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Management Techniques for Conifer Plantations – Part II

Using a Density Management Diagram

By Mark Richardson

This is the second in a series of three articles on conifer management techniques. Part I of the series introduced the general concepts behind a relatively new tool called the Density Management Diagram (DMD), which can be used to help landowners manage even-aged, single-species stands that were either planted or are natural in origin. Part I also discussed the fundamental idea that there is a limit to the amount (volume) of biomass that land can support.

In its simplest sense, forest management is a series of steps that help to achieve a landowner's management objectives. If one of the objectives includes maximizing revenues from a stand of conifers, the landowner needs to capitalize on the growth potential of the site through a series of judiciously timed thinnings. The best way to do this is to use the DMD as a decision-making tool for determining when and how much to thin the stand. Figure 1 shows the DMD for red pine plantations. Remember, there are different DMDs for different species and for both natural and planted stands. Please ensure that the correct DMD is used.

Part II will describe how to use the DMD (along with some easily collected stand inventory information) to determine what needs to be done in your woodlot. Here are the four steps involved in using this new forest management tool.

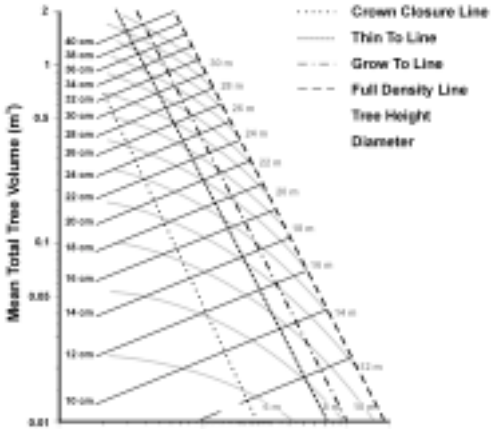

Figure 1: The typical Density Management

Step 1: Collecting Forest Inventory Information

A proper forest inventory is a fundamental management activity, regardless of the type or age of the forest. You should never conduct harvesting operations without first using an inventory to determine if harvesting is appropriate and to see how much timber to harvest. These are perhaps the two most important forest management questions to answer if the goal is to manage the forest sustainably.

The forest inventory provides a comparison of what is growing now to what is recommended. It is the basis by which all informed decisions are made and it is the first step toward achieving the management objectives.

Unfortunately, methods of collecting forest inventory information go beyond the scope and intent of this article. However, an inventory in a conifer stand is a relatively easy and inexpensive task, because in most cases, the stand is made up of one tree species similar in size (diameter and height). If an inventory shows that there are multiple species, or if the range in diameters is large, it is recommended that the landowner seek help from a qualified forest resource person before harvesting any trees. (For a list of forestry consultants contact the Ontario Woodlot Association.)

Table 1 contains information about a hypothetical forest inventory. Please note that the inventory has captured three of the four variables used by the DMD – these are density, average diameter and stand height. The fourth variable on the DMD is average stem volume (Y-axis), which is a function of the height and diameter.

Table 1 Sample Forest Inventory Summary (Red Pine Plantation)

Variable	Inventory Value	Comments
Average Diameter	14.1 (cm)	Diameter taken at breast height (1.3 m).
Density	2,400 (trees / ha)	No stumps present.
Stand Top Height	15 (m)	Average height of the largest trees.
Stand Age	30 (years)	Determined from planting records.
Stand Area	10 (ha)	Determined from planting records.

When used in conjunction with the correct DMD, Table 1 provides all the necessary information to make informed management decisions about the conifer stand. By comparing the timber growing now to what is recommended by science, a landowner can determine if the stand needs thinning, how many trees to remove, and can estimate the volume of the harvest. Future thinnings and volumes can also be predicted.

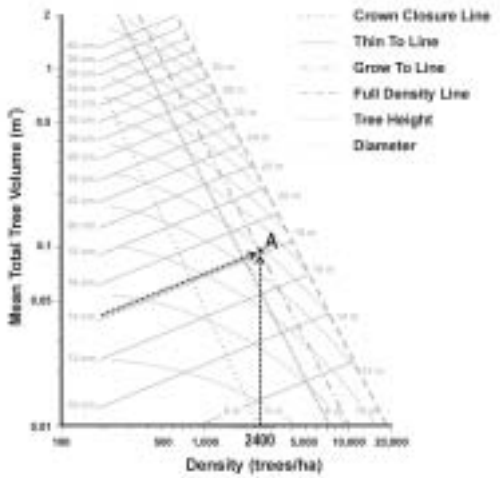

Figure 2: The stand from Table 1 plotted on a DMD

Step 2 – Plotting the Stand on the DMD

In order to plot where a stand "fits" on the Density Management Diagram (DMD), the landowner needs only two pieces of information: tree density and average tree diameter. The example from Table 1 is shown at point "A" in Figure 2. Note that this point is an intersection of two lines; the stand density, drawn vertically off the x-axis at 2,400 trees/ha; and the upwardly sloped line representing the average diameter of 14.1 cm. In most cases, average diameters must be interpreted between two lines. In this example, the point is a little bit above the 14-cm line.

Step 3 – Comparing the Stand to What Forest Science Recommends

As demonstrated in Step 2, any conifer stand can be plotted on the DMD using easily collected inventory information. This provides a picture of where the stand is now; it does not show where the stand should be. Determining what should be done is simply a matter of comparing an actual stand to what is recommended. This comparison is often referred to as a stand's stocking, which is another way of saying that there is either too much or not enough biomass for the site. A stand can be overstocked, understocked or ideally stocked, depending on the number of trees within it. Stocking levels, however, are not as simple as saying there are too many or too few trees. This is because the number of trees a site can support is related to the size (diameter) of the trees. A pine plantation with 2,400 trees per hectare could be overstocked or understocked depending on the average diameter of the trees within it. This concept was introduced in Part 1 of the series.

What about using tree height…

While height could also be used with either average diameter or tree density to determine where the stand plots on the DMD, it is not recommended. In fact, if all three variables were plotted on the same graph, they probably would not line up. There is good reason for this: tree height is a function of two unrelated variables, genetics and site quality. For the most part, genetic differences among trees in the same stand can be ignored unless the original seed source came from a region well outside the site where it is now growing.

Site differences however, do influence how tall a stand of trees will grow. Generally, trees growing on a better site tend to grow taller then similar trees on a poorer site. Although tree height will be discussed in greater detail in Part III of the series, in order to use the DMD to determine thinning numbers, two general assumptions must be made. These are:

1. The shape of the height line is more important than the actual number attached to it. On the DMD, height lines curve down from left to right – it is this trend that is important not the fact that one line represents 14 m while another represents 16 m. Again… more on this in Part III of this article.

2. Trees growing on a similar site should be comparatively equal in height. Trees compete for light by growing up at a rate that is determined in their genetic makeup, which as mentioned, should not vary much from tree to tree. As a result, most conifer plantations contain trees that are the same height unless there are site changes

For the landowner, the determination of stocking is easily made by comparing where the stand sits in relation to the four downwardly sloping lines shown in Figure 4. These lines (and the areas between them) were developed from the analysis of growth and yield data from hundreds of stands across Ontario. If a stand falls below Line B, it is understocked and does not need thinning. If it falls between Line B and Line C, it is optimally stocked and is growing at its ideal rate. It would only need thinning if it fell very close to, or on Line C, the Grow-To Line. If the stand falls above Line C, then it is overstocked and needs

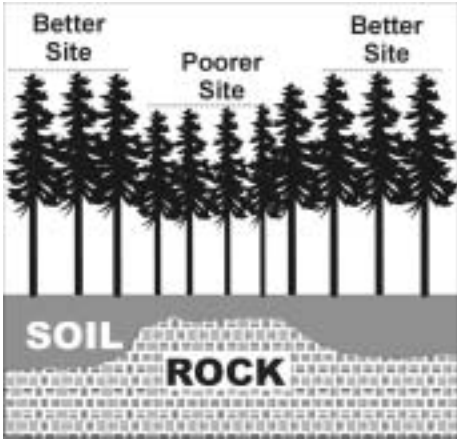

Figure 3: Stand height differences attributed to site.

thinning. Note that if the point falls well above Line C, Mother Nature is managing the stand and it may be too late to capitalize on the growth potential of the site. In this case, the landowner should seek professional advice because thinning may not be worth it, or may increase the susceptibility of windthrow.

The stand from Table 1 is shown in Figure 4 at Point A. This stand is overstocked and should be thinned because it falls above Line C.

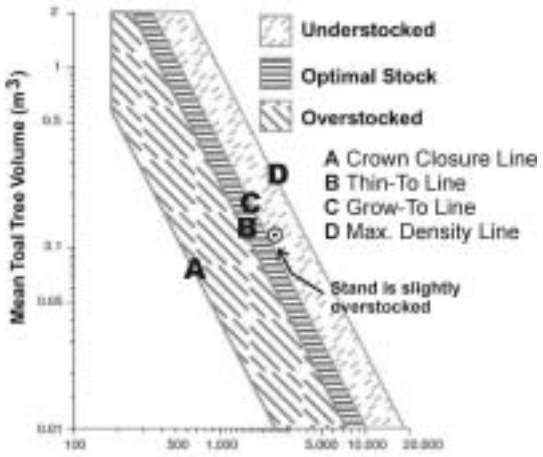

Figure 4: A DMD showing relative stocking lines and zones. Note for demonstration purposes, height and diameter lines are not shown.

Note: The graph shows the understocked and overstocked zones in reverse order; the understocked zone falls between Lines A and B, while the overstocked zone is above Line C.

Step 4 – Determining How Much to Thin

If the landowner decides to thin the stand, the next step is to determine exactly how many trees need to be removed. Keep in mind, the goal of thinning is to reduce the stocking to a point where the growth rate will be at its best – good growth usually means healthier trees, and healthier trees usually means more money in the landowner's pocket. The target for thinning is easily interpreted from the DMD. In most cases, it is recommended to thin the stand to the Thin-To Line (Line B). Having a stand that plots on, or near the Thin-To Line means that the number of years between thinning operations is at its maximum and the stand is growing at its optimal rate.

To determine how much the density needs to be reduced, follow along the path of the height line until it intersects the Thin-To Line (Point B on Figure 5). Now, draw a vertical line down to the X-axis (Point C on Figure 5). This represents the stand density after thinning. In this case, the recommended final density is 1,400 trees per hectare. If the landowner follows this recommendation, the harvest would be 1,000 trees per hectare (2,400 – 1,000 = 1,400) or about 40 percent of the stand.

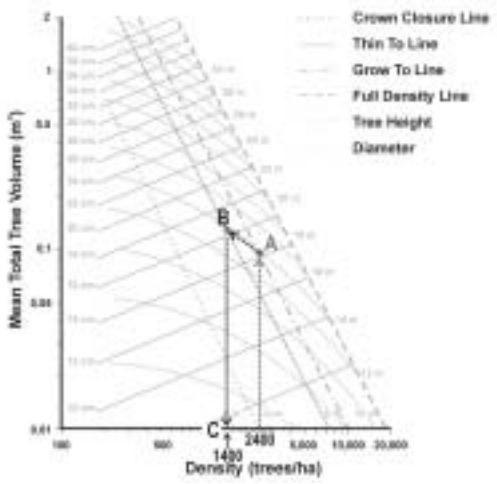

Figure 5: DMD shows the optimal density of the stand should be 1,400 trees / ha.

Why follow along the trend of the height line and not go horizontally across to the Thin-To Line? Thinning operations focus on poorer trees that more often then not, are smaller in diameter. As a result, thinning tends to increase average tree diameter of the stand. However, thinning does not increase the overall stand height because as mentioned, conifer stands usually contain trees

that are equal in height. Moving the point parallel to the x-axis on the DMD would decrease the stand top height. Following the height line trend back to the Thin-To Line provides a better estimate of what will actually happen in a stand after thinning.

The next question would be: "Is 40 percent of the stand too much?" In some cases, removing too many trees increases the chances of windthrow of the remaining trees. In this example, because the initial density and average diameter place the stand pretty close to the Grow-To Line, the answer is probably not. If on the other hand, the original stand plotted well above the Grow-To Line, the landowner would be wise to reduce the level of harvest. Often, a maximum of one-third of the total number of stems is cited as the target figure for dramatically overstocked stands. Under these circumstances, it is advisable to seek the help of a forest resource professional with experience in managing conifer stands.

This article introduces only some aspects of using a DMD as a management tool for conifer stands. It is meant to familiarize the landowner with the general concepts behind this forest management tool. The article should not be used as a management guide for individual stands. There are other important steps for achieving management objectives that are not discussed here.

In Part III, the final article in this series, the concepts around estimating harvest volumes and predicting when future harvests might occur will be discussed. For additional information on conifer management, please contact the author.

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