Chapter 4: Establishing Fixed-Radius Plots

In previous chapters, you mapped out your stands, identified where sample plots will go, and learned how to navigate in the woods to your first plot location. This chapter will teach you how to establish a fixed area plot. Advanced users may also wish to read Chapter 5 to learn about a variable area plot. As a reminder, you are sampling your stand using plots so that you can extrapolate the data collected to the full stand on a per-acre basis.

Establishing plots and collecting data in them is much more manageable when you are working with a partner. Dividing the labor makes things go faster; for example, one person can be standing at the center of the plot and recording data while the other delineates the plot or takes tree measurements.

Learning Objectives

1. Determine an appropriate plot size.
2. Establish the boundary of a fixed plot.
3. Identify and count "in" trees (sample trees).
4. Understand the relationship between the number of trees in a plot and the number of trees in a stand on a per acre basis.

Materials Needed

1. Measuring tape or logger's tape
2. Colored survey ribbon
3. Orange timber marking crayon (optional)
4. Permanent marker (optional)
5. Rope (optional)

A. Plot size

Just as it sounds, a fixed area plot has a known area. When you establish the first plot in any given stand, you will need to choose an appropriate plot size. This size should then be used throughout the rest of the stand. You will want to choose a plot size that gives you an average of 5 to 10 trees per plot. Try a starting plot size such as 1/20th of an acre, and see if you get in the neighborhood of 5 to 10 trees.

If you find that the trees in your stand are widely spaced such that you have very few trees in your plot (4 or fewer) and this wide spacing looks to be consistent throughout the stand, consider increasing your plot size (e.g., to 1/10 acre). Similarly, if your stand is dense such that you have numerous trees (12 or more), consider smaller plots (e.g., 1/30 acre).

B. Establish the boundary of your fixed plot

Plots can be established in various shapes, but circular plots are the easiest to use in a forest. To establish your circular plot, you will need to know the plot radius, which is the distance from the plot center to the outer edge of the plot (Figure 4-1). Table 4-1 shows plot radius values for a range of plot sizes.

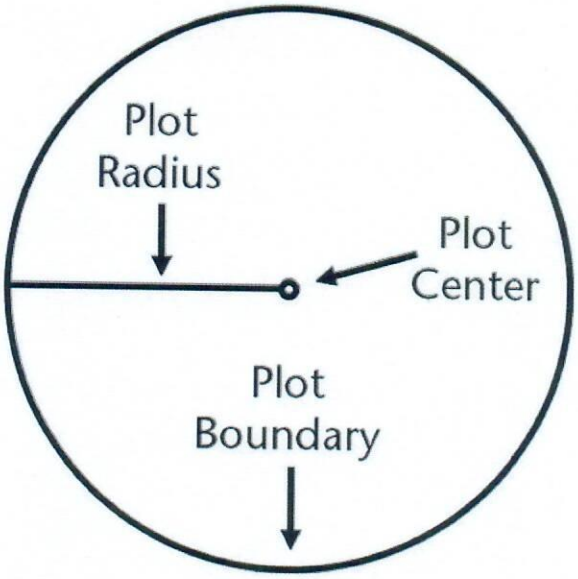

Figure 4-1: The plot radius is the distance between the plot center and outer boundary of the plot. Table 4-1 lists plot radii for different-sized plots.

To establish your plot boundary (i.e., perimeter), start at plot center and walk out the prescribed distance in various directions and hang a colored survey ribbon on a nearby branch or shrub to mark the plot boundary. You should go out at least six different directions to get a good sense of where the plot boundary is. Once you have six or more flagged points marked around your plot boundary, you will need to visually "connect the dots" to estimate the complete boundary of your plot.

When measuring out the distance from your plot center to your plot boundary, you can use a cloth measuring

Watch a video clip of how to establish a fixed area plot:
http://breeze.wsu.edu/inv_fixedplot/

Table 4-1: Common plot radius values for different sizes of fixed, circular plots.

Plot Size (acres)	Radius (feet)
1/5	52.7 (≈52′8″)
1/10	37.2 (≈37′2″)
1/20	26.3 (≈26′4″)
1/30	21.5 (≈21′6″)
1/40	18.6 (≈18′7″)
1/50	16.7 (≈16′8″)
1/60	15.2 (≈15′2″)
1/100	11.8 (≈11′10″)
1/250	7.4 (≈7′5″)

tape or a logger's tape. You can also use a rope that has been pre-cut to the length of your plot radius. This may save time and effort in marking your plot boundary.

C. Determining "in" trees

Now that you have marked the boundary of your plot, you will need to determine which trees are in the plot. A tree is considered "in" if the center of the tree falls within the plot boundary. Starting from a given direction (e.g., north, or the direction you traveled to get to the plot), systematically work your way around the plot in a clockwise direction and identify your "in" trees. It may be helpful to flag these trees with colored survey ribbon as you go. You can use a permanent marker to number the flags to help you keep track of each tree. You can also use an orange timber-marking crayon to mark/number the "in" trees.

When identifying trees in your plot, there should be a minimum size limit. For the purposes of this manual, we will focus on overstory trees, which we will define as live trees that are at least four inches in diameter at breast height (DBH). (See Chapter 6 for more information about DBH.) Snags (dead trees), smaller trees, and other features of the stand may also be of interest to you, depending on your management objectives and the purposes of your inventory. There are techniques to inventory these features. See the sidebar for an example of how to use stocking plots to measure reforestation. Your local Extension forester may have additional examples and suggestions on how to include special features of interest in your inventory strategy.

You may run into the issue of borderline trees that appear to be on the plot boundary. If necessary, run the tape or rope from the plot center directly to the tree to determine whether the center of the tree at breast height falls inside or outside the plot boundary. Figure 4-2 shows a schematic of a fixed plot with "in" trees identified in blue.

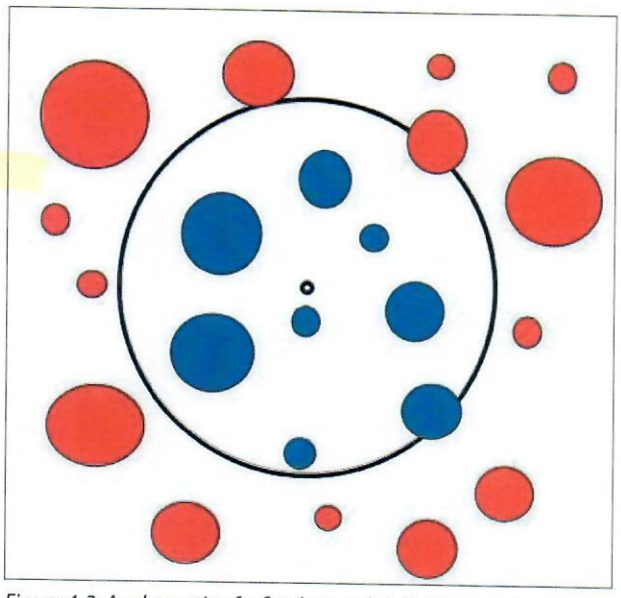

Figure 4-2: A schematic of a fixed area plot. "In" (sample) trees are identified in blue, and "out" trees are shown in red. Trees that fall along the plot boundary are determined as "in" or "out" based on whether the center of the tree falls within the plot.

D. How do plot trees relate to the larger stand?

An advantage of fixed area plots is that the relationship between a plot tree and the larger stand is straightforward. For example, a tree in a 1/20th acre plot would represent 20 trees per acre (TPA) in the larger stand. This is also referred to as the tree's expansion factor. When multiple plots are established, the number of trees per acre computed for each plot are added together and divided by the number of plots to establish an average value.

> **Example:** Suppose you put in three 1/20th acre plots in a stand and count 5, 7, and 8 trees, respectively, in each plot (Table 4-2). Each plot tree represents 1 x 20 = 200 trees per acre in the stand, for a computed value of 100, 140, and 160 trees per acre in each plot, respectively. Adding these numbers up and dividing by three (the number of plots) yields an average of approximately 133 trees per acre in the stand.

Table 4-2: Computing the average trees per acre for a stand from three 1/20th acre plots.

Plot	Trees	TPA
1	5	100
2	7	140
3	8	160
Sum of plots		400
Average of plots		133

Stocking Plots

Many forest decisions made early in the life of a forest stand require simple estimates of the number of trees/acre, regardless of size (e.g., to assess reforestation success or pre-commercial thinning needs).

Such estimates are usually made with fixed-area plots. The number and size of plots taken can vary according to many factors, but three 1/100th acre plots (a plot radius of 11 feet, 9 inches) per acre is a good rule of thumb for measuring reforestation stocking. If the unit is smaller than 4 acres, measure at least 10 plots for the whole unit. For more information, see the OSU Extension publication EC1133.[3] As with other forest sampling decisions, separating the site into different zones for data collection and analysis may yield better estimates.

Some foresters like to use 250th acre stocking plots, in part because the smaller plot radius (7.4 feet) makes it easier for a single person to measure these plots using a wooden stick that length for the radius and themselves as the plot center.

Stocking plots can also be used to measure other attributes, such as tree height or health. For example, it is important to monitor young white pines every few years for blister rust infections to decide whether to prune for blister rust.

Stocking plots can also be integrated with efforts to sample for stand volume and other characteristics. For example, in doing a volume cruise, a landowner may also want to include a nested stocking plot on the same points used for volume to estimate the quantity and species composition of understory regeneration.

On your own:

Starting with a 1/20th acre plot size, mark out the boundary for your first plot. Give a quick count of the number of trees to decide if the plot size is acceptable, and adjust/remark the plot boundary as necessary. Once you settle on a plot size, use it throughout the stand. Flag or mark all the trees that are in your plot as described above. You are now ready to measure your plot trees (Chapter 6).

[3] Green, D., M. Bondi, and W. Emmingham. 1997. Mapping and Managing Poorly Stocked Douglas-fir Stands. OSU Extension publication EC1133, http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/13913/ec1133.pdf.