forest management note

Note No. 1 Northern Forest Research Centre Edmonton, Alberta

SITE INDEX CURVES FOR ASPEN IN THE PRAIRIE PROVINCES

Site index (SI), the average height of dominant trees at a specified reference age, has been widely accepted and used to describe site quality and productivity of even-aged, single-species stands. Trembling aspen (*Populus tremuloides* Michx.) in Alberta, Saskatchewan, and Manitoba usually grows in such stands.

Although the extensive aspen resource in the B.18a Mixedwood Forest Section (Rowe 1972) generally has been unexploited in the past, its use is now increasing, and a need is emerging for information related to the growth, yield, and productivity of aspen stands. One specific need is for a common set of aspen SI curves for the mixedwood forests of western Canada in a form that would lend itself to computer processing.

Based on available data, the following equation was developed to express the relationship between dominant height, stand age, and SI:

$$H_{dom} = 11.2831X + 16.3545X^2 - 29.9919X^3 - 27.3295X^4 + (1.0 + 0.5131X - 1.8902X^2 + 2.4873X^3)SI$$

where $X = (age - 50)/100$

Using the above equation, height curves were calculated for ages 10 to 80 years for SI classes of 12, 14, 16, 18, 20, and 22 m at age 50; they are illustrated in Fig. 1. To estimate mean H_{dom} and age on a sample plot, three or four trees are usually sufficient if the plot is stocked primarily with one aspen clone or even with different clones of similar height growth characteristics (Steneker and Wall 1970). If several clones of different height growth characteristics are present, some proportional sampling scheme should be used to estimate H_{dom}. Having an estimate of present H_{dom} and age, future height can be found simply by following the curves to the desired age and reading the corresponding height.

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REFERENCES

Johnson, F.A. and B. Worthington. 1963. Procedure for developing a site index estimating system from stem analysis data. U.S. For. Serv., Pac. Northwest For. Range Exp. Stn. Res. Pap. PNW7.

Johnstone, W.D. 1977. Yield of fully stocked spruce-poplar stands in the Mixedwood Forest Section of Alberta. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton, Alberta. Inf. Rep. NOR-X-175.

Kirby, C.L., W.S. Bailey, and J.G. Gilmour. 1957. Growth and yield of aspen in Saskatchewan. Sask. Dep. Nat. Resour., For. Br. Tech. Bull. 3.

Rowe, J.S. 1972. Forest regions of Canada. Environ. Can., Can. For. Serv. Ottawa, Ontario. Publ. No. 1300.

Steneker, G.A. and R.E. Wall. 1970. Aspen clones, their significance and recognition. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab. Winnipeg, Manitoba. Liaison Serv. Note MS-L-8.

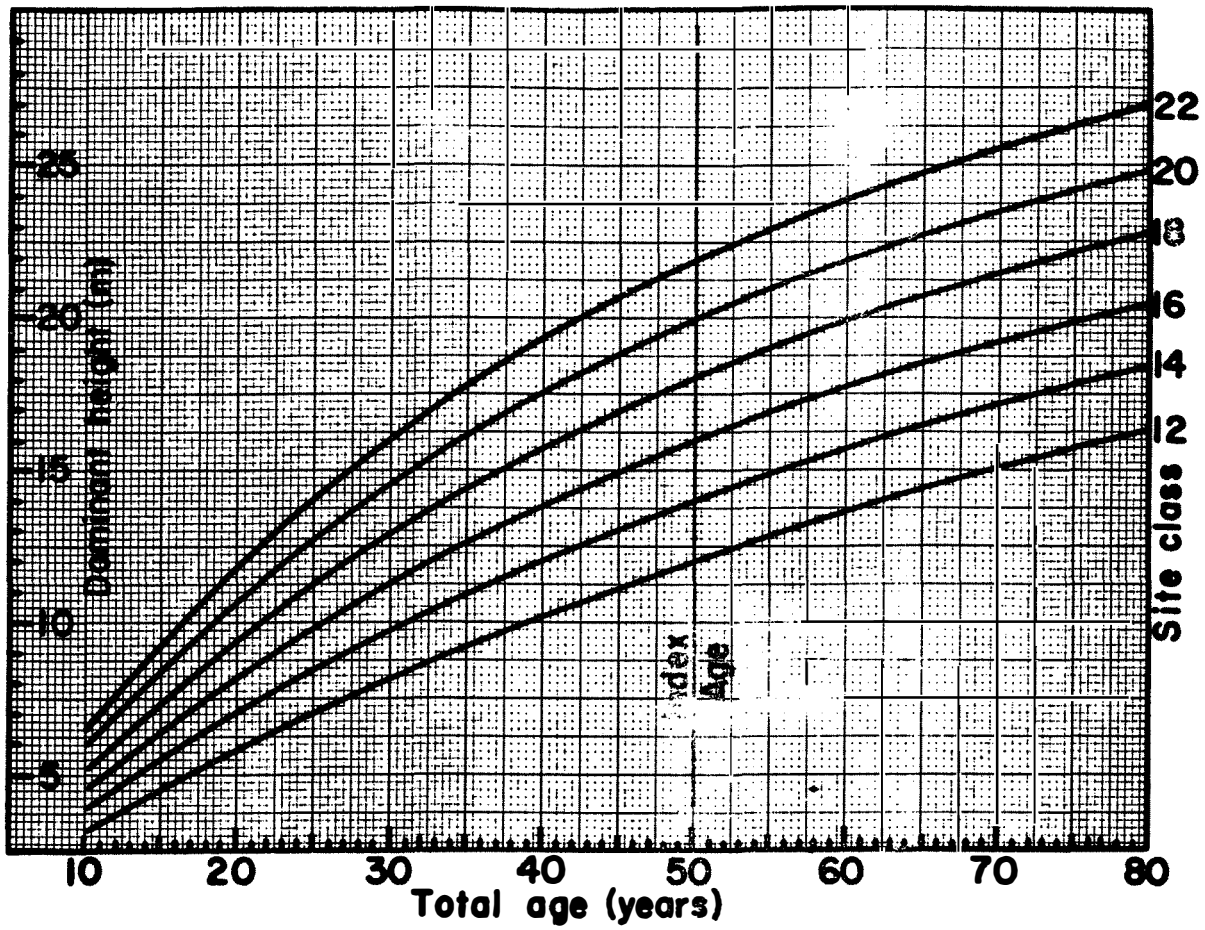

Figure 1. Site index curves for aspen.

DATA AND ANALYSIS

Site index curves may be prepared from measurements of height and age in a number of stands or from stem analysis of selected sample trees. An estimate of SI is available directly from the latter using measured height at reference age and also from projected heights from other ages.

Three sets of data were used to prepare the SI curves presented here:

1) values read from hand-drawn SI curves (plot data) in an unpublished report (CFS file A-9) on aspen growth and yield in central and northern Alberta,
2) values read from hand-drawn curves (plot data) published by Kirby *et al.* (1957),
3) from stem analysis of 30 suitable dominant aspen trees around 80 years of age sampled near Hudson Bay, Saskatchewan. Field sampling was done by the Aspenite Division of MacMillan-Bloedel Ltd., and laboratory analysis was by the CFS.

For deriving the present SI curves, an approach was used similar to that described by Johnson and Worthington (1963), Johnstone (1977), and others. Plotting all data revealed that the two sets of values read from the SI curves generally overlapped and were well within the midranges of the stem analysis data.

Linear regressions for each 5-year age interval were derived from these data using the form:

$$H_{dom} = a + b\ SI$$

Each value read from the SI curves represented many more source data points than the interpolated values from stem analysis. To allow for this, arbitrary weights were assigned: 3 to the Alberta and 4 to the Saskatchewan points. These weights were related inversely to the number of levels of SI curves (5 and 3, respectively) and hence to the number of values read. Thus the values from the two SI curves provided 27 data points compared to 29 points from the stem analyses (data from one tree was rejected).

To combine the above series of regressions, intercept values (a's) thus derived were fitted over age using polynomial models conditioned to zero at age 50. A 4th-degree polynomial provided a satisfactory fit:

$$a = 0.0 + 11.2831X + 16.3545X^2 - 29.9919X^3 - 27.3295X^4$$

where $X = (age - 50)/100$, $n = 16$, $R^2 = 0.999$

Similarly, b coefficients were fitted over age using polynomial models conditioned to equal 1.0 at age 50. The following model provided a satisfactory fit:

$$b = 1.0 + 0.5131X - 1.8902X^2 + 2.4873X^3$$

where $X = (age - 50)/100$, $n = 16$, $R^2 = 0.999$

Substituting the regressions for a and b into the general model ($H_{dom} = a + b\ SI$) resulted in this final SI equation:

$$H_{dom} = 11.2831X + 16.3545X^2 - 29.9919X^3 - 27.3295X^4 + (1.0 + 0.5131X - 1.8902X^2 + 2.4873X^3)SI$$

where $X = (age - 50)/100$

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