Forest Management for Small Landowners

Thinning

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Introduction

Thinning is the term used for a partial or selective harvest of a stand from around age 15 to 40 or more years.

- Pre-Commercial Thinning (*PCT*) is usually done when the trees are in their mid-teens. The trees are cut by hand, and as the name indicates, they have no commercial value and are left on the ground.
- Early Commercial Thinning (*ECT*) is an option in the absence of a PCT and may be done when the trees are in their late teens to early 20s, Machinery is used to cut the trees after they are large enough to sell as pulp and hopefully some sawlogs.
- Commercial Thinning (*CT*) is the traditional thinning, usually done around age 30, but which can be done more than once if the stand is to be grown for more than 40 years.

The number of trees per acre (*TPA*) in a stand will determine whether a thinning is needed. To determine TPA, a pre-cruise must be done. See *Chapter 7, "Land Exams"* for instructions on doing a pre- or post-cruise using sample plots.

For information on marketing the logs from thinning, see *Chapter 12, "Marketing and Final Harvest"*.

Pre-Commercial Thinning (PCT)

Pre-commercial thinning (*PCT*) is generally conducted at an early age, between 10-16 years, and unlike the other thinning processes, it will be an expense rather than income to the landowner. However, it will add a tremendous future value to the stand and landowner. PCT is a silvicultural tool to reduce stand volume for both stand improvement *(remove trees that will have a lower merchantable value at harvest time*) and stocking reduction *(to allow more growth on the trees that are left).* If you elect to do a PCT, then either you can do the job for the exercise value, or you will have to pay someone to do it. On industrial forest land it has fallen out of favor in the last 30 years and been replaced by an option which will be discussed later, Early Commercial Thinning (*ECT*).

When to thin and which method to use can be intimidating. If you go into your stand too early, the competitors may re-sprout vigorously enough to again outgrow the selected leave trees. Plants like Himalayan and evergreen blackberry, alder, bitter cherry, and bigleaf maple can re-sprout (especially if not cut in the thinning window) and again become major competitors (*See Doug Belz diagram in Chapter 9, "Plant Competition".)* If you wait until the late teens to do a PCT the trees may so big and tall that they are very hard to get down to the ground.

Before PCT

After PCT

One option is to hire a slashing crew (*same as the PCT crew*) to slash all the competitors at an early age and then deal with any re-sprouting at the PCT or ECT operation. In the productive low elevation tree growing ground there can be 2-3 times the number of stems over what was planted, just from competition.

What to Cut and What to Leave:

Virtually all foresters recommend doing a "thinning from below". This means removing the small diameter trees, all the competing woody vegetation, and as many trees with quality defects as possible *(see Chapter 12, "Marketing and Final Harvest" for a list of quality defects),* and still leave a stand with distributed stocking at the trees per acre (TPA) that you want.

In addition to making cut or leave decisions at eye level, you also need to be looking up near the top of the tree. Many of the defects you see in the stand now will still be an issue at the next thinning or harvest. Defects like sinuosity, ramicorn branching and double tops (schoolmarms) will continue through the life of the tree.

Pre Commercial Thinning process

Reasons to Conduct a PCT

(Numbers given are intended as examples only.) (See Chapter 13, "Growing Douglas-fir") for more information about spacing.)

- If 538 trees per acre (TPA) [*9' X 9' spacing]* were planted, (*or naturals have filled-in to this level*) and the decision is to manage intensively, then a PCT operation makes a lot of sense for a first thinning entry. 538 planted TPA will not experience enough mortality (*unless something unexpected happens*) by age 30 to conduct a normal commercial thinning. The stocking at age 30 will be around 397 TPA (*using 1% mortality per year*). At this level the trees are going to be such a small diameter that the only market available will be the pulp market which is generally a low value market.
- It is a good time in the life of a young stand to cut out all the unwanted vegetation that is still competing with the crop trees. If not thinned, then 5-10 years later, the competing vegetation (*wild cherry, alder [if unwanted], bigleaf maple, and in some cases evergreen blackberry*) may have taken over portions of the stand.
- It will be very expensive to do an Early Commercial Thinning with machinery on small acreages (*from 1- to 20-acres*). In these cases, a PCT operation makes the most sense and to thin the stand down to a final harvest level like 180-200 TPA.
- A manual PCT thinning does not require roads to thin the stand. Thus, the remaining stand will have 10-15% more trees to select from when the first "for profit" commercial thinning is done. (*See later comments on thinning roads and profitability of ECT versus CT.*)
- It is an excellent time to thin the conifers so they can continue at a rapid growth rate. If you wait another 5-10 years to do an ECT (*see next page),* the stand growth may have slowed down enough so it will take a year or more to regain its working crown and continue its former growth rate.

- It can be an excellent opportunity for you the small landowner who wants to actively manage your land. I can guarantee that the exercise will improve the future stand values and be done at a lower cost than paying for the same exercise at a health club.

Reasons Not to Conduct a PCT

- A PCT operation is a cash outlay with no revenue flow from the thinning.
- If you do a PCT operation along a county or state road, the Forest Practice Rules require you to reduce the fire hazard by removing (by burning, chipping, or moving) all the thinning slash in a 200 foot buffer along the road.
- Fire hazard will be increased throughout the unit for several years. If this is a concern, you may want to wait and do an ECT (*see next page*). When a cut-to-length system is used, the amount of logging slash is greatly reduced.

Prescription Recommendations for PCT

- If you are planning to do a commercial thinning following PCT, then leave 300 TPA (*12 x 12*). 300 TPA is a nice, neat number that allows enough growth on the stems to put over 60% of the loads into a domestic log market at commercial thinning time. Anything less will tend to raise logging costs because fewer logs to harvest at commercial thinning requires more time to move between harvested trees and less volume.
- If the stand is pre-commercially thinned and then left for final harvest, leave around 180 to 200 TPA. (*There is no easy spacing that you can use. Leave 1.8-2 trees per 1/100 acre plot and monitor as the job is being done.*) Leaving 300 TPA will mean too many small diameter logs at final harvest.
- If the ground is too steep for commercial thinning, then default to the lower stocking level (180-200 TPA).
- Try to conduct the PCT during late June to early July to minimize sprouting of plants like bigleaf maple and bitter cherry. *(See Chapter 9, "Plant Competition", Red Alder slashing window, page 6.)*

Natural Seedlings

Natural seedlings can be a surprise when you do a walk-through or a pre-cruise for either PCT or ECT. You can find an entire stand uniformly covered with natural seedlings or just a few scattered naturals.

Normally the naturals will be much smaller and will be cut out in a PCT, however if there are openings in the planted stand, you may wish to leave naturals to fill in.

Smaller diameter trees are naturals

Early Commercial Thinning (ECT)

Early Commercial Thinning is a relatively new industry term applied to a mechanical thinning operation done at a much earlier age than the historical commercial thinning at age 30. As soon as the stand has any commercial value (*generally pulp*), it can be considered an ECT candidate. That point usually is reached in the early 20s and will generally yield about 2-3 loads of pulp for every load of very small sawlogs. This compares to a conventional age 30 thinning that will yield 2-3 loads of sawlogs to every load of pulp.

23 year old stand before ECT

23 year old stand after ECT

This operation began because industry was finding it hard to hire PCT thinning crews. At the same time, cut-to-length (*CTL*) machines were becoming available, and it was a logical move to make.

The biggest advantage for an ECT is that the landowner can often break even or in some cases make money. In a poor pulp market, the landowner may have some expense, but hopefully it will not be more than a PCT would have cost. If you use CTL equipment to do an ECT, then wait at least 10 years before re-entering the stand for a conventional commercial thinning (*CT*).

When cut-to-length equipment is used, the area cut for the operating roads will often exceed 10% of the area logged. For instance, if the road width is 10 feet and the equipment can reach out 30 feet on either side, then the road area is 14% of the stand. This is not a major loss of ground as the tree crowns will grow toward each other and totally fill the area, but the landowner will have lost the sawlog value of the road cut trees in the next more profitable thinning.

ECT sawlog deck

Commercial Thinning (CT)

Historical Commercial Thinning was done after the plantation had been thinned with a PCT to approximately 300 TPA (*12' x 12'*) between 10 to 15 years of age. Then at age 30, the stand would have been ready for a CT yielding 2 to 3 sawlog loads to 1 load of pulp (*or less*). *(All of the above numbers are dependent on the site of the land, the topography and most important, the stocking.)* Thinning when there are too few trees is not cost effective until the stand is much older. When there are too many trees, they are small, and thinning is not profitable. There is no hard definition of ECT and CT. To me it should be called CT when most of the logs produced will be made into a lumber product.

Thin from Below or Above

Thinning from below selects the smaller diameter trees and those of poor log quality for harvest. Based on my previous comments I assume you will realize this is the recommended method.

Thinning from above selects the larger trees for harvest and is thus often referred to as "high grading". In earlier times, many thinning and logging operations were conducted this way, giving a bad reputation to them and all loggers in general.

In Chapter 2, "Tree Growth", the difference between an open-grown tree and a suppressed tree was discussed. In the silvicultural practice of growing a "stand of trees" we are looking for the optimum density and maximum growth of the stand (not the tree singular). A well-spaced stand with approximately 33% to 50% live crown has for years been considered the goal (measured from the top of the tree to the lowest well developed limb – not the last limb with one needle on it). Keep in mind your stand of trees is a very interactive process.

If the stand has too many trees and crowns are rapidly diminishing, the landowner should not expect the stand to "flip the switch" and begin a rapid growth phase the moment it is thinned. The thinning interrupted a process that is likely to continue for a while.

Also, a stand of trees needs or expresses varying levels of active crown. At time of planting and up until crown closure, the plantation needs that full 100% crown. After thinning and up until the next harvest entry, the crown will slowly begin to grow or reduce depending on how many trees were removed, how many TPA remain, and where in that time period you look at the crown.

Ideal Age and Stocking for the First Commercial Thinning

Forestry is an art, in addition to a science. Every forester and landowner will have a different opinion based on their experiences. The numbers below are based on my experiences but are by no means hard and fast rules set in concrete.

Ideally a CT is conducted after the crowns have closed off light to the forest floor, thus reducing forest floor competition, and the active crowns are between 33% and 50% of the total tree height. Tree crowns can be measured and/or the forest floor vegetation can be examined to see if it has died or is suffering from light exclusion. The other obvious thing to look at is the size of the smaller trees that will be cut. Do they have enough diameter at the small end of the log to make a sawlog?

- Age 30 is near the ideal point for the first CT, if:
    - the stocking level is around 300 TPA; and
    - the terrain is suitable for thinning equipment, and
    - the ground is medium or high site; and
    - about 2/3 of the trees will make a small sawlog. Each mill has different requirements for SED (*small end diameter*) logs.
- The typical post-thinning goal is 160 to 180 trees per acre. If the stocking level is higher or the site is lower (*poorer quality soil*), the trees will be smaller, and a CT probably will need to be deferred for 5 to 10 years. If the stocking level is lower, it may not be economically feasible to do a CT.
- The difficulty of raising a stand from planting and ending up at age 30 with 300 TPA is the issue of mortality. Foresters use a general rule of 1% mortality per year in a non-thinned stand, but this is a guideline only. (*Nature rarely follows the 1% guideline.*) Since no one has figured a way to plant X amount of TPA and end up at 300 TPA at age 30, you will have to rely on planting more trees per acre and thinning to your desired 300 TPA. (*See Chapter 13, "Growing Douglas-fir", for causes of stand mortality.*)
- Starting with 300 uniformly spaced TPA and thinning to 160-180 TPA will generally yield 2 or more loads of chip & saw (*C & S*) logs and 1 or less of pulp per acre. In stands with more than 350 TPA, the trees will be smaller in diameter, yielding more pulp and less C & S logs, thus less profit per acre. At 200-250 TPA the trees will be larger, but:
    - The logging cost will likely be higher due to the machinery spending more time traveling to cut each tree.
    - The revenue cash flow for the thinning will be less and perhaps enough to make it a non-profitable thinning.
    - More time will be spent merchandizing because the logs will have more limbs.
- The general rule used to be to wait a minimum of 10 years after a thinning to re-enter the stand. Some foresters use 15 years, but they need to watch the crown development and potential growth slow-down very closely. If you are not willing to watch for canopy closure and log marketability, then the ten year rule is still a good general guide. If an ECT was conducted at age 24, then it likely will be necessary to wait beyond age 30 to do the first CT. However, if you PCT'ed at 12- to 15-years, the age 30 will still be just fine for the first CT (site dependent).
    - Most of industry companies that are still thinning will rely on one thinning to position the stand for a harvest between 35- to 40-years. This thinning is usually the ECT.
    - For small landowners, final harvest age is based on factors that are different than industry. Some want to harvest in their lifetime; others may want to

leave it to their children. With longer rotations, multiple commercial thinning entries can be feasible.

- It should probably be obvious by now that the numbers are important if you want to make a profit. Leaving a stand to develop naturally will not fit nicely into any of the situations I have developed. You can still do everything naturally, but you may have to wait 10- to 20-years longer to do a final harvest, unless you are willing to harvest a small diameter stand (*small diameter stands will limit the final lumber options*).
- One forester friend uses an average stand DBH of 10 inches and tree height between 50 and 60 feet as the ideal time to thin. This will yield a minimum of one sawlog 5 inches by 16 feet or greater. His goal is to remove enough stems starting at the smallest to get the average remaining trees to the 160-180 TPA level. If he has done a PCT or Early Commercial Thinning, then he should have the same ratio of 2- 3-loads of sawlogs to 1 load of pulp. He also commented that mills prefer the short logs in a mix of 8 and 10 foot multiples (*16, 18, 20, and 24 foot lengths, all plus trim*). Manufacturing from these short logs does not allow very much mill overrun (*very little taper*), as compared to manufacturing from long logs, therefore lower average prices are generally offered on short logs.

Damage During a Traditional CT Operation:

Historically a thinning operation would have been a one man operation with a small dozer or skidder and a chain saw. Two factors have caused this method to fall out of favor.

- Soil disturbance: A D-8 dozer can do a lot of damage during the winter with just one pass on saturated soils. You might think that a small farm tractor would not do the same, but with enough passes over the same ground, the damage will equal the large dozer
- Rub damage: If the logger could skid in perfectly straight lines, rub damage would not occur. But laying out skid roads on uneven ground of varying topography and trying to connect to a road system that also is not straight makes it almost impossible to yard logs without damage to the leave trees. The damage to the leave trees will look bad, but the real damage comes 10- to 20-years later when the trees are harvested. During the final harvest, every damaged tree will have some level of rot in the area of the damage. During the merchandizing of the log in the final harvest, from 2-20 feet of the butt log will be trimmed off!!! The butt log is your most valuable log, and you don't want to trim any more than necessary. When there were more small logging operators, there were some who took a lot of care and wrapped every potential rub tree or left a tall stump to act as a rub tree. Damage would be minimized but it still happened, especially on uneven ground as the logs were skidded to the landing. The Cut-To-Length equipment that is used today, and with a careful operator, will leave almost no soil or tree damage and leave all competing vegetation that is cut laying on the ground!

I used to tell friends that I did more damage to my stands operating a small 4-wheel drive tractor than my friend who contacted to thin my stands with cut-to-length equipment.

Cut-To-Length Thinning (CTL)

CTL processor

90% of commercial thinning being done today in the Pacific Northwest is by modern cut-to-length machinery. Instead of one man and a total investment in equipment of less than $25,000, the CTL sides are investments of at least $500,000. The process requires two pieces of equipment. The processor, which has an articulated boom with a light weight falling and processing head, cuts the tree and gently guides its fall. The falling head is too light to completely control the falling tree like a heavy-duty feller-buncher. While the tree is falling, the processor begins to run up the tree bole, severing the limbs. Limbs are left on the ground in front of the machine to cushion the soil as the processor and forwarder drive through the stand. Once the tree is on the ground, the operator can partially pick it up and yard it closer to the equipment, then run the processor up the log removing more branches. Desired lengths are programed into the processor's computer based on log length and quality, and cut when the desired length arrives, or the operator overrides the computer and tells it when to cut the log.

Logs are stacked by market, sawlog, and pulp, for the forwarder to pick up. The forwarder is a low ground pressure, articulated machine with bunk beds that moves through the stand after the processor, loading the logs onto its bunk and taking them to a landing. CTL logging is expensive, but it leaves very few damaged trees with minimal soil disturbance and is pleasing to the eye since most of the brush and small logs have been smashed beneath the equipment tracks.

CTL processor head

CTL forwarder

When and How Much To Thin

The following are guidelines only. Each forester and landowner will want to tweak them to suit their wants, needs and situation. It is based on the numbers of trees to plant described in *Chapter 13, "Growing Douglas-fir",* with additional mixing options at each of the planting levels.

Option I: Plant 258 TPA, 13' x 13' spacing (*this is the "no thinning" option*)
Final Harvest age 40, 173 TPA, 16' x 16'

Option II: Plant 436 TPA, 10' x 10' spacing
Age 20 to 25 years, ECT to 300 TPA, 12' x 12'
Age 30 to 35 years, CT to 160-180 TPA, 16' x 16' (*delay CT 10 years from ECT)*
Age 40 to 45 years, final harvest of 140-160 TPA,
(*18' x 18' = 134 TPA & 16' x 16' = 170 TPA*)

Option III: Plant 538 TPA, 9' x 9' spacing
Age 10 to 15 years, PCT to 300 TPA, 12' x 12'
OR Age 15 – early 20s, ECT to 300 TPA, 16' x 16'
Age 30 years, CT to 160-180 TPA, 16' x 16'
(May need to delay second thinning depending on ECT age)
Age 40 years, final harvest of 140-160 TPA
(*18' x 18' = 134 TPA & 16' x 16' = 170 TPA*)
Or
Age 40 years, CT to 100 TPA, 21' x 21' spacing
Age 50 years, *final harvest, 80-100-TPA,
(*23' x 23' = 82 TPA & 21' x 21' = 99 TPA*)
**80-100 TPA should yield 75% plus of the trees 18 inch diameter at breast Height (DBH), and if so, those trees will average over 12 inches diameter at 40 feet and qualify for the 2 saw grade (min. 12 inch dia. on small end).*

More thinnings can be done but several negative factors can affect your decision making process.

- The larger the tree the more likely there will be falling or rubbing damage to residual trees. It used to be the fallers were experienced with falling large trees and would snub the stump to lessen the impact of a large tree. The old -time faller could also fall a tree exactly where they wanted it to go. This has all changed and most of the fallers today know how to fall a tree only. Where it's going to go no one knows, and the fallers have no concept or care about trying to lessen the damage from hitting stumps and breaks.

- By age 50, trees may become too large for current markets. Beyond age 50, the problem becomes even worse. Today's mills are built for a smaller log diameter than in the historical past. (*See Chapter 12, "Final Harvest and Marketing".)"*

General Thinning Comments:

- Field studies by several companies have shown that if a PCT was conducted and the stand later thinned at age 30, the yield would be **2 to 3-Chip &Saw loads for every load of pulp**. On the other hand, those stands that were not PCT'ed or ECT'ed and held till 30 years of age for CT, had **2 loads of pulp for each load of C&S**. The reason is the unthinned stand had too many trees per acre and due to overstocking, most were very small in diameter. That ratio is the difference between a profitable operation and a loss operation in many cases.
- All the thinning operations should be done under the premise of improving the stand, both in quality and spacing (*thinning from below*). To do this the operator should be told, if possible, to remove all trees that do not meet your definition of a future harvestable tree.
- Two or three trees can be left much closer to each other, but it tends to add difficulty to the tree spacing. If two or three close trees are left, reach out a little further than normal on the next tree selection. The goal is to have the average spacing close to the desired tree spacing.
- If there is a hole in the stand (*area of no trees)* then close down the spacing along the edges.
- One log quality item that often is overlooked is "double topped trees" or "schoolmarms". If a tree has two tops growing from the approximate halfway point in the tree height, then it is not a question of "**if it will split**", but "**when it will split**". I used to think it was OK to leave them and at least be able to harvest a decent sized first log and two small diameter logs, but I've totally changed my mind. I now realize these trees are the first to suffer any kind of wind damage and a few years later they lose the second top, and a year later the rot has advanced enough to rule out salvaging a log out of the base log. I now feel it is much better to adjust your thinning spacings and take out the double topped trees. (*If your spacing is 20 x 20 feet and your best choice for a leave tree at that spacing is a double-topped tree, then remove the double top tree and try to close the spacing down around the hole you created to compensate.*)

Double top or schoolmarm

One top has fallen

- Some species of trees will become "height stagnant" if they become overtopped, but not Douglas-fir. A 100 foot tall tree with only 10 feet of crown will begin to grow in crown size if released. Since the stand has been opened up, the bottom of the crown stays alive and at the same level, and the top of the crown increases in height

growth every year. It may take 10 or more years to develop a crown of 33% of the total height but when it does, it will be producing enough food to increase the tree growth in height and diameter.

- Research has shown that if a thinning operation is done at the right timing, then 10 years later is about right for another thinning entry. An exception to this is if a PCT was done at age 10. If so, it will take about another 20-years for the crown to close, and more importantly the stand to grow enough to have the merchantable wood that you, the logger, and the mill want. If you do an ECT operation at 20 then the stand will be ready to be re-thinned at 30 years and 40 years if you so elect (*If you do the ECT at age 25 years, then remember to wait 10 years before the next entry*).
- All thinning operations have two disadvantages.
    - The chance of wind damage increases for the first few years after thinning. After a harvesting operation the roots expand to take over the area the removed trees occupied, but this takes time, approximately 3 years. In addition, the trees removed in a thinning operation will leave a lot more room for the remaining trees to sway back and forth. Heavy winds or snow loads can cause blowdown.

Wind damage after CT

This comes from Dick Hopkins, former college instructor and now a forestry consultant with his wife Paula. There are some soils that are not considered to be enough wind firm for thinning operations. You should ask your tree farm neighbors, your consultant, the WSU extension Service, or DNR field foresters for help with this before jumping into a thinning operation. Also see Chapter 3 – Soils; and Chapter 11- Thinning for additional information

    - Most mills and exporters want longer logs than the typical CTL log. In the mill, logs are placed on a traveling belt and pass a computer scanner which makes an instantaneous log cut decision, based on current mill needs and log quality. The log flow speed of this operation is very fast, and it allows the mill to operate at a maximum production capacity. Short logs take more handling time and the distance between the short logs is greater than if cut from long logs, resulting in lower production rates at the mill. Also, if only 16 foot logs are available, the mill has less flexibility to react to changing market conditions. When industry started operating the cut-to-length machines in the 1970s, most mills refused to accept the 16' to 24' log lengths and even now in 2020 it is sometimes still difficult to find a mill willing to take that size of wood.
- To thin or not? Many foresters will tell you that the landowner can do as well by planting and doing no thinning. My personal belief is there may be an incentive to CT, especially when the revenue is compounded forward to final harvest and

combined with the value of the final harvest. In addition, if planting Option III and likely Option II (*see Chapter 13, "Growing Douglas-fir"*) are used, then thinning will be needed to maximize the stand diameter. On our tree farm we have found that no revenue has been lost by CT, using the numbers available to date. (With the last of our timber logged in 2023, w*e now know that commercial thinning was very profitable for us, but what we did was very intensive and probably not suitable for the average tree farmer. See Chapter 17 - Tale of 3 Stands.*

- In all thinning and final harvest operations, there is always a chance the pulp prices may be so low that the landowner can't afford to haul it to the mill or yard. Since the logger will have cutting time into the pulpwood, they may be willing to yard it in and then haul it to a pulp market if they can cover some of their costs. We did one thinning operation where we left the pulp in the woods as it was not worth it for either party. In two other thinning operations, we gave the pulp to the logger. It can reach a point that the $10-$20 profit per pulp load is not worth it to the owner but will still allow the logger to cover all their costs and maybe get a small bonus out of it!

Load of small logs from a commercial thinning