Forest Management for Small Landowners

Land Exams

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Land Exam

Pre-PCT Exam

Post-PCT Exam

Introduction

A land exam is a simple cruise that the individual landowner can do to determine stocking [*trees per acre (TPA*)], survival, and seedling health. Any other data can be collected and analyzed, but I like to advise landowners to follow the **KISS Method (*Keep it Simple Stupid*)!** Within the land exam category you can have a regeneration exam, (pre- and post) pre-commercial thin exam, (pre and post) commercial thinning exam, and pre-logging exam.

Equipment Needed

- Shovel with a nail in the handle top, or some other kind of plot center.
- Spencer tape (*retractable tape carried on a belt or pants loop*). 50 feet will work just fine. I recommend a tape measured in tenths of a foot because the plot radius will be in tenths and hundredths of a foot. You can use inches but if you do, multiply the tenths of a foot by 12 to convert.
- A field notebook or use a spreadsheet program to generate your own field form. "Rite-In-The-Rain" paper is recommended and can be purchased from J.R. Darling Corp., Tacoma, WA or local logging and forestry supply stores.
- If you have a field grade computer, then the data can be recorded directly to the computer.
- Compass: with cardinal directions (*E, W, N, S*), degrees and able to set magnetic declination is best.

Vest, shovel, Spencer tape, paint, compass, notebook

Rite-in-the-Rain notebook and pen

Most maps are oriented to true north, while compass needles are attracted to magnetic north. Maps give you the correction factor (*declination*) to get true north for your area, but over the last 10- to 20years it has been changing faster than previously. A good compass will have a set screw that allows you to adjust the compass, so it points to true north while the needle continues to point to magnetic north.
If you are not familiar with using a compass, watch this video and the written instructions, prepared by Recreational Equipment, Inc. (REI).
https://www.rei.com/learn/expert-advice/navigation-basics.html

- Ribbon to mark plot centers (*or seedling locations*) in case you want to come back later.
- Tree marking paint: sold bulk or in pressurized cans.
- Height pole, if you want to measure tree height.
- Yellow sunglasses sold as tinted safety glasses. (They allow a person to distinguish the different colors of green so the seedlings stand out.)

All of the above can be acquired at local logging or forestry supply stores or found on the internet.

Pacing

Most foresters do measurements in chains. A chain is an old surveying term for 66 feet. As you learn how to use your pacing and chains, you will also see why it is far easier to use this process instead of something like 100 feet by 50 feet. You will want to lay out several chains on flat ground (*in your forest or logged unit to keep your pace realistic*) to determine your basic pace per chain. Practice your pacing so that it is consistent in different types of ground (*flat ground basic pace per chain, downhill, and uphill pacing per chain*).

Your pace will be counted every time your right or left foot hits the ground (*2 steps = 1 pace*). Always start with the same foot so you do not get confused aboutwhen to count the pace. On flat ground your pace will likely be between 5.0 and 6.0 feet. The number of paces per chain going uphill will be greater, while going downhill will be fewer (*Keep reading for why to use chains.*) When counting your pace, do not try to keep track of feet, rather count the paces and adjust uphill and downhill accordingly.

- For instance, if your pace on level ground is 6 feet and your downhill pace is 7 feet, then every 6 paces drop one pace.
- On the other hand, if your uphill pace is 5 feet per pace then every 6th pace, add one pace.

My pace is 6 feet on flat ground. I usually will start from my last plot center or the starting point on my left foot going ½ a pace and say "and", then when my right foot hits the ground I say "one". I repeat this process of "and", then the "pace" until I get to my plot. I find it is easy to be distracted while pacing to the next plot, and if I do it the same way every time, there is no question of when to count the pace. Little things like this are important if you don't do this every day!

Plot Layout and Size

A random series of plots that you select as you walk through the planted unit will never give an accurate number for land exam results. When we walk randomly through a unit, placing plots where we think they should go, we end up being biased in where we put our plots. Even the best of us will do this! A more accurate way of doing it is to draw a grid on your map or plat, marking the plots at the correct plot interval. I'm old-fashioned and like the grid for simplicity and because it allows me to walk over all the ground in a systematic manner. (*See the next page for plot size options.)*

A more statistically accurate process is to use a random plot selection that is computer-generated, but this requires using a different compass bearing to each plot. If you do want to do the job using computer-selected plot placement, software programs are available that will generate the plot locations for you.

Plot Size in Feet & Hundredths or Feet & Inches

Plot Size Fraction of an Acre	**Plot Size** Radius in Feet and Hundredths	**Plot Size** In Feet and Inches
1/10 Acre	37.24	37’ 3”
1/20 Acre	26.33	26’ 4”
1/50 Acre	16.65	16’ 8”
1/100 Acre	11.78	11’ 9”

Drawing Plots on a Grid

- Prior to starting your plot installation, draw a grid that you want to follow on a unit map.
- Try to obtain a photo scale ruler, which will have different increments for various photo or map scales. For instance, if you have a 1:400 (*1 inch = 400 feet*) scale map and can find a ruler with that scale, then you can draw your grids with a lot of accuracy.
- When drawing the grid, try to use cardinal directions for the pattern.
  - If you use something like N17˚E (*north 17˚ east*) for your first bearing line and want to go 90˚ left or right, it takes a few moments to do the math in your head and increases the chance of errors.
  - For this reason, it is easier to use cardinal directions!
- Look at the “Examples of chain distance” below and decide which grid is best for you. 2 x 2 chains is the most intense on the chart (*greatest number of plots per acre*) and 10 x 10 chains is the least (*fewest number of plots per acre*). Examples of a grid you might choose are 3 chains by 3 chains, or 2 chains by 5 chains.

Examples of chain distance for plot placement and plots per acre

Chain Grid	Distance One	Distance Two	Square Feet	Divided By	Plot Acre
2 x 2	132 ft. 2x66’	132 ft.2x66’	21,384 sq. ft.	43,560 sq. ft. =	0.5 ac./plot
3 x 3	198 ft.	198 ft.	39,204 sq. ft.	43,560 sq. ft. =	0.9 ac./plot
2 x 5	132 ft.	330 ft.	43,560 sq. ft.	43,560 sq. ft. =	1.0 ac./plot.
5 x 5	330 ft.	330 ft.	108,900 sq. ft.	43,560 sq. ft. =	2.5 ac./plot
10 x 10	660 ft.	660 ft.	435,600 sq. ft.	43,560 sq. ft. =	10.0 ac/plot

Plot Pacing on a Grid

- When you are ready to start your pacing and data collection, you can look at the map and determine the distance and bearing to the plot you want to start on. *For sample route and plot location map see Figure 7.1*
- If your compass line bisects a known point, such as a corner or a road junction, then start there.
- Set your compass for the correct bearing and go 1.5 chains *(half the distance of the 3 x 3 chain grid)* to the first plot. Write on your map the plot number at the correct location.
- After doing the plot, continue on your bearing line at the 3 chain grid interval until you are less than 3 chains from your unit boundary.
- Write down your last plot number on the map. Set your compass for 90˚ of your just completed line and pace 3 chains toward your next bearing line.

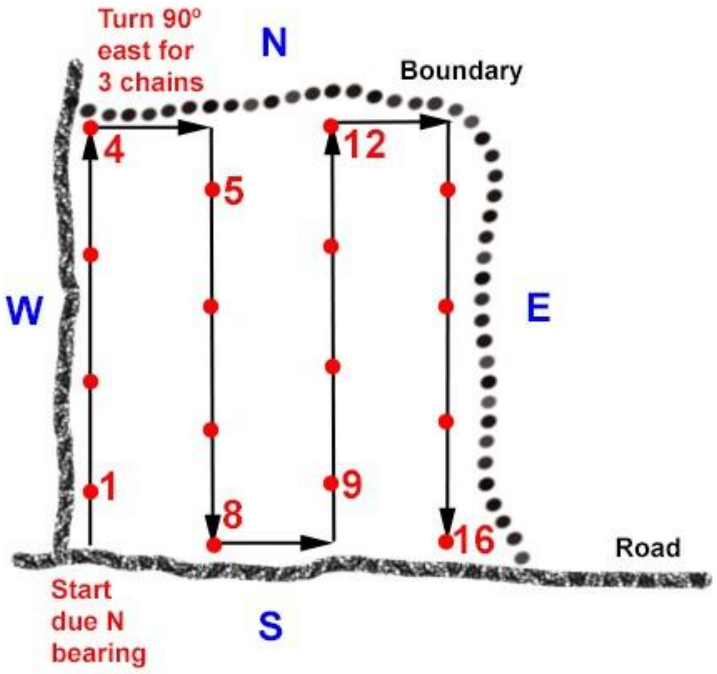

Figure 7.1 Map of route and plot locations

If my selected grid is 3 x 3 chains, I try to alternate the plots when turning to start a new line. For instance, if I ended my strip on plot 7 and turned due north for 3 chains, then at the end of the third chain I would turn either east or west and go 1½ chains (half of my grid) to start the next row. Each row is then offset half the distance between the plots. A serious forester with a passion for accuracy would scoff at my practice, but I continue to believe that for a small landowner the extra accuracy that some other plot-taking method may gain is not worth the time to try and explain. If you are a serious math and accuracy person then be aware there are more accurate processes! The process I have described is a great improvement from a general walk through your plantation, placing plots wherever you think they should be placed! If you do that, then inevitably the majority of the plots will fall in nice, easy, and open ground. We are subconsciously biased in the ground we select.

- When you get to the new bearing line, you likely will be close to the unit boundary on your left or right. Set your compass back 90˚ to the original bearing and go 1.5 chains toward the boundary to install the next plot, if there is room. If there is not room, go 1.5 chains in the opposite direction to install the plot. Draw and

label the plot on your map. (*By going half the 3 chain distance, you will be offsetting your plots one-half the grid distance on each bearing line.*)

- Continue with plots at the 3 chain interval, turning 90˚ each time you reach the boundary and offsetting the plots on each bearing line.

Plot Installation Example

- A 1/100 acre plot with a radius of 11.78 feet is used in this example. *See Figure 7.2*
- When your foot comes down on the plot center, place a shovel with a nail in the handle or some other plot center pole into the place your heel landed.
- Place the end of your Spencer tape or rope over the nail and go out 11.78 horizontal feet (*1/100th acre plot*). Be careful to keep the tape horizontally level when measuring the plot radius. If you don't, then serious error can be inserted into your results (*a tree may be counted when it shouldn't and vice versa*).

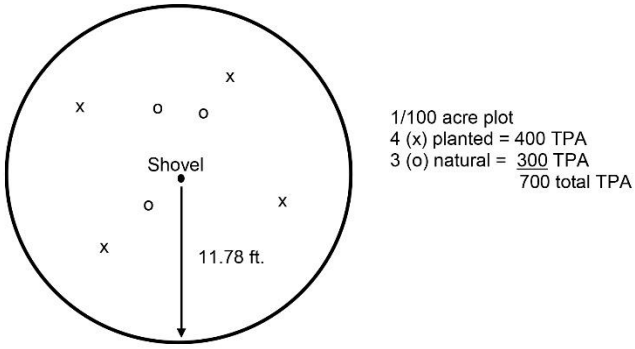

Figure 7-2: Sample plot

- Using your compass to determine north for your starting point, go clockwise (*or counterclockwise)* around the boundary of the circle, counting the trees inside the plot between you and the center post. Depending on how many trees per plot and how old the stand is, you may want to mark the trees and boundary with paint as you walk the circumference and count trees. Marking trees helps to insure you counted all the trees, and by marking the boundary it is easy to step back and view the plot or re-count the trees (*especially with larger plots).*
- If you have 5 trees on the plot, write either 5 trees or 500 trees on the record-keeping form.
    - 5 x 100 (*5 x the denominator of the plot size* [100]) = 500 TPA.
    - For a 1/20th acre plot, the denominator [20] x 5 trees = 100 TPA.
- After the plot is installed, record your plot data. It can be as detailed as you want or very simple. If you hire someone to do the land exam for you, you will want them to mark the plot center so you can do a "check cruise".
- When you are done recording the data, continue your bearing for 3 chains to the next plot and repeat the same plot installation.

Plots on Steep Ground

- If your ground is steep and measuring a horizontal line is difficult, consider putting in ½ circle plots. When you arrive at the plot center, take a bearing on the downhill slope. (*You are going to be using the downhill slope for your plot.*) Then rotate your compass dial 90˚ and shoot the direction. Once you have marked this line or memorized it, you can either look 180˚ and sight the new direction using the compass dial in the same position or adjust the dial to the correct bearing. Either way you will now have the circle bisected into a ½ circle.
- You can take all ½ circle plots or mix them up depending on the terrain. At the end of the cruise, you need to either combine two ½ circles and lump with the full circles or work the cruise up with all ½ circle plots. If you use all ½ circle plots, then you will need to multiply the TPA and any volumes you worked up by 2 to get a corrected answer.

Types of Land Exams

Planting Exams The planting exam is used to work behind a planting crew and take quality plots, possible for payment purposes, and at the very least to tell the crew how they are doing. *More on planting exams in Chapter 5, "Planting".*

Survival Plots: Survival plot installations are installed after the planting project is completed. By putting in a series of plots, marking the plot centers, and marking all the seedling inside the plot, you will be able to tell the following year your exact survival rate. *More on survival plots in Chapter 5, "Planting".*

Thinning Exams: Thinning exams would include:

- Pre & Post Pre-Commercial Thinning exams
- Pre & Post Early Commercial Thinning exams
- Pre & Post Commercial Thinning exams

The "pre" exams are before the thinning operation and the "post" exam is after the thinning operation. When doing a pre-exam, record your data with a **cut**, and **leave** column with corresponding diameter and height for each. Work each up as a separate cruise and as a total cruise of all the data combined. You will then have the current stand stocking, diameters, and heights, as well as the selected cut trees and leave trees. If you are doing a "thin from below", the stand you are leaving should have a higher diameter, height, and volume (*usually not a lot but it should not be the reverse*). This data can aid you in estimating when to re-enter the stand using the "Density Management Table" mentioned in *Chapter 13, "Growing Douglas-fir".*

Logging Exams: You can also use the land exam process for a pre-logging exam to tell your logger how many trees per acre will be logged and the average diameter. From this they can estimate how long the logging operation will last, how many truck loads, and the type of markets the wood will go into. If you have some basic cruising skills, you can also provide a volume per acre to log. However, 99% of forest landowners do not know how to cruise for volume and value, and if they do know how, they likely do not practice it enough to be accurate. If you want a cruise estimate of

volume, then my recommendation is to hire someone who does it for a living. The result will be far better than anything you can do.

Additional Land Exam Plot Comments

- Rite-In-The-Rain paper is very handy for any data collection if the weather is wet or very humid. When it is wet, you can use a soft pencil with Rite-In-The-Rain paper, but if you want to use a pen you will need a Rite-In-The-Rain pen.
- Some people see blue paint better than orange.
- If you have trouble seeing the seedlings, both at installation and especially one year later, then try a pair of yellow-tinted safety glasses. For most individuals the yellow color will make it easier to differentiate the various colors of green.
- A seedling planting bag makes a good "extra pocket" to carry everything. (*The planting bag is probably one of the most underutilized tools on the tree farm.*)
- Having a map of your tree farm is important for many purposes such as planting, land exams, FPA applications, sharing with visitors, etc. Look around for someone in the business to help you acquire an accurate map. Consulting foresters often have the equipment and software to do it. We have a base map with our roads, culverts, and streams, then a second base map with the planting units, and future logging units, and a third with trails. In addition, we have a map with 10 and 20-foot topographic contours, a Lidar photo, and aerial color photos.
- Recording data:
    - If you are installing 1/100th acre plots and are only interested in how many trees there are, then you can probably remember the data for 1-3 plots before stopping to write it on your collection form. By doing this you should be able to do 100+ plots per day, depending on logging debris, steepness of the terrain, and your age.
    - If you want tree heights and number of naturals in addition to the number of planted trees, then you will need to take the time to record the data at each plot.
    - If you are doing a land exam such as described, it will be very difficult to find very many naturals at the end of the first growing season unless you did a very good site preparation job, and the previous year was a very good seed year for neighboring timber. You will be more likely to see naturals by the 3rd or 4th year land exam.
- Information typically collected
    - For a 1- to 2-year exam: surviving trees, competition, and browse would be logical data to consider collecting.
    - For a 5- to 6-year exam: planted trees, natural trees, competition, browse, height and diameter could be collected if desired.
    - If recording on paper or notebook, use the left column for plot number. Across the top place categories you want to record (*trees planted, trees surviving, tree height, etc.*).

- The process to arrive at TPA, average diameter, average height, etc. is all simple math learned early in our education. You can speed the process by using a program like Excel to do the math for you. If you do this, then keep a copy so the next year you do not have to re-invent the process. If you are using a hand-held computer, then your program should do all the calculations for you.
- When doing a 1-year survival exam, look at your notes of trees per plot and plot location, to see if you can correlate poor stocking with visible evidence of slopes, topography, heavy competition, or excessively heavy logging debris.
- Similarly, if you record competition, you can look for areas where you may need to do some kind of release treatment.