

CHAPTER

11

SUMMARIZING A LINE-PLOT FOREST INVENTORY

The image shows a Texas Instruments TI-30XII calculator and a green pencil resting on a grid-lined worksheet. The worksheet contains handwritten data for a forest inventory. The data is organized into columns with labels: 'Plot size: 1/2 (lbs./acre)', 'Weight (lbs.)', 'Total Height (ft.)', 'Total Pnds/acre', and 'Plot size: 1/2 (lbs./acre)'. The handwritten entries include '47000', '2200', '2200', '1100', '4756', '410', and '471'. A thick black horizontal bar is drawn across the bottom of the table.

Plot size: 1/2 (lbs./acre)	Weight (lbs.)	Total Height (ft.)	Total Pnds/acre	Plot size: 1/2 (lbs./acre)
	47000			
	2200			
	2200			
	1100			
	4756			
	410			
	471			



Summarizing a Line-Plot Forest Inventory

In prior chapters you learned the steps to measure trees, compass and pace, make maps, establish number of plots needed for a forest inventory, and create tally cards. Now it is time to pull it all together to conduct a full line-plot forest inventory.

Line-plot inventories are a systematic way of assessing a forest. Often considered one of the most efficient forest inventory methods, plots are arranged along a cruise line and spaced in a square or rectangular pattern. Plots often are circular but may be any shape or size if you know the area of the plot used for sampling.

STEPS FOR COMPLETING A LINE-PLOT INVENTORY

BEFORE GOING INTO THE FIELD

1. Determine inventory and land management objectives; that is, what do you want or need to sample for?
2. Determine how your forest inventory will be structured:
 - plot size
 - percent inventory
 - number of plots
 - plot spacing
3. Draw in cruise lines and plot locations to scale on a map.
4. Develop tally cards.

IN THE FIELD

1. Consider taking the following items with you to the field:
 - clinometer
 - compass
 - logger's tape
 - flagging
 - tally cards

- map with plot locations
- water/light snacks
- pencils
- scale/ruler

2. Begin at your designated starting point along the boundary. You will run a cruise line at the appropriate compass heading until the opposite boundary is reached. The first point of your cruise line will be placed half the distance of the plot spacing interval from the boundary. All subsequent points along that line will be spaced at the calculated plot spacing interval.
3. Use your compass and pace to plot locations. At each plot location, measure trees on the plot using the specifications outlined on your tally card. Remember to keep up with the number of plots that you measure and complete tally cards in the field.

COMPLETING A FIELD INVENTORY TALLY CARD

Let's look at how you can summarize the information collected to know a little more about your forest. Table 11.1 is an example of data collected in field and added to a forest inventory tally card. On this plot, six trees were measured for diameter at breast height (DBH) to the nearest 1 inch and total height to the nearest 10 feet. Four were pines and two were hardwood trees.



Begin the inventory at the designated starting point along the boundary.

Table 11.1. Example of Data Collected in Field

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres Plot number: 1				Names: L. Landowner and M. Neighbor Plot size: 1/20	
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	8	60			
Pine	5	50			
Pine	7	60			
Hardwood	5	50			
Hardwood	5	50			
Pine	10	60			
				Total pounds per acre	
				Tons per acre	

ESTIMATING TREES PER ACRE

The first thing to do is use the field data to determine trees per acre for this plot. To do this we take the number of trees counted on the plot and multiply by plot size.

Total trees counted on the plot = 6
 $6 \times 20 = 120$ total trees per acre

Pine trees counted on the plot = 4
 $4 \times 20 = 80$ pine trees per acre

Hardwood trees counted on the plot = 2
 $2 \times 20 = 40$ hardwood trees per acre

ESTIMATING TREE WEIGHT OR VOLUME

Next we can estimate the weight or volume of wood per tree and then the weight or volume per acre represented by this plot. Many mills in the southeastern United States purchase timber based on weight, thus the landowner is paid by the tons (every 2,000 pounds) of wood delivered. Some mills purchase timber based on volume. You may see this reported as cubic feet or board feet.

Special forestry tree weight or volume tables have been developed for different tree species and different regions of the country to help landowners estimate the amount of wood on an acre. When you are choosing weight or volume tables, it is important to select ones that are suitable for your tree species and region.

Weight and volume tables often can be found online. For demonstration purposes, we only use weight tables from the following two publications:

- For pines, we use table 1 in "Tables for Estimating Total-Tree Weights, Stem Weights, and Volumes of Planted and Natural Southern Pines in the Southeast."
- For hardwoods, we use table 73 in "Total-Tree Weight, Stem Weight, and Volume Tables for Hardwood Species in the Southeast."

For the tally card shown in table 11.2, we used table 1 for pines. Based on tree diameter and height, we filled in the corresponding weights in pounds. For the tally card shown in table 11.3, we used table 73 for hardwoods to fill in the weights for the two hardwood trees.

Contact your local Extension office or forestry professionals in your area for information on weight or volume tables that will work best for your region and species. You should work with a land management professional to select the weight or volume table that is best for your situation.

Table 11.2. Pine Weight Estimates

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres				Names: L. Landowner and M. Neighbor	
Plot number: 1				Date: 4/28/2020	
				Plot size: 1/20	
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	8	60	697		
Pine	5	50	217		
Pine	7	60	525		
Hardwood	5	50			
Hardwood	5	50			
Pine	10	60	1,121		
				Total pounds per acre	
				Tons per acre	

Table 11.3. Hardwood Weight Estimates

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres				Names: L. Landowner and M. Neighbor	
Plot number: 1				Date: 4/28/2020	
				Plot size: 1/20	
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	8	60	697		
Pine	5	50	217		
Pine	7	60	525		
Hardwood	5	50	272		
Hardwood	5	50	272		
Pine	10	60	1,121		
				Total pounds per acre	
				Tons per acre	

CALCULATING WEIGHT PER ACRE

The next step is to calculate weight per acre represented by each tree on the plot. This plot is 1/20 acre, which means that each tree represents 20 trees per acre. We must multiply the weight per tree by 20 to get its per-acre equivalent.

For the example in table 11.4, we put 20 in each cell in the plot size column. If you were using a 1/10-acre plot, this number would be a 10, for a 1/40-acre plot, the number would be 40, and so on. Next, we multiplied the weight per tree by the number in the plot size column and put that number in the weight/acre column. We then calculated the weight per acre for each tree and summed up those weights to get the total pounds per acre. Finally,

we calculated tons per acre by dividing the total pounds per acre by a ton (2,000 pounds): $62,080 \div 2,000 = 31.04$ tons/acre.

Based on the information from the forest inventory tally card, this 18-acre stand has an estimated 110 trees per acre (80 pine trees and 40 hardwood trees) and 31.04 tons per acre of wood. We also can break out the amount of wood per acre by tree species:

Pines
 $13,940 + 4,340 + 10,500 + 22,420$
 $= 51,200$ pounds per acre

$51,200$ pounds per acre \div 2,000 pounds per ton
 $= 25.6$ tons per acre of pines

Table 11.4. Calculating Weight per Acre (Plot 1)

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres Plot number: 1				Names: L. Landowner and M. Neighbor Date: 4/28/2020 Plot size: 1/20	
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	8	60	697	20	13,940
Pine	5	50	217	20	4,340
Pine	7	60	525	20	10,500
Hardwood	5	50	272	20	5,440
Hardwood	5	50	272	20	5,440
Pine	10	60	1,121	20	22,420
				Total pounds per acre	62,080
				Tons per acre	31.04

Hardwoods
5,440 + 5,400 = 10,880 pounds per acre

10,880 pounds per acre ÷ 2,000 pounds per ton
= 5.44 tons per acre of hardwoods

From a line-plot inventory, you can learn how much wood is growing in your forest and estimate its worth.

These three plots are very different from each other, even though they are based on measurements taken from the same forest stand. To summarize these to get an estimate for the stand, we average the trees per acre and tons per acre across all plots (table 11.7). You also can estimate the total tons in a stand by multiplying the average tons per acre across all plots by the number of acres in the stand.

TALLYING MORE THAN ONE PLOT

A full line-plot inventory is based on more than just one plot. Let’s look at how that is summarized. For this example, we start with the completed plot tally card we were working with (table 11.4) and add two more completed plots (tables 11.5 and 11.6). We are using a small sample of three plots for demonstration purposes only. In an actual forest inventory, more than three plots usually are needed.

Table 11.5. Calculating Weight per Acre (Plot 2)

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres Plot number: 2				Names: L. Landowner and M. Neighbor Date: 4/28/2020 Plot size: 1/20	
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	16	90	4,413	20	88,260
Pine	12	80	2,148	20	42,960
Pine	6	50	320	20	6,400
Pine	5	40	177	20	3,540
Pine	5	40	177	20	3,540
				Total pounds per acre	144,700
				Tons per acre	72.35

Table 11.6. Calculating Weight per Acre (Plot 3)

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres				Names: L. Landowner and M. Neighbor	
Plot number: 3				Date: 4/28/2020	
				Plot size: 1/20	
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	16	90	4,413	20	88,260
Pine	5	40	177	20	3,540
Pine	7	50	444	20	8,880
Pine	9	50	758	20	15,160
Pine	5	40	177	20	3,540
Pine	16	90	4,413	20	88,260
Pine	5	40	177	20	3,540
				Total pounds per acre	211,180
				Tons per acre	105.59

Table 11.7. Calculating Total Tons per Acre for Multiple Plots

Plot	Trees/Acre	Tons/Acre
Plot 1	120	31.04
Plot 2	100	72.35
Plot 3	140	105.59
Average/acre for the stand	120	69.66
Total tons for the stand (69.66 tons per ac. × 18 ac.)	1,253.88 total tons	

If we had based our stand description on just one plot, the trees per acre might have been close, but the tons per acre would not. That is the power of sampling a forest using a line-plot inventory. You get a good idea of what a stand is like based on samples from across the forest. By keeping up with plot locations on a map, you can also tie data for a given plot back to a point on the ground. This can help you know where larger or smaller trees can be found and where dense or sparse pockets of trees are located.

YOUR TURN

Based on the three-plot sample (tables 11.8 to 11.10), determine the trees per acre and tons per acre represented by each plot from a line-plot inventory of 35 acres. Then, determine the average trees per acre and tons per acre for the stand (table 11.11).

Always check the tally cards for specifications, such as acres and plot size. Remember, more than three plots may be needed for a full inventory. These three plots are provided as a sample dataset only.

For pine tree weights, use table 1 in “Tables for Estimating Total-Tree Weights, Stem Weights, and Volumes of Planted and Natural Southern Pines in the Southeast.”

Table 11.8. Data Collected in Field (Plot 1)

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres					
Names: L. Landowner and M. Neighbor		Plot number: 1		Date: 5/05/2020	Plot size: 1/20
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	6	40			
Pine	16	80			
Pine	11	60			
Pine	7	50			
				Total pounds per acre	
				Tons per acre	

Table 11.9. Data Collected in Field (Plot 2)

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres					
Names: L. Landowner and M. Neighbor		Plot number: 2		Date: 5/05/2020	Plot size: 1/20
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	8	60			
Pine	13	80			
Pine	8	60			
Pine	10	70			
				Total pounds per acre	
				Tons per acre	

Table 11.10. Data Collected in Field (Plot 3)

Stand description: Old Field Pines Stand, Section 4, T14N, R16W, 18 acres					
Names: L. Landowner and M. Neighbor		Plot number: 3		Date: 5/05/2020	Plot size: 1/20
Species (pine/ hardwood)	DBH (in.)	Height (ft.)	Weight (lb.)	Plot Size	Weight per Acre (lb. per ac.)
Pine	14	80			
Pine	15	80			
Pine	9	60			
Pine	7	40			
Pine	14	70			
				Total pounds per acre	
				Tons per acre	

Table 11.11. Inventory Summary for the Stand

Plot	Trees per Acre	Tons per Acre
Plot 1		
Plot 2		
Plot 3		
Average for the stand		

ANSWERS

Inventory Summary for the Stand

Plot	Trees per Acre	Tons per Acre
Plot 1	80	60.41
Plot 2	80	52.31
Plot 3	100	103.36
Average for the stand	87	72.03



A full line-plot inventory is based on more than just one plot. This gives you a good idea of what a stand is like based on samples from across the forest.