Sugarbush Mapping

What's in your woods? Measuring density

Looking around your woods you'll see that there are far more trees on the landscape than you have time to measure. The science of forestry has taught us that similar stands (ones that have the same species composition, size classes, productivity, and management history) do not need to undergo a 100% census to get an accurate picture of what is there. Foresters use sampling methods that inventory stands to get an accurate representation of what is in them and the quality of the resource.

The first major premise with sampling is that there is no bias used to determine sampling plot locations. It is human nature that you will walk where it is easiest, avoiding brush, dense thickets of regeneration, low areas, and high areas, and each time that happens you are adding an increasing level of bias into the sample.

There are two easy ways to randomly select your plot locations to avoid this kind of bias. The first point should be randomly set. I do this by tossing a steel pin flag over my

shoulder, and then by following a preset compass bearing and distance that I will walk to find the first sample point. I continue collecting sampling points along the same compass bearing and preset distance until I am no longer in the stand. I attempt to obtain at least one sample plot per two acres. If the stand is large you might need to run parallel sampling transects 120-150 feet from the first transect along the reverse bearing to cover more ground.

As an example, the image below shows transect lines that were run to obtain stand stocking levels. Along each of the lines we measured a sample plot every 250 ft. Sample plots within similar age and diameter classes as well as species type will allow you to obtain estimates of basal area. Basal area is the measure of living wood in square feet that is growing across an acre of ground. Scientific studies show there is only so much living wood that an acre of forest can support. These

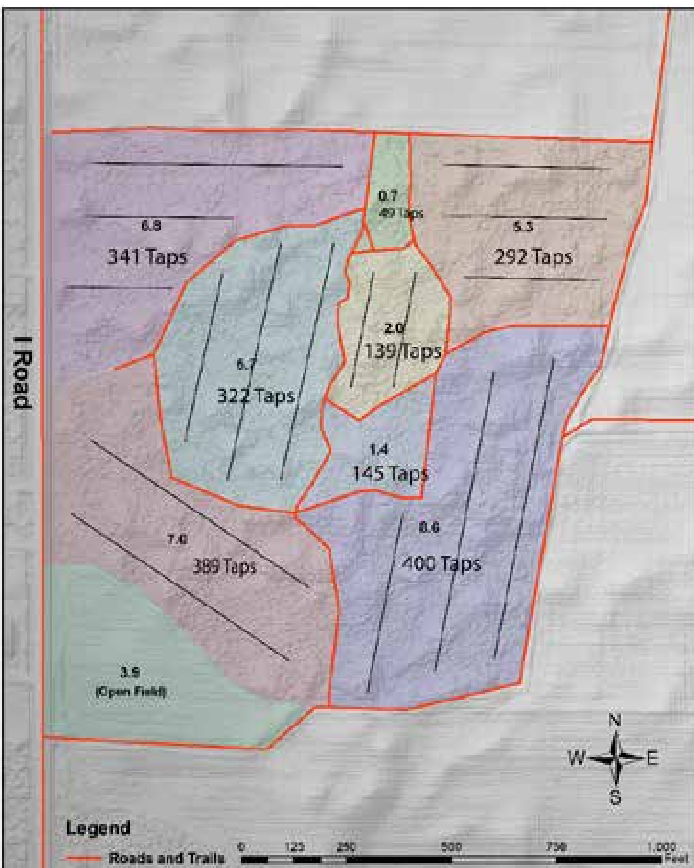

Figure 1: Maping transect lines to determine stocking levels.

values of acceptable density relate to the age/size of the trees, the type of trees, and the productivity of the soil.

In forest stands that are too dense (i.e. a high basal area) the trees do not have room for canopy growth and are placed under increasing belowground competitive stress for moisture and nutrients. As these stressors increase in severity, trees are more susceptible to insect and disease attacks, which further erodes the health and productivity of the stand. Less stress and more room to grow equals healthy trees that produce more sap with high sugar content.

On the flip side, having too little basal area growing per acre means that you are not maximizing the potential on that acre of ground, leaving resources and space underutilized. Furthermore, the trees will be farther apart which could interfere with the logistics of running mainlines and lateral lines, since there will be less support and more line sagging.

The sweet spot is to maximize tree and tap counts while maintaining fast growth and increased sugar production thru photosynthesis, all while facilitating tubing and mainline installation and maintenance.

Basal area is a repeatable measure – meaning several different people can take measurements at the same reference point and come up with the exact same basal area numbers. As such, you can measure across the years to determine how stands are growing. To be repeatable, foresters use what is called a basal area prism. These prisms come in different “factors” (e.g. 5, 10, 20) with different regions of the US using different factors based on

existing tree density and tradition. In the mature sugar maple-dominated woods you will be hard pressed to find a forester using anything but a 10-factor prism. Simply put, the prism factors are multipliers. Prisms are available online at various retailers and cost $30-$50 depending on size, shape, and color of glass. You can also measure basal area values by using what is called an angle gauge which differs slightly in the method of use but is still inexpensive ($15), repeatable, and determines basal areas accurately. A poor man's angle gauge can be made with a standard piece of black electrical tape on a ruler stick which equates closely to a 10 factor gauge multiplier.

Whatever system you use (prism, or angle gauge), you must remain consistent in your "In vs. Out" tree determinations. "In" trees are ones that overlap when looking thru the prism, or are overlapping on both sides of the angle gauge. "Out" trees do not overlap in the prism field of view nor do they overlap both sides of the angle gauge (see diagrams below). Most of the time "in vs. out" trees are easy to determine but the tricky part lies with the "borderline" trees. Foresters are often consistent when they deal with borderline trees. They normally count every other one to ensure a non-biased measure. This means that the first borderline tree is counted as "in" and the second is "out", the third is "in" etc. etc. As you tally up the "in" trees it is also important that you estimate these trees' Diameter at Breast Height (DBH). DBH is measured at a standard height of 4.5 ft above the ground. Once you have all the measurements for your sample plots, it is time to figure out what you have for basal area

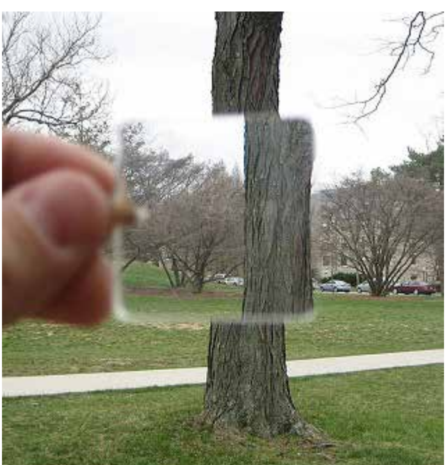

Figure 2: Basal area prism, (left). Basal area angle gauge (right).

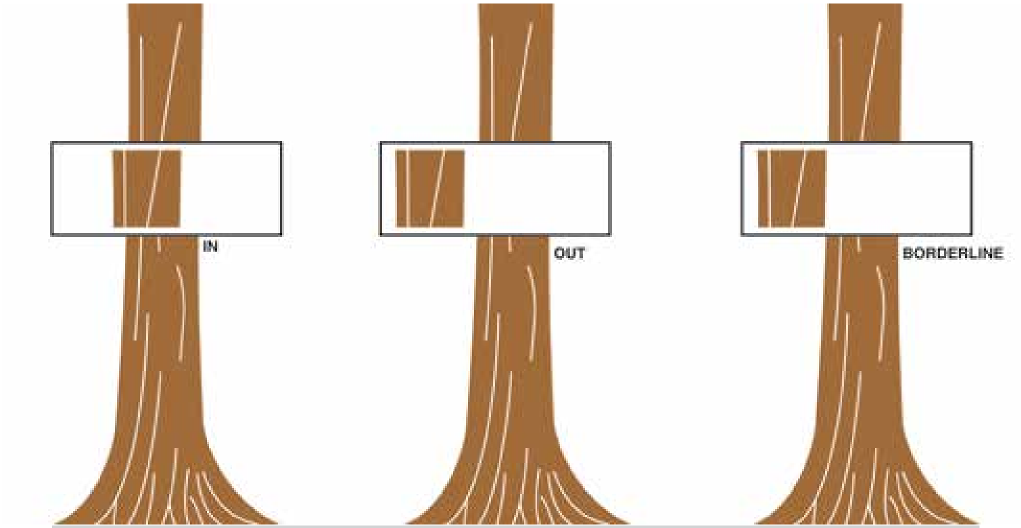

Figure 3: Through a prism, trees will be ‘in,’ ‘out,’ or ‘borderline.’

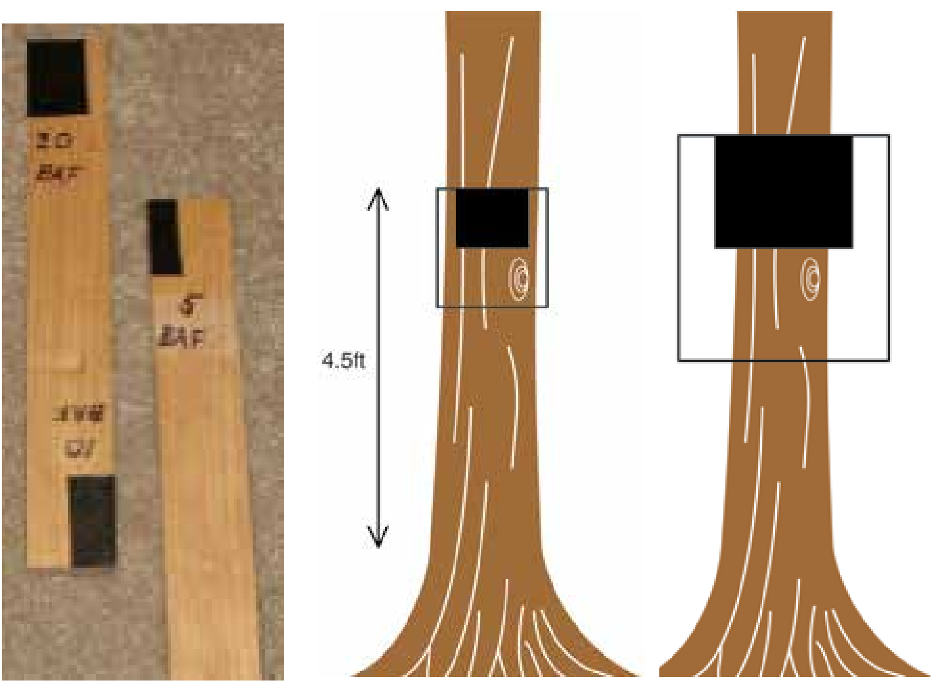

Figure 4: A ‘poor man’s angle gauge’ and determining if a tree is ‘in’ or ‘out.’

and where your stand's stocking levels. are at.

To determine basal area - take the number of "In" trees counted and multiply it by the prism factor. 13 (# of In trees counted) x 10 (factor) = 130 Sq. ft. of basal area. We would do these calculations for each of the plots individually within each stand. If the stand was 20 acres in size we would have roughly 10 individual sample plot averages for DBH and basal area. We would then average together all 10 plot level DBH averages to get a stand average and then do the same for all 10 basal areas. By averaging the 10 sample plots we get a much more robust and accurate estimate of the stand composition to make further management calculations and decisions.

plot # 1		
10 factor Prism		
"In" Tree #	Species	DBH
1	s. maple	14
2	s. maple	14
3	beech	10
4	s. maple	12
5	ash	20
6	s. maple	15
7	s. maple	14
8	beech	11
9	birch	12
10	hemlock	18
11	s. maple	17
12	s. maple	16
13	s. maple	10
	ave. DBH	**14.1**
130	**Basal Area**	

Figure 5: Sample inventory.

Now that we have both the basal area in sq. ft. and the average diameter calculations we can use those two numbers to determine stems per acre. Using what is called a stocking table we can find our average basal area on the left axis and the average stem DBH on the top axis. Where those two lines intersect is the stocking level on the right axis and if we drop straight down from that intersection point we can determine the stems per acre of dominant and co dominant trees (See example diagram). There are many forestry stocking tables that have been developed over the years for a variety of tree species, stand compositions (northern hardwood, central uplands, mixed oak, bottomland hardwoods, red pine, walnut, oak, etc.), as well as for plantation grown and naturally established stands. Make sure you choose the one that is most appropriate for your stand type and location. Here we will focus on using a Northern hardwood stocking table created and disseminated by USFS researchers. This table is for maple-dominated stands in the northern region and care should be applied if you are on the southern or western edge of the maple region. Reach out to your local forester or this author for help in determining the most appropriate stocking table to use.

Stocking diagrams, at first

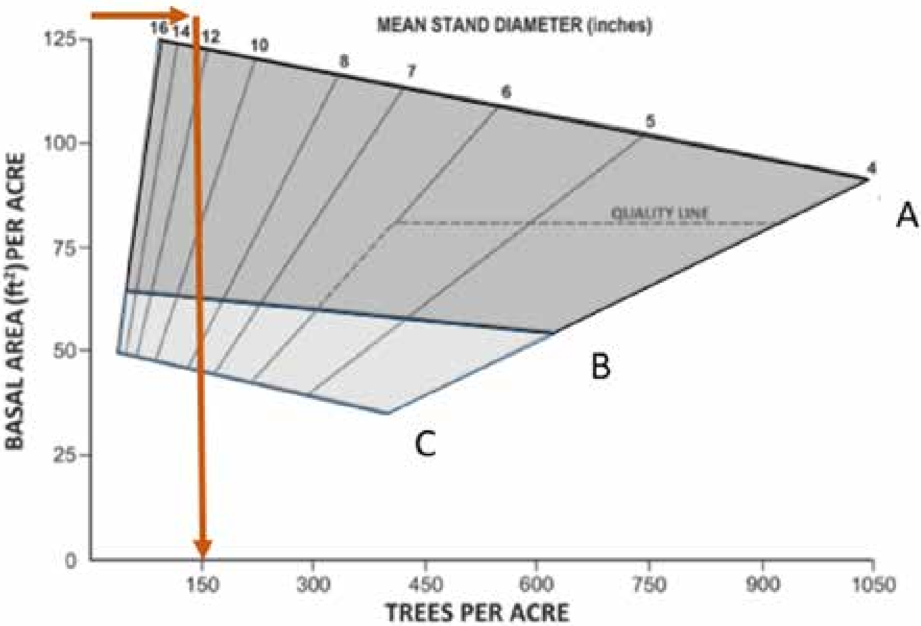

Figure 6: Stocking diagram.

glance, appear daunting with a host of letters, numbers, lines and multiple axes. But, when one views the diagram, specifically where our data falls, we can begin to get an idea of potential stocking levels, trees/acre and guidance for near term woodlot management. In our case the sample plots yielded an average DBH of 14 inches (the values across the top of the graph). Smaller diameters to the right and larger more mature tree diameters to the left. We locate our basal area estimate on the left axis (130 sq. ft.) and draw a horizontal line until you reach the line denoting the average tree diameter that we sampled (13). If we drop a line straight down to the bottom axis, and see that our stand is estimated to have approximately 150 stems/acre.

Before we go any further we need to understand what the different shaded areas are that also Shaded areas correspond to the dark lines and the zones on the right axis labeled A, B, and C. Research has shown that if the stand estimates for basal area and average stand diameter fall in the darker shaded area (between lines A and B) then the stand is fully stocked with trees, and those trees still have room to grow. If like in our example, the lines intersect above the A line the stand is over-stocked and tree growth has slowed along with sugar production capacity. Competition is increasing in the stand and the stand needs to be to continue to add growth and production potential to the residual stems. If the intersection of stand diameter and basal area fell within the lighter shaded zone (between B and C on the right axis) the stand should reach the B line in the next 10 years and should be carefully watched and remeasured every few years to confirm the stand is growing and approaching the fully stocked with room to grow zone. If for some reason a stand falls below the C line one needs to consult a professional forester as the stand is not fully stocked and research shows that it will not reach the B line and additions (planting) may be needed.

In the next insert we will discuss hiring a consulting forester, followed by common practices for dealing with overstocked stands, and ways to carefully thin focusing on improving younger pole size stands to add rapid growth and production while maintaining stocking levels.

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