SITE INDEX EQUATIONS FOR DOUGLAS FIR IN KAINGAROA FOREST

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ABSTRACT

Site index (height of the dominant stand at some specified reference age) is a practical and commonly used method for quantifying site quality in pure even-aged stands. Permanent plot records from Douglas fir (**Pseudotsuga menziesii** (Mirb) Franco) stands in Kaingaroa Forest were used to compute site index equations. Coefficients for the equation developed are presented, and limitations in the application of the equation are discussed.

INTRODUCTION

More than 12 000 ha have been planted with Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) in Kaingaroa Forest. To manage these stands prudently and to make judicious decisions regarding possible future establishment of Douglas fir, it is important that reliable methods for quantifying site quality and for projecting height development be available. A practical means for quantifying site quality is the use of the height of the dominant stand at a specified reference age — a site index. This note reports on Douglas fir site index equations for Kaingaroa Forest.

DATA

Data from plots in the Forest Service Permanent Sample Plot computerised system were used to derive site index equations. This analysis was restricted to Kaingaroa Forest because sufficient data were not available for other areas and there was no sound basis for combining the limited data from other forests with that from Kaingaroa.

In total 557 observations from 74 permanent plots were used for the analyses reported here. Observations consisted of mean top height, defined as the predicted mean height of the 100 largest-diameter stems per hectare*, and stand age (years since planting). In addition, site index (base age 40†) was determined for each plot by fitting the function

$$\ln(H) = b_0 + b_1 (1/A)$$

where H is mean top height and A is number of years since planting.

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* Although mean top height is defined on a per-hectare basis, in practice sample plots much smaller than 1 ha are generally used in its determination. However, to date, a standard plot size has not been specified.

† The use of base age 40 for Douglas fir site index in Kaingaroa Forest was originally suggested by C. Mountfort.

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The plot height-age function was evaluated at A = 40 to determine site index. To avoid large errors in estimating site index, only plots with measurements near age 40 were used. If height measurements occurred at ages below and above 40, the plot was retained. For plots with all measurements below age 40, the last measurement was required to be at age 36 or older to retain the plot; in plots with all measurements above age 40, the first measurement must have occurred at age 44 or younger to use the plot records for subsequent analyses.

All sample plots were in pure even-aged stands of Douglas fir. Many of the plots had been thinned; however there was considerable variation in the timing and intensity of the thinning. Records covered a range of age from 18 to 63 years, and a range of site index (base age 40) from 23.9 to 35.9 m.

ANALYSES AND RESULTS

Analytical procedures followed for the Kaingaroa Douglas fir height-growth data were similar to those used by Burkhart and Tennent (1977) for radiata pine (*Pinus radiata* D. Don). The model employed to express height as a function of age and site index was:

$$H = (S/(1\text{-}\exp(b_1.S.40))^{b}2)\ (1\text{-}\exp(b_1.S.A))^{b}2$$

where H is mean top height (m) at a given age (years since planting) A, S is site index (mean top height at age 40), and b_1 and b_2 are constants to be estimated from the data. Solving for coefficients by using non-linear regression techniques gave the following result:

$$H = (S/(1\text{-}\exp(-0.0011619S.40))^{1.8835})\ (1\text{-}\exp(-0.0011619S.A))^{1.8835}$$

with standard error of estimate equal to 1.028 m and standard errors of b_1 and b_2 of 0.00005064 and 0.07497 respectively. Site index curves generated from the equation shown above are displayed in Fig. 1.

DISCUSSION

Predicted height development from the equation presented here is quite similar to the "North Island pumice" height growth trend given by Spurr (1963). However, after age 50 the Kaingaroa site index equation "flattens" more than Spurr's height growth curves.

Spurr (1963) showed considerable variation between height growth patterns in Douglas fir stands on North Island pumice and on South Island sites. The site index equation presented here may not be applicable outside Kaingaroa Forest. Before applying the equation beyond the area for which it was developed, its validity should be verified with measurement data.

ACKNOWLEDGMENTS

See Burkhart and Tennent (1977).

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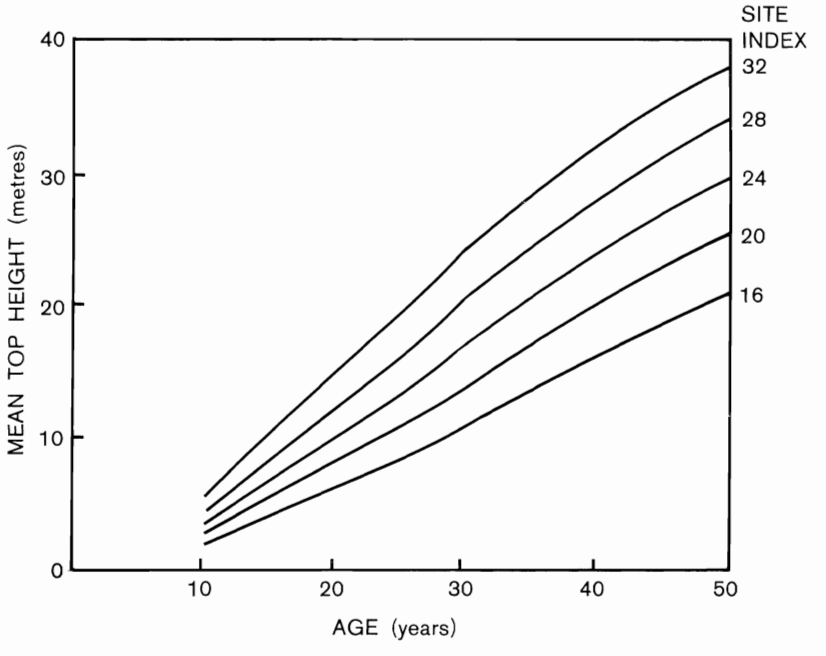

FIG. 1—Site index curves for Douglas fir in Kaingaroa Forest.