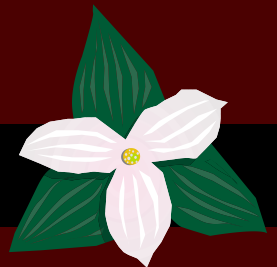
- ◆ **Plantations very vulnerable until crown closure and lower limbs removed**
- ◆ **Create fire guards in areas where fire can start e.g. along road**
- ◆ **Fire guards throughout larger plantations (road system)**



Disasters - Fire



Caring for Your Land Series of Workshops



Disasters - Fire

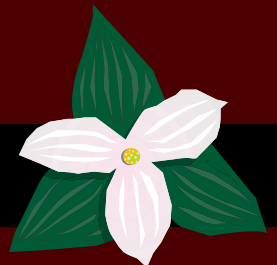


Caring for Your Land Series of Workshops



Disasters — Violent Storms

- ◆ **Lightning**
- ◆ **Wind**
- ◆ **Ice**



Summary

Potential Problems

- ◆ Insects
- ◆ Diseases
- ◆ Man
- ◆ Animals
- ◆ Fire
- ◆ Drought
- ◆ Flood
- ◆ Violent storms
- ◆ Monitor regularly

Options

- ◆ Do nothing
- ◆ Removal by hand
- ◆ Mechanical
- ◆ Chemical
- ◆ Integrated pest management
- ◆ Design
- ◆ Preventative work

Monitor Regularly

- ◆ Maintain records
- ◆ Act when required



Conifer Plantation Management Workshops

- ◆ **Have been funded by:**
 - ◆ **Ministry of Natural Resources
and**
 - ◆ **Eastern Ontario Model Forest
through**
 - ◆ **The Stewardship Program**

- ◆ **Prepared by Bill Hardy, Hardy Consulting**
- ◆ **Layout and design by the LandOwner Resource Centre**



Conifer Plantations

Module #7 Restoring Your Plantation



Disasters

◆ Disasters can take many forms

- ◆ Flood
- ◆ Drought
- ◆ Fire
- ◆ Violent storms
- ◆ Tornadoes
- ◆ Lightning
- ◆ Ice storms



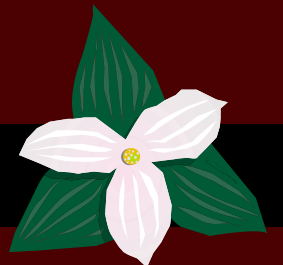
Restoring Your Plantation

**Minimizing the effects
of ice damage in your
young conifer stands**



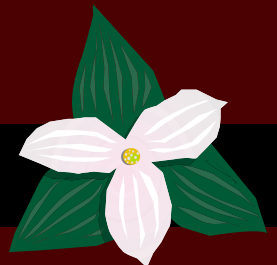
Restoration

- ◆ **Ice storm '98 — one of the greatest Canadian natural disasters**
- ◆ **Impact on some plantations was devastating**
 - ◆ **Particularly 15 cm and greater in red pine**
 - ◆ **Most plantations had some damage 10-100%**
- ◆ **Looking at conifers — focus on red pine, white pine, and jack pine with a brief look at white spruce, and larch**



Restoration

- ◆ **Before doing a lot of physical work, need to review:**
 - ◆ **extent of damage**
 - ◆ **other problems**
 - ◆ **why is the plantation there**





Assessment Records

Plantation Restoration Assessment

Current Conditions: Species present(%) _____%, _____%

Age _____ Height _____ Spacing _____ x _____ Survival _____

Has plantation been thinned never every 4th row other _____

Is regeneration present - none up to 25% 26-50% over 50%

Species present and % _____

Do the trees have crooks (%) 0-25% 26-50% over 50%

Do trees have multiple leaders(%) 0-25% 26-50% over 50%

Are trees bent severely or broken (due to ice damage) 0-25% 26-50% over 50%

Are tree leaders broken or missing (due to ice damage) 0-25% 26-50% over 50%

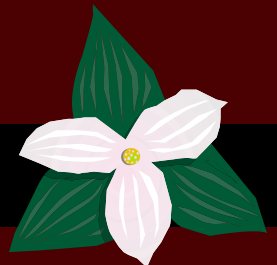
Other conditions _____ 0-25% 26-50% over 50%

_____ 0-25% 26-50% over 50%

What was original objective for plantation:

Observations: (wildlife, birds, drainage, issues, trail maintenance, etc..)

- ◆ **Need to know**
 - ◆ **Why a plantation?**
 - ◆ **What is growing?**
 - ◆ **What is wrong and how much?**
 - ◆ **What work done?**
 - ◆ **The dynamics**

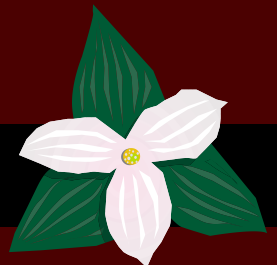




Assessment Records

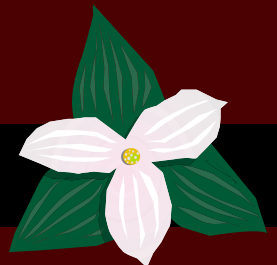
Plan for Restoration	
New Objectives:	
<hr/>	
Action Plan:	
First thinning:	when:
Second thinning:	when:
Potential products:	
Identify crop trees by:	when:
Reduce multiple leaders by:	when:
Remove diseased trees by:	when:
Release regeneration by:	when:
Other actions:	when:
<hr/>	
Annual Plan:	
Check for insects and diseases	
Maintain trails	
Prune crop trees	
Check for markets for my next crop	

- ◆ **Have to decide on:**
 - ◆ **Your Goals**
 - ◆ **Potential products**
 - ◆ **An Action plan to address concerns**



Points to Remember

- ◆ **Originally planted 2,000+ trees/hectare**
- ◆ **Final crop will be 200-300 trees/hectare**
- ◆ **Identify potential crop trees — enough?**
- ◆ **Will pruning improve potential for sawlogs?**

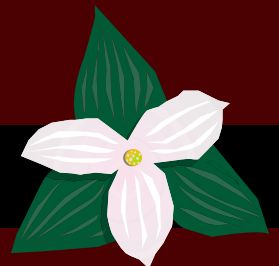


Points to Remember — 2



- ◆ **What were the silvicultural objectives for the plantation?**
- ◆ **What do you want?**

- ◆ **What other factors need to be considered?**
 - ◆ **convert now**
 - ◆ **Replant with conifers**



Species and their Roles

◆ Red pine

- ◆ “nurse crop” to provide a suitable micro site for the development of a hardwood understory**
- ◆ provide an excellent range of forest products**
- ◆ good return on investment**
- ◆ usually not part of natural forest on site after the final harvest**

◆ White pine

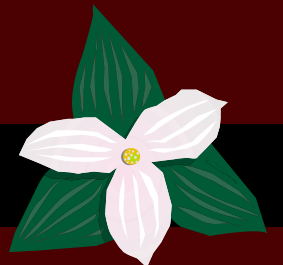
- ◆ “nurse crop” as above but will be part of future natural forest on site**



Species and their Roles

◆ Jack pine

- ◆ “nurse crop” for those difficult sites**
- ◆ able to capture shallow dry sites**
- ◆ provide site protection**
- ◆ may provide suitable environment for invasion of hardwoods**
- ◆ little opportunity for forest products**



Red Pine — Older Plantations



- ◆ **Damage can be total — domino effect**
- ◆ **Partial loss needs to be designed into thinning**

**Start conversion
process sooner**



Red Pine — Younger Plantations



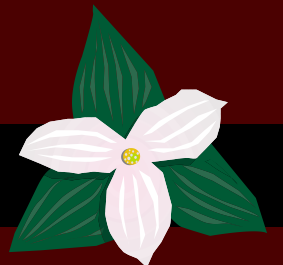
- ◆ **Prune for leader to make 2 sawlogs**
- ◆ **Clip all branches except one in top whorl**
- ◆ **Design thinning to remove trees with broken tops**



White Pine



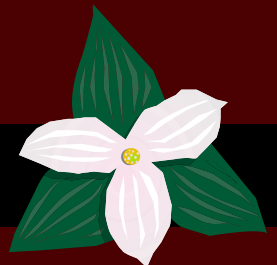
- ◆ **Variable damage in plantations up to 15 metres**
- ◆ **Compounded by heavy weevil damage**
- ◆ **Enough crop trees?**
- ◆ **Is pruning an option?**
- ◆ **Patience**



Jack Pine



- ◆ **Nurse crop for hardwood invasion**
- ◆ **On older sites hardwoods usually present**
- ◆ **Damage on jack pine will actually release hardwoods**
- ◆ **Clean trails and reduce fire hazard without injuring hardwoods**

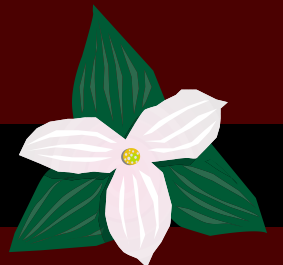


Tamarack/Larch



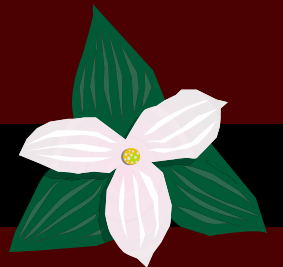
clip

- ◆ **In many cases top 1-2 metres broken off trees 10-15 metres high**
- ◆ **Original planting survival sometimes low**
- ◆ **May need clipping**
- ◆ **Broken stub could be trimmed to allow tree to “heal” sooner**

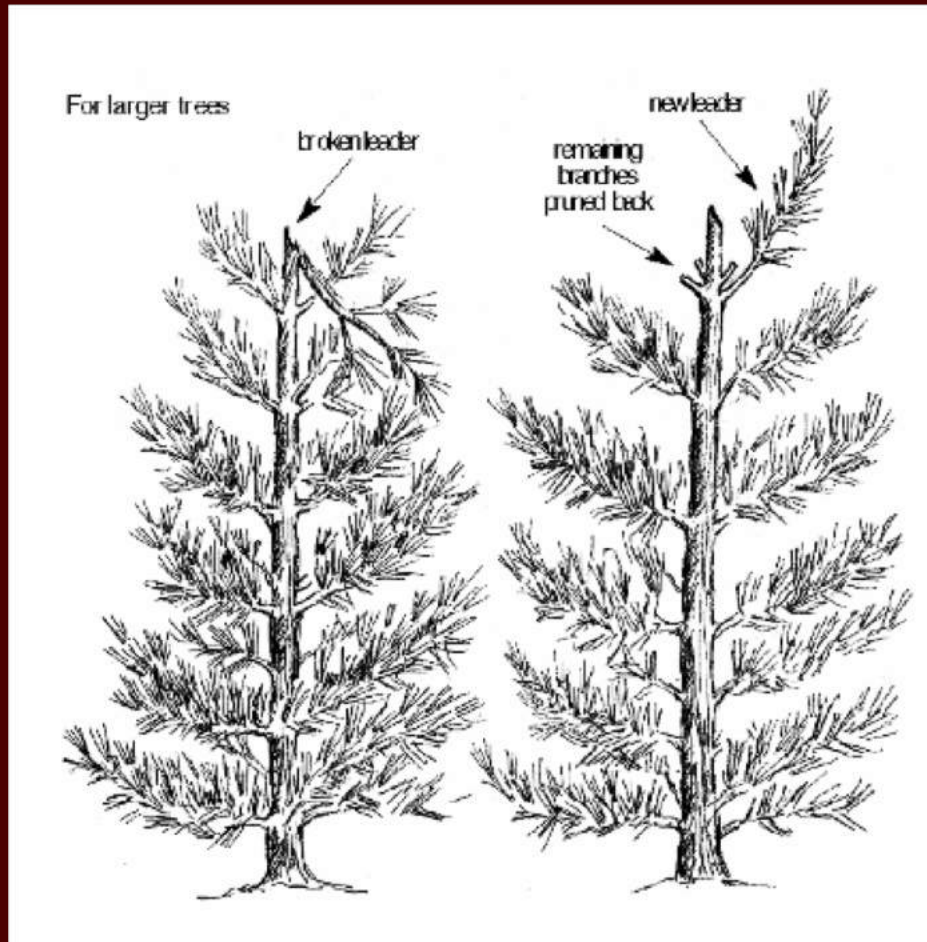


White Spruce

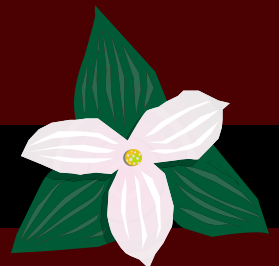
- ◆ **Little to no damage**
- ◆ **Where leaders broken, clip all but one lateral to ensure only one leader**
- ◆ **Consider early thinning**



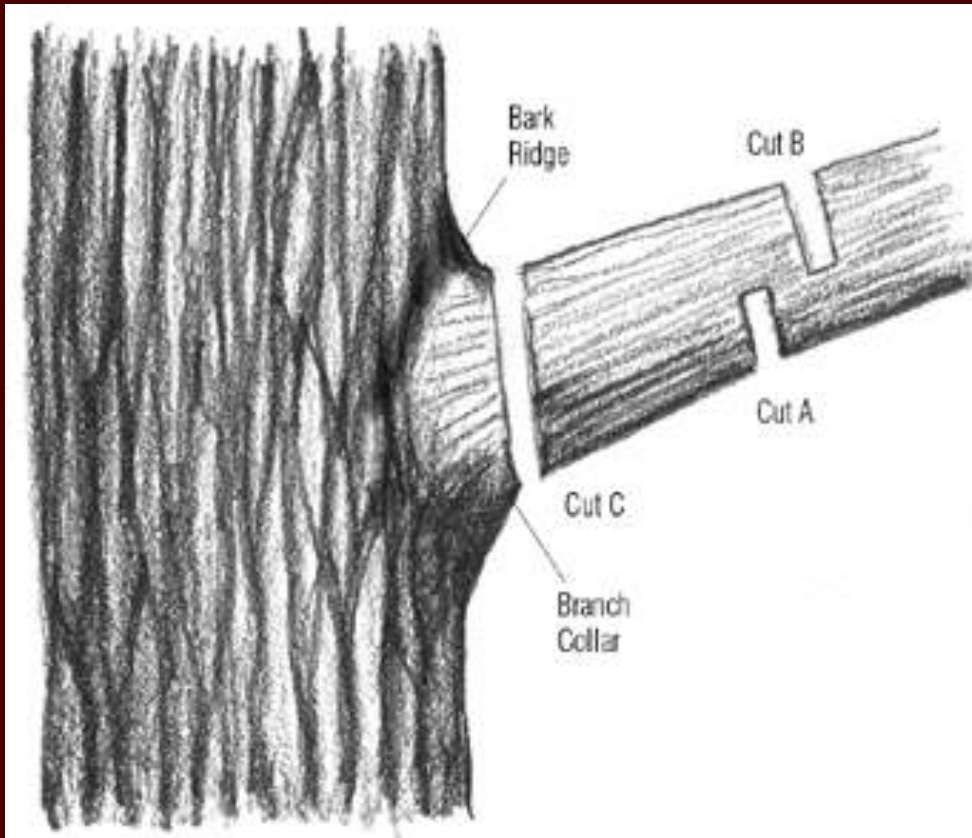
Why Prune Broken Tops?



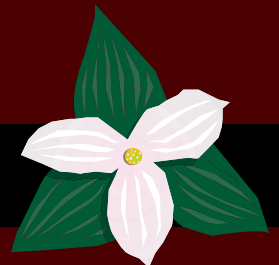
- ◆ **Tree has one leader**
- ◆ **Clean stub — healing**
- ◆ **Increase log length**



How to Prune

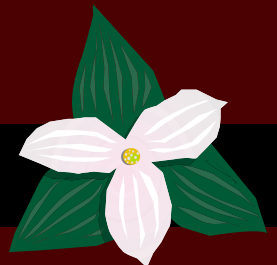


- ◆ **Pruning cuts should be made just outside the branch collar**
- ◆ **Large branches should be removed by 3 step method**
- ◆ **Cuts in leader should be at 45 degrees or along a branch bark ridge**



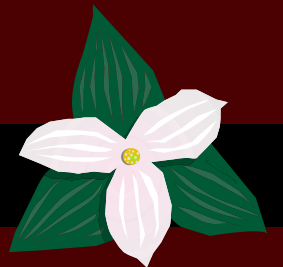
When to Prune

- ◆ **Prune live branches in dormant season**
 - ◆ **Late winter or early spring before leaf formation**
 - ◆ **Maximizes growth and wound closure**
- ◆ **Remove diseased or dead branches any time**



Pruning Equipment

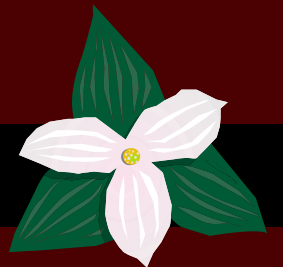
- ◆ **Use proper tools**
- ◆ **Clean and sharpen**
- ◆ **Comes with extension poles for pruning to 17 feet**



In Summary

- ◆ **Assess the whole health of trees and plantation**
- ◆ **Review goals**
- ◆ **Develop action plan**
- ◆ **Review annually**

- ◆ **Do any corrective work in dormant season**
- ◆ **Concentrate Work on crop trees**
- ◆ **Cut slash close to ground**
- ◆ **Use proper tools**



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