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EVALUATING GROWTH PERFORMANCE OF YOUNG STANDS

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ABSTRACT

A simple procedure for evaluating the diameter growth of young stands in relation to potential growth is described. A comparison technique is developed which contrasts relative diameter of crop trees to the relative diameter growth of the last decade to show the condition and trend of growth in the stand. The method is objective, easy to use, and has several applications such as: (1) determining relative growth performance of trees and stands, (2) confirming the need for thinning and setting of priority among stands, and (3) determining the growth impact of disease and other growth depressing agents. The technique does not replace more complex, precise methods of growth study.

INTRODUCTION

"How does the growth performance in this stand measure up?" This question is frequently asked by foresters when they examine young stands. To answer this question, the forester often makes some simple diameter measurements and an increment boring or two in the stand and rates stand performance as good, fair, or poor, according to his judgment of how fast such a stand should grow. This rating of relative stand growth performance is highly subjective, but the forester often cannot spend the time to estimate stand growth objectively using more complex measurements.

This paper presents a simple technique for objectively evaluating the growth performance of young stands by contrasting actual growth with a standard of potential growth. The concept is easy to use, requires relatively few measurements, and quickly provides substantial information about growth of individual trees and entire stands.

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ESSENTIALS OF THE TECHNIQUE

Potential growth.--Individual trees of a given species on a given site quality have the potential to achieve a certain growth rate. Growth rates of trees that have sufficient space to grow rapidly and at the same time do not develop excessive limbiness provide a practical standard for estimating potential growth.[2]

To understand the condition and trend of growth either in individual trees or stands, two growth elements must be dealt with as follows:

1. Relative diameter is determined by comparing the tree's actual diameter with its potential diameter; it shows how well the tree has grown from seed to its present age.

2. Relative growth rate is determined by comparing the tree's last 10-year growth with its potential decadal growth; it shows the tree's present performance.

Comparing relative diameter with relative growth rate illustrates the trend of growth. For example, if the relative diameter is 90 percent of potential but the relative growth rate is only 50 percent of potential, the tree has performed well up to the present decade, but it has started a downward trend in growth.

Potential curves for western larch are shown below. In figure 1A, curve "Pg" shows the potential diameter growth (in inches per decade) for western larch, site index 70. In figure 1B, "Pd" is the potential diameter in inches, outside bark (or sum of all past growth) for larch, site index 70.

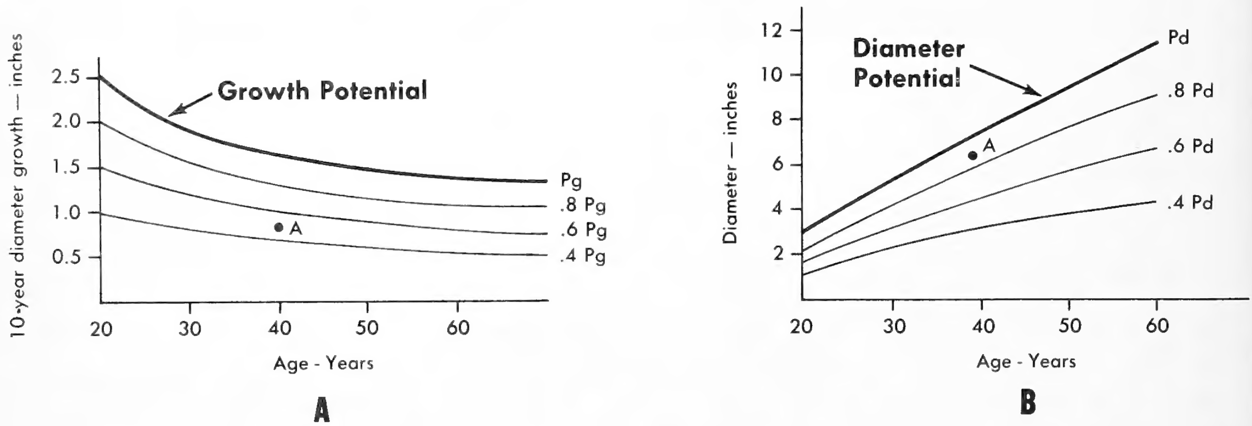

Figure 1.--Growth and diameter potentials for western larch, site index 70.

[2] This is an arbitrary growth standard. The Intermountain Forest and Range Experiment Station is developing potential growth curves that relate growth rate to tree age, stocking, and other environmental factors. The technique described in this paper could be used with any growth curve selected as a standard.

GROWTH POTENTIAL CLASS AND DIAMETER POTENTIAL CLASS

Dividing the range of performance into classes facilitates classifying trees and summarizing tree measurements. In figures 1A and 1B, curves are plotted at 0.8, 0.6, and 0.4 of the potential 10-year growth and potential diameter, respectively. These curves divide performance or achievement of the potential into four classes:

Potential class
>0.80
0.60-0.79
0.40-0.59
<0.40

The above classes provide a tool with which the forester may classify a tree without calculating the ratio of actual growth to potential growth. To illustrate, the actual growth of tree A plotted in figure 1A falls between 0.40 and 0.60 of potential 10-year growth: the growth potential class of tree A is 0.40 to 0.59. Similarly, figure 1B shows that the present diameter of tree A is greater than 0.80 of potential diameter: the diameter potential class of tree A is >0.80.

COMPARING GROWTH OF INDIVIDUAL TREES

Potential classes permit comparison of trees even though they are different species, have different ages, and occur on lands of different site quality. Figure 2 compares the growth of two western larch trees (A and B), aged 40 and 50 years, growing on site index 70 land, with three grand fir trees (C, D, and E), aged 30, 47, and 55 years, respectively, growing on site index 80 land. The growth potential classification of these trees is: tree D, >0.80; trees B and C, 0.60 to 0.79; tree A, 0.40 to 0.59; and tree E, <0.40. Diameters of individual trees can be similarly compared using diameter potential classification.

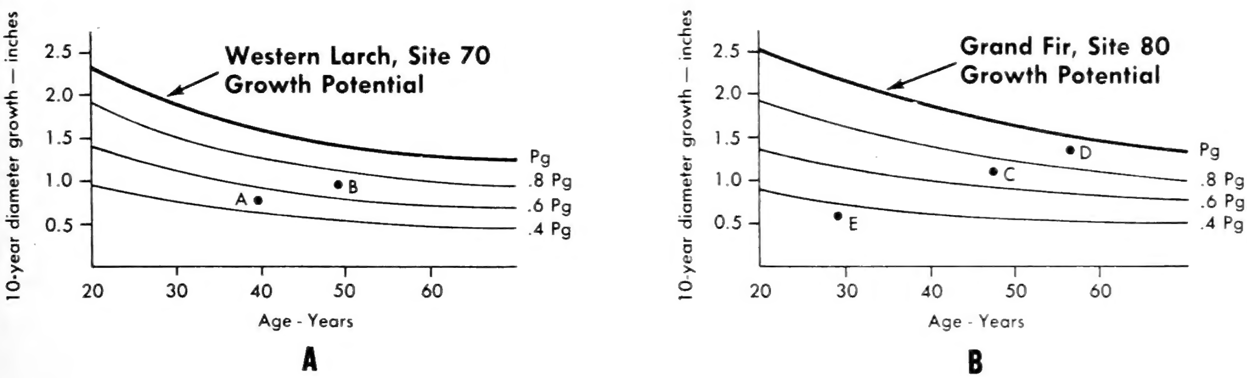

Figure 2.--Comparing growth of trees using potential curves. (Curves for western larch are drafted from unpublished data in Intermountain Forest and Range Experiment Station files. Curves for grand fir are hypothetical and are used only for illustration.)

DISTRIBUTION OF GROWTH IN STANDS

Classifying trees by growth potential class shows the distribution of growth performance within the stand. This is not provided by actual growth measurements. For example, assume the five trees from figure 2 are sample trees from a mixed stand of western larch and grand fir. The actual growth of each tree and the average growth of all five trees are shown in table 1, column I. These growth measurements do not reflect the difference in growth potential by species and age. However, values in columns II and III do show growth values in relation to species and age potential, and the distribution of growth in the stand. The distribution can be shown either as frequency of number of trees, as in column III, or in percent, as in column IV.

Table 1.--Growth potential classification of sample trees

Tree	I	II	III	IV
	Growth	Growth potential class	Class frequency	Class frequency
	Inches		Number of trees	Percent
D	1.5	> 0.80	1	20
B, C	1.0, 1.2	0.60-0.79	2	40
A	0.7	0.40-0.59	1	20
E	0.6	<0.40	1	20
Total	5.0			
Average	1.0			

The trend of growth in a stand is revealed by comparing present growth performance to past growth performance. Under natural conditions, trees usually begin growing at or near their potential rate. As the stand ages, crowding may cause individual trees to grow more slowly. One way to recognize this slowdown in growth is to compare growth potential class and diameter potential class frequencies. The tabulation below shows 88 percent of the trees in the stand are in diameter potential class >0.80; this means that for most of its life this stand grew at or near its full potential. But, during the past decade growth has slowed down as shown by the shift of trees into lower potential classes. Growth of more than half the trees is now in the two lowest potential classes.

Potential class	Diameter potential frequency (percent)	Growth potential frequency (percent)
>0.80	88	12
0.60-0.79	6	35
0.40-0.59	6	35
<0.40	0	18

If the downward trend continues because of overstocking, we can expect a greater proportion of trees in the lower growth potential classes in the future. Eventually the slowdown in growth will also be reflected in a downward shift in diameter potential class distribution.

COMPARING STANDS

Evaluating condition and the trend of growth in stands is one of the important tasks facing the land manager as he develops his work program. He must (1) determine if the stand needs silvicultural treatment, and (2) set priorities among stands requiring treatment. The comparison technique employing the distribution of tree diameter and 10-year diameter growth in potential classes provides an objective tool to use for evaluating the stands.

DETERMINING NEEDS FOR TREATMENT

The extent to which the diameter and growth rates of trees have achieved their potential reflects the degree of competition in the stand and, in turn, the need for treatment.

For example, stands A and B shown below have made good past growth; in both stands, all trees are in the upper two diameter potential classes. But there is a considerable difference in trend of growth in these stands. Stand A has maintained good growth as indicated by a high proportion of trees in the upper two 10-year growth potential classes. In stand B, however, growth is declining more rapidly than in stand A, as shown by the higher proportion of trees in the lower growth potential classes. This declining growth shows the effect of overstocking in stand B, which has 470 trees per acre. The manager would conclude that this stand needs thinning.

Table 2.--Comparing growth performance, stands A and B

Potential class	Stand A		Stand B	
	Diameter potential	Growth potential	Diameter potential	Growth potential
	Percent			
>0.80	63	56	70	0
0.60-0.79	37	25	30	25
0.40-0.59	0	12	0	37
<0.40	0	7	0	38

SETTING PRIORITIES FOR TREATMENT

After the land manager has determined whether stands need treatment, he still may need to decide which stand he is going to treat first. The diameter potential classes in stands B and C below show that neither stand has had a history of long suppression. In both stands growth is now declining, as shown by the downward shift of trees in 10-year growth potential classes. This indicates both stands are suffering from some degree of overstocking. However, stand B shows a more severe growth decline because the 10-year growth rates of about three-fourths of the crop trees fall in the lower two potential classes, as compared to stand C where only about 40 percent of the trees are found in the lower two classes. From this comparison the manager may conclude that in stand B more crop trees would benefit by removal of excess trees.

Table 3.--Comparing growth performance, stands B and C

Potential class	Stand B		Stand C	
	Diameter potential	Growth potential	Diameter potential	Growth potential
	Percent			
>0.80	70	0	75	9
0.60-0.79	30	25	20	50
0.40-0.59	0	37	5	33
<0.40	0	38	0	8

EVALUATING EFFECTS OF TREATMENT

The comparison technique reveals stand dynamics and to this extent it is useful in evaluating the effect of thinning. For example, in the stand described by the tabulation below, which was thinned 10 years ago,[3] nearly one-half of the trees are in the lower two classes, showing considerably depressed growth in the past. However, examination of the frequencies of 10-year growth potential rates shows that most trees are now achieving growth at or near the potential rate. In fact, about 80 percent of the trees are in the upper two potential classes; this points to a substantial response to crop-tree thinning.

Potential class	Diameter potential (percent)	Growth potential (percent)
>0.80	20	60
0.60-0.79	32	20
0.40-0.59	43	12
<0.40	5	8

[3] Approximately 175 dominant and codominant western larch trees of good form and free from visible defect were left after thinning.

THE TECHNIQUE IN PRACTICE

This technique can be used in any sampling method such as plot, strip, and random selection where tree age, diameter, and growth measurements are made. The only requirement is that enough trees be included in the sample to show the distribution of trees among potential classes. In some of the examples we have used only a few trees to simplify the illustration. Usually at least 25 trees would be included in a sample, and in some cases more may be required to accurately reflect distribution of trees in potential classes.

Usually the manager is primarily concerned with condition and trend of the crop trees in a stand. Therefore, the technique should be applied to crop trees or that portion of the stand that will be featured in management. Obviously, including trees that would not be considered in management would merely tend to distort the picture by skewing the distribution into lower potential classes.

This technique has several uses. In the preceding examples we have illustrated its use in detecting overcrowding and setting priorities for thinning. In addition, it can be used to measure other factors such as release from overstory or the impact of insects, disease, and other growth-depressing agents.

The technique is intended primarily as a convenient management tool that can be readily used with simple field measurements. It does not replace the more sophisticated analysis techniques used in making timber inventories, planning allowable cuts, or similar activities.