FOREST PRACTICES

Forest Site Management Section
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SILVICULTURE NOTE 21

PROGRESS REPORT: DEVELOPING A NEW SITE INDEX PREDICTOR FOR COMPLEX STANDS

Introduction

The BC Forest Productivity Council defines complex stands as those stands that are "uneven-aged, multi-storied, or mixed species with vertical structure[1]." A recent review suggests that site quality in complex stands will frequently be described as site index – just as it is in stands with a simple, even-aged structure (Site Productivity Working Group 1999). Unlike simple stands, it is difficult and, in many cases, impossible to estimate site index from the height and age of dominant trees in complex stands. Therefore, new techniques to estimate site index are required which are suitable for use in complex stands.

The Site Productivity Working Group (SPWG) coordinates the development of site productivity estimation techniques in BC (Site Productivity Working Group 1998). The SPWG is developing methods to estimate site productivity in complex stands. This note provides a brief, simplified overview of the progress of one project within the SPWG complex stands project area.

With Forest Renewal BC funding, the SPWG initiated a project in 1997 to develop a site index estimator suitable for complex stands that is based on radial increment. The initial focus was on uneven-aged Douglas-fir stands. This project was led by Pat Salm, RPF of Weyerhaeuser Canada Ltd. Weyerhaeuser contracted J.S. Thrower and Associates Ltd. to undertake the work that is described in this note.

1 Source: Forest Productivity Council of British Columbia web site (http://www.forestproductivity.gov.bc.ca/Standards/complex_stands.htm)

Data

Healthy, uneven-aged Douglas-fir stands without recent harvesting, in the IDFdk and IDFxh between Merritt and Princeton BC, were sampled (Table 1). Data were collected from 37 plots. At each plot, sample trees were selected by prism. Trees were measured for diameter (dbh), total height, previous 10 year radial increment and many other variables. In the vicinity of the plot, site trees were identified and their height and age used to estimate site index.

Table 1. Characteristics of the data

	Basal area[1] (m^2/ha)	Tree density[1] (#/ha)	Mean diameter[1] (cm)	Douglas-fir site index (m)
N of plots	37	37	37	30
Minimum	10.7	88	16.8	10.2
Maximum	84.0	2173	51.7	24.6
Median	32.0	714	30.1	18.6
Mean	39.2	831	30.5	17.7
Std. Dev.	20.5	545	7.9	3.7

1 All trees >7.5 cm dbh.

Map Label Site Index

For 16 plots, the site index reported on the forest cover map label could be compared to the site index estimated from site trees sampled on the ground (Figure 1). On average, the forest cover map labels underestimate site index by 2 m.

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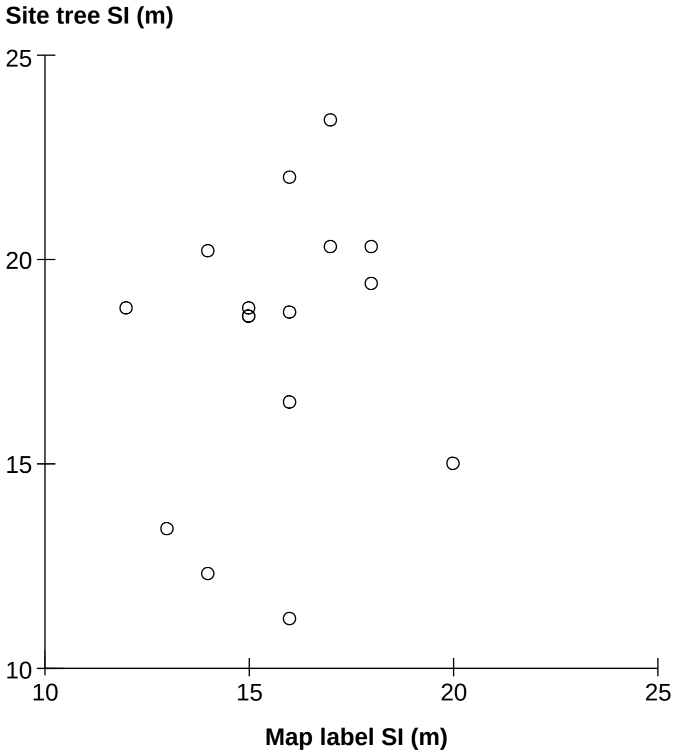

Figure 1. Comparison of forest cover map label site index and ground estimate of site index in the 16 plots where both were available.

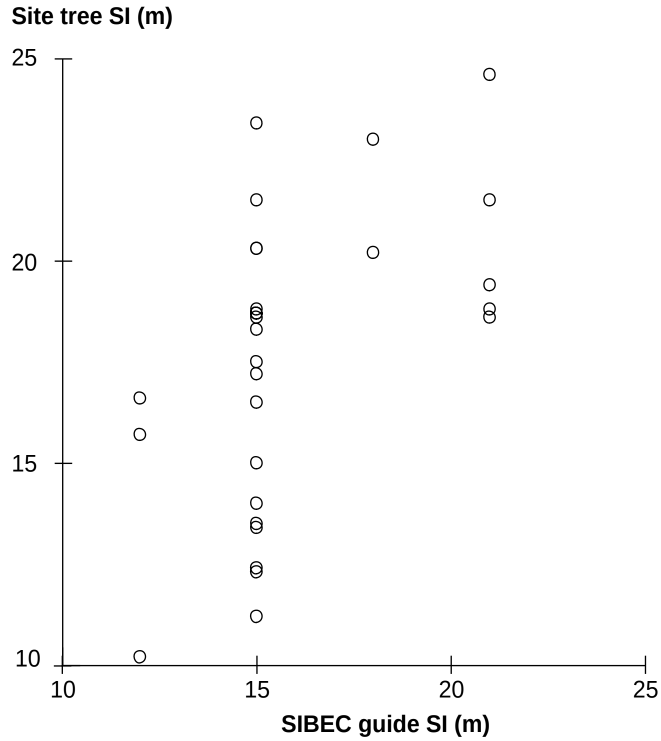

Figure 2. Comparison of SIBEC site index and ground estimate of site index in the 29 plots where both were available.

SIBEC Site Index

For 29 plots, the site index estimated by the provincial SIBEC guide (BC Ministry of Forests 1997) could be compared to the site index estimated from site trees sampled on the ground (Figure 2). Though SIBEC site index follows the trends in site productivity suggested by the ground estimates of site index, considerable variation remains. On sites where the SIBEC guide estimates a site index of 15 m, the average ground estimate is 17 m.

Site Index Prediction Model

A preliminary model was developed that predicts site index from:

1. average 10 year radial increment
2. average height
3. variability of diameters expressed as weighted standard deviation of dbh divided by average dbh.

This site index model had a root mean square error of 2.4 m and an R^2 of 58%. More detail on the data and model are provided in the project report (J.S. Thrower and Associates Ltd. 1999).

For 30 plots, the site index estimated by the new model could be compared to the ground estimate of site index (Figure 3).

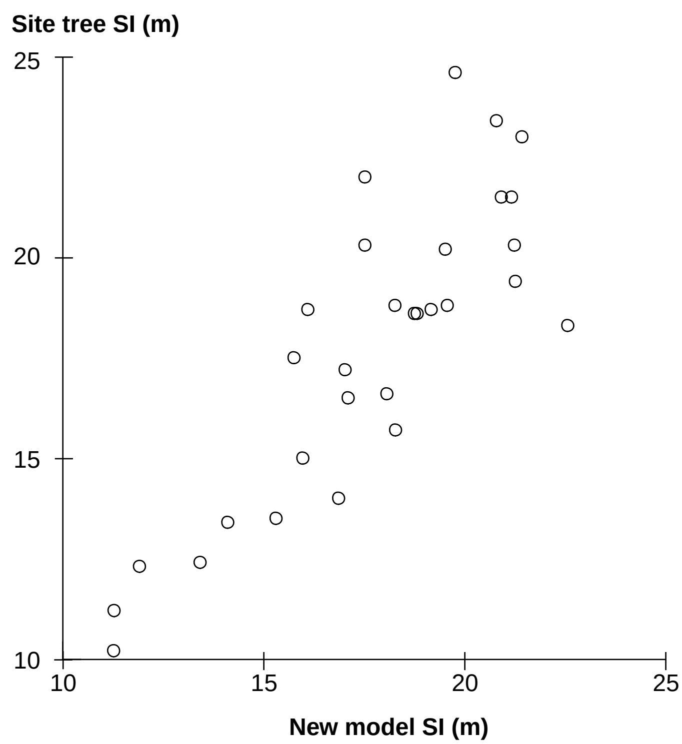

Figure 3. Comparison of the site index estimated by the new model and the ground estimate of site index in the 30 plots where both were available.

Site index and radial increment

On sites where trees achieve greater 10 year radial growth, the model predicts a higher site index. Figure 4 displays the behaviour of the site index model in stands with an average height of 15.2 m and a typical variability of diameters.

Site index and average height

On sites where trees achieve a greater average height, the model predicts a higher site index. Figure 5 illustrates the impact of variation in average height on the site index-radial increment relationship. Site index predictions outside of the range of the sample data are excluded from the graph.

Site index and variability of tree size

On sites where stands develop a greater variation in tree size, the model predicts a higher site index. Figure 6 illustrates the impact on the site index-radial increment relationship of changes in the degree of variation of diameters in a stand. Site index predictions outside of the range of the sample data are excluded from the graph.

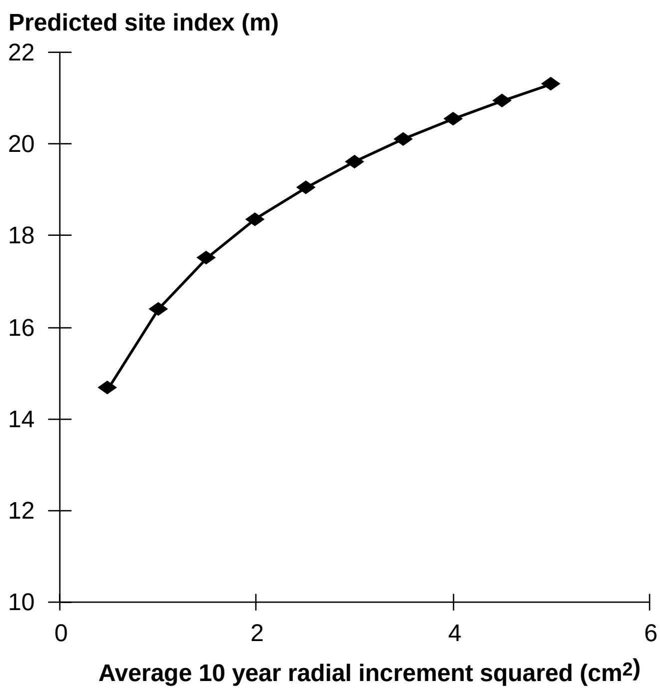

Figure 4. The relationship between predicted site index and radial increment in stands with an average height of 15.2 m and a typical variability of diameters.

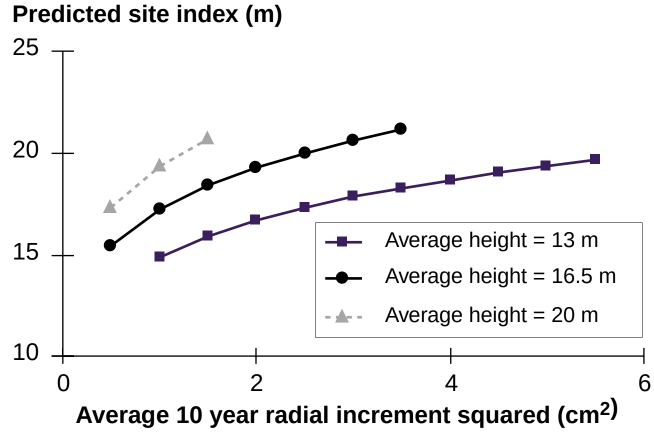

Figure 5. Impact of variation in average height on the relationship between predicted site index and radial increment given a typical variability of diameters.

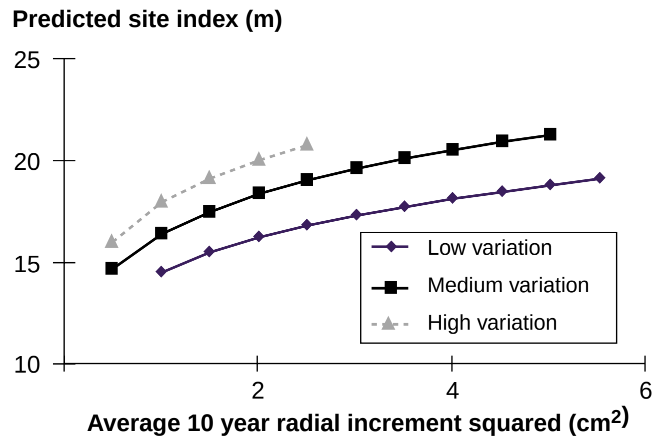

Figure 6. The degree of variation of diameters in a stand impacts the relationship between predicted site index and radial increment. Stand average height is 15.2 m.

Discussion

In 1999, the SPWG is continuing work on the preliminary site index model. This work focuses on evaluating, refining and improving the model. Once that task is completed, the full description of a method to estimate site index from radial increment, which is suitable for use in complex stands, will be published. The structure of the model and the relationships depicted in this paper may change as a result of the next round of refinements. The preliminary model appears unsuitable for stands that have received partial harvesting.

Monserud (1984) found that with careful screening, site trees could be selected in many uneven-aged Douglas-fir stands. Though site trees were selected carefully in our study, the possibility remains that the ground estimates of site index are biased due to suppression.

Complex stands pose numerous problems to growth and yield specialists. Other approaches to estimating site productivity that can be employed in stands with complex structures are also being developed by the SPWG. The project described in this note is being pursued as part of a coordinated program to develop site productivity estimators suitable for all forest stand and site conditions in BC (Site Productivity Working Group 1998).

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Site Productivity Working Group