Ecologically Based Site Index Curves and Tables

for

Major Alberta Tree Species

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ABSTRACT

This document presents ecologically based, reference-age invariant polymorphic height growth and site index models for major Alberta tree species. The models were developed using tree sectioning data from dominant and codominant trees. They can be used to predict the following: 1) tree height from site index and breast height age, 2) site index from tree height and breast height age, 3) years needed for a tree to grow to any specified height, and 4) height growth intercept. Since the models were fitted for the province as a whole and for groups of newly classified Natural Regions of Alberta, they can also be used to examine the regional differences of the height growth patterns. Relationships among breast height age, stump age and total age were also established so that compatible height growth and site index predictions can be made from any type of tree age. Tables and computer programs for predicting height growth and site index were prepared, along with a brief description of how to use them. The companion document, Ecologically Based Reference-Age Invariant Polymorphic Height Growth and Site Index Curves for White Spruce in Alberta (Huang 1994a), provides more detailed descriptions of the development of the models and procedures for implementing them.

Additional keywords: height-age relationship, polymorphic site index curves, ecosystem management, stand productivity.

1.0 INTRODUCTION

This document presents ecologically based, reference-age invariant polymorphic height growth and site index models for major Alberta tree species. The models were developed using the most recent ecological site classification results (Alberta Environmental Protection 1994) and were tied to the Natural Regions of Alberta (also called Ecoregions of Alberta, see Figure 1). They are an important mensurational component of the ecosystem-based forest management that is being actively pursued by the Alberta Land and Forest Services. Development of the height growth and site index models is also a primary and necessary step toward establishing ecologically based, variable density growth and yield estimations for natural and regenerated stands in Alberta.

The ecologically based height growth and site index models presented here have a number of desirable characteristics (Goelz and Burk 1992), including polymorphism, reference-age invariance, pass through appropriate heights at the reference-age and logical behaviour beyond the range of the original data. More detailed descriptions of the development of the models and their associated theoretical and practical implications are presented in Ecologically Based Reference-Age Invariant Polymorphic Height Growth and Site Index Curves for White Spruce in Alberta (Huang 1994a). The models can be used to accomplish the following:

1. Estimate total tree height from site index and breast height age. The model can be used to predict tree height at any age from site index and breast height age, or from any current height and breast height age without requiring a known site index.

2. Estimate site index from total height and breast height age. The model provides reference-age invariant polymorphic site index estimation given total height and breast height age (see Appendix 1 for the computations). The site index estimation is compatible with the total height estimation. Polymorphic site index curves that pass through appropriate heights at the reference-age can be constructed from the height growth and site index model.

3. Calculate years needed for a tree to grow to any specified height. The model answers a frequently asked question — how many years are needed for a tree to grow to 2 m, 5 m, 10 m, 20 m, or any other height on different sites and in different natural regions?

4. Compute height growth intercept. Growth intercept is the periodic height increment above a defined base height (usually breast height, 1.5 m, or 2.0 m). It is often used to estimate site productivity in young and regenerated stands. The model developed in this study can be used to compute and compare height growth intercepts and to evaluate height growth performance and estimate site productivity.

5. Examine the regional height growth differences. The model was fitted for the province as a whole and for groups of newly classified Natural Regions of Alberta. This approach allows regional differences of the height growth and site index curves to be examined and compared.

Provincial stem analysis data from felled trees were used to develop the height growth and site index models for major Alberta tree species. The data were randomly collected throughout the inventoried areas of the province to provide representative information for a variety of densities, heights, species compositions, stand structures, ages and site conditions. A more detailed description of the data is provided in Huang (1994a) and in Alberta Forest Service (1988).

Although most results are presented using breast height age, relationships among stump age, total age and breast height age were established so that compatible height growth and site index estimations could be made from any type of tree age (Huang 1994a). The use of the Natural Regions of Alberta (Figure 1) as a basis for subdividing Alberta reflects a significant refinement over the previously defined volume sampling regions (Alberta Forest Service 1985a), and should ensure compatibility with the ever-increasing needs of ecologically based, integrated forest management in Alberta.

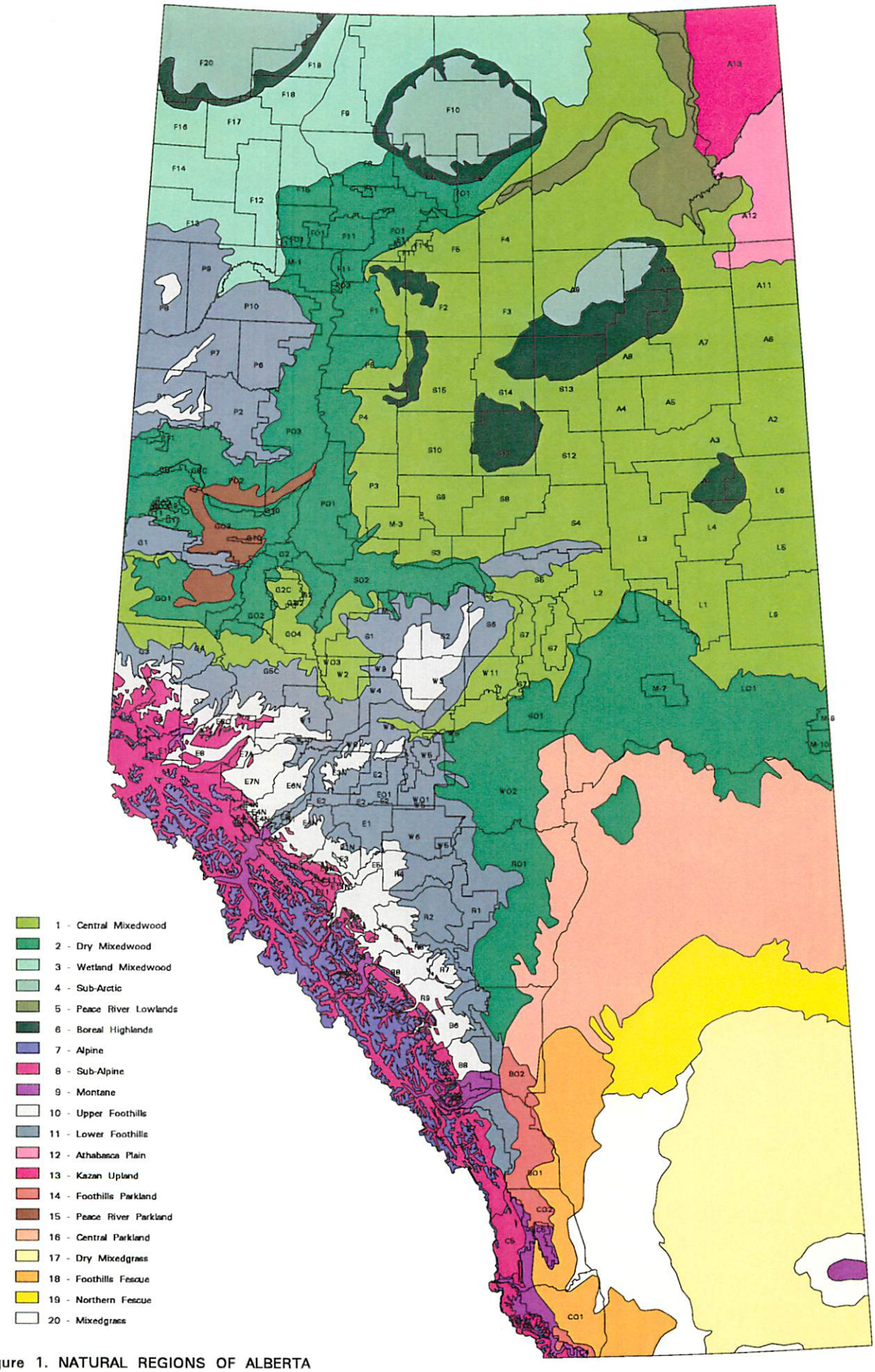

Figure 1. NATURAL REGIONS OF ALBERTA

Produced by Forest Resource Information Branch, Edmonton

Scale 1:5 000 000

2.0 SITE INDEX CURVES AND TABLES

This section lists the following items for each of the major tree species in Alberta:

1. Height growth and site index models;
2. Nonlinear least squares estimates of the parameters, along with associated fit statistics;
3. Site index curves, overlaid to actual height growth trajectories from felled trees; and
4. Height growth and site index tables for predicting total height and site index.

Development of the ecologically based height growth and site index models, together with detailed application guidelines and examples, were described in Huang (1994a). A brief summary of how to use the models and tables is provided in Section 4.0 of this document. The nonlinear least squares fit statistics and residual plots are shown in Ecologically Based Reference-Age Invariant Polymorphic Height Growth and Site Index Curves for Major Alberta Tree Species: Least Squares Fit Statistics and Residual Plots (Huang 1994b). The coefficient of determination (R^2) and the mean squared error (MSE) for the height growth and site index models are calculated according to the following formulas:

$$[1] \qquad R^2 = 1 - \frac{\sum_{i=1}^{n} (H_{2i} - \hat{H}_{2i})^2}{\sum_{i=1}^{n} (H_{2i} - \bar{H})^2}$$

$$[2] \qquad MSE = \frac{\sum_{i=1}^{n} (H_{2i} - \hat{H}_{2i})^2}{n-m}$$

where: H_{2i} = actual tree height (m)

$\hat{H}_{2i}$ = predicted tree height (m)

$\bar{H}$ = observed average tree height (m)

m = number of parameters

n = number of observations.

2.1 WHITE SPRUCE

White spruce height growth model:

$$[3] \quad H_2 = 1.3+(H_1-1.3)\left(\frac{1-\exp\left(-b_0\left(H_1-1.3\right)^{b_1}b_2^{\left(H_1-1.3\right)/T_1}T_2\right)}{1-\exp\left(-b_0\left(H_1-1.3\right)^{b_1}b_2^{\left(H_1-1.3\right)/T_1}T_1\right)}\right)^{b_3\left(H_1-1.3\right)^{b_4}T_1^{b_5}}$$

where:

H_2 = tree height (m) at time two

T_2 = breast height age (years) at time two

H_1 = tree height (m) at time one

T_1 = breast height age (years) at time one

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

White spruce site index model (which is a special variant of the height growth model [3] with H_1 replaced by the site index SI and T_1 replaced by the reference-age T_R, respectively):

$$[4] \quad H = 1.3+(SI-1.3)\left(\frac{1-\exp\left(-b_0\left(SI-1.3\right)^{b_1}b_2^{\left(SI-1.3\right)/T_R}T_B\right)}{1-\exp\left(-b_0\left(SI-1.3\right)^{b_1}b_2^{\left(SI-1.3\right)/T_R}T_R\right)}\right)^{b_3\left(SI-1.3\right)^{b_4}T_R^{b_5}}$$

where:

H = tree height (m) at T_B

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at T_R

T_R = reference-age (= 50 years breast height age)

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Table 1. Fit statistics for the white spruce height growth model [3].

Natural regions[1]	Parameter	Estimate	Std. error	n	MSE	R^2
All	b_0	0.010168	0.000089	123,336	4.327	0.935
(provincial)	b_1	0.004801	0.002358			
	b_2	4.997735	0.102584			
	b_3	0.802776	0.002184			
	b_4	-0.243297	0.001797			
	b_5	0.325438	0.001723			
9, 11, 14	b_0	0.009934	0.000122	65,756	4.382	0.938
	b_1	0.003402	0.003171			
	b_2	5.251458	0.149279			
	b_3	0.812856	0.002901			
	b_4	-0.238341	0.002308			
	b_5	0.323275	0.002273			
7, 8, 10	b_0	0.008678	0.000190	16,612	4.332	0.938
	b_1	-0.016794	0.006018			
	b_2	6.696763	0.404300			
	b_3	0.821344	0.005915			
	b_4	-0.219351	0.004793			
	b_5	0.281849	0.004337			
1, 2, 3, 4, 5, 6	b_0	0.009656	0.000161	40,968	3.790	0.935
12, 13, 15, 16	b_1	0.098678	0.004449			
	b_2	3.707591	0.132483			
	b_3	0.720408	0.003575			
	b_4	-0.264794	0.003422			
	b_5	0.372548	0.003198			

[1]See Figure 1 for the list of natural regions and their designation numbers.

White Spruce Site Index Curves

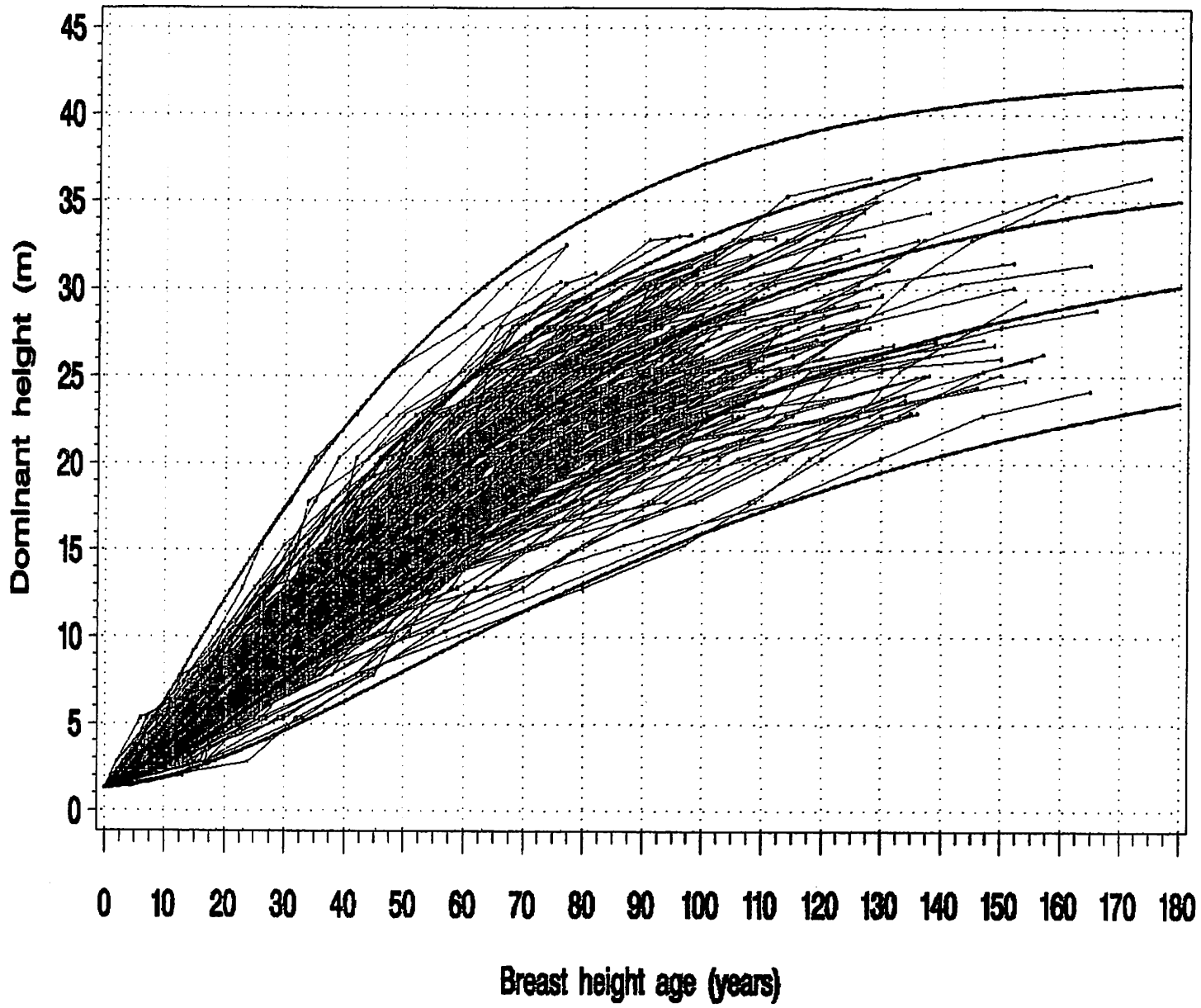

Figure 2. White spruce site index curves for natural regions 9, 11 and 14, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 8.0, 12.5, 17.0, 21.5 and 26.0 metres at a reference breast height age of 50 years (part I).

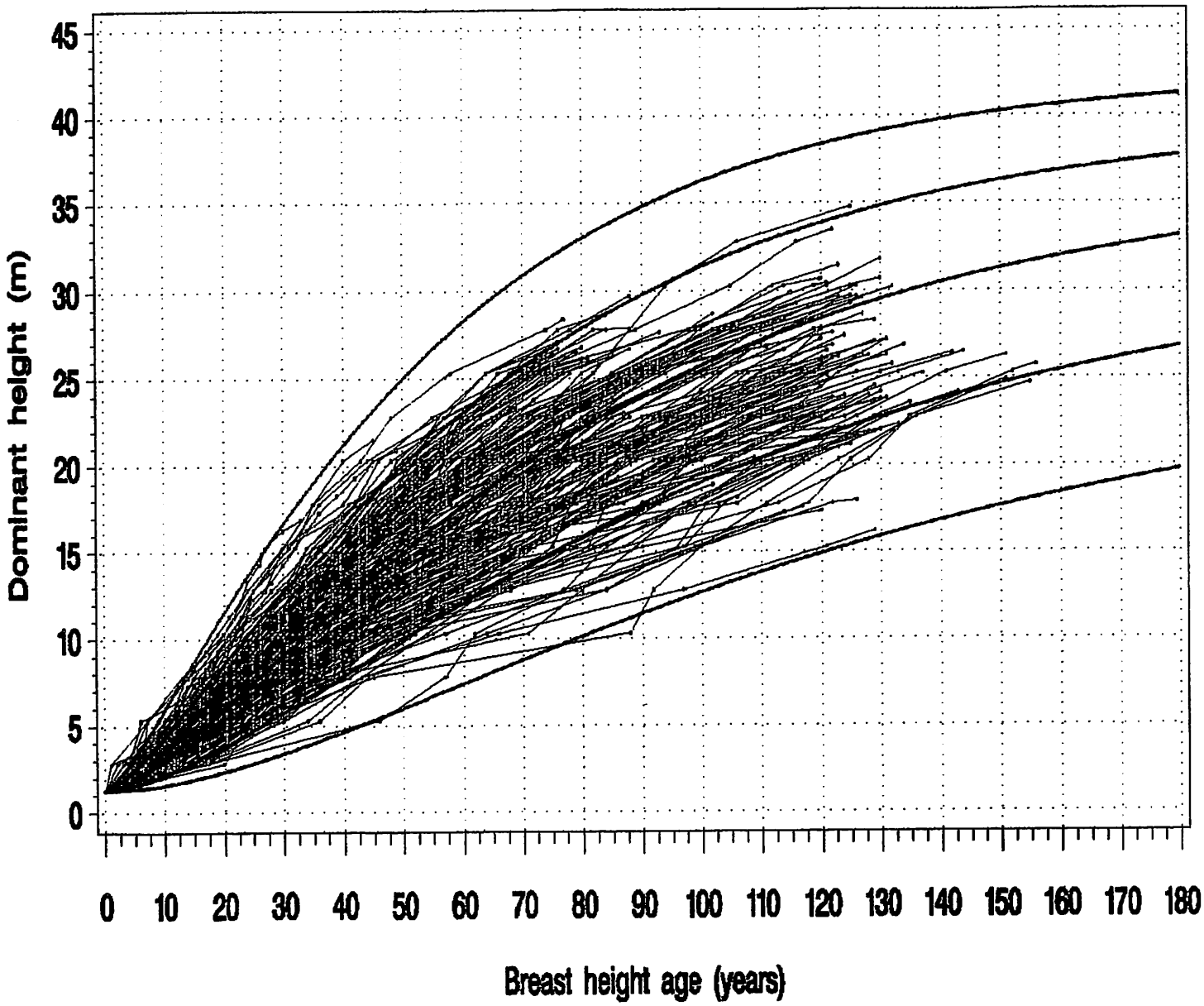

Figure 3. White spruce site index curves for natural regions 9, 11 and 14, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 6.0, 10.0, 15.0, 20.0 and 25.0 metres at a reference breast height age of 50 years (part II).

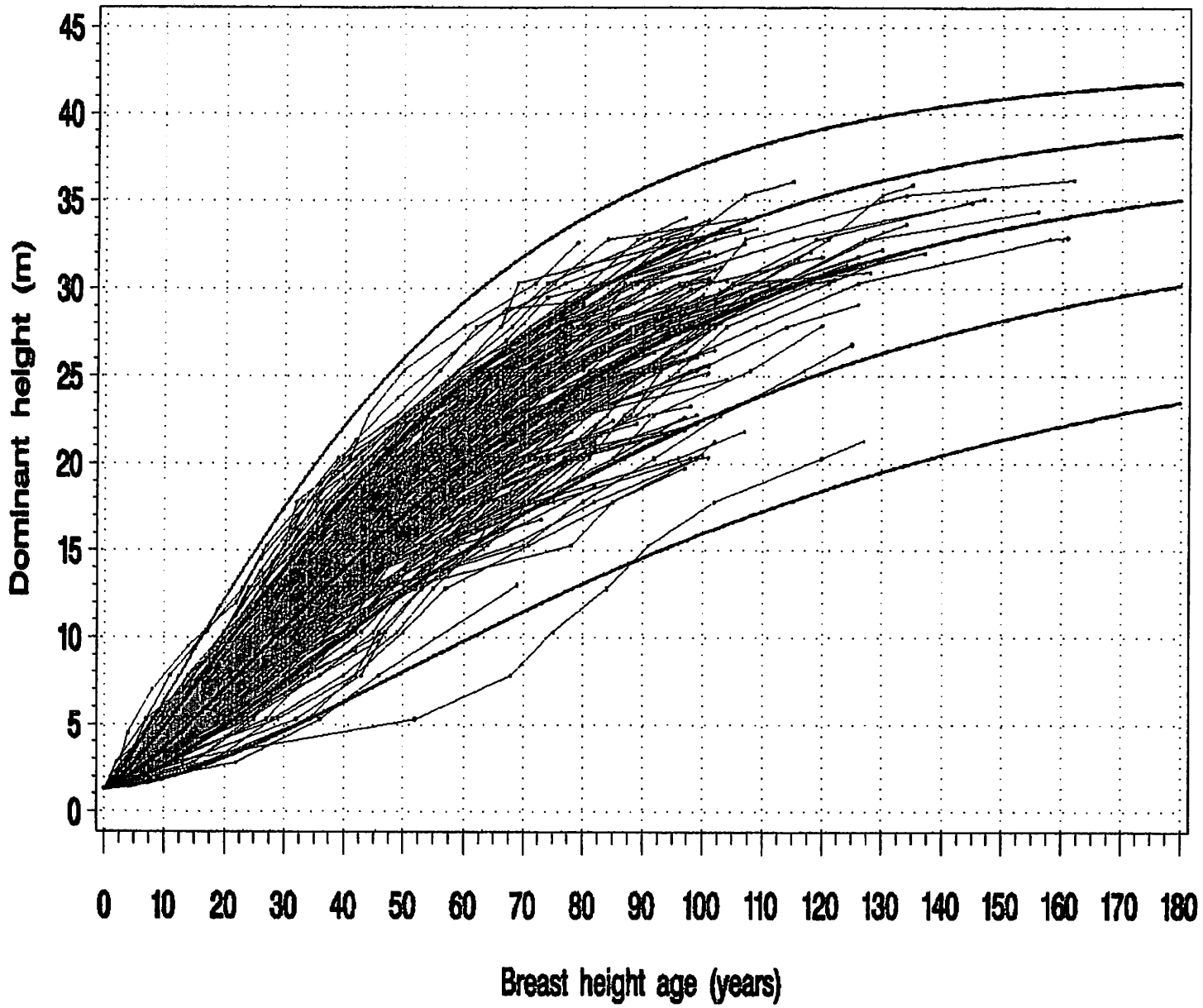

Figure 4. White spruce site index curves for natural regions 9, 11 and 14, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 8.0, 12.5, 17.0, 21.5 and 26.0 metres at a reference breast height age of 50 years (part III).

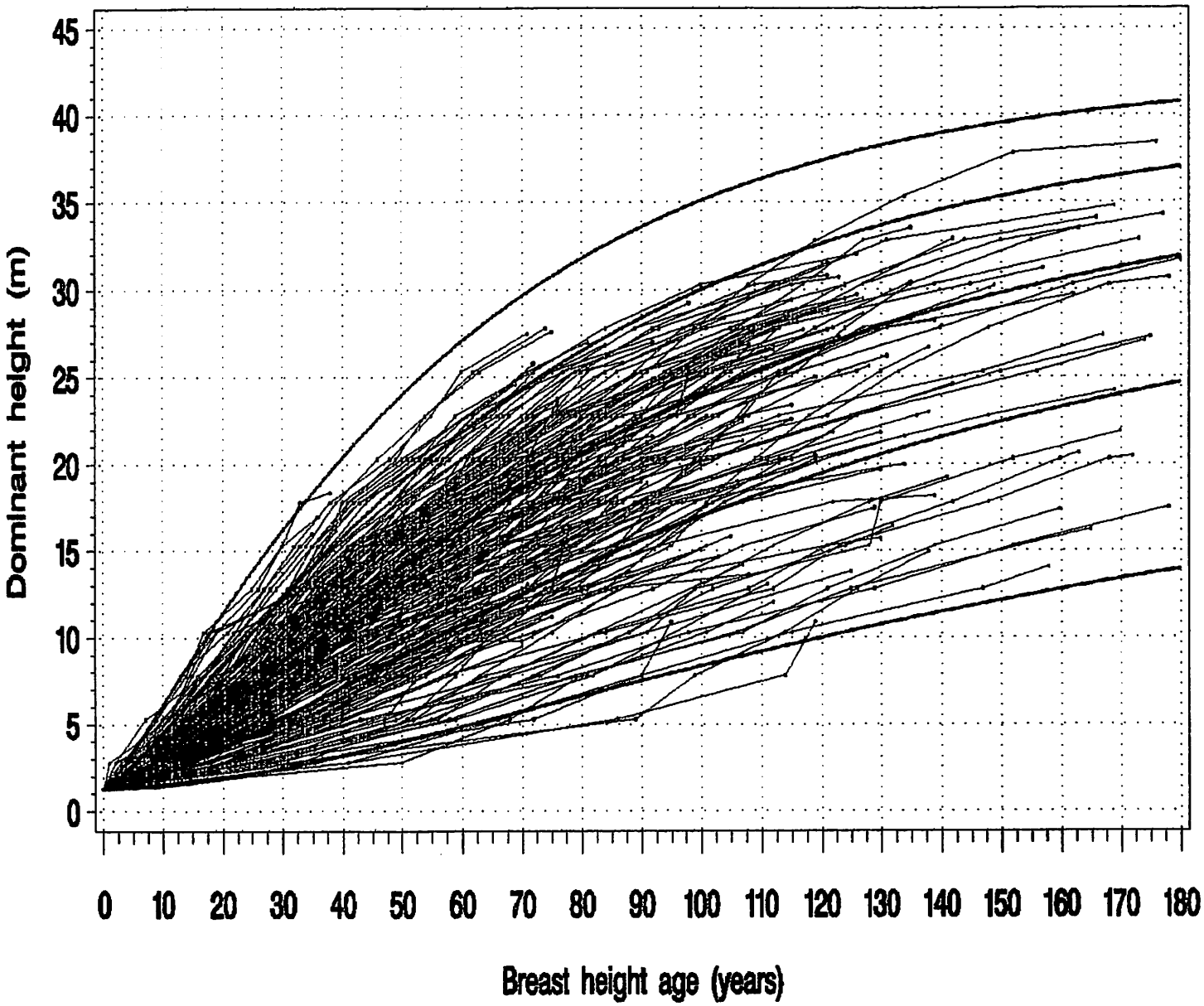

Figure 5. White spruce site index curves for natural regions 7, 8 and 10, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 4.0, 9.0, 14.0, 19.0 and 24.0 metres at a reference breast height age of 50 years.

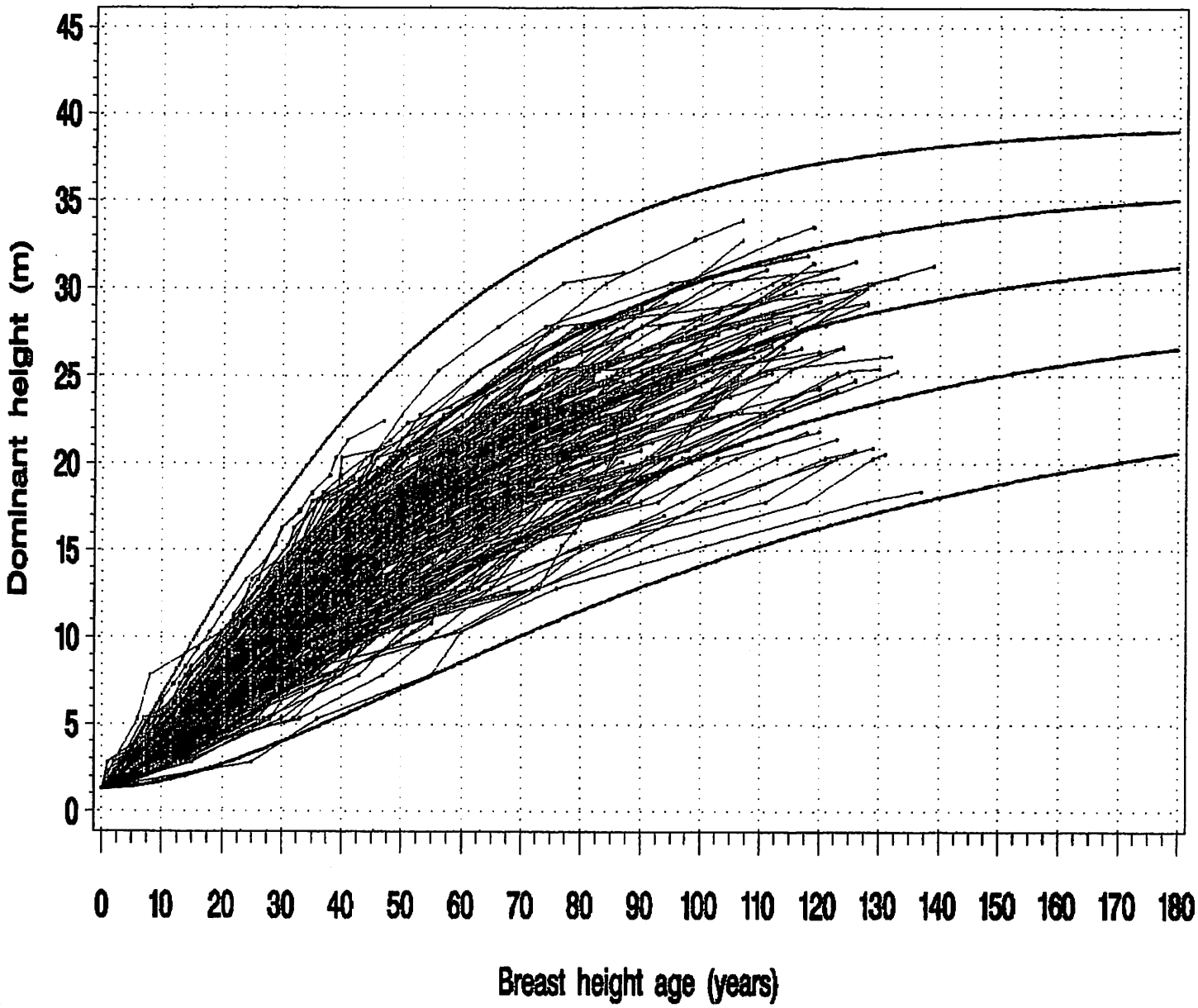

Figure 6. White spruce site index curves for natural regions 1 to 6, 12, 13, 15 and 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 7.0, 11.5, 16.0, 20.5 and 26.0 metres at a reference breast height age of 50 years (part I).

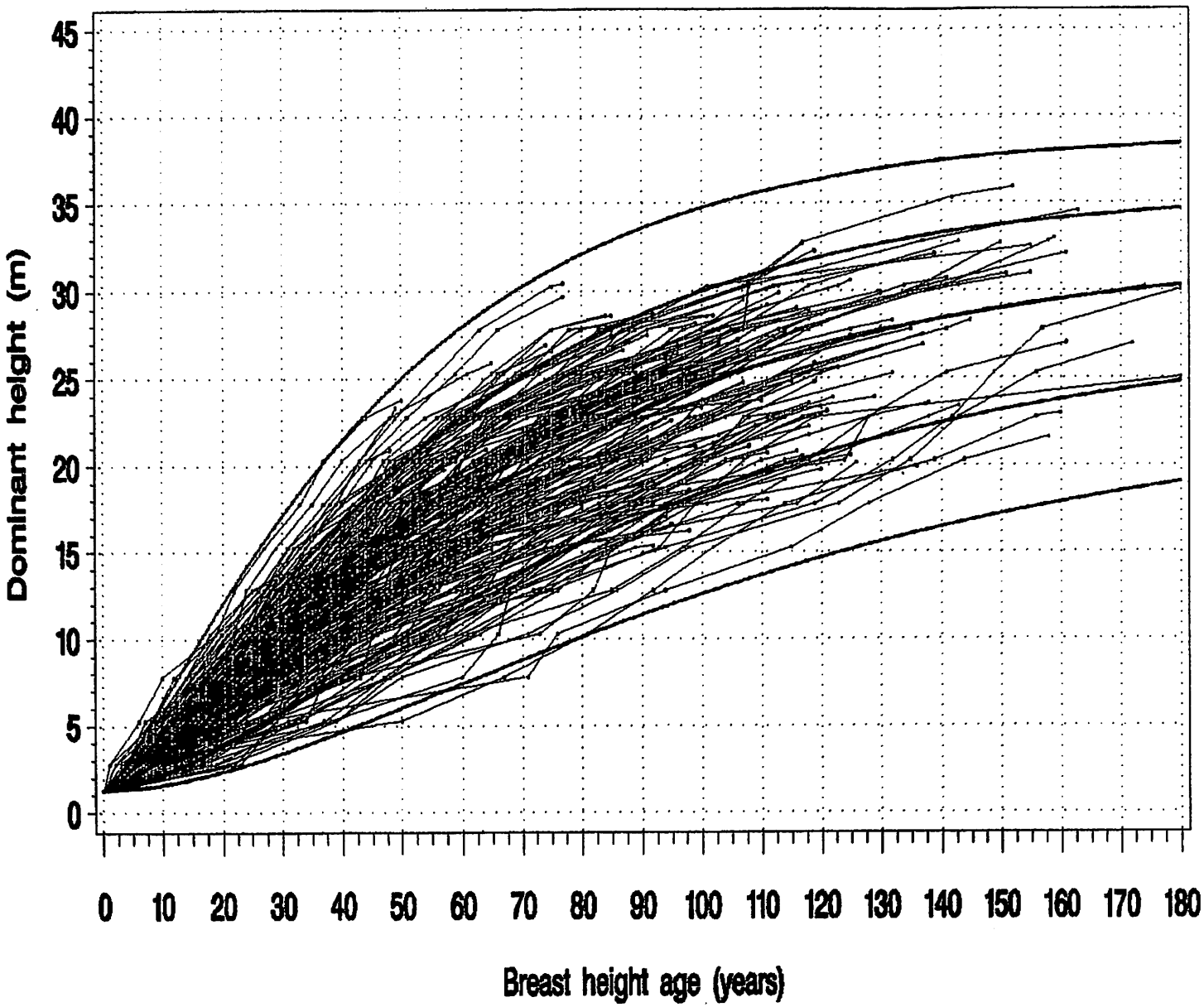

Figure 7. White spruce site index curves for natural regions 1 to 6, 12, 13, 15 and 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 6.0, 10.0, 15.0, 20.0 and 25.0 metres at a reference breast height age of 50 years (part II).

White Spruce Site Index Tables

Table 2. Provincial white spruce height growth and site index table (natural regions: 1 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	3.0	3.2	3.3	3.5
10	1.4	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2	3.4	3.6	3.9	4.2	4.4	4.7	5.0	5.4	5.7	6.0	6.4
15	1.6	1.7	1.9	2.2	2.4	2.7	2.9	3.2	3.5	3.9	4.2	4.6	4.9	5.3	5.7	6.1	6.5	7.0	7.4	7.9	8.3	8.8	9.4
20	1.8	2.1	2.4	2.7	3.1	3.4	3.8	4.2	4.7	5.1	5.6	6.0	6.5	7.0	7.6	8.1	8.6	9.2	9.8	10.4	11.0	11.6	12.3
25	2.1	2.5	2.9	3.3	3.8	4.3	4.8	5.3	5.9	6.4	7.0	7.6	8.2	8.8	9.4	10.1	10.8	11.4	12.1	12.8	13.5	14.3	15.0
30	2.4	2.9	3.4	4.0	4.6	5.2	5.8	6.5	7.1	7.8	8.4	9.1	9.8	10.6	11.3	12.0	12.8	13.6	14.3	15.1	15.9	16.8	17.6
35	2.7	3.4	4.0	4.7	5.4	6.1	6.9	7.6	8.4	9.1	9.9	10.7	11.5	12.3	13.1	13.9	14.8	15.6	16.5	17.3	18.2	19.1	20.0
40	3.1	3.9	4.7	5.5	6.3	7.1	7.9	8.7	9.6	10.4	11.3	12.2	13.0	13.9	14.8	15.7	16.6	17.5	18.4	19.4	20.3	21.2	22.2
45	3.6	4.4	5.3	6.2	7.1	8.0	9.0	9.9	10.8	11.7	12.7	13.6	14.6	15.5	16.5	17.4	18.4	19.3	20.3	21.3	22.2	23.2	24.2
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.5	5.6	6.7	7.8	8.9	9.9	11.0	12.1	13.2	14.2	15.3	16.3	17.4	18.4	19.5	20.5	21.5	22.6	23.6	24.6	25.6	26.6	27.7
60	4.9	6.2	7.4	8.5	9.7	10.9	12.0	13.1	14.3	15.4	16.5	17.6	18.7	19.8	20.8	21.9	22.9	24.0	25.0	26.1	27.1	28.1	29.2
65	5.4	6.7	8.0	9.3	10.5	11.8	13.0	14.2	15.3	16.5	17.6	18.8	19.9	21.0	22.1	23.2	24.3	25.3	26.4	27.4	28.5	29.5	30.5
70	5.9	7.3	8.7	10.1	11.4	12.6	13.9	15.1	16.4	17.6	18.7	19.9	21.0	22.2	23.3	24.4	25.5	26.6	27.6	28.7	29.7	30.7	31.7
75	6.4	7.9	9.4	10.8	12.2	13.5	14.8	16.1	17.3	18.6	19.8	21.0	22.1	23.3	24.4	25.5	26.6	27.7	28.7	29.8	30.8	31.8	32.8
80	6.9	8.5	10.0	11.5	12.9	14.3	15.7	17.0	18.3	19.5	20.8	22.0	23.1	24.3	25.4	26.6	27.6	28.7	29.8	30.8	31.8	32.8	33.8
85	7.4	9.1	10.7	12.2	13.7	15.1	16.5	17.8	19.1	20.4	21.7	22.9	24.1	25.3	26.4	27.5	28.6	29.7	30.7	31.7	32.7	33.7	34.7
90	7.9	9.6	11.3	12.9	14.4	15.8	17.3	18.6	20.0	21.3	22.5	23.8	25.0	26.1	27.3	28.4	29.5	30.5	31.6	32.6	33.6	34.5	35.5
95	8.3	10.2	11.9	13.5	15.1	16.6	18.0	19.4	20.8	22.1	23.4	24.6	25.8	27.0	28.1	29.2	30.3	31.3	32.4	33.4	34.3	35.3	36.2
100	8.8	10.7	12.4	14.1	15.7	17.3	18.7	20.1	21.5	22.8	24.1	25.4	26.6	27.7	28.9	30.0	31.0	32.1	33.1	34.0	35.0	35.9	36.8
105	9.2	11.2	13.0	14.7	16.4	17.9	19.4	20.8	22.2	23.5	24.8	26.1	27.3	28.4	29.6	30.6	31.7	32.7	33.7	34.7	35.6	36.5	37.4
110	9.7	11.7	13.5	15.3	17.0	18.5	20.0	21.5	22.9	24.2	25.5	26.7	27.9	29.1	30.2	31.3	32.3	33.3	34.3	35.2	36.2	37.1	37.9
115	10.1	12.2	14.1	15.8	17.5	19.1	20.6	22.1	23.5	24.8	26.1	27.3	28.5	29.7	30.8	31.9	32.9	33.9	34.8	35.8	36.7	37.5	38.4
120	10.5	12.6	14.6	16.4	18.1	19.7	21.2	22.7	24.1	25.4	26.7	27.9	29.1	30.2	31.3	32.4	33.4	34.4	35.3	36.2	37.1	38.0	38.8
125	10.9	13.1	15.0	16.9	18.6	20.2	21.8	23.2	24.6	26.0	27.2	28.5	29.6	30.8	31.8	32.9	33.9	34.8	35.8	36.7	37.5	38.3	39.2
130	11.3	13.5	15.5	17.4	19.1	20.7	22.3	23.7	25.1	26.5	27.7	29.0	30.1	31.2	32.3	33.3	34.3	35.3	36.2	37.0	37.9	38.7	39.5
135	11.7	13.9	15.9	17.8	19.6	21.2	22.8	24.2	25.6	26.9	28.2	29.4	30.6	31.7	32.7	33.7	34.7	35.6	36.5	37.4	38.2	39.0	39.8
140	12.1	14.3	16.4	18.3	20.0	21.7	23.2	24.7	26.1	27.4	28.7	29.8	31.0	32.1	33.1	34.1	35.1	36.0	36.9	37.7	38.5	39.3	40.0
145	12.4	14.7	16.8	18.7	20.4	22.1	23.6	25.1	26.5	27.8	29.1	30.2	31.4	32.5	33.5	34.5	35.4	36.3	37.2	38.0	38.8	39.5	40.3
150	12.8	15.1	17.2	19.1	20.8	22.5	24.0	25.5	26.9	28.2	29.4	30.6	31.7	32.8	33.8	34.8	35.7	36.6	37.4	38.2	39.0	39.8	40.5
155	13.1	15.4	17.5	19.4	21.2	22.9	24.4	25.9	27.3	28.6	29.8	31.0	32.1	33.1	34.1	35.1	36.0	36.8	37.7	38.5	39.2	40.0	40.7
160	13.4	15.8	17.9	19.8	21.6	23.2	24.8	26.2	27.6	28.9	30.1	31.3	32.4	33.4	34.4	35.3	36.2	37.1	37.9	38.7	39.4	40.1	40.8
165	13.7	16.1	18.2	20.1	21.9	23.6	25.1	26.6	27.9	29.2	30.4	31.6	32.6	33.7	34.6	35.6	36.4	37.3	38.1	38.9	39.6	40.3	41.0
170	14.0	16.4	18.5	20.4	22.2	23.9	25.4	26.9	28.2	29.5	30.7	31.8	32.9	33.9	34.9	35.8	36.7	37.5	38.3	39.0	39.7	40.4	41.1
175	14.3	16.7	18.8	20.8	22.5	24.2	25.7	27.2	28.5	29.8	31.0	32.1	33.1	34.1	35.1	36.0	36.8	37.7	38.4	39.2	39.9	40.6	41.2
180	14.5	16.9	19.1	21.0	22.8	24.5	26.0	27.4	28.8	30.0	31.2	32.3	33.4	34.4	35.3	36.2	37.0	37.8	38.6	39.3	40.0	40.7	41.3

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 3. Regional white spruce height growth and site index table (natural regions: 9, 11, 14)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.0	2.2	2.3	2.4	2.5	2.6	2.8	2.9	3.1	3.2	3.4
10	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.6	3.8	4.1	4.3	4.6	4.9	5.2	5.5	5.9	6.2
15	1.6	1.7	1.9	2.1	2.4	2.6	2.9	3.2	3.5	3.8	4.1	4.5	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.7	8.2	8.7	9.2
20	1.8	2.0	2.3	2.7	3.0	3.4	3.8	4.2	4.6	5.0	5.5	5.9	6.4	6.9	7.4	8.0	8.5	9.1	9.6	10.2	10.8	11.4	12.1
25	2.0	2.4	2.8	3.3	3.8	4.2	4.7	5.3	5.8	6.3	6.9	7.5	8.1	8.7	9.3	10.0	10.6	11.3	12.0	12.7	13.4	14.1	14.8
30	2.4	2.9	3.4	4.0	4.5	5.1	5.8	6.4	7.0	7.7	8.4	9.0	9.7	10.5	11.2	11.9	12.7	13.4	14.2	15.0	15.8	16.6	17.4
35	2.7	3.4	4.0	4.7	5.4	6.1	6.8	7.5	8.3	9.0	9.8	10.6	11.4	12.2	13.0	13.8	14.7	15.5	16.3	17.2	18.1	19.0	19.9
40	3.1	3.9	4.7	5.4	6.2	7.1	7.9	8.7	9.5	10.4	11.2	12.1	13.0	13.9	14.7	15.6	16.5	17.4	18.4	19.3	20.2	21.2	22.1
45	3.5	4.4	5.3	6.2	7.1	8.0	8.9	9.9	10.8	11.7	12.6	13.6	14.5	15.5	16.4	17.4	18.3	19.3	20.2	21.2	22.2	23.2	24.1
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.5	5.6	6.7	7.8	8.9	10.0	11.0	12.1	13.2	14.2	15.3	16.4	17.4	18.5	19.5	20.5	21.6	22.6	23.6	24.6	25.7	26.7	27.7
60	5.0	6.2	7.4	8.6	9.8	10.9	12.1	13.2	14.3	15.4	16.6	17.7	18.7	19.8	20.9	22.0	23.0	24.1	25.1	26.2	27.2	28.2	29.2
65	5.4	6.8	8.1	9.4	10.6	11.8	13.1	14.2	15.4	16.6	17.7	18.9	20.0	21.1	22.2	23.3	24.4	25.4	26.5	27.5	28.6	29.6	30.6
70	6.0	7.4	8.8	10.1	11.5	12.7	14.0	15.3	16.5	17.7	18.9	20.0	21.2	22.3	23.4	24.6	25.6	26.7	27.8	28.8	29.8	30.9	31.9
75	6.5	8.0	9.5	10.9	12.3	13.6	14.9	16.2	17.5	18.7	19.9	21.1	22.3	23.5	24.6	25.7	26.8	27.9	28.9	30.0	31.0	32.0	33.0
80	7.0	8.6	10.1	11.6	13.1	14.5	15.8	17.2	18.5	19.7	21.0	22.2	23.4	24.5	25.7	26.8	27.9	28.9	30.0	31.0	32.0	33.0	34.0
85	7.5	9.2	10.8	12.3	13.8	15.3	16.7	18.0	19.4	20.7	21.9	23.1	24.3	25.5	26.7	27.8	28.9	29.9	31.0	32.0	33.0	34.0	34.9
90	8.0	9.7	11.4	13.0	14.6	16.1	17.5	18.9	20.2	21.5	22.8	24.1	25.3	26.4	27.6	28.7	29.8	30.8	31.9	32.9	33.8	34.8	35.7
95	8.4	10.3	12.1	13.7	15.3	16.8	18.3	19.7	21.1	22.4	23.7	24.9	26.1	27.3	28.4	29.5	30.6	31.7	32.7	33.7	34.6	35.6	36.5
100	8.9	10.9	12.7	14.4	16.0	17.5	19.0	20.5	21.8	23.2	24.5	25.7	26.9	28.1	29.2	30.3	31.4	32.4	33.4	34.4	35.3	36.2	37.1
105	9.4	11.4	13.2	15.0	16.6	18.2	19.7	21.2	22.6	23.9	25.2	26.5	27.7	28.8	29.9	31.0	32.1	33.1	34.1	35.0	36.0	36.9	37.7
110	9.9	11.9	13.8	15.6	17.3	18.9	20.4	21.9	23.3	24.6	25.9	27.2	28.4	29.5	30.6	31.7	32.7	33.7	34.7	35.6	36.5	37.4	38.3
115	10.3	12.4	14.4	16.2	17.9	19.5	21.0	22.5	23.9	25.3	26.6	27.8	29.0	30.1	31.2	32.3	33.3	34.3	35.3	36.2	37.1	37.9	38.7
120	10.8	12.9	14.9	16.7	18.5	20.1	21.7	23.1	24.5	25.9	27.2	28.4	29.6	30.7	31.8	32.9	33.9	34.8	35.8	36.7	37.5	38.4	39.2
125	11.2	13.4	15.4	17.3	19.0	20.7	22.2	23.7	25.1	26.5	27.7	29.0	30.1	31.3	32.3	33.4	34.4	35.3	36.2	37.1	37.9	38.8	39.5
130	11.6	13.8	15.9	17.8	19.5	21.2	22.8	24.3	25.7	27.0	28.3	29.5	30.7	31.8	32.8	33.8	34.8	35.7	36.6	37.5	38.3	39.1	39.9
135	12.0	14.3	16.3	18.3	20.0	21.7	23.3	24.8	26.2	27.5	28.8	30.0	31.1	32.2	33.3	34.3	35.2	36.1	37.0	37.9	38.7	39.4	40.2
140	12.4	14.7	16.8	18.7	20.5	22.2	23.8	25.2	26.7	28.0	29.2	30.4	31.6	32.7	33.7	34.7	35.6	36.5	37.4	38.2	39.0	39.7	40.5
145	12.8	15.1	17.2	19.2	21.0	22.6	24.2	25.7	27.1	28.4	29.7	30.9	32.0	33.1	34.1	35.0	36.0	36.8	37.7	38.5	39.3	40.0	40.7
150	13.1	15.5	17.6	19.6	21.4	23.1	24.7	26.1	27.5	28.8	30.1	31.3	32.4	33.4	34.4	35.4	36.3	37.1	38.0	38.7	39.5	40.2	40.9
155	13.5	15.9	18.0	20.0	21.8	23.5	25.1	26.5	27.9	29.2	30.5	31.6	32.7	33.8	34.7	35.7	36.6	37.4	38.2	39.0	39.7	40.4	41.1
160	13.8	16.2	18.4	20.4	22.2	23.9	25.4	26.9	28.3	29.6	30.8	32.0	33.0	34.1	35.0	36.0	36.8	37.7	38.5	39.2	39.9	40.6	41.3
165	14.1	16.6	18.7	20.7	22.5	24.2	25.8	27.3	28.6	29.9	31.1	32.3	33.3	34.4	35.3	36.2	37.1	37.9	38.7	39.4	40.1	40.8	41.4
170	14.4	16.9	19.1	21.1	22.9	24.6	26.1	27.6	29.0	30.2	31.4	32.6	33.6	34.6	35.6	36.4	37.3	38.1	38.9	39.6	40.3	40.9	41.6
175	14.7	17.2	19.4	21.4	23.2	24.9	26.5	27.9	29.3	30.5	31.7	32.8	33.9	34.9	35.8	36.7	37.5	38.3	39.0	39.7	40.4	41.1	41.7
180	15.0	17.5	19.7	21.7	23.5	25.2	26.8	28.2	29.5	30.8	32.0	33.1	34.1	35.1	36.0	36.9	37.7	38.5	39.2	39.9	40.6	41.2	41.8

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 4. Regional white spruce height growth and site index table (natural regions: 1 to 6, 12, 13, 15, 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.5	2.6	2.7	2.9	3.1	3.2	3.4	3.6
10	1.4	1.5	1.6	1.7	1.8	2.0	2.2	2.3	2.5	2.7	2.9	3.2	3.4	3.7	4.0	4.2	4.5	4.8	5.2	5.5	5.8	6.2	6.6
15	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.2	3.5	3.9	4.2	4.6	5.0	5.4	5.8	6.2	6.7	7.1	7.6	8.1	8.6	9.1	9.6
20	1.7	2.0	2.3	2.7	3.0	3.4	3.8	4.2	4.7	5.1	5.6	6.1	6.6	7.2	7.7	8.3	8.8	9.4	10.0	10.6	11.3	11.9	12.6
25	2.0	2.4	2.8	3.3	3.8	4.3	4.8	5.3	5.9	6.5	7.1	7.7	8.3	8.9	9.6	10.3	11.0	11.6	12.4	13.1	13.8	14.6	15.4
30	2.3	2.8	3.4	4.0	4.6	5.2	5.8	6.5	7.1	7.8	8.5	9.2	10.0	10.7	11.5	12.2	13.0	13.8	14.6	15.4	16.2	17.1	17.9
35	2.7	3.3	4.0	4.7	5.4	6.1	6.9	7.6	8.4	9.2	10.0	10.8	11.6	12.4	13.2	14.1	14.9	15.8	16.7	17.5	18.4	19.3	20.3
40	3.1	3.9	4.6	5.4	6.3	7.1	7.9	8.8	9.6	10.5	11.4	12.2	13.1	14.0	14.9	15.8	16.7	17.7	18.6	19.5	20.5	21.4	22.4
45	3.5	4.4	5.3	6.2	7.1	8.0	9.0	9.9	10.8	11.8	12.7	13.7	14.6	15.6	16.5	17.5	18.4	19.4	20.4	21.3	22.3	23.3	24.3
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.5	5.6	6.7	7.8	8.9	9.9	11.0	12.1	13.1	14.2	15.2	16.3	17.3	18.4	19.4	20.4	21.4	22.5	23.5	24.5	25.5	26.5	27.5
60	5.0	6.2	7.4	8.6	9.7	10.9	12.0	13.1	14.2	15.3	16.4	17.5	18.5	19.6	20.7	21.7	22.8	23.8	24.8	25.9	26.9	27.9	28.9
65	5.5	6.8	8.1	9.3	10.5	11.7	12.9	14.1	15.2	16.4	17.5	18.6	19.7	20.8	21.9	22.9	24.0	25.0	26.1	27.1	28.1	29.1	30.1
70	6.0	7.4	8.8	10.1	11.3	12.6	13.8	15.0	16.2	17.4	18.5	19.6	20.8	21.9	23.0	24.0	25.1	26.1	27.2	28.2	29.2	30.2	31.2
75	6.5	8.0	9.4	10.8	12.1	13.4	14.7	15.9	17.1	18.3	19.5	20.6	21.8	22.9	24.0	25.0	26.1	27.2	28.2	29.2	30.2	31.2	32.2
80	7.1	8.6	10.1	11.5	12.9	14.2	15.5	16.8	18.0	19.2	20.4	21.5	22.7	23.8	24.9	26.0	27.0	28.1	29.1	30.1	31.1	32.1	33.1
85	7.6	9.2	10.7	12.2	13.6	15.0	16.3	17.6	18.8	20.0	21.2	22.4	23.5	24.6	25.7	26.8	27.9	28.9	29.9	30.9	31.9	32.9	33.8
90	8.1	9.8	11.4	12.9	14.3	15.7	17.0	18.3	19.6	20.8	22.0	23.2	24.3	25.4	26.5	27.6	28.6	29.7	30.7	31.6	32.6	33.6	34.5
95	8.6	10.4	12.0	13.5	15.0	16.4	17.7	19.0	20.3	21.5	22.7	23.9	25.0	26.2	27.2	28.3	29.3	30.3	31.3	32.3	33.2	34.2	35.1
100	9.1	10.9	12.5	14.1	15.6	17.0	18.4	19.7	21.0	22.2	23.4	24.6	25.7	26.8	27.9	28.9	30.0	30.9	31.9	32.9	33.8	34.7	35.6
105	9.6	11.4	13.1	14.7	16.2	17.6	19.0	20.3	21.6	22.8	24.0	25.2	26.3	27.4	28.5	29.5	30.5	31.5	32.5	33.4	34.3	35.2	36.1
110	10.1	11.9	13.6	15.2	16.8	18.2	19.6	20.9	22.2	23.4	24.6	25.8	26.9	28.0	29.0	30.0	31.0	32.0	32.9	33.9	34.8	35.6	36.5
115	10.6	12.4	14.2	15.8	17.3	18.8	20.1	21.5	22.7	24.0	25.2	26.3	27.4	28.5	29.5	30.5	31.5	32.5	33.4	34.3	35.2	36.0	36.9
120	11.0	12.9	14.7	16.3	17.8	19.3	20.7	22.0	23.3	24.5	25.6	26.8	27.9	28.9	30.0	31.0	31.9	32.9	33.8	34.7	35.5	36.4	37.2
125	11.5	13.4	15.1	16.8	18.3	19.8	21.1	22.5	23.7	24.9	26.1	27.2	28.3	29.4	30.4	31.3	32.3	33.2	34.1	35.0	35.8	36.7	37.5
130	11.9	13.8	15.6	17.2	18.8	20.2	21.6	22.9	24.2	25.4	26.5	27.6	28.7	29.7	30.7	31.7	32.6	33.5	34.4	35.3	36.1	36.9	37.7
135	12.3	14.2	16.0	17.7	19.2	20.6	22.0	23.3	24.6	25.8	26.9	28.0	29.1	30.1	31.1	32.0	33.0	33.8	34.7	35.5	36.4	37.2	37.9
140	12.7	14.7	16.4	18.1	19.6	21.1	22.4	23.7	25.0	26.1	27.3	28.4	29.4	30.4	31.4	32.3	33.2	34.1	35.0	35.8	36.6	37.4	38.1
145	13.1	15.0	16.8	18.5	20.0	21.4	22.8	24.1	25.3	26.5	27.6	28.7	29.7	30.7	31.7	32.6	33.5	34.3	35.2	36.0	36.8	37.6	38.3
150	13.5	15.4	17.2	18.8	20.4	21.8	23.1	24.4	25.6	26.8	27.9	29.0	30.0	31.0	31.9	32.8	33.7	34.6	35.4	36.2	37.0	37.7	38.5
155	13.8	15.8	17.5	19.2	20.7	22.1	23.5	24.7	25.9	27.1	28.2	29.2	30.3	31.2	32.2	33.0	33.9	34.8	35.6	36.4	37.1	37.9	38.6
160	14.2	16.1	17.9	19.5	21.0	22.4	23.8	25.0	26.2	27.4	28.5	29.5	30.5	31.4	32.4	33.2	34.1	34.9	35.7	36.5	37.3	38.0	38.7
165	14.5	16.4	18.2	19.8	21.3	22.7	24.1	25.3	26.5	27.6	28.7	29.7	30.7	31.6	32.6	33.4	34.3	35.1	35.9	36.6	37.4	38.1	38.8
170	14.8	16.7	18.5	20.1	21.6	23.0	24.3	25.6	26.7	27.9	28.9	29.9	30.9	31.8	32.7	33.6	34.4	35.2	36.0	36.8	37.5	38.2	38.9
175	15.1	17.0	18.8	20.4	21.9	23.3	24.6	25.8	27.0	28.1	29.1	30.1	31.1	32.0	32.9	33.7	34.6	35.3	36.1	36.9	37.6	38.3	39.0
180	15.4	17.3	19.0	20.6	22.1	23.5	24.8	26.0	27.2	28.3	29.3	30.3	31.2	32.2	33.0	33.9	34.7	35.5	36.2	37.0	37.7	38.4	39.1

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 5. Regional white spruce height growth and site index table (natural regions: 7, 8, 10)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.8	2.9	3.1	3.2	3.4	3.6	3.8
10	1.5	1.6	1.7	1.8	2.0	2.1	2.3	2.5	2.7	2.9	3.2	3.4	3.6	3.9	4.2	4.4	4.7	5.0	5.4	5.7	6.0	6.4	6.8
15	1.6	1.8	2.1	2.3	2.6	2.8	3.1	3.4	3.8	4.1	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.3	7.7	8.2	8.7	9.2	9.7
20	1.9	2.2	2.5	2.9	3.2	3.6	4.0	4.5	4.9	5.3	5.8	6.3	6.8	7.3	7.8	8.4	8.9	9.5	10.1	10.7	11.3	11.9	12.6
25	2.1	2.6	3.0	3.5	4.0	4.5	5.0	5.5	6.1	6.6	7.2	7.8	8.4	9.0	9.7	10.3	11.0	11.7	12.4	13.1	13.8	14.5	15.3
30	2.5	3.0	3.6	4.1	4.7	5.3	6.0	6.6	7.3	7.9	8.6	9.3	10.0	10.8	11.5	12.2	13.0	13.8	14.5	15.3	16.1	17.0	17.8
35	2.8	3.5	4.1	4.8	5.5	6.3	7.0	7.7	8.5	9.2	10.0	10.8	11.6	12.4	13.2	14.1	14.9	15.7	16.6	17.5	18.3	19.2	20.1
40	3.2	4.0	4.7	5.5	6.4	7.2	8.0	8.8	9.7	10.5	11.4	12.3	13.1	14.0	14.9	15.8	16.7	17.6	18.5	19.4	20.4	21.3	22.3
45	3.6	4.5	5.4	6.3	7.2	8.1	9.0	9.9	10.9	11.8	12.7	13.7	14.6	15.5	16.5	17.4	18.4	19.4	20.3	21.3	22.3	23.2	24.2
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.4	5.5	6.6	7.7	8.8	9.9	11.0	12.0	13.1	14.2	15.2	16.3	17.3	18.4	19.4	20.5	21.5	22.5	23.6	24.6	25.6	26.6	27.6
60	4.9	6.1	7.3	8.5	9.6	10.8	11.9	13.1	14.2	15.3	16.4	17.5	18.6	19.7	20.8	21.8	22.9	24.0	25.0	26.0	27.1	28.1	29.1
65	5.3	6.6	7.9	9.2	10.4	11.7	12.9	14.1	15.2	16.4	17.6	18.7	19.8	20.9	22.0	23.1	24.2	25.3	26.3	27.4	28.4	29.4	30.5
70	5.7	7.2	8.5	9.9	11.2	12.5	13.8	15.0	16.2	17.4	18.6	19.8	21.0	22.1	23.2	24.3	25.4	26.5	27.6	28.6	29.7	30.7	31.7
75	6.2	7.7	9.2	10.6	12.0	13.3	14.6	15.9	17.2	18.4	19.7	20.9	22.0	23.2	24.3	25.5	26.6	27.7	28.7	29.8	30.8	31.8	32.8
80	6.6	8.2	9.8	11.3	12.7	14.1	15.5	16.8	18.1	19.4	20.6	21.9	23.1	24.2	25.4	26.5	27.6	28.7	29.8	30.8	31.8	32.8	33.8
85	7.1	8.8	10.4	11.9	13.4	14.9	16.3	17.7	19.0	20.3	21.6	22.8	24.0	25.2	26.4	27.5	28.6	29.7	30.7	31.8	32.8	33.7	34.7
90	7.5	9.3	11.0	12.6	14.1	15.6	17.1	18.5	19.8	21.2	22.4	23.7	24.9	26.1	27.3	28.4	29.5	30.6	31.6	32.6	33.6	34.6	35.5
95	8.0	9.8	11.5	13.2	14.8	16.3	17.8	19.2	20.6	22.0	23.3	24.5	25.8	27.0	28.1	29.2	30.3	31.4	32.4	33.4	34.4	35.4	36.3
100	8.4	10.3	12.1	13.8	15.4	17.0	18.5	20.0	21.4	22.7	24.1	25.3	26.6	27.8	28.9	30.0	31.1	32.2	33.2	34.2	35.1	36.0	36.9
105	8.8	10.8	12.6	14.4	16.1	17.7	19.2	20.7	22.1	23.5	24.8	26.1	27.3	28.5	29.7	30.8	31.8	32.9	33.9	34.8	35.8	36.7	37.5
110	9.2	11.3	13.2	15.0	16.7	18.3	19.9	21.4	22.8	24.2	25.5	26.8	28.0	29.2	30.3	31.4	32.5	33.5	34.5	35.4	36.4	37.2	38.1
115	9.6	11.7	13.7	15.5	17.3	18.9	20.5	22.0	23.4	24.8	26.2	27.4	28.7	29.8	31.0	32.1	33.1	34.1	35.1	36.0	36.9	37.8	38.6
120	10.0	12.2	14.2	16.0	17.8	19.5	21.1	22.6	24.1	25.5	26.8	28.1	29.3	30.4	31.6	32.6	33.7	34.7	35.6	36.5	37.4	38.2	39.0
125	10.4	12.6	14.6	16.5	18.3	20.0	21.7	23.2	24.6	26.0	27.4	28.6	29.9	31.0	32.1	33.2	34.2	35.2	36.1	37.0	37.8	38.7	39.4
130	10.8	13.0	15.1	17.0	18.9	20.6	22.2	23.7	25.2	26.6	27.9	29.2	30.4	31.5	32.6	33.7	34.7	35.6	36.5	37.4	38.2	39.0	39.8
135	11.1	13.4	15.5	17.5	19.3	21.1	22.7	24.3	25.7	27.1	28.4	29.7	30.9	32.0	33.1	34.1	35.1	36.1	36.9	37.8	38.6	39.4	40.1
140	11.5	13.8	16.0	18.0	19.8	21.6	23.2	24.7	26.2	27.6	28.9	30.2	31.4	32.5	33.5	34.6	35.5	36.4	37.3	38.2	38.9	39.7	40.4
145	11.8	14.2	16.4	18.4	20.3	22.0	23.7	25.2	26.7	28.1	29.4	30.6	31.8	32.9	34.0	35.0	35.9	36.8	37.7	38.5	39.2	40.0	40.7
150	12.1	14.6	16.8	18.8	20.7	22.5	24.1	25.7	27.1	28.5	29.8	31.0	32.2	33.3	34.3	35.3	36.3	37.1	38.0	38.8	39.5	40.2	40.9
155	12.5	14.9	17.2	19.2	21.1	22.9	24.5	26.1	27.5	28.9	30.2	31.4	32.6	33.7	34.7	35.7	36.6	37.4	38.3	39.0	39.8	40.5	41.1
160	12.8	15.3	17.5	19.6	21.5	23.3	24.9	26.5	27.9	29.3	30.6	31.8	32.9	34.0	35.0	36.0	36.9	37.7	38.5	39.3	40.0	40.7	41.3
165	13.1	15.6	17.9	20.0	21.9	23.6	25.3	26.9	28.3	29.7	30.9	32.1	33.3	34.3	35.3	36.3	37.1	38.0	38.8	39.5	40.2	40.9	41.5
170	13.4	15.9	18.2	20.3	22.2	24.0	25.7	27.2	28.7	30.0	31.3	32.5	33.6	34.6	35.6	36.5	37.4	38.2	39.0	39.7	40.4	41.0	41.7
175	13.6	16.2	18.5	20.6	22.6	24.3	26.0	27.5	29.0	30.3	31.6	32.8	33.9	34.9	35.9	36.8	37.6	38.4	39.2	39.9	40.6	41.2	41.8
180	13.9	16.5	18.8	21.0	22.9	24.7	26.3	27.9	29.3	30.6	31.9	33.0	34.1	35.1	36.1	37.0	37.8	38.6	39.4	40.1	40.7	41.3	41.9

[1]See Figure 1 for the list of natural regions and their designation numbers.

2.2 LODGEPOLE PINE

Lodgepole pine height growth model:

$$[5] \quad H_2 = 1.3+(H_1-1.3)\left(\frac{1-\exp(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)}T_2)}{1-\exp(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)}T_1)}\right)^{b_3(H_1-1.3)^{b_4}T_1^{b_5}}$$

where:

H_2 = tree height (m) at time two

T_2 = breast height age (years) at time two

H_1 = tree height (m) at time one

T_1 = breast height age (years) at time one

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Lodgepole pine site index model (which is a special variant of the height growth model [5] with H_1 replaced by the site index SI and T_1 replaced by the reference-age T_R, respectively):

$$[6] \quad H = 1.3+(SI-1.3)\left(\frac{1-\exp(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)}T_B)}{1-\exp(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)}T_R)}\right)^{b_3(SI-1.3)^{b_4}T_R^{b_5}}$$

where:

H = tree height (m) at T_B

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at T_R

T_R = reference-age (= 50 years breast height age)

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Table 6. Fit statistics for the lodgepole pine height growth model [5].

Natural regions[1]	Parameter	Estimate	Std. error	n	MSE	R^2
All	b_0	0.026714	0.000203	92,040	3.611	0.927
(provincial)	b_1	-0.314562	0.005350			
	b_2	1.033165	0.000502			
	b_3	0.799658	0.001366			
	b_4	-0.439270	0.002004			
	b_5	0.401374	0.001238			
4, 10	b_0	0.029225	0.000364	34,724	3.262	0.921
	b_1	-0.388372	0.007985			
	b_2	1.036619	0.000827			
	b_3	0.782731	0.002291			
	b_4	-0.465705	0.003560			
	b_5	0.416191	0.002182			
7, 8	b_0	0.024669	0.001054	5,772	2.126	0.913
	b_1	-0.343898	0.035590			
	b_2	1.027053	0.004318			
	b_3	0.669981	0.006140			
	b_4	-0.552565	0.011002			
	b_5	0.467140	0.005845			
6, 9, 11, 14	b_0	0.026521	0.000249	48,968	3.575	0.937
	b_1	-0.285783	0.006545			
	b_2	1.033059	0.000597			
	b_3	0.812875	0.001708			
	b_4	-0.435476	0.002420			
	b_5	0.407971	0.001550			
1, 2, 3, 5, 12	b_0	0.017891	0.001118	2,576	2.420	0.934
13, 15, 16	b_1	-0.166174	0.047432			
	b_2	1.032859	0.004370			
	b_3	0.679699	0.008813			
	b_4	-0.446473	0.013606			
	b_5	0.417274	0.008123			

[1]See Figure 1 for the list of natural regions and their designation numbers.

Lodgepole Pine Site Index Curves

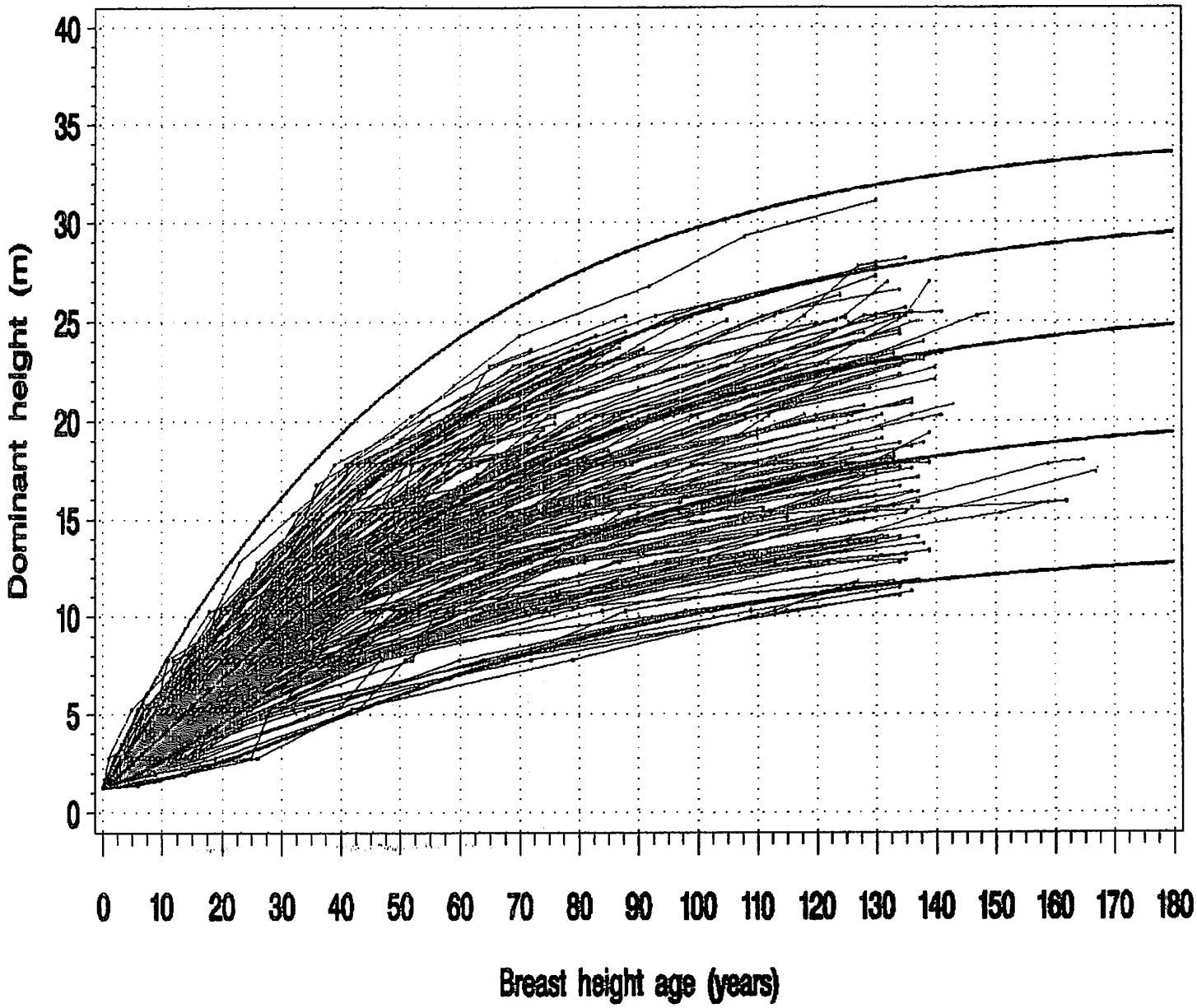

Figure 8. Lodgepole pine site index curves for natural region 10, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 6.0, 10.0, 14.0, 18.0 and 22.0 metres at a reference breast height age of 50 years (part I).

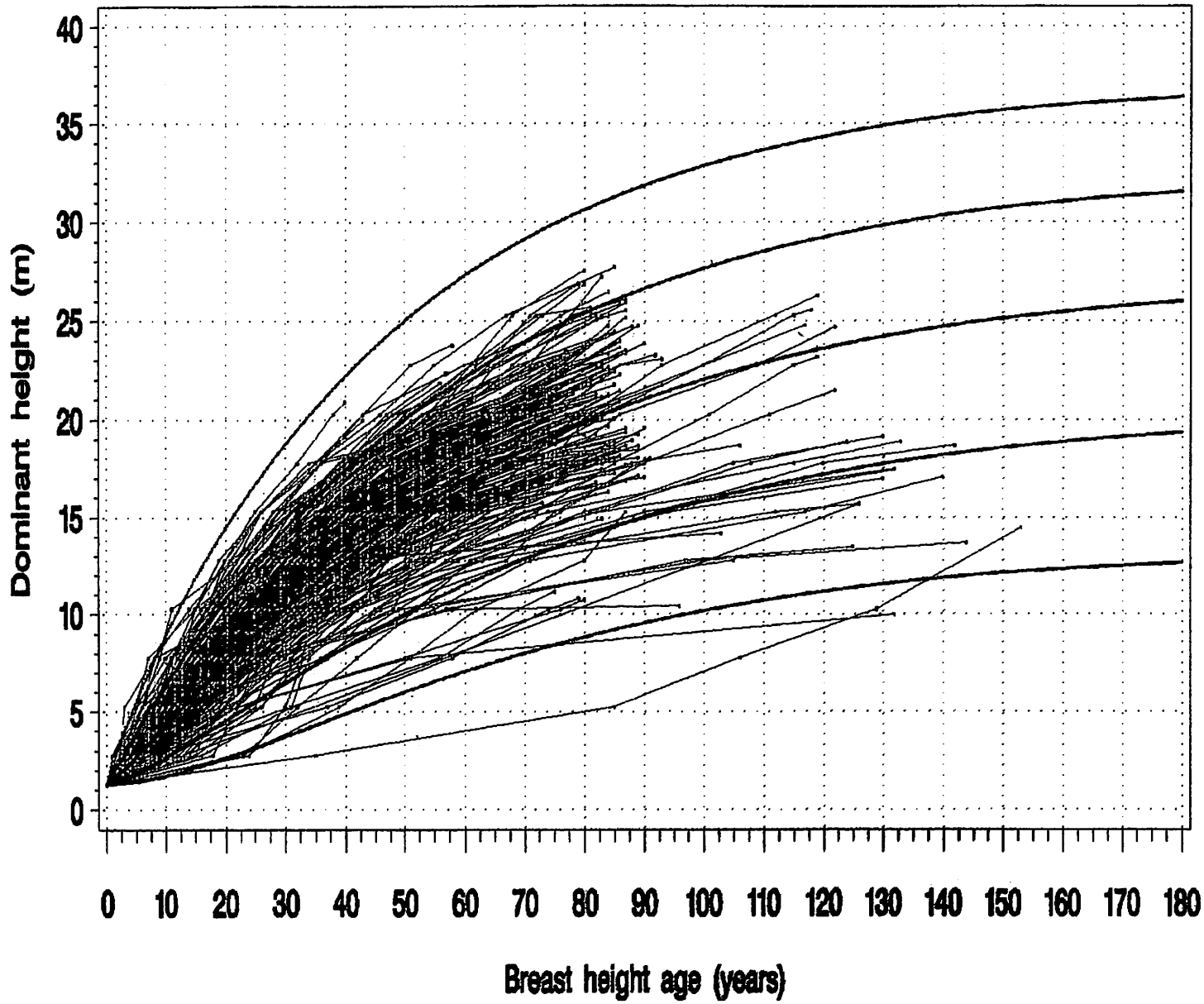

Figure 9. Lodgepole pine site index curves for natural region 10, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 6.0, 10.0, 15.0, 20.0 and 25.0 metres at a reference breast height age of 50 years (part II).

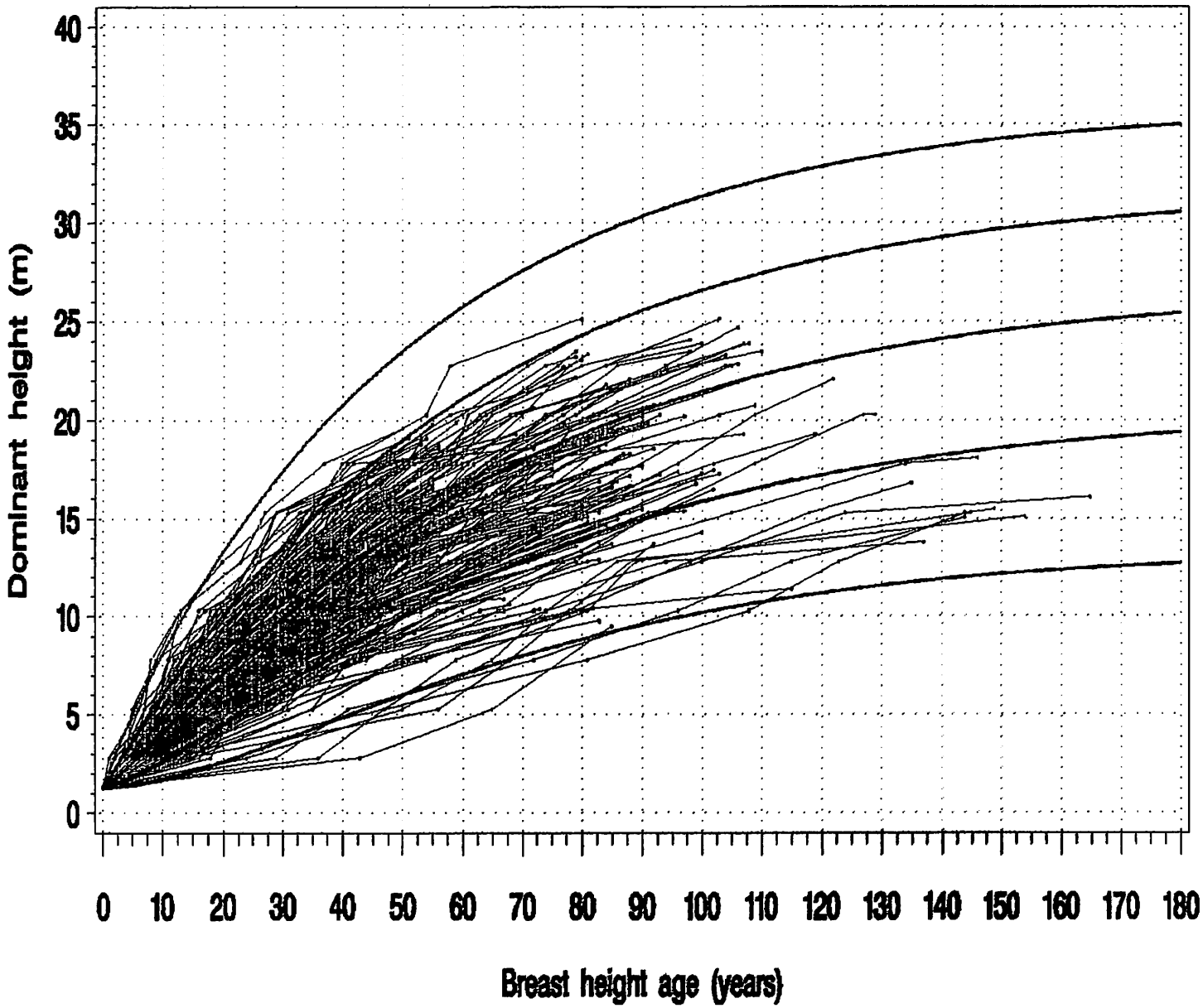

Figure 10. Lodgepole pine site index curves for natural region 10, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 6.0, 10.0, 14.5, 19.0 and 23.5 metres at a reference breast height age of 50 years (part III).

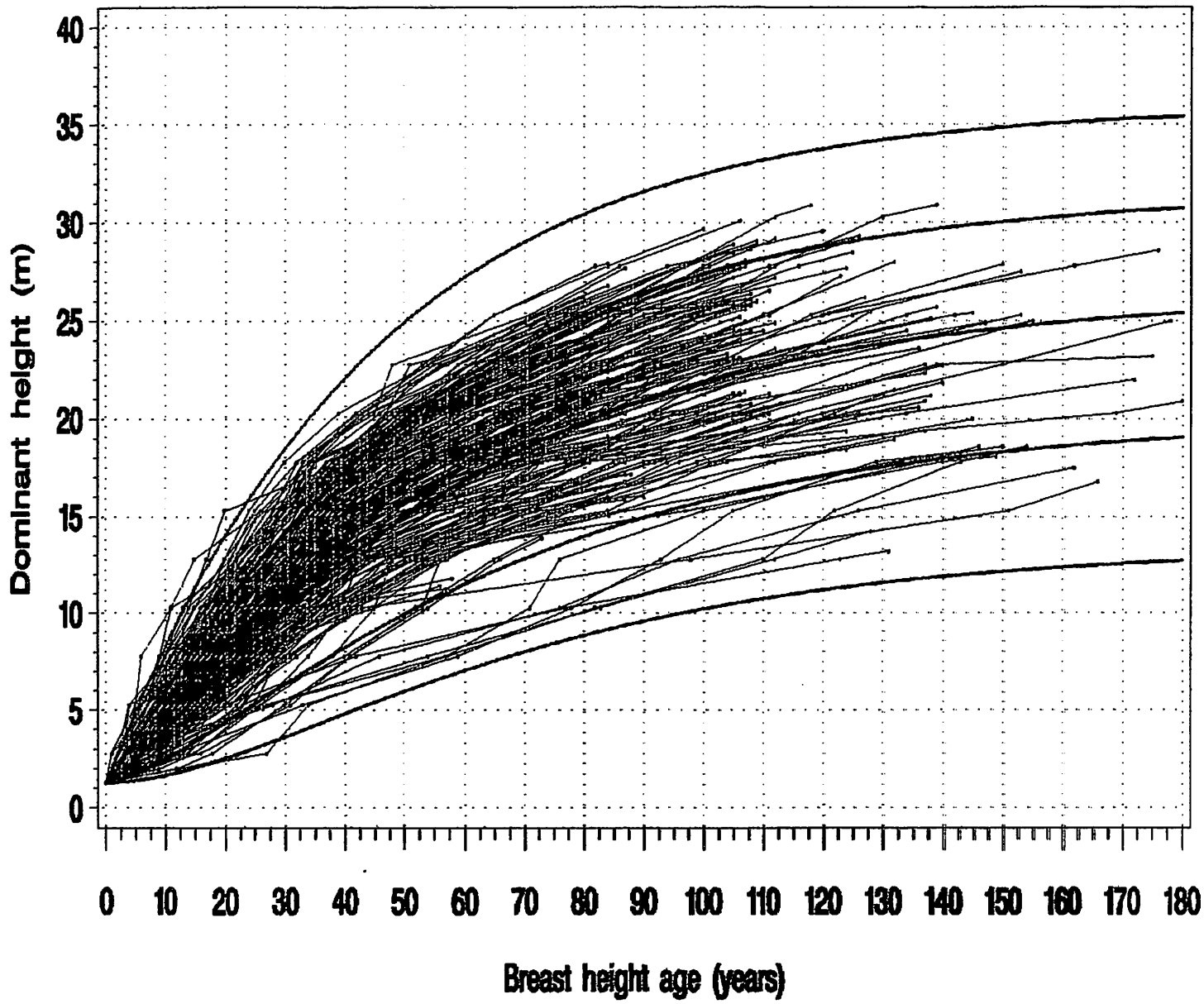

Figure 11. Lodgepole pine site index curves for natural regions 6, 9, 11 and 14, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 6.0, 10.0, 15.0, 20.0 and 25.0 metres at a reference breast height age of 50 years (part I).

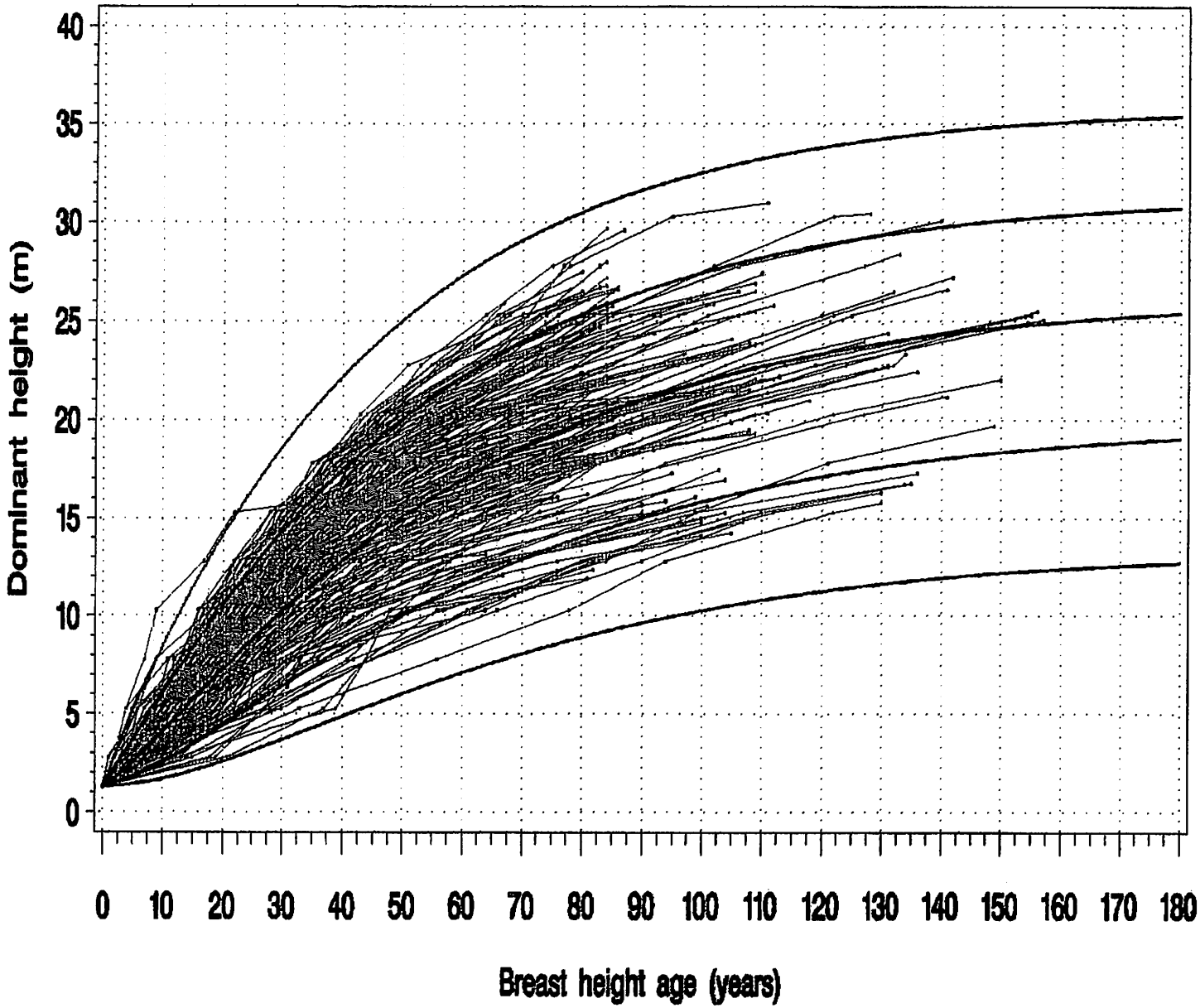

Figure 12. Lodgepole pine site index curves for natural regions 6, 9, 11 and 14, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 6.0, 10.0, 15.0, 20.0 and 25.0 metres at a reference breast height age of 50 years (part II).

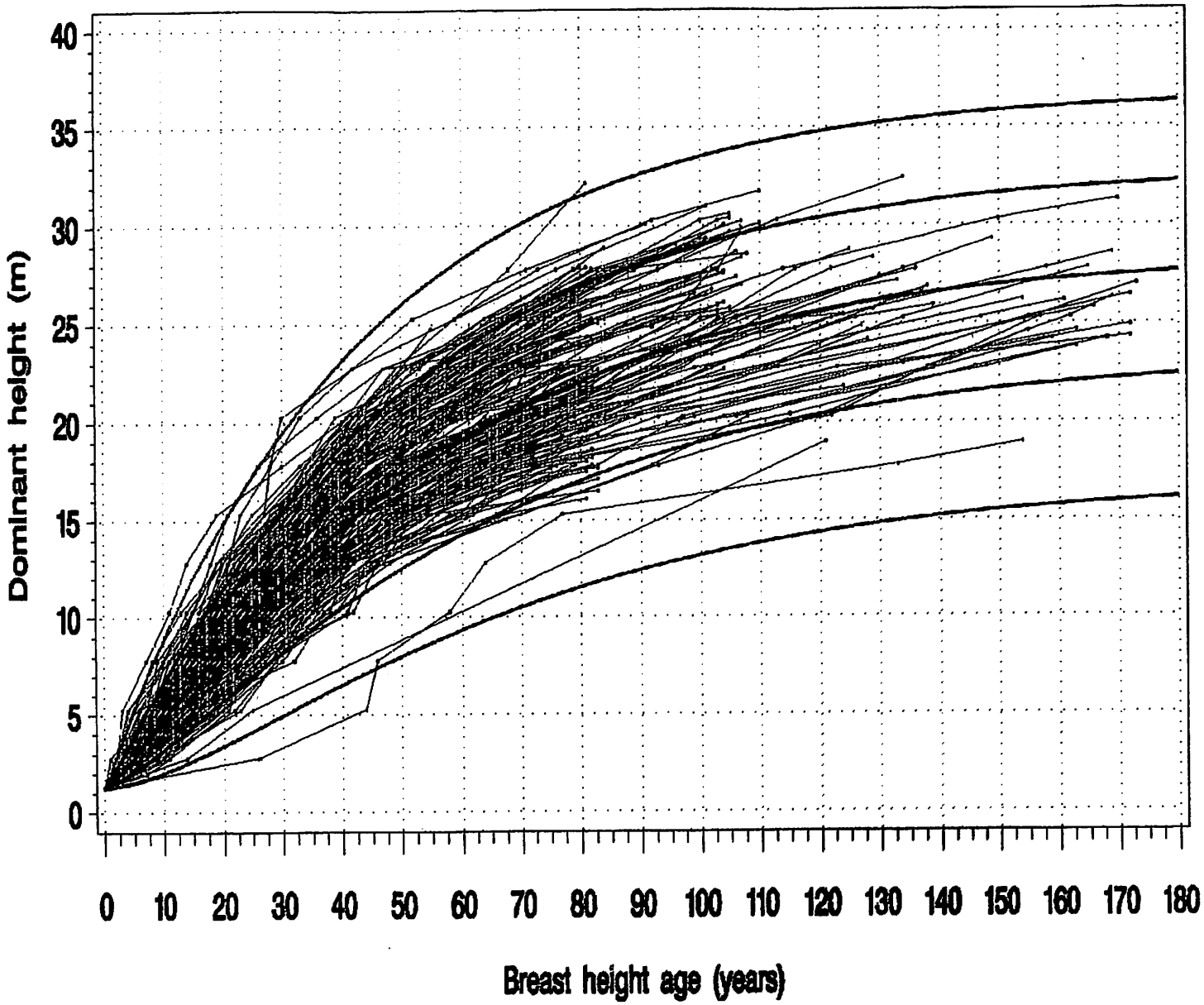

Figure 13. Lodgepole pine site index curves for natural regions 6, 9, 11 and 14, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 8.0, 12.5, 17.0, 21.5 and 26.0 metres at a reference breast height age of 50 years (part III).

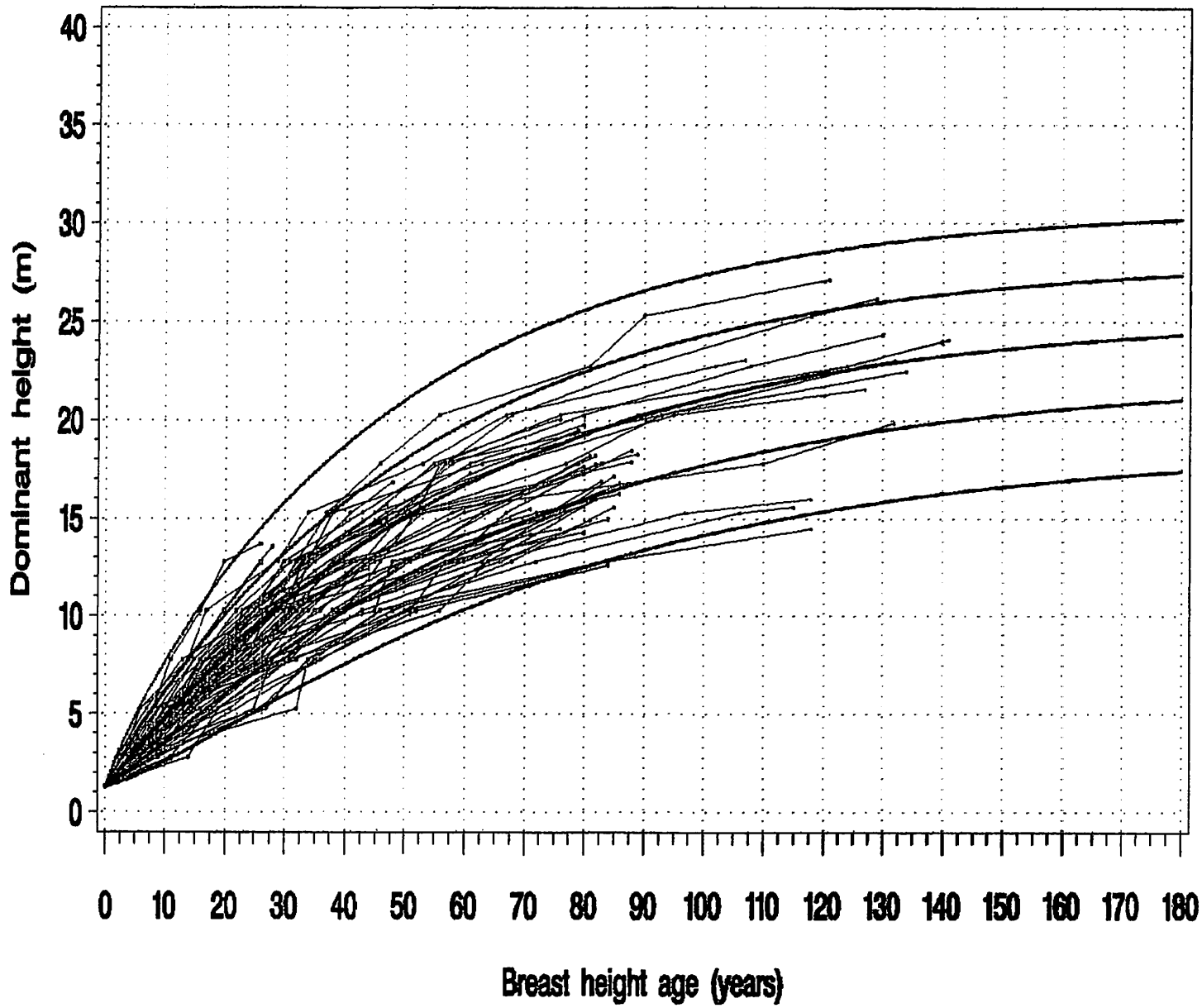

Figure 14. Lodgepole pine site index curves for natural regions 1, 2, 3, 5, 12, 13, 15 and 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 9.0, 12.0, 15.0, 18.0 and 21.0 metres at a reference breast height age of 50 years.

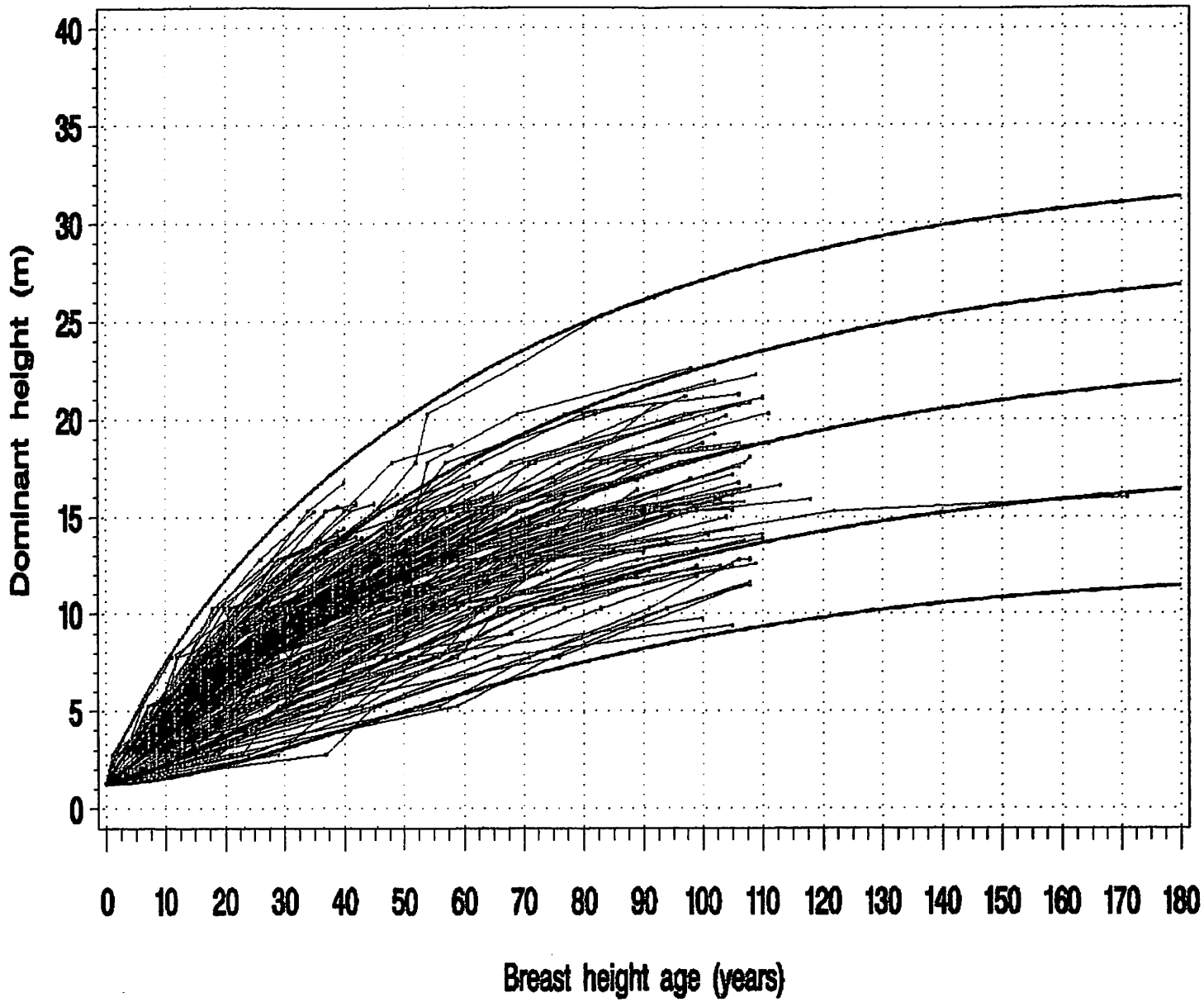

Figure 15. Lodgepole pine site index curves for natural regions 7 and 8, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 5.0, 8.0, 12.0, 16.0 and 20.0 metres at a reference breast height age of 50 years.

Lodgepole Pine Site Index Tables

Table 7. Provincial lodgepole pine height growth and site index table (natural regions: 1 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.3	3.5	3.8	4.1	4.3	4.6	4.9	5.3	5.6
10	1.4	1.5	1.7	1.9	2.1	2.3	2.6	2.9	3.2	3.5	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.7	7.1	7.6	8.1	8.6	9.1
15	1.6	1.8	2.1	2.4	2.8	3.1	3.5	3.9	4.4	4.8	5.3	5.8	6.3	6.8	7.4	7.9	8.5	9.1	9.7	10.3	10.9	11.6	12.2
20	1.9	2.2	2.6	3.0	3.5	4.0	4.5	5.0	5.6	6.2	6.7	7.4	8.0	8.6	9.3	9.9	10.6	11.3	12.0	12.7	13.5	14.2	15.0
25	2.2	2.6	3.1	3.7	4.3	4.9	5.5	6.1	6.8	7.5	8.1	8.8	9.6	10.3	11.0	11.8	12.6	13.3	14.1	14.9	15.7	16.5	17.4
30	2.5	3.1	3.7	4.4	5.0	5.7	6.5	7.2	7.9	8.7	9.5	10.2	11.0	11.9	12.7	13.5	14.3	15.2	16.0	16.9	17.8	18.6	19.5
35	2.9	3.6	4.3	5.0	5.8	6.6	7.4	8.2	9.0	9.9	10.7	11.6	12.4	13.3	14.2	15.1	15.9	16.8	17.7	18.7	19.6	20.5	21.4
40	3.2	4.0	4.9	5.7	6.6	7.4	8.3	9.2	10.1	11.0	11.9	12.8	13.7	14.6	15.6	16.5	17.4	18.4	19.3	20.3	21.2	22.2	23.1
45	3.6	4.5	5.4	6.4	7.3	8.2	9.2	10.1	11.1	12.0	13.0	13.9	14.9	15.9	16.8	17.8	18.8	19.7	20.7	21.7	22.7	23.7	24.6
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.4	5.5	6.5	7.6	8.7	9.7	10.8	11.8	12.9	13.9	14.9	16.0	17.0	18.0	19.1	20.1	21.1	22.1	23.2	24.2	25.2	26.2	27.2
60	4.7	5.9	7.0	8.2	9.3	10.4	11.5	12.6	13.7	14.7	15.8	16.9	17.9	19.0	20.0	21.1	22.1	23.2	24.2	25.2	26.3	27.3	28.3
65	5.1	6.3	7.5	8.7	9.9	11.0	12.2	13.3	14.4	15.5	16.6	17.7	18.8	19.9	20.9	22.0	23.1	24.1	25.1	26.2	27.2	28.2	29.3
70	5.4	6.7	8.0	9.2	10.4	11.6	12.8	14.0	15.1	16.3	17.4	18.5	19.6	20.7	21.8	22.8	23.9	25.0	26.0	27.0	28.1	29.1	30.1
75	5.7	7.1	8.4	9.7	11.0	12.2	13.4	14.6	15.8	16.9	18.1	19.2	20.3	21.4	22.5	23.6	24.7	25.7	26.8	27.8	28.9	29.9	30.9
80	6.0	7.4	8.8	10.1	11.4	12.7	13.9	15.2	16.4	17.5	18.7	19.8	21.0	22.1	23.2	24.3	25.4	26.4	27.5	28.5	29.6	30.6	31.6
85	6.2	7.8	9.2	10.6	11.9	13.2	14.5	15.7	16.9	18.1	19.3	20.4	21.6	22.7	23.8	24.9	26.0	27.1	28.1	29.2	30.2	31.2	32.2
90	6.5	8.1	9.5	10.9	12.3	13.6	14.9	16.2	17.4	18.6	19.8	21.0	22.1	23.3	24.4	25.5	26.6	27.6	28.7	29.7	30.8	31.8	32.8
95	6.7	8.3	9.9	11.3	12.7	14.0	15.4	16.6	17.9	19.1	20.3	21.5	22.6	23.8	24.9	26.0	27.1	28.1	29.2	30.2	31.3	32.3	33.3
100	6.9	8.6	10.2	11.6	13.1	14.4	15.8	17.0	18.3	19.5	20.8	21.9	23.1	24.2	25.4	26.5	27.5	28.6	29.7	30.7	31.7	32.7	33.7
105	7.1	8.8	10.4	11.9	13.4	14.8	16.1	17.4	18.7	19.9	21.2	22.4	23.5	24.7	25.8	26.9	28.0	29.0	30.1	31.1	32.1	33.1	34.1
110	7.3	9.0	10.7	12.2	13.7	15.1	16.5	17.8	19.1	20.3	21.5	22.7	23.9	25.1	26.2	27.3	28.4	29.4	30.5	31.5	32.5	33.5	34.5
115	7.5	9.3	10.9	12.5	14.0	15.4	16.8	18.1	19.4	20.7	21.9	23.1	24.3	25.4	26.5	27.6	28.7	29.8	30.8	31.8	32.8	33.8	34.8
120	7.6	9.4	11.1	12.7	14.2	15.7	17.1	18.4	19.7	21.0	22.2	23.4	24.6	25.7	26.9	28.0	29.0	30.1	31.1	32.1	33.1	34.1	35.1
125	7.7	9.6	11.3	12.9	14.5	15.9	17.3	18.7	20.0	21.3	22.5	23.7	24.9	26.0	27.1	28.2	29.3	30.4	31.4	32.4	33.4	34.4	35.4
130	7.9	9.8	11.5	13.1	14.7	16.2	17.6	18.9	20.3	21.5	22.8	24.0	25.1	26.3	27.4	28.5	29.6	30.6	31.7	32.7	33.7	34.6	35.6
135	8.0	9.9	11.7	13.3	14.9	16.4	17.8	19.2	20.5	21.8	23.0	24.2	25.4	26.5	27.7	28.8	29.8	30.9	31.9	32.9	33.9	34.8	35.8
140	8.1	10.0	11.8	13.5	15.1	16.6	18.0	19.4	20.7	22.0	23.2	24.4	25.6	26.8	27.9	29.0	30.0	31.1	32.1	33.1	34.1	35.0	36.0
145	8.2	10.1	12.0	13.6	15.2	16.7	18.2	19.6	20.9	22.2	23.4	24.6	25.8	27.0	28.1	29.2	30.2	31.3	32.3	33.3	34.3	35.2	36.2
150	8.2	10.2	12.1	13.8	15.4	16.9	18.4	19.7	21.1	22.4	23.6	24.8	26.0	27.2	28.3	29.4	30.4	31.4	32.5	33.4	34.4	35.4	36.3
155	8.3	10.3	12.2	13.9	15.5	17.1	18.5	19.9	21.3	22.5	23.8	25.0	26.2	27.3	28.4	29.5	30.6	31.6	32.6	33.6	34.6	35.5	36.4
160	8.4	10.4	12.3	14.0	15.7	17.2	18.7	20.1	21.4	22.7	24.0	25.2	26.3	27.5	28.6	29.7	30.7	31.7	32.8	33.7	34.7	35.6	36.6
165	8.4	10.5	12.4	14.1	15.8	17.3	18.8	20.2	21.5	22.8	24.1	25.3	26.5	27.6	28.7	29.8	30.9	31.9	32.9	33.9	34.8	35.7	36.7
170	8.5	10.6	12.5	14.2	15.9	17.4	18.9	20.3	21.7	23.0	24.2	25.4	26.6	27.7	28.9	29.9	31.0	32.0	33.0	34.0	34.9	35.8	36.8
175	8.5	10.7	12.6	14.3	16.0	17.5	19.0	20.4	21.8	23.1	24.3	25.6	26.7	27.9	29.0	30.0	31.1	32.1	33.1	34.1	35.0	35.9	36.8
180	8.6	10.7	12.6	14.4	16.1	17.6	19.1	20.5	21.9	23.2	24.5	25.7	26.8	28.0	29.1	30.1	31.2	32.2	33.2	34.2	35.1	36.0	36.9

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 8. Regional lodgepole pine height growth and site index table (natural regions: 4, 10)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.3	2.5	2.7	2.9	3.1	3.4	3.7	3.9	4.2	4.5	4.8	5.2	5.5	5.9
10	1.4	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.2	3.6	3.9	4.3	4.7	5.1	5.5	5.9	6.4	6.9	7.3	7.8	8.4	8.9	9.4
15	1.6	1.8	2.1	2.4	2.8	3.1	3.5	4.0	4.4	4.9	5.4	5.9	6.4	6.9	7.5	8.1	8.7	9.3	9.9	10.5	11.2	11.8	12.5
20	1.9	2.2	2.6	3.0	3.5	4.0	4.5	5.1	5.6	6.2	6.8	7.4	8.1	8.7	9.4	10.1	10.7	11.4	12.2	12.9	13.6	14.4	15.2
25	2.2	2.6	3.1	3.7	4.3	4.9	5.5	6.1	6.8	7.5	8.2	8.9	9.6	10.4	11.1	11.9	12.6	13.4	14.2	15.0	15.9	16.7	17.5
30	2.5	3.1	3.7	4.4	5.0	5.7	6.5	7.2	8.0	8.7	9.5	10.3	11.1	11.9	12.7	13.6	14.4	15.2	16.1	17.0	17.8	18.7	19.6
35	2.9	3.6	4.3	5.0	5.8	6.6	7.4	8.2	9.1	9.9	10.7	11.6	12.5	13.3	14.2	15.1	16.0	16.9	17.8	18.7	19.6	20.6	21.5
40	3.2	4.0	4.9	5.7	6.6	7.4	8.3	9.2	10.1	11.0	11.9	12.8	13.7	14.7	15.6	16.5	17.4	18.4	19.3	20.3	21.2	22.2	23.2
45	3.6	4.5	5.4	6.4	7.3	8.2	9.2	10.1	11.1	12.0	13.0	13.9	14.9	15.9	16.8	17.8	18.8	19.8	20.7	21.7	22.7	23.7	24.7
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.4	5.5	6.5	7.6	8.7	9.7	10.8	11.8	12.9	13.9	14.9	16.0	17.0	18.0	19.1	20.1	21.1	22.1	23.2	24.2	25.2	26.2	27.2
60	4.7	5.9	7.0	8.2	9.3	10.4	11.5	12.6	13.7	14.8	15.8	16.9	17.9	19.0	20.0	21.1	22.1	23.2	24.2	25.2	26.2	27.3	28.3
65	5.1	6.3	7.5	8.7	9.9	11.0	12.2	13.3	14.4	15.5	16.6	17.7	18.8	19.9	20.9	22.0	23.1	24.1	25.1	26.2	27.2	28.2	29.3
70	5.4	6.7	8.0	9.2	10.5	11.6	12.8	14.0	15.1	16.3	17.4	18.5	19.6	20.7	21.8	22.8	23.9	25.0	26.0	27.0	28.1	29.1	30.1
75	5.7	7.1	8.4	9.7	11.0	12.2	13.4	14.6	15.8	16.9	18.1	19.2	20.3	21.4	22.5	23.6	24.7	25.7	26.8	27.8	28.9	29.9	30.9
80	6.0	7.4	8.8	10.2	11.5	12.7	14.0	15.2	16.4	17.6	18.7	19.9	21.0	22.1	23.2	24.3	25.4	26.4	27.5	28.5	29.6	30.6	31.6
85	6.2	7.7	9.2	10.6	11.9	13.2	14.5	15.7	17.0	18.1	19.3	20.5	21.6	22.7	23.8	24.9	26.0	27.1	28.2	29.2	30.2	31.3	32.3
90	6.5	8.0	9.5	11.0	12.3	13.7	15.0	16.2	17.5	18.7	19.9	21.0	22.2	23.3	24.4	25.5	26.6	27.7	28.7	29.8	30.8	31.8	32.8
95	6.7	8.3	9.9	11.3	12.7	14.1	15.4	16.7	18.0	19.2	20.4	21.6	22.7	23.8	25.0	26.1	27.1	28.2	29.3	30.3	31.3	32.4	33.4
100	6.9	8.6	10.2	11.7	13.1	14.5	15.8	17.1	18.4	19.6	20.8	22.0	23.2	24.3	25.5	26.6	27.6	28.7	29.8	30.8	31.8	32.8	33.8
105	7.1	8.8	10.4	12.0	13.4	14.9	16.2	17.5	18.8	20.1	21.3	22.5	23.6	24.8	25.9	27.0	28.1	29.2	30.2	31.2	32.3	33.3	34.2
110	7.2	9.0	10.7	12.3	13.8	15.2	16.6	17.9	19.2	20.4	21.7	22.9	24.0	25.2	26.3	27.4	28.5	29.6	30.6	31.6	32.6	33.6	34.6
115	7.4	9.2	10.9	12.5	14.0	15.5	16.9	18.2	19.5	20.8	22.0	23.2	24.4	25.6	26.7	27.8	28.9	29.9	31.0	32.0	33.0	34.0	35.0
120	7.5	9.4	11.2	12.8	14.3	15.8	17.2	18.5	19.9	21.1	22.4	23.6	24.7	25.9	27.0	28.1	29.2	30.3	31.3	32.3	33.3	34.3	35.3
125	7.6	9.6	11.3	13.0	14.6	16.0	17.5	18.8	20.2	21.4	22.7	23.9	25.1	26.2	27.3	28.4	29.5	30.6	31.6	32.6	33.6	34.6	35.6
130	7.8	9.7	11.5	13.2	14.8	16.3	17.7	19.1	20.4	21.7	23.0	24.2	25.4	26.5	27.6	28.7	29.8	30.8	31.9	32.9	33.9	34.8	35.8
135	7.9	9.9	11.7	13.4	15.0	16.5	18.0	19.3	20.7	22.0	23.2	24.4	25.6	26.8	27.9	29.0	30.1	31.1	32.1	33.1	34.1	35.1	36.0
140	8.0	10.0	11.9	13.6	15.2	16.7	18.2	19.6	20.9	22.2	23.5	24.7	25.9	27.0	28.1	29.2	30.3	31.3	32.4	33.4	34.3	35.3	36.2
145	8.0	10.1	12.0	13.7	15.4	16.9	18.4	19.8	21.1	22.4	23.7	24.9	26.1	27.2	28.4	29.4	30.5	31.5	32.6	33.6	34.5	35.5	36.4
150	8.1	10.2	12.1	13.9	15.5	17.1	18.6	20.0	21.3	22.6	23.9	25.1	26.3	27.4	28.6	29.6	30.7	31.7	32.8	33.7	34.7	35.7	36.6
155	8.2	10.3	12.2	14.0	15.7	17.2	18.7	20.1	21.5	22.8	24.1	25.3	26.5	27.6	28.7	29.8	30.9	31.9	32.9	33.9	34.9	35.8	36.7
160	8.3	10.4	12.3	14.1	15.8	17.4	18.9	20.3	21.7	23.0	24.2	25.5	26.6	27.8	28.9	30.0	31.0	32.1	33.1	34.1	35.0	36.0	36.9
165	8.3	10.5	12.4	14.3	15.9	17.5	19.0	20.5	21.8	23.1	24.4	25.6	26.8	27.9	29.1	30.1	31.2	32.2	33.2	34.2	35.1	36.1	37.0
170	8.4	10.6	12.5	14.4	16.1	17.6	19.2	20.6	22.0	23.3	24.5	25.8	26.9	28.1	29.2	30.3	31.3	32.4	33.3	34.3	35.3	36.2	37.1
175	8.4	10.6	12.6	14.5	16.2	17.8	19.3	20.7	22.1	23.4	24.7	25.9	27.1	28.2	29.3	30.4	31.5	32.5	33.5	34.4	35.4	36.3	37.2
180	8.4	10.7	12.7	14.5	16.3	17.9	19.4	20.8	22.2	23.5	24.8	26.0	27.2	28.3	29.4	30.5	31.6	32.6	33.6	34.5	35.5	36.4	37.3

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 9. Regional lodgepole pine height growth and site index table (natural regions: 7, 8)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.7	1.8	2.0	2.2	2.4	2.7	2.9	3.2	3.5	3.9	4.2	4.5	4.9	5.3	5.7	6.1	6.5	7.0	7.4
10	1.4	1.6	1.8	2.0	2.3	2.6	2.9	3.3	3.7	4.1	4.5	5.0	5.5	5.9	6.4	7.0	7.5	8.1	8.6	9.2	9.8	10.4	11.0
15	1.6	1.9	2.2	2.6	3.0	3.4	3.9	4.4	4.9	5.4	6.0	6.6	7.2	7.8	8.4	9.1	9.7	10.4	11.1	11.8	12.5	13.2	13.9
20	1.8	2.2	2.7	3.2	3.7	4.3	4.8	5.4	6.1	6.7	7.4	8.1	8.8	9.5	10.2	10.9	11.7	12.4	13.2	14.0	14.8	15.5	16.3
25	2.1	2.6	3.2	3.8	4.4	5.1	5.8	6.5	7.2	7.9	8.7	9.5	10.2	11.0	11.8	12.6	13.4	14.2	15.1	15.9	16.7	17.6	18.5
30	2.5	3.1	3.8	4.5	5.2	5.9	6.7	7.5	8.3	9.1	9.9	10.7	11.6	12.4	13.3	14.1	15.0	15.9	16.7	17.6	18.5	19.4	20.3
35	2.8	3.6	4.3	5.1	5.9	6.8	7.6	8.4	9.3	10.2	11.0	11.9	12.8	13.7	14.6	15.5	16.4	17.3	18.3	19.2	20.1	21.0	22.0
40	3.2	4.0	4.9	5.8	6.6	7.5	8.4	9.3	10.3	11.2	12.1	13.0	14.0	14.9	15.8	16.8	17.7	18.7	19.6	20.6	21.5	22.5	23.5
45	3.6	4.5	5.5	6.4	7.3	8.3	9.2	10.2	11.2	12.1	13.1	14.0	15.0	16.0	17.0	17.9	18.9	19.9	20.9	21.8	22.8	23.8	24.8
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.4	5.5	6.5	7.6	8.6	9.7	10.7	11.8	12.8	13.8	14.9	15.9	16.9	17.9	19.0	20.0	21.0	22.0	23.0	24.1	25.1	26.1	27.1
60	4.8	5.9	7.0	8.1	9.2	10.3	11.4	12.5	13.5	14.6	15.7	16.7	17.8	18.8	19.8	20.9	21.9	22.9	24.0	25.0	26.0	27.1	28.1
65	5.1	6.3	7.5	8.7	9.8	10.9	12.0	13.1	14.2	15.3	16.4	17.5	18.5	19.6	20.7	21.7	22.8	23.8	24.8	25.9	26.9	28.0	29.0
70	5.5	6.8	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.0	17.1	18.2	19.3	20.3	21.4	22.5	23.5	24.6	25.6	26.7	27.7	28.8	29.8
75	5.8	7.2	8.4	9.7	10.9	12.0	13.2	14.4	15.5	16.6	17.7	18.8	19.9	21.0	22.1	23.2	24.3	25.3	26.4	27.4	28.5	29.5	30.6
80	6.2	7.5	8.8	10.1	11.3	12.5	13.7	14.9	16.1	17.2	18.3	19.4	20.6	21.7	22.8	23.8	24.9	26.0	27.1	28.1	29.2	30.2	31.3
85	6.5	7.9	9.2	10.5	11.8	13.0	14.2	15.4	16.6	17.7	18.9	20.0	21.1	22.2	23.3	24.4	25.5	26.6	27.7	28.7	29.8	30.8	31.9
90	6.7	8.2	9.6	10.9	12.2	13.5	14.7	15.9	17.1	18.3	19.4	20.5	21.7	22.8	23.9	25.0	26.1	27.2	28.2	29.3	30.4	31.4	32.5
95	7.0	8.5	9.9	11.3	12.6	13.9	15.1	16.3	17.5	18.7	19.9	21.0	22.2	23.3	24.4	25.5	26.6	27.7	28.8	29.8	30.9	32.0	33.0
100	7.3	8.8	10.3	11.6	13.0	14.3	15.5	16.8	18.0	19.2	20.3	21.5	22.6	23.8	24.9	26.0	27.1	28.2	29.3	30.3	31.4	32.4	33.5
105	7.5	9.1	10.6	12.0	13.3	14.6	15.9	17.2	18.4	19.6	20.8	21.9	23.1	24.2	25.3	26.4	27.5	28.6	29.7	30.8	31.8	32.9	33.9
110	7.7	9.3	10.9	12.3	13.6	15.0	16.3	17.5	18.7	20.0	21.1	22.3	23.5	24.6	25.7	26.9	28.0	29.0	30.1	31.2	32.2	33.3	34.3
115	7.9	9.6	11.1	12.6	14.0	15.3	16.6	17.9	19.1	20.3	21.5	22.7	23.8	25.0	26.1	27.2	28.3	29.4	30.5	31.6	32.6	33.7	34.7
120	8.1	9.8	11.4	12.8	14.2	15.6	16.9	18.2	19.4	20.6	21.8	23.0	24.2	25.3	26.5	27.6	28.7	29.8	30.9	31.9	33.0	34.0	35.1
125	8.3	10.0	11.6	13.1	14.5	15.9	17.2	18.5	19.7	21.0	22.2	23.3	24.5	25.7	26.8	27.9	29.0	30.1	31.2	32.3	33.3	34.4	35.4
130	8.4	10.2	11.8	13.3	14.7	16.1	17.5	18.7	20.0	21.2	22.5	23.6	24.8	26.0	27.1	28.2	29.3	30.4	31.5	32.6	33.6	34.6	35.7
135	8.6	10.4	12.0	13.5	15.0	16.4	17.7	19.0	20.3	21.5	22.7	23.9	25.1	26.2	27.4	28.5	29.6	30.7	31.8	32.8	33.9	34.9	36.0
140	8.7	10.5	12.2	13.7	15.2	16.6	17.9	19.2	20.5	21.8	23.0	24.2	25.3	26.5	27.6	28.8	29.9	30.9	32.0	33.1	34.1	35.2	36.2
145	8.8	10.7	12.4	13.9	15.4	16.8	18.1	19.5	20.7	22.0	23.2	24.4	25.6	26.7	27.9	29.0	30.1	31.2	32.3	33.3	34.4	35.4	36.4
150	9.0	10.8	12.5	14.1	15.6	17.0	18.4	19.7	21.0	22.2	23.4	24.6	25.8	27.0	28.1	29.2	30.3	31.4	32.5	33.5	34.6	35.6	36.6
155	9.1	10.9	12.7	14.2	15.7	17.2	18.5	19.9	21.2	22.4	23.6	24.8	26.0	27.2	28.3	29.4	30.5	31.6	32.7	33.7	34.8	35.8	36.8
160	9.2	11.1	12.8	14.4	15.9	17.3	18.7	20.0	21.3	22.6	23.8	25.0	26.2	27.4	28.5	29.6	30.7	31.8	32.9	33.9	35.0	36.0	37.0
165	9.2	11.2	12.9	14.5	16.0	17.5	18.9	20.2	21.5	22.8	24.0	25.2	26.4	27.5	28.7	29.8	30.9	32.0	33.1	34.1	35.1	36.2	37.2
170	9.3	11.3	13.0	14.7	16.2	17.6	19.0	20.4	21.7	22.9	24.2	25.4	26.6	27.7	28.9	30.0	31.1	32.1	33.2	34.3	35.3	36.3	37.3
175	9.4	11.4	13.1	14.8	16.3	17.8	19.2	20.5	21.8	23.1	24.3	25.5	26.7	27.9	29.0	30.1	31.2	32.3	33.4	34.4	35.4	36.5	37.5
180	9.5	11.5	13.2	14.9	16.4	17.9	19.3	20.6	22.0	23.2	24.5	25.7	26.9	28.0	29.1	30.3	31.4	32.4	33.5	34.6	35.6	36.6	37.6

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 10. Regional lodgepole pine height growth and site index table (natural regions: 6, 9, 11, 14)[1]

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.1	3.3	3.6	3.9	4.1	4.4	4.7	5.0	5.3
10	1.4	1.5	1.7	1.8	2.0	2.3	2.5	2.8	3.1	3.4	3.7	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.9	7.4	7.9	8.4	8.9
15	1.6	1.8	2.1	2.4	2.7	3.0	3.4	3.8	4.2	4.7	5.2	5.6	6.1	6.7	7.2	7.7	8.3	8.9	9.5	10.1	10.7	11.4	12.0
20	1.8	2.2	2.5	3.0	3.4	3.9	4.4	4.9	5.5	6.0	6.6	7.2	7.8	8.5	9.1	9.8	10.4	11.1	11.8	12.6	13.3	14.0	14.8
25	2.1	2.6	3.1	3.6	4.2	4.8	5.4	6.0	6.7	7.3	8.0	8.7	9.4	10.2	10.9	11.7	12.4	13.2	14.0	14.8	15.6	16.4	17.3
30	2.5	3.0	3.7	4.3	5.0	5.7	6.4	7.1	7.8	8.6	9.4	10.2	10.9	11.8	12.6	13.4	14.2	15.1	15.9	16.8	17.7	18.6	19.4
35	2.8	3.5	4.2	5.0	5.8	6.5	7.3	8.2	9.0	9.8	10.6	11.5	12.4	13.2	14.1	15.0	15.9	16.8	17.7	18.6	19.5	20.5	21.4
40	3.2	4.0	4.8	5.7	6.5	7.4	8.3	9.2	10.0	10.9	11.8	12.8	13.7	14.6	15.5	16.5	17.4	18.3	19.3	20.2	21.2	22.1	23.1
45	3.6	4.5	5.4	6.4	7.3	8.2	9.2	10.1	11.1	12.0	13.0	13.9	14.9	15.8	16.8	17.8	18.8	19.7	20.7	21.7	22.7	23.7	24.6
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.4	5.5	6.5	7.6	8.7	9.7	10.8	11.8	12.9	13.9	15.0	16.0	17.0	18.1	19.1	20.1	21.1	22.1	23.2	24.2	25.2	26.2	27.2
60	4.8	5.9	7.1	8.2	9.3	10.4	11.5	12.6	13.7	14.8	15.8	16.9	18.0	19.0	20.1	21.1	22.1	23.2	24.2	25.2	26.2	27.3	28.3
65	5.1	6.4	7.6	8.8	9.9	11.1	12.2	13.3	14.5	15.6	16.7	17.7	18.8	19.9	21.0	22.0	23.1	24.1	25.1	26.2	27.2	28.2	29.2
70	5.4	6.8	8.0	9.3	10.5	11.7	12.9	14.0	15.2	16.3	17.4	18.5	19.6	20.7	21.8	22.8	23.9	24.9	26.0	27.0	28.0	29.1	30.1
75	5.8	7.1	8.5	9.8	11.0	12.3	13.5	14.6	15.8	17.0	18.1	19.2	20.3	21.4	22.5	23.6	24.6	25.7	26.7	27.8	28.8	29.8	30.8
80	6.1	7.5	8.9	10.2	11.5	12.8	14.0	15.2	16.4	17.6	18.7	19.9	21.0	22.1	23.2	24.3	25.3	26.4	27.4	28.5	29.5	30.5	31.5
85	6.3	7.8	9.3	10.6	12.0	13.3	14.5	15.7	17.0	18.1	19.3	20.4	21.6	22.7	23.8	24.9	25.9	27.0	28.0	29.1	30.1	31.1	32.1
90	6.6	8.1	9.6	11.0	12.4	13.7	15.0	16.2	17.5	18.7	19.8	21.0	22.1	23.2	24.3	25.4	26.5	27.5	28.6	29.6	30.6	31.6	32.6
95	6.8	8.4	10.0	11.4	12.8	14.1	15.4	16.7	17.9	19.1	20.3	21.5	22.6	23.7	24.8	25.9	27.0	28.0	29.1	30.1	31.1	32.1	33.1
100	7.0	8.7	10.3	11.7	13.1	14.5	15.8	17.1	18.3	19.6	20.8	21.9	23.1	24.2	25.3	26.4	27.4	28.5	29.5	30.5	31.5	32.5	33.5
105	7.2	8.9	10.5	12.0	13.5	14.8	16.2	17.5	18.7	20.0	21.2	22.3	23.5	24.6	25.7	26.8	27.8	28.9	29.9	30.9	31.9	32.9	33.9
110	7.4	9.2	10.8	12.3	13.8	15.2	16.5	17.8	19.1	20.3	21.5	22.7	23.8	25.0	26.1	27.1	28.2	29.2	30.3	31.3	32.3	33.2	34.2
115	7.6	9.4	11.0	12.6	14.0	15.5	16.8	18.1	19.4	20.6	21.9	23.0	24.2	25.3	26.4	27.5	28.5	29.6	30.6	31.6	32.6	33.5	34.5
120	7.7	9.6	11.2	12.8	14.3	15.7	17.1	18.4	19.7	20.9	22.2	23.3	24.5	25.6	26.7	27.8	28.8	29.9	30.9	31.9	32.8	33.8	34.7
125	7.9	9.7	11.4	13.0	14.5	16.0	17.4	18.7	20.0	21.2	22.4	23.6	24.8	25.9	27.0	28.0	29.1	30.1	31.1	32.1	33.1	34.0	35.0
130	8.0	9.9	11.6	13.2	14.7	16.2	17.6	18.9	20.2	21.5	22.7	23.9	25.0	26.1	27.2	28.3	29.3	30.4	31.4	32.3	33.3	34.2	35.2
135	8.1	10.0	11.8	13.4	14.9	16.4	17.8	19.1	20.4	21.7	22.9	24.1	25.2	26.4	27.4	28.5	29.6	30.6	31.6	32.5	33.5	34.4	35.4
140	8.2	10.2	11.9	13.6	15.1	16.6	18.0	19.4	20.7	21.9	23.1	24.3	25.5	26.6	27.7	28.7	29.7	30.8	31.7	32.7	33.7	34.6	35.5
145	8.3	10.3	12.1	13.7	15.3	16.8	18.2	19.5	20.8	22.1	23.3	24.5	25.6	26.8	27.8	28.9	29.9	30.9	31.9	32.9	33.8	34.7	35.7
150	8.4	10.4	12.2	13.9	15.4	16.9	18.3	19.7	21.0	22.3	23.5	24.7	25.8	26.9	28.0	29.1	30.1	31.1	32.1	33.0	34.0	34.9	35.8
155	8.5	10.5	12.3	14.0	15.6	17.1	18.5	19.9	21.2	22.4	23.6	24.8	26.0	27.1	28.2	29.2	30.2	31.2	32.2	33.1	34.1	35.0	35.9
160	8.5	10.6	12.4	14.1	15.7	17.2	18.6	20.0	21.3	22.6	23.8	25.0	26.1	27.2	28.3	29.3	30.4	31.3	32.3	33.3	34.2	35.1	36.0
165	8.6	10.6	12.5	14.2	15.8	17.3	18.8	20.1	21.4	22.7	23.9	25.1	26.2	27.3	28.4	29.5	30.5	31.5	32.4	33.4	34.3	35.2	36.1
170	8.7	10.7	12.6	14.3	15.9	17.4	18.9	20.2	21.6	22.8	24.0	25.2	26.3	27.4	28.5	29.6	30.6	31.6	32.5	33.5	34.4	35.3	36.2
175	8.7	10.8	12.7	14.4	16.0	17.5	19.0	20.3	21.7	22.9	24.1	25.3	26.5	27.6	28.6	29.7	30.7	31.6	32.6	33.5	34.5	35.4	36.2
180	8.7	10.8	12.7	14.5	16.1	17.6	19.1	20.4	21.8	23.0	24.2	25.4	26.5	27.6	28.7	29.7	30.7	31.7	32.7	33.6	34.5	35.4	36.3

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 11. Regional lodgepole pine height growth and site index table (natural regions: 1, 2, 3, 5, 12, 13, 15, 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.5	1.5	1.7	1.8	2.0	2.1	2.3	2.5	2.8	3.0	3.3	3.5	3.8	4.1	4.5	4.8	5.1	5.5	5.9	6.3	6.7
10	1.4	1.6	1.8	2.0	2.3	2.5	2.8	3.2	3.5	3.9	4.3	4.7	5.2	5.6	6.1	6.6	7.1	7.6	8.1	8.7	9.3	9.8	10.4
15	1.6	1.9	2.2	2.6	2.9	3.4	3.8	4.3	4.8	5.3	5.8	6.4	6.9	7.5	8.1	8.8	9.4	10.0	10.7	11.4	12.1	12.8	13.5
20	1.9	2.3	2.7	3.2	3.7	4.2	4.8	5.4	6.0	6.6	7.2	7.9	8.6	9.3	10.0	10.7	11.5	12.2	13.0	13.7	14.5	15.3	16.1
25	2.2	2.7	3.2	3.8	4.4	5.1	5.7	6.4	7.1	7.9	8.6	9.3	10.1	10.9	11.7	12.5	13.3	14.1	14.9	15.8	16.6	17.5	18.4
30	2.5	3.1	3.8	4.5	5.2	5.9	6.7	7.4	8.2	9.0	9.8	10.7	11.5	12.3	13.2	14.1	14.9	15.8	16.7	17.6	18.5	19.4	20.3
35	2.9	3.6	4.3	5.1	5.9	6.7	7.6	8.4	9.3	10.1	11.0	11.9	12.8	13.7	14.6	15.5	16.4	17.3	18.3	19.2	20.1	21.1	22.0
40	3.2	4.1	4.9	5.8	6.6	7.5	8.4	9.3	10.2	11.2	12.1	13.0	13.9	14.9	15.8	16.8	17.7	18.7	19.7	20.6	21.6	22.6	23.5
45	3.6	4.5	5.5	6.4	7.3	8.3	9.2	10.2	11.2	12.1	13.1	14.0	15.0	16.0	17.0	17.9	18.9	19.9	20.9	21.9	22.9	23.9	24.8
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.4	5.5	6.5	7.6	8.6	9.7	10.7	11.8	12.8	13.8	14.8	15.9	16.9	17.9	18.9	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0
60	4.8	5.9	7.0	8.1	9.2	10.3	11.4	12.5	13.5	14.6	15.6	16.7	17.7	18.8	19.8	20.8	21.8	22.9	23.9	24.9	25.9	26.9	27.9
65	5.1	6.3	7.5	8.7	9.8	10.9	12.0	13.1	14.2	15.3	16.3	17.4	18.5	19.5	20.6	21.6	22.6	23.7	24.7	25.7	26.7	27.7	28.7
70	5.5	6.8	8.0	9.2	10.3	11.5	12.6	13.7	14.8	15.9	17.0	18.1	19.2	20.2	21.3	22.3	23.3	24.4	25.4	26.4	27.4	28.4	29.4
75	5.8	7.2	8.4	9.6	10.8	12.0	13.2	14.3	15.4	16.5	17.6	18.7	19.8	20.8	21.9	22.9	24.0	25.0	26.0	27.0	28.0	29.0	30.0
80	6.2	7.5	8.8	10.1	11.3	12.5	13.7	14.8	16.0	17.1	18.2	19.3	20.4	21.4	22.5	23.5	24.6	25.6	26.6	27.6	28.6	29.6	30.6
85	6.5	7.9	9.2	10.5	11.7	12.9	14.1	15.3	16.4	17.6	18.7	19.8	20.9	21.9	23.0	24.0	25.1	26.1	27.1	28.1	29.1	30.1	31.1
90	6.8	8.2	9.6	10.9	12.1	13.4	14.6	15.8	16.9	18.0	19.2	20.3	21.4	22.4	23.5	24.5	25.6	26.6	27.6	28.6	29.6	30.5	31.5
95	7.1	8.5	9.9	11.2	12.5	13.8	15.0	16.2	17.3	18.5	19.6	20.7	21.8	22.9	23.9	25.0	26.0	27.0	28.0	29.0	30.0	30.9	31.9
100	7.4	8.8	10.2	11.6	12.9	14.1	15.4	16.6	17.7	18.9	20.0	21.1	22.2	23.3	24.3	25.3	26.4	27.4	28.4	29.4	30.3	31.3	32.2
105	7.6	9.1	10.6	11.9	13.2	14.5	15.7	16.9	18.1	19.2	20.4	21.5	22.5	23.6	24.7	25.7	26.7	27.7	28.7	29.7	30.6	31.6	32.5
110	7.9	9.4	10.8	12.2	13.5	14.8	16.0	17.2	18.4	19.6	20.7	21.8	22.9	23.9	25.0	26.0	27.0	28.0	29.0	30.0	30.9	31.9	32.8
115	8.1	9.6	11.1	12.5	13.8	15.1	16.3	17.5	18.7	19.9	21.0	22.1	23.2	24.2	25.3	26.3	27.3	28.3	29.3	30.2	31.2	32.1	33.1
120	8.3	9.9	11.3	12.7	14.1	15.4	16.6	17.8	19.0	20.2	21.3	22.4	23.5	24.5	25.5	26.6	27.6	28.6	29.5	30.5	31.4	32.3	33.3
125	8.5	10.1	11.6	13.0	14.3	15.6	16.9	18.1	19.3	20.4	21.5	22.6	23.7	24.8	25.8	26.8	27.8	28.8	29.7	30.7	31.6	32.5	33.5
130	8.7	10.3	11.8	13.2	14.6	15.9	17.1	18.3	19.5	20.7	21.8	22.9	23.9	25.0	26.0	27.0	28.0	29.0	29.9	30.9	31.8	32.7	33.6
135	8.9	10.5	12.0	13.4	14.8	16.1	17.3	18.5	19.7	20.9	22.0	23.1	24.1	25.2	26.2	27.2	28.2	29.2	30.1	31.1	32.0	32.9	33.8
140	9.0	10.7	12.2	13.6	15.0	16.3	17.5	18.7	19.9	21.1	22.2	23.3	24.3	25.4	26.4	27.4	28.4	29.3	30.3	31.2	32.1	33.0	33.9
145	9.2	10.8	12.3	13.8	15.2	16.5	17.7	18.9	20.1	21.3	22.4	23.5	24.5	25.5	26.6	27.6	28.5	29.5	30.4	31.3	32.2	33.1	34.0
150	9.3	11.0	12.5	14.0	15.3	16.6	17.9	19.1	20.3	21.4	22.5	23.6	24.7	25.7	26.7	27.7	28.7	29.6	30.5	31.5	32.4	33.3	34.1
155	9.4	11.1	12.7	14.1	15.5	16.8	18.0	19.3	20.4	21.6	22.7	23.8	24.8	25.8	26.8	27.8	28.8	29.7	30.7	31.6	32.5	33.4	34.2
160	9.6	11.2	12.8	14.2	15.6	16.9	18.2	19.4	20.6	21.7	22.8	23.9	24.9	26.0	27.0	27.9	28.9	29.8	30.8	31.7	32.6	33.4	34.3
165	9.7	11.4	12.9	14.4	15.8	17.1	18.3	19.5	20.7	21.9	23.0	24.0	25.1	26.1	27.1	28.1	29.0	29.9	30.9	31.8	32.6	33.5	34.4
170	9.8	11.5	13.0	14.5	15.9	17.2	18.5	19.7	20.8	22.0	23.1	24.1	25.2	26.2	27.2	28.2	29.1	30.0	30.9	31.8	32.7	33.6	34.4
175	9.9	11.6	13.2	14.6	16.0	17.3	18.6	19.8	21.0	22.1	23.2	24.2	25.3	26.3	27.3	28.2	29.2	30.1	31.0	31.9	32.8	33.7	34.5
180	10.0	11.7	13.3	14.7	16.1	17.4	18.7	19.9	21.1	22.2	23.3	24.3	25.4	26.4	27.4	28.3	29.3	30.2	31.1	32.0	32.8	33.7	34.6

[1]See Figure 1 for the list of natural regions and their designation numbers.

2.3 ASPEN

Aspen height growth model:

$$[7] \quad H_2 = 1.3+(H_1-1.3)\left(\frac{1-\exp(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)}T_2)}{1-\exp(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)}T_1)}\right)^{b_3(H_1-1.3)^{b_4}T_1^{b_5}}$$

where:

H_2 = tree height (m) at time two

T_2 = breast height age (years) at time two

H_1 = tree height (m) at time one

T_1 = breast height age (years) at time one

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Aspen site index model (which is a special variant of the height growth model [7] with H_1 replaced by the site index SI and T_1 replaced by the reference-age T_R, respectively):

$$[8] \quad H = 1.3+(SI-1.3)\left(\frac{1-\exp(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)}T_B)}{1-\exp(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)}T_R)}\right)^{b_3(SI-1.3)^{b_4}T_R^{b_5}}$$

where:

H = tree height (m) at T_B

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at T_R

T_R = reference-age (= 50 years breast height age)

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Table 12. Fit statistics for the aspen height growth model [7].

Natural regions[1]	Parameter	Estimate	Std. error	n	MSE	R^2
All (provincial)	b_0	0.035930	0.000460	47,568	3.605	0.917
	b_1	-0.486239	0.009723			
	b_2	1.041916	0.000971			
	b_3	0.818283	0.002409			
	b_4	-0.594641	0.003299			
	b_5	0.522558	0.002001			
2, 14, 15, 16	b_0	0.041480	0.001783	4,996	2.779	0.922
	b_1	-0.629239	0.036731			
	b_2	1.062898	0.003923			
	b_3	0.866399	0.008224			
	b_4	-0.660315	0.010187			
	b_5	0.537256	0.005878			
1, 3, 4, 5 6, 12, 13	b_0	0.038405	0.000683	21,638	3.332	0.921
	b_1	-0.465919	0.013460			
	b_2	1.042713	0.001387			
	b_3	0.836287	0.003470			
	b_4	-0.585070	0.004816			
	b_5	0.526580	0.002982			
9, 11	b_0	0.032049	0.000713	17,616	3.885	0.917
	b_1	-0.455481	0.016610			
	b_2	1.038805	0.001555			
	b_3	0.777423	0.003878			
	b_4	-0.588933	0.005520			
	b_5	0.528329	0.003316			
7, 8, 10	b_0	0.028612	0.001858	3,318	3.997	0.904
	b_1	-0.464755	0.048603			
	b_2	1.047753	0.004836			
	b_3	0.783610	0.011108			
	b_4	-0.558863	0.013836			
	b_5	0.481366	0.007076			

[1]See Figure 1 for the list of natural regions and their designation numbers.

Aspen Site Index Curves

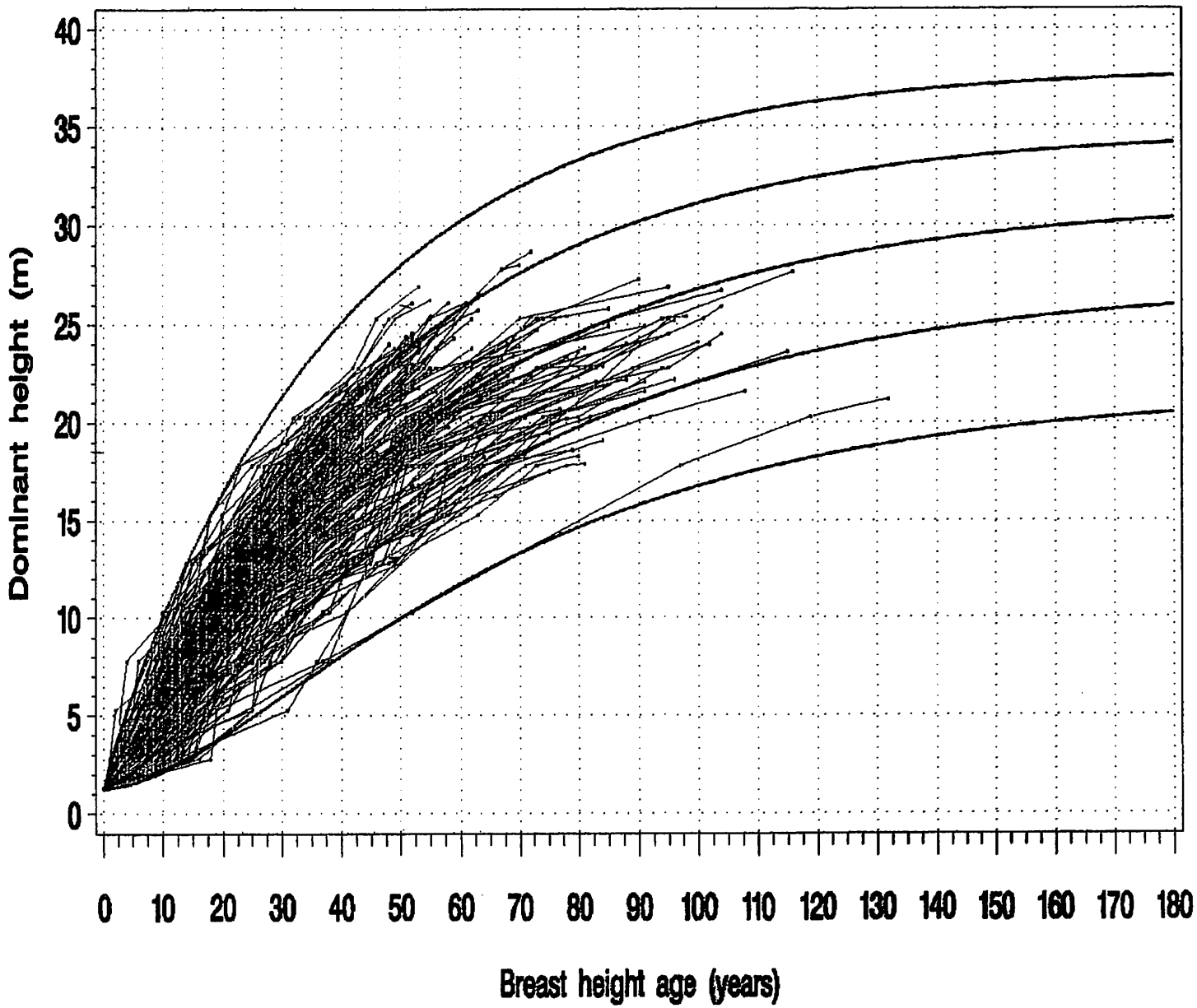

Figure 16. Aspen site index curves for natural regions 1, 3, 4, 5, 6, 12 and 13, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 10.0, 14.5, 19.0, 23.5 and 28.0 metres at a reference breast height age of 50 years (part I).

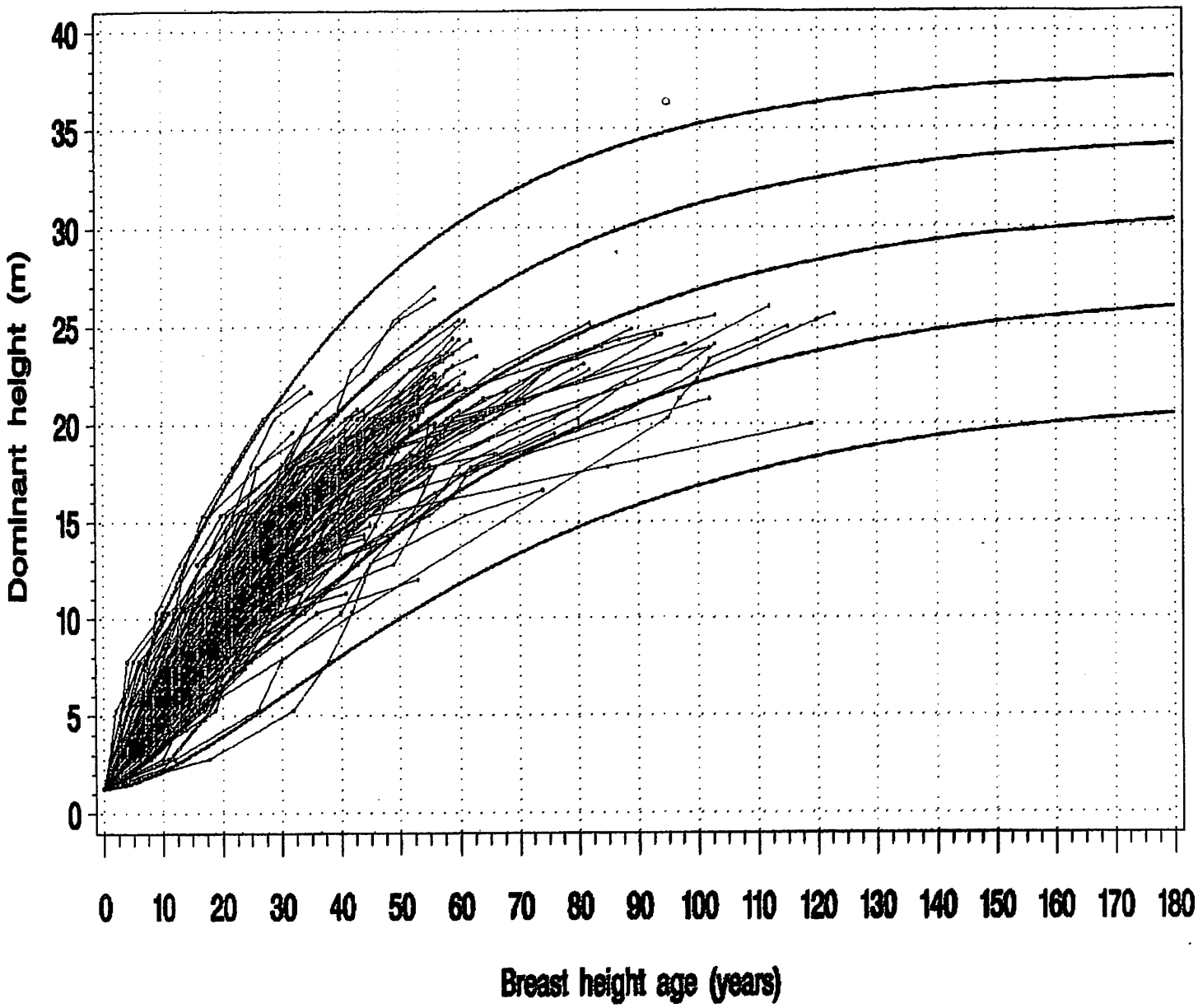

Figure 17. Aspen site index curves for natural regions 1, 3, 4, 5, 6, 12 and 13, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 10.0, 14.5, 19.0, 23.5 and 28.0 metres at a reference breast height age of 50 years (part II).

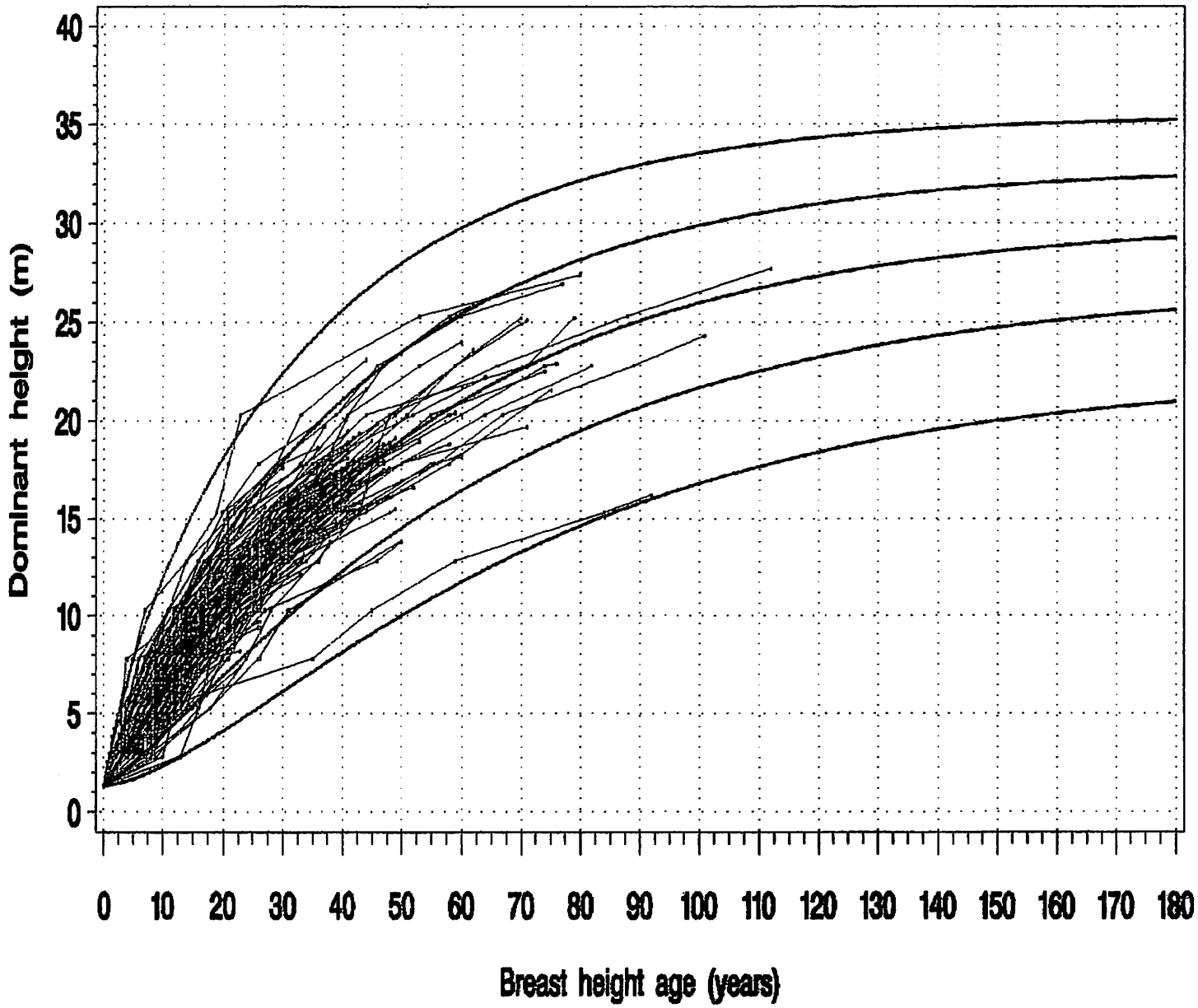

Figure 18. Aspen site index curves for natural regions 2, 14, 15 and 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 10.0, 14.5, 19.0, 23.5 and 28.0 metres at a reference breast height age of 50 years.

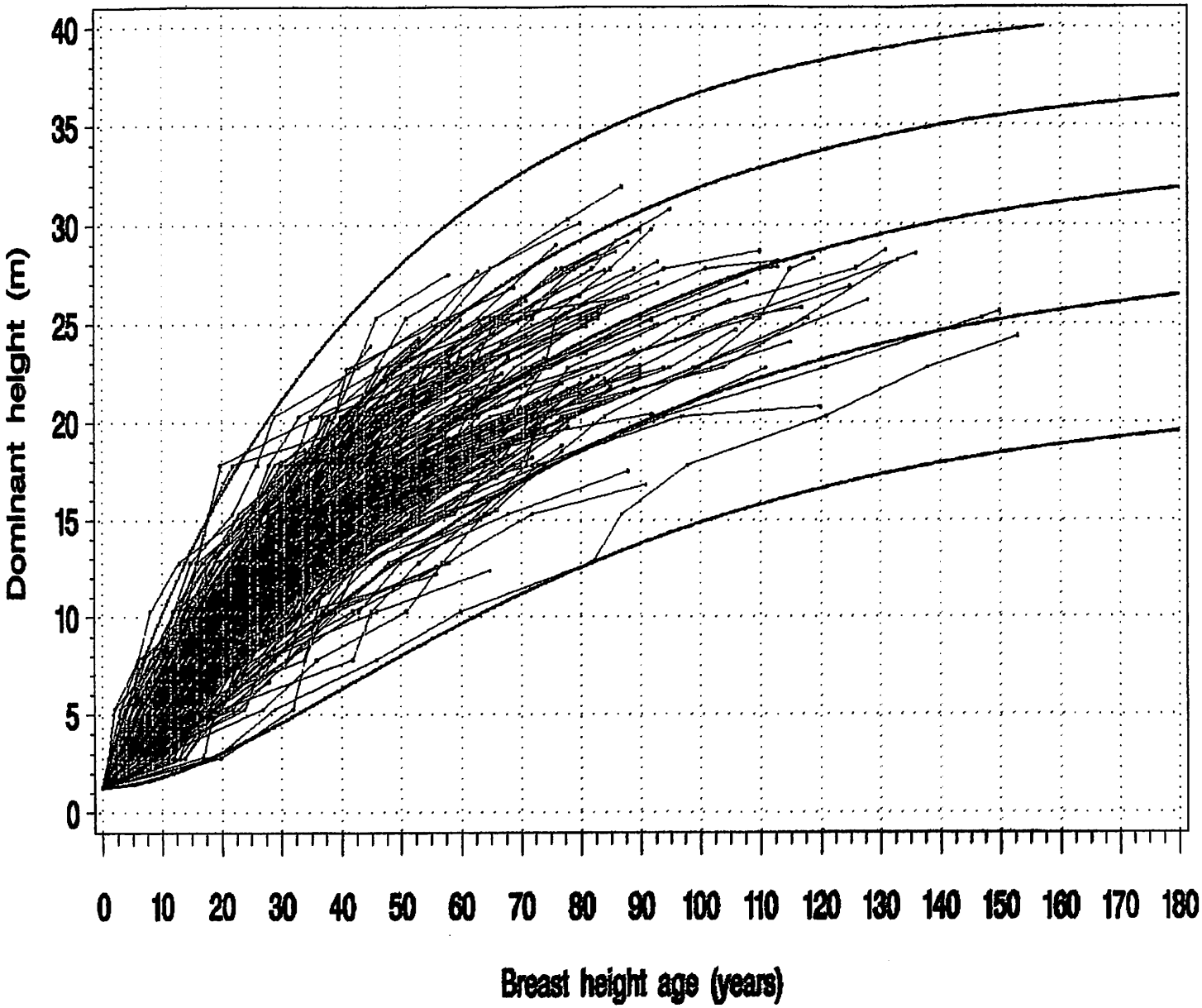

Figure 19. Aspen site index curves for natural regions 9 and 11, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 8.0, 13.0, 18.0, 23.0 and 28.0 metres at a reference breast height age of 50 years.

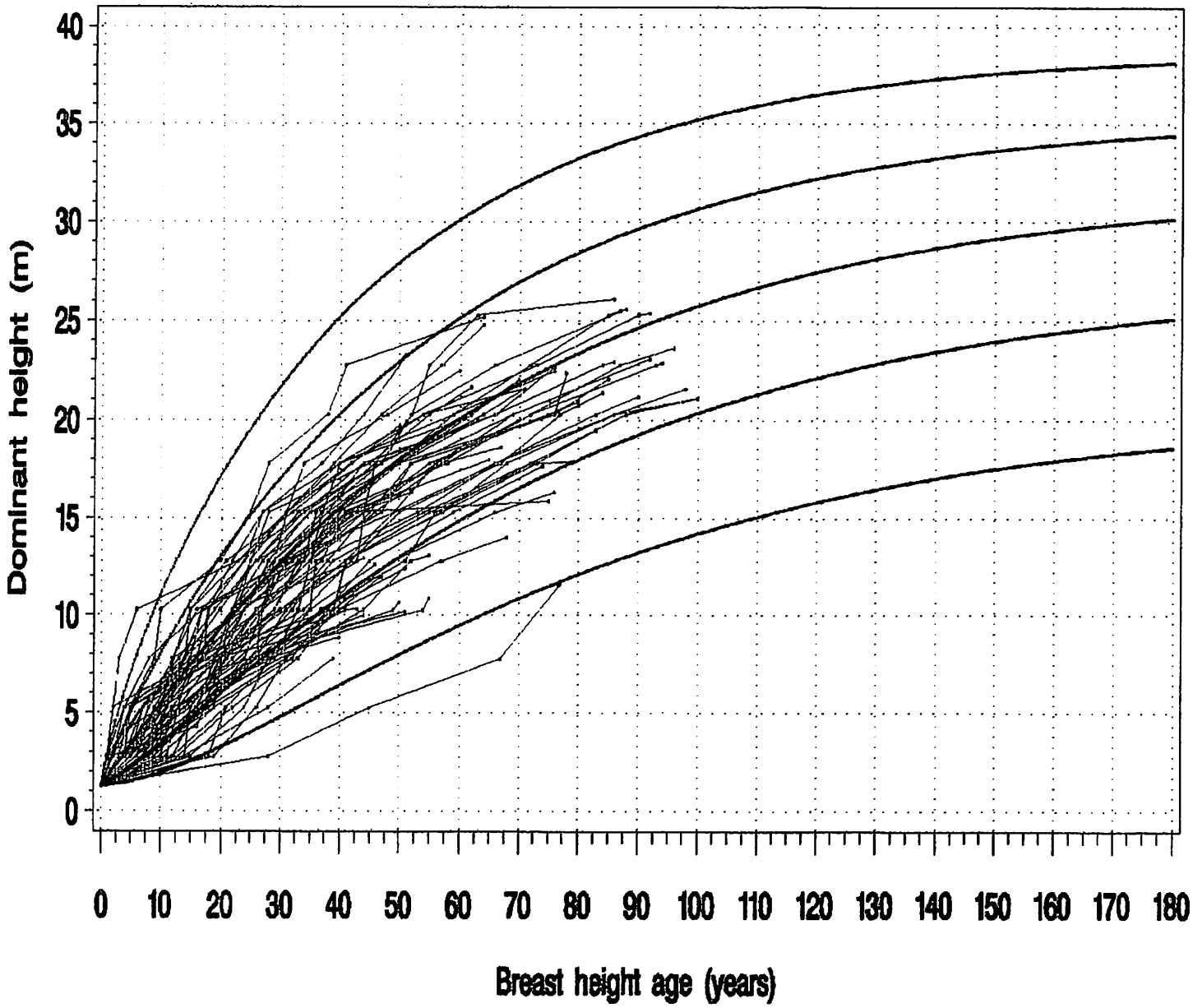

Figure 20. Aspen site index curves for natural regions 7, 8 and 10, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 8.0, 13.0, 18.0, 23.0 and 28.0 metres at a reference breast height age of 50 years.

Aspen Site Index Tables

Table 13. Provincial aspen height growth and site index table (natural regions: 1 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.8	2.0	2.2	2.3	2.5	2.8	3.0	3.3	3.5	3.8	4.1	4.5	4.8	5.2	5.5	5.9	6.3
10	1.5	1.6	1.8	2.0	2.2	2.5	2.8	3.1	3.4	3.8	4.1	4.5	5.0	5.4	5.9	6.4	6.9	7.4	7.9	8.5	9.0	9.6	10.2
15	1.8	2.1	2.4	2.7	3.0	3.4	3.9	4.3	4.8	5.3	5.8	6.4	6.9	7.5	8.1	8.7	9.4	10.0	10.7	11.4	12.1	12.8	13.6
20	2.2	2.6	3.0	3.5	4.0	4.5	5.1	5.6	6.2	6.8	7.5	8.1	8.8	9.5	10.2	11.0	11.7	12.5	13.2	14.0	14.8	15.6	16.5
25	2.7	3.2	3.8	4.4	5.0	5.6	6.3	6.9	7.6	8.4	9.1	9.9	10.6	11.4	12.2	13.0	13.8	14.7	15.5	16.4	17.2	18.1	19.0
30	3.3	4.0	4.6	5.3	6.0	6.7	7.5	8.3	9.0	9.8	10.7	11.5	12.3	13.2	14.0	14.9	15.8	16.7	17.6	18.5	19.4	20.3	21.3
35	4.0	4.7	5.5	6.2	7.0	7.8	8.7	9.5	10.4	11.2	12.1	13.0	13.9	14.8	15.7	16.6	17.6	18.5	19.4	20.4	21.3	22.3	23.3
40	4.6	5.5	6.3	7.2	8.0	8.9	9.8	10.7	11.7	12.6	13.5	14.4	15.4	16.3	17.3	18.2	19.2	20.1	21.1	22.1	23.1	24.0	25.0
45	5.3	6.2	7.2	8.1	9.0	10.0	10.9	11.9	12.9	13.8	14.8	15.8	16.7	17.7	18.7	19.7	20.7	21.6	22.6	23.6	24.6	25.6	26.6
50	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0
55	6.7	7.7	8.8	9.9	10.9	12.0	13.0	14.0	15.1	16.1	17.1	18.1	19.2	20.2	21.2	22.2	23.2	24.2	25.2	26.2	27.2	28.2	29.2
60	7.3	8.5	9.6	10.7	11.8	12.9	13.9	15.0	16.1	17.1	18.2	19.2	20.2	21.3	22.3	23.3	24.3	25.4	26.4	27.4	28.4	29.4	30.4
65	8.0	9.2	10.3	11.5	12.6	13.7	14.8	15.9	17.0	18.1	19.1	20.2	21.2	22.3	23.3	24.3	25.4	26.4	27.4	28.4	29.4	30.4	31.4
70	8.6	9.8	11.0	12.2	13.4	14.5	15.7	16.8	17.9	19.0	20.0	21.1	22.1	23.2	24.2	25.3	26.3	27.3	28.3	29.3	30.3	31.3	32.3
75	9.1	10.4	11.7	12.9	14.1	15.3	16.4	17.6	18.7	19.8	20.9	21.9	23.0	24.0	25.1	26.1	27.1	28.1	29.1	30.1	31.1	32.1	33.0
80	9.7	11.0	12.3	13.6	14.8	16.0	17.2	18.3	19.4	20.5	21.6	22.7	23.8	24.8	25.8	26.9	27.9	28.9	29.9	30.9	31.8	32.8	33.8
85	10.2	11.6	12.9	14.2	15.4	16.7	17.8	19.0	20.1	21.2	22.3	23.4	24.5	25.5	26.5	27.6	28.6	29.6	30.6	31.5	32.5	33.4	34.4
90	10.6	12.1	13.5	14.8	16.0	17.3	18.5	19.6	20.8	21.9	23.0	24.1	25.1	26.2	27.2	28.2	29.2	30.2	31.2	32.1	33.1	34.0	35.0
95	11.1	12.6	14.0	15.3	16.6	17.8	19.0	20.2	21.4	22.5	23.6	24.7	25.7	26.8	27.8	28.8	29.8	30.8	31.7	32.7	33.6	34.6	35.5
100	11.5	13.0	14.4	15.8	17.1	18.4	19.6	20.8	21.9	23.0	24.1	25.2	26.3	27.3	28.3	29.3	30.3	31.3	32.2	33.2	34.1	35.0	35.9
105	11.8	13.4	14.9	16.3	17.6	18.9	20.1	21.3	22.4	23.5	24.6	25.7	26.8	27.8	28.8	29.8	30.8	31.7	32.7	33.6	34.5	35.4	36.3
110	12.2	13.8	15.3	16.7	18.0	19.3	20.5	21.7	22.9	24.0	25.1	26.2	27.2	28.2	29.2	30.2	31.2	32.2	33.1	34.0	34.9	35.8	36.7
115	12.5	14.1	15.7	17.1	18.4	19.7	21.0	22.1	23.3	24.4	25.5	26.6	27.6	28.7	29.7	30.6	31.6	32.5	33.5	34.4	35.3	36.2	37.0
120	12.8	14.5	16.0	17.4	18.8	20.1	21.3	22.5	23.7	24.8	25.9	27.0	28.0	29.0	30.0	31.0	31.9	32.9	33.8	34.7	35.6	36.5	37.3
125	13.0	14.8	16.3	17.8	19.2	20.5	21.7	22.9	24.1	25.2	26.3	27.3	28.4	29.4	30.4	31.3	32.3	33.2	34.1	35.0	35.9	36.7	37.6
130	13.3	15.0	16.6	18.1	19.5	20.8	22.0	23.2	24.4	25.5	26.6	27.7	28.7	29.7	30.7	31.6	32.6	33.5	34.4	35.3	36.1	37.0	37.8
135	13.5	15.3	16.9	18.4	19.8	21.1	22.3	23.5	24.7	25.8	26.9	28.0	29.0	30.0	31.0	31.9	32.8	33.7	34.6	35.5	36.4	37.2	38.0
140	13.7	15.5	17.1	18.6	20.0	21.4	22.6	23.8	25.0	26.1	27.2	28.2	29.3	30.2	31.2	32.2	33.1	34.0	34.9	35.7	36.6	37.4	38.2
145	13.9	15.7	17.4	18.9	20.3	21.6	22.9	24.1	25.2	26.4	27.4	28.5	29.5	30.5	31.4	32.4	33.3	34.2	35.1	35.9	36.8	37.6	38.4
150	14.1	15.9	17.6	19.1	20.5	21.8	23.1	24.3	25.5	26.6	27.7	28.7	29.7	30.7	31.7	32.6	33.5	34.4	35.2	36.1	36.9	37.7	38.6
155	14.2	16.1	17.7	19.3	20.7	22.1	23.3	24.5	25.7	26.8	27.9	28.9	29.9	30.9	31.9	32.8	33.7	34.6	35.4	36.3	37.1	37.9	38.7
160	14.3	16.2	17.9	19.5	20.9	22.3	23.5	24.7	25.9	27.0	28.1	29.1	30.1	31.1	32.0	32.9	33.8	34.7	35.6	36.4	37.2	38.0	38.8
165	14.5	16.4	18.1	19.6	21.1	22.4	23.7	24.9	26.1	27.2	28.3	29.3	30.3	31.3	32.2	33.1	34.0	34.9	35.7	36.5	37.3	38.1	38.9
170	14.6	16.5	18.2	19.8	21.3	22.6	23.9	25.1	26.3	27.4	28.4	29.5	30.4	31.4	32.3	33.2	34.1	35.0	35.8	36.6	37.5	38.2	39.0
175	14.7	16.6	18.4	19.9	21.4	22.8	24.0	25.3	26.4	27.5	28.6	29.6	30.6	31.5	32.5	33.4	34.3	35.1	35.9	36.8	37.6	38.3	39.1
180	14.8	16.7	18.5	20.1	21.5	22.9	24.2	25.4	26.6	27.7	28.7	29.7	30.7	31.7	32.6	33.5	34.4	35.2	36.0	36.9	37.6	38.4	39.2

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 14. Regional aspen height growth and site index table (natural regions: 2, 14, 15, 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.8	1.9	2.1	2.3	2.5	2.8	3.0	3.3	3.7	4.0	4.4	4.8	5.2	5.6	6.1	6.6	7.1	7.6
10	1.5	1.6	1.8	2.0	2.3	2.6	2.9	3.3	3.6	4.1	4.5	5.0	5.5	6.0	6.5	7.1	7.7	8.4	9.0	9.7	10.4	11.1	11.9
15	1.8	2.1	2.4	2.7	3.1	3.6	4.0	4.5	5.1	5.6	6.2	6.9	7.5	8.2	8.9	9.6	10.3	11.1	11.9	12.7	13.5	14.4	15.2
20	2.2	2.6	3.1	3.5	4.1	4.6	5.2	5.9	6.5	7.2	7.9	8.6	9.4	10.2	11.0	11.8	12.6	13.5	14.3	15.2	16.2	17.1	18.0
25	2.7	3.3	3.8	4.4	5.1	5.7	6.4	7.2	7.9	8.7	9.5	10.3	11.1	12.0	12.9	13.8	14.7	15.6	16.5	17.5	18.4	19.4	20.4
30	3.3	4.0	4.6	5.3	6.1	6.9	7.6	8.5	9.3	10.1	11.0	11.9	12.8	13.7	14.6	15.5	16.5	17.4	18.4	19.4	20.4	21.4	22.4
35	4.0	4.7	5.5	6.3	7.1	7.9	8.8	9.7	10.6	11.5	12.4	13.3	14.3	15.2	16.2	17.1	18.1	19.1	20.1	21.1	22.1	23.1	24.1
40	4.6	5.5	6.3	7.2	8.1	9.0	9.9	10.9	11.8	12.7	13.7	14.6	15.6	16.6	17.6	18.6	19.5	20.5	21.5	22.6	23.6	24.6	25.6
45	5.3	6.2	7.2	8.1	9.1	10.0	11.0	12.0	12.9	13.9	14.9	15.9	16.9	17.9	18.8	19.8	20.8	21.8	22.8	23.9	24.9	25.9	26.9
50	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0
55	6.7	7.7	8.8	9.8	10.9	11.9	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0
60	7.3	8.5	9.6	10.7	11.7	12.8	13.8	14.9	15.9	16.9	18.0	19.0	20.0	21.0	22.0	23.0	24.0	24.9	25.9	26.9	27.9	28.8	29.8
65	8.0	9.1	10.3	11.4	12.5	13.6	14.7	15.7	16.8	17.8	18.8	19.8	20.9	21.8	22.8	23.8	24.8	25.8	26.7	27.7	28.6	29.6	30.5
70	8.6	9.8	11.0	12.1	13.3	14.4	15.5	16.5	17.6	18.6	19.6	20.6	21.6	22.6	23.6	24.6	25.5	26.5	27.4	28.4	29.3	30.2	31.1
75	9.1	10.4	11.6	12.8	14.0	15.1	16.2	17.2	18.3	19.3	20.4	21.4	22.4	23.3	24.3	25.3	26.2	27.1	28.1	29.0	29.9	30.8	31.7
80	9.7	11.0	12.3	13.5	14.6	15.7	16.8	17.9	19.0	20.0	21.0	22.0	23.0	24.0	24.9	25.9	26.8	27.7	28.6	29.5	30.4	31.3	32.2
85	10.2	11.5	12.8	14.1	15.2	16.4	17.5	18.5	19.6	20.6	21.6	22.6	23.6	24.6	25.5	26.4	27.3	28.2	29.1	30.0	30.9	31.7	32.6
90	10.6	12.0	13.4	14.6	15.8	16.9	18.0	19.1	20.2	21.2	22.2	23.2	24.1	25.1	26.0	26.9	27.8	28.7	29.6	30.4	31.3	32.1	33.0
95	11.1	12.5	13.9	15.1	16.3	17.5	18.6	19.6	20.7	21.7	22.7	23.7	24.6	25.6	26.5	27.4	28.2	29.1	30.0	30.8	31.6	32.5	33.3
100	11.4	12.9	14.3	15.6	16.8	18.0	19.1	20.1	21.2	22.2	23.2	24.1	25.1	26.0	26.9	27.8	28.6	29.5	30.3	31.1	32.0	32.8	33.5
105	11.8	13.3	14.7	16.0	17.3	18.4	19.5	20.6	21.6	22.6	23.6	24.5	25.5	26.4	27.3	28.1	29.0	29.8	30.6	31.4	32.2	33.0	33.8
110	12.2	13.7	15.1	16.4	17.7	18.8	19.9	21.0	22.0	23.0	24.0	24.9	25.8	26.7	27.6	28.5	29.3	30.1	30.9	31.7	32.5	33.2	34.0
115	12.5	14.1	15.5	16.8	18.0	19.2	20.3	21.4	22.4	23.4	24.3	25.3	26.2	27.0	27.9	28.7	29.6	30.4	31.2	31.9	32.7	33.4	34.2
120	12.7	14.4	15.8	17.2	18.4	19.6	20.7	21.7	22.7	23.7	24.7	25.6	26.5	27.3	28.2	29.0	29.8	30.6	31.4	32.1	32.9	33.6	34.3
125	13.0	14.7	16.1	17.5	18.7	19.9	21.0	22.0	23.1	24.0	25.0	25.9	26.7	27.6	28.4	29.2	30.0	30.8	31.6	32.3	33.0	33.8	34.5
130	13.2	14.9	16.4	17.8	19.0	20.2	21.3	22.3	23.3	24.3	25.2	26.1	27.0	27.8	28.7	29.5	30.2	31.0	31.7	32.5	33.2	33.9	34.6
135	13.5	15.2	16.7	18.0	19.3	20.5	21.6	22.6	23.6	24.6	25.5	26.4	27.2	28.1	28.9	29.6	30.4	31.2	31.9	32.6	33.3	34.0	34.7
140	13.7	15.4	16.9	18.3	19.6	20.7	21.8	22.9	23.9	24.8	25.7	26.6	27.4	28.2	29.0	29.8	30.6	31.3	32.0	32.7	33.4	34.1	34.8
145	13.8	15.6	17.1	18.5	19.8	21.0	22.1	23.1	24.1	25.0	25.9	26.8	27.6	28.4	29.2	30.0	30.7	31.4	32.2	32.9	33.5	34.2	34.9
150	14.0	15.8	17.3	18.7	20.0	21.2	22.3	23.3	24.3	25.2	26.1	27.0	27.8	28.6	29.4	30.1	30.8	31.6	32.3	33.0	33.6	34.3	35.0
155	14.1	16.0	17.5	18.9	20.2	21.4	22.5	23.5	24.5	25.4	26.3	27.1	27.9	28.7	29.5	30.2	31.0	31.7	32.4	33.0	33.7	34.4	35.0
160	14.3	16.1	17.7	19.1	20.4	21.5	22.6	23.7	24.6	25.5	26.4	27.3	28.1	28.9	29.6	30.4	31.1	31.8	32.5	33.1	33.8	34.4	35.1
165	14.4	16.2	17.8	19.3	20.5	21.7	22.8	23.8	24.8	25.7	26.6	27.4	28.2	29.0	29.7	30.5	31.2	31.9	32.5	33.2	33.8	34.5	35.1
170	14.5	16.4	18.0	19.4	20.7	21.9	23.0	24.0	24.9	25.8	26.7	27.5	28.3	29.1	29.8	30.5	31.2	31.9	32.6	33.3	33.9	34.5	35.2
175	14.6	16.5	18.1	19.5	20.8	22.0	23.1	24.1	25.1	26.0	26.8	27.6	28.4	29.2	29.9	30.6	31.3	32.0	32.7	33.3	33.9	34.6	35.2
180	14.7	16.6	18.2	19.7	21.0	22.1	23.2	24.2	25.2	26.1	26.9	27.7	28.5	29.3	30.0	30.7	31.4	32.1	32.7	33.4	34.0	34.6	35.2

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 15. Regional aspen height growth and site index table (natural regions: 1, 3, 4, 5, 6, 12, 13)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.4	2.6	2.9	3.1	3.4	3.6	3.9	4.2	4.6	4.9	5.3	5.7	6.1
10	1.5	1.6	1.8	2.0	2.2	2.4	2.7	3.0	3.3	3.6	4.0	4.4	4.8	5.2	5.7	6.2	6.7	7.2	7.7	8.3	8.8	9.4	10.0
15	1.8	2.0	2.3	2.6	3.0	3.4	3.8	4.2	4.7	5.2	5.7	6.2	6.8	7.4	8.0	8.6	9.2	9.9	10.6	11.3	12.0	12.7	13.5
20	2.2	2.6	3.0	3.4	3.9	4.4	5.0	5.5	6.1	6.8	7.4	8.0	8.7	9.4	10.1	10.9	11.6	12.4	13.2	14.0	14.8	15.6	16.4
25	2.7	3.2	3.8	4.3	4.9	5.6	6.2	6.9	7.6	8.3	9.0	9.8	10.6	11.3	12.1	13.0	13.8	14.6	15.5	16.4	17.2	18.1	19.0
30	3.3	3.9	4.6	5.3	6.0	6.7	7.4	8.2	9.0	9.8	10.6	11.4	12.3	13.1	14.0	14.9	15.8	16.7	17.6	18.5	19.4	20.4	21.3
35	4.0	4.7	5.4	6.2	7.0	7.8	8.7	9.5	10.4	11.2	12.1	13.0	13.9	14.8	15.7	16.6	17.6	18.5	19.5	20.4	21.4	22.4	23:3
40	4.6	5.5	6.3	7.2	8.0	8.9	9.8	10.7	11.6	12.6	13.5	14.4	15.4	16.3	17.3	18.2	19.2	20.2	21.1	22.1	23.1	24.1	25.1
45	5.3	6.2	7.2	8.1	9.0	10.0	10.9	11.9	12.9	13.8	14.8	15.8	16.7	17.7	18.7	19.7	20.7	21.7	22.7	23.6	24.6	25.6	26.6
50	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0
55	6.7	7.7	8.8	9.9	10.9	12.0	13.0	14.0	15.1	16.1	17.1	18.1	19.1	20.2	21.2	22.2	23.2	24.2	25.2	26.2	27.2	28.2	29.2
60	7.3	8.4	9.6	10.7	11.8	12.8	13.9	15.0	16.0	17.1	18.1	19.2	20.2	21.2	22.2	23.3	24.3	25.3	26.3	27.3	28.3	29.3	30.2
65	7.9	9.1	10.3	11.4	12.6	13.7	14.8	15.9	16.9	18.0	19.1	20.1	21.1	22.2	23.2	24.2	25.2	26.2	27.2	28.2	29.2	30.2	31.2
70	8.5	9.7	11.0	12.2	13.3	14.5	15.6	16.7	17.8	18.9	19.9	21.0	22.0	23.1	24.1	25.1	26.1	27.1	28.1	29.1	30.0	31.0	32.0
75	9.0	10.3	11.6	12.8	14.0	15.2	16.3	17.4	18.5	19.6	20.7	21.8	22.8	23.8	24.9	25.9	26.9	27.9	28.8	29.8	30.8	31.7	32.7
80	9.5	10.9	12.2	13.4	14.7	15.8	17.0	18.1	19.2	20.3	21.4	22.5	23.5	24.6	25.6	26.6	27.6	28.6	29.5	30.5	31.4	32.4	33.3
85	10.0	11.4	12.7	14.0	15.3	16.5	17.6	18.8	19.9	21.0	22.1	23.1	24.2	25.2	26.2	27.2	28.2	29.2	30.1	31.1	32.0	33.0	33.9
90	10.4	11.8	13.2	14.5	15.8	17.0	18.2	19.4	20.5	21.6	22.7	23.7	24.8	25.8	26.8	27.8	28.8	29.7	30.7	31.6	32.5	33.5	34.4
95	10.8	12.3	13.7	15.0	16.3	17.5	18.7	19.9	21.0	22.1	23.2	24.3	25.3	26.3	27.3	28.3	29.3	30.2	31.2	32.1	33.0	33.9	34.8
100	11.1	12.7	14.1	15.5	16.8	18.0	19.2	20.4	21.5	22.6	23.7	24.7	25.8	26.8	27.8	28.8	29.7	30.7	31.6	32.5	33.4	34.3	35.2
105	11.5	13.0	14.5	15.9	17.2	18.5	19.7	20.8	22.0	23.1	24.1	25.2	26.2	27.2	28.2	29.2	30.1	31.1	32.0	32.9	33.8	34.6	35.5
110	11.8	13.4	14.9	16.3	17.6	18.8	20.1	21.2	22.4	23.5	24.5	25.6	26.6	27.6	28.6	29.5	30.5	31.4	32.3	33.2	34.1	34.9	35.8
115	12.0	13.7	15.2	16.6	17.9	19.2	20.4	21.6	22.7	23.8	24.9	26.0	27.0	28.0	28.9	29.9	30.8	31.7	32.6	33.5	34.4	35.2	36.0
120	12.3	13.9	15.5	16.9	18.3	19.5	20.8	21.9	23.1	24.2	25.2	26.3	27.3	28.3	29.2	30.2	31.1	32.0	32.9	33.8	34.6	35.4	36.3
125	12.5	14.2	15.7	17.2	18.6	19.8	21.1	22.3	23.4	24.5	25.6	26.6	27.6	28.6	29.5	30.4	31.4	32.3	33.1	34.0	34.8	35.7	36.5
130	12.7	14.4	16.0	17.5	18.8	20.1	21.4	22.5	23.7	24.8	25.8	26.9	27.8	28.8	29.8	30.7	31.6	32.5	33.3	34.2	35.0	35.8	36.6
135	12.9	14.6	16.2	17.7	19.1	20.4	21.6	22.8	23.9	25.0	26.1	27.1	28.1	29.1	30.0	30.9	31.8	32.7	33.5	34.4	35.2	36.0	36.8
140	13.0	14.8	16.4	17.9	19.3	20.6	21.8	23.0	24.2	25.2	26.3	27.3	28.3	29.3	30.2	31.1	32.0	32.9	33.7	34.5	35.3	36.2	36.9
145	13.2	15.0	16.6	18.1	19.5	20.8	22.0	23.2	24.4	25.5	26.5	27.5	28.5	29.4	30.4	31.3	32.2	33.0	33.9	34.7	35.5	36.3	37.1
150	13.3	15.1	16.8	18.3	19.7	21.0	22.2	23.4	24.6	25.6	26.7	27.7	28.7	29.6	30.5	31.4	32.3	33.2	34.0	34.8	35.6	36.4	37.2
155	13.4	15.3	16.9	18.4	19.8	21.2	22.4	23.6	24.7	25.8	26.9	27.9	28.8	29.8	30.7	31.6	32.4	33.3	34.1	34.9	35.7	36.5	37.3
160	13.5	15.4	17.0	18.6	20.0	21.3	22.6	23.8	24.9	26.0	27.0	28.0	29.0	29.9	30.8	31.7	32.6	33.4	34.2	35.0	35.8	36.6	37.3
165	13.6	15.5	17.2	18.7	20.1	21.5	22.7	23.9	25.0	26.1	27.1	28.1	29.1	30.0	30.9	31.8	32.7	33.5	34.3	35.1	35.9	36.7	37.4
170	13.7	15.6	17.3	18.8	20.3	21.6	22.8	24.0	25.2	26.2	27.3	28.3	29.2	30.1	31.0	31.9	32.8	33.6	34.4	35.2	36.0	36.7	37.5
175	13.8	15.7	17.4	18.9	20.4	21.7	23.0	24.1	25.3	26.3	27.4	28.4	29.3	30.2	31.1	32.0	32.8	33.7	34.5	35.3	36.0	36.8	37.5
180	13.8	15.8	17.5	19.0	20.5	21.8	23.1	24.3	25.4	26.4	27.5	28.5	29.4	30.3	31.2	32.1	32.9	33.7	34.5	35.3	36.1	36.8	37.6

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 16. Regional aspen height growth and site index table (natural regions: 9, 11)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.8	2.0	2.2	2.3	2.5	2.8	3.0	3.3	3.5	3.8	4.1	4.4	4.8	5.1	5.5	5.9	6.3
10	1.5	1.6	1.8	2.0	2.2	2.5	2.8	3.1	3.4	3.8	4.1	4.5	4.9	5.4	5.8	6.3	6.8	7.3	7.8	8.4	8.9	9.5	10.1
15	1.8	2.1	2.3	2.7	3.0	3.4	3.9	4.3	4.8	5.3	5.8	6.3	6.9	7.5	8.1	8.7	9.3	9.9	10.6	11.3	12.0	12.7	13.4
20	2.2	2.6	3.0	3.5	4.0	4.5	5.0	5.6	6.2	6.8	7.4	8.1	8.8	9.4	10.1	10.9	11.6	12.3	13.1	13.9	14.7	15.4	16.3
25	2.7	3.2	3.8	4.3	4.9	5.6	6.2	6.9	7.6	8.3	9.0	9.8	10.5	11.3	12.1	12.9	13.7	14.5	15.4	16.2	17.1	17.9	18.8
30	3.3	3.9	4.6	5.3	6.0	6.7	7.4	8.2	9.0	9.8	10.6	11.4	12.2	13.1	13.9	14.8	15.7	16.5	17.4	18.3	19.2	20.2	21.1
35	3.9	4.7	5.4	6.2	7.0	7.8	8.6	9.5	10.3	11.2	12.1	12.9	13.8	14.7	15.6	16.5	17.5	18.4	19.3	20.3	21.2	22.1	23.1
40	4.6	5.4	6.3	7.1	8.0	8.9	9.8	10.7	11.6	12.5	13.5	14.4	15.3	16.3	17.2	18.2	19.1	20.1	21.0	22.0	23.0	23.9	24.9
45	5.3	6.2	7.1	8.1	9.0	10.0	10.9	11.9	12.8	13.8	14.8	15.7	16.7	17.7	18.7	19.6	20.6	21.6	22.6	23.6	24.6	25.5	26.5
50	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0
55	6.7	7.8	8.8	9.9	10.9	12.0	13.0	14.1	15.1	16.1	17.2	18.2	19.2	20.2	21.2	22.3	23.3	24.3	25.3	26.3	27.3	28.3	29.3
60	7.4	8.5	9.6	10.7	11.8	12.9	14.0	15.1	16.1	17.2	18.2	19.3	20.3	21.4	22.4	23.4	24.4	25.5	26.5	27.5	28.5	29.5	30.5
65	8.0	9.2	10.4	11.6	12.7	13.8	14.9	16.0	17.1	18.2	19.2	20.3	21.4	22.4	23.4	24.5	25.5	26.5	27.5	28.6	29.6	30.6	31.6
70	8.7	9.9	11.1	12.3	13.5	14.7	15.8	16.9	18.0	19.1	20.2	21.2	22.3	23.4	24.4	25.4	26.5	27.5	28.5	29.5	30.5	31.5	32.5
75	9.3	10.6	11.9	13.1	14.3	15.4	16.6	17.7	18.9	20.0	21.0	22.1	23.2	24.3	25.3	26.3	27.4	28.4	29.4	30.4	31.4	32.4	33.4
80	9.9	11.2	12.5	13.8	15.0	16.2	17.4	18.5	19.6	20.8	21.9	22.9	24.0	25.1	26.1	27.2	28.2	29.2	30.2	31.2	32.2	33.2	34.2
85	10.4	11.8	13.1	14.4	15.7	16.9	18.1	19.2	20.4	21.5	22.6	23.7	24.8	25.8	26.9	27.9	28.9	30.0	31.0	32.0	32.9	33.9	34.9
90	10.9	12.4	13.7	15.0	16.3	17.5	18.7	19.9	21.1	22.2	23.3	24.4	25.5	26.5	27.6	28.6	29.6	30.6	31.6	32.6	33.6	34.6	35.5
95	11.4	12.9	14.3	15.6	16.9	18.2	19.4	20.6	21.7	22.8	24.0	25.0	26.1	27.2	28.2	29.3	30.3	31.3	32.3	33.2	34.2	35.2	36.1
100	11.9	13.4	14.8	16.2	17.5	18.7	20.0	21.1	22.3	23.4	24.6	25.6	26.7	27.8	28.8	29.8	30.8	31.8	32.8	33.8	34.7	35.7	36.6
105	12.3	13.8	15.3	16.7	18.0	19.3	20.5	21.7	22.9	24.0	25.1	26.2	27.3	28.3	29.4	30.4	31.4	32.4	33.3	34.3	35.2	36.2	37.1
110	12.7	14.3	15.7	17.1	18.5	19.8	21.0	22.2	23.4	24.5	25.6	26.7	27.8	28.8	29.9	30.9	31.9	32.8	33.8	34.8	35.7	36.6	37.5
115	13.0	14.7	16.2	17.6	18.9	20.2	21.5	22.7	23.8	25.0	26.1	27.2	28.2	29.3	30.3	31.3	32.3	33.3	34.2	35.2	36.1	37.0	37.9
120	13.4	15.0	16.6	18.0	19.4	20.7	21.9	23.1	24.3	25.4	26.5	27.6	28.7	29.7	30.7	31.7	32.7	33.7	34.6	35.5	36.5	37.4	38.3
125	13.7	15.4	16.9	18.4	19.7	21.0	22.3	23.5	24.7	25.8	26.9	28.0	29.1	30.1	31.1	32.1	33.1	34.0	35.0	35.9	36.8	37.7	38.6
130	14.0	15.7	17.3	18.7	20.1	21.4	22.7	23.9	25.1	26.2	27.3	28.4	29.4	30.5	31.5	32.5	33.4	34.4	35.3	36.2	37.1	38.0	38.9
135	14.2	16.0	17.6	19.0	20.4	21.8	23.0	24.2	25.4	26.6	27.7	28.7	29.8	30.8	31.8	32.8	33.7	34.7	35.6	36.5	37.4	38.3	39.1
140	14.5	16.2	17.9	19.3	20.7	22.1	23.3	24.6	25.7	26.9	28.0	29.0	30.1	31.1	32.1	33.1	34.0	34.9	35.9	36.8	37.6	38.5	39.4
145	14.7	16.5	18.1	19.6	21.0	22.4	23.6	24.9	26.0	27.2	28.3	29.3	30.4	31.4	32.4	33.3	34.3	35.2	36.1	37.0	37.9	38.7	39.6
150	14.9	16.7	18.4	19.9	21.3	22.6	23.9	25.1	26.3	27.4	28.5	29.6	30.6	31.6	32.6	33.6	34.5	35.4	36.3	37.2	38.1	38.9	39.8
155	15.1	16.9	18.6	20.1	21.5	22.9	24.2	25.4	26.6	27.7	28.8	29.8	30.9	31.9	32.9	33.8	34.7	35.6	36.5	37.4	38.3	39.1	39.9
160	15.3	17.1	18.8	20.3	21.8	23.1	24.4	25.6	26.8	27.9	29.0	30.1	31.1	32.1	33.1	34.0	34.9	35.8	36.7	37.6	38.4	39.3	40.1
165	15.4	17.3	19.0	20.5	22.0	23.3	24.6	25.8	27.0	28.1	29.2	30.3	31.3	32.3	33.3	34.2	35.1	36.0	36.9	37.7	38.6	39.4	40.2
170	15.6	17.5	19.2	20.7	22.2	23.5	24.8	26.1	27.2	28.3	29.4	30.5	31.5	32.5	33.4	34.4	35.3	36.2	37.0	37.9	38.7	39.5	40.4
175	15.7	17.6	19.3	20.9	22.4	23.7	25.0	26.2	27.4	28.5	29.6	30.7	31.7	32.7	33.6	34.5	35.4	36.3	37.2	38.0	38.9	39.7	40.5
180	15.8	17.8	19.5	21.1	22.5	23.9	25.2	26.4	27.6	28.7	29.8	30.8	31.8	32.8	33.8	34.7	35.6	36.5	37.3	38.2	39.0	39.8	40.6

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 17. Regional aspen height growth and site index table (natural regions: 7, 8, 10)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.4	1.4	1.5	1.6	1.7	1.9	2.0	2.2	2.4	2.6	2.8	3.1	3.4	3.7	4.0	4.3	4.6	5.0	5.4	5.8	6.2	6.6	7.1
10	1.6	1.7	1.9	2.2	2.4	2.7	3.1	3.4	3.8	4.2	4.6	5.0	5.5	5.9	6.4	7.0	7.5	8.0	8.6	9.2	9.8	10.4	11.1
15	1.9	2.2	2.5	2.9	3.3	3.7	4.2	4.7	5.2	5.7	6.3	6.9	7.4	8.1	8.7	9.3	10.0	10.7	11.4	12.1	12.8	13.6	14.4
20	2.4	2.8	3.2	3.7	4.3	4.8	5.4	6.0	6.6	7.3	7.9	8.6	9.3	10.0	10.8	11.5	12.3	13.1	13.8	14.7	15.5	16.3	17.2
25	2.9	3.4	4.0	4.6	5.2	5.9	6.6	7.3	8.0	8.7	9.5	10.3	11.0	11.8	12.7	13.5	14.3	15.2	16.0	16.9	17.8	18.7	19.6
30	3.5	4.1	4.8	5.5	6.2	7.0	7.7	8.5	9.3	10.1	11.0	11.8	12.7	13.5	14.4	15.3	16.2	17.1	18.0	18.9	19.8	20.8	21.7
35	4.1	4.8	5.6	6.4	7.2	8.0	8.9	9.7	10.6	11.5	12.4	13.2	14.2	15.1	16.0	16.9	17.8	18.8	19.7	20.7	21.7	22.6	23.6
40	4.7	5.6	6.4	7.3	8.2	9.1	10.0	10.9	11.8	12.7	13.7	14.6	15.5	16.5	17.4	18.4	19.4	20.3	21.3	22.3	23.3	24.3	25.2
45	5.4	6.3	7.2	8.2	9.1	10.1	11.0	12.0	12.9	13.9	14.9	15.8	16.8	17.8	18.8	19.8	20.7	21.7	22.7	23.7	24.7	25.7	26.7
50	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0
55	6.6	7.7	8.8	9.8	10.9	11.9	12.9	14.0	15.0	16.0	17.1	18.1	19.1	20.1	21.1	22.1	23.1	24.1	25.2	26.2	27.2	28.2	29.1
60	7.3	8.4	9.5	10.6	11.7	12.8	13.8	14.9	15.9	17.0	18.0	19.1	20.1	21.1	22.1	23.2	24.2	25.2	26.2	27.2	28.2	29.2	30.2
65	7.9	9.0	10.2	11.3	12.5	13.6	14.7	15.7	16.8	17.9	18.9	20.0	21.0	22.1	23.1	24.1	25.1	26.1	27.1	28.1	29.1	30.1	31.1
70	8.4	9.7	10.9	12.0	13.2	14.3	15.4	16.6	17.6	18.7	19.8	20.8	21.9	22.9	24.0	25.0	26.0	27.0	28.0	29.0	30.0	30.9	31.9
75	9.0	10.3	11.5	12.7	13.9	15.1	16.2	17.3	18.4	19.5	20.6	21.6	22.7	23.7	24.7	25.8	26.8	27.8	28.8	29.7	30.7	31.7	32.6
80	9.5	10.8	12.1	13.4	14.6	15.7	16.9	18.0	19.1	20.2	21.3	22.4	23.4	24.4	25.5	26.5	27.5	28.5	29.4	30.4	31.4	32.3	33.3
85	10.0	11.4	12.7	13.9	15.2	16.4	17.5	18.7	19.8	20.9	22.0	23.0	24.1	25.1	26.1	27.1	28.1	29.1	30.1	31.0	32.0	32.9	33.9
90	10.5	11.9	13.2	14.5	15.8	17.0	18.1	19.3	20.4	21.5	22.6	23.6	24.7	25.7	26.7	27.7	28.7	29.7	30.7	31.6	32.5	33.5	34.4
95	10.9	12.4	13.7	15.0	16.3	17.5	18.7	19.8	21.0	22.1	23.2	24.2	25.3	26.3	27.3	28.3	29.3	30.2	31.2	32.1	33.0	33.9	34.8
100	11.4	12.8	14.2	15.5	16.8	18.0	19.2	20.4	21.5	22.6	23.7	24.7	25.8	26.8	27.8	28.8	29.8	30.7	31.6	32.6	33.5	34.4	35.2
105	11.7	13.2	14.7	16.0	17.3	18.5	19.7	20.9	22.0	23.1	24.2	25.2	26.3	27.3	28.3	29.2	30.2	31.1	32.1	33.0	33.9	34.8	35.6
110	12.1	13.6	15.1	16.4	17.7	19.0	20.2	21.3	22.5	23.6	24.6	25.7	26.7	27.7	28.7	29.7	30.6	31.5	32.4	33.3	34.2	35.1	36.0
115	12.5	14.0	15.5	16.8	18.1	19.4	20.6	21.8	22.9	24.0	25.0	26.1	27.1	28.1	29.1	30.0	31.0	31.9	32.8	33.7	34.6	35.4	36.3
120	12.8	14.4	15.8	17.2	18.5	19.8	21.0	22.1	23.3	24.4	25.4	26.5	27.5	28.5	29.4	30.4	31.3	32.2	33.1	34.0	34.8	35.7	36.5
125	13.1	14.7	16.2	17.6	18.9	20.1	21.3	22.5	23.6	24.7	25.8	26.8	27.8	28.8	29.8	30.7	31.6	32.5	33.4	34.3	35.1	35.9	36.8
130	13.3	15.0	16.5	17.9	19.2	20.5	21.7	22.9	24.0	25.1	26.1	27.2	28.1	29.1	30.1	31.0	31.9	32.8	33.7	34.5	35.3	36.2	37.0
135	13.6	15.3	16.8	18.2	19.5	20.8	22.0	23.2	24.3	25.4	26.4	27.4	28.4	29.4	30.3	31.3	32.2	33.0	33.9	34.7	35.6	36.4	37.2
140	13.8	15.5	17.0	18.5	19.8	21.1	22.3	23.5	24.6	25.7	26.7	27.7	28.7	29.7	30.6	31.5	32.4	33.3	34.1	34.9	35.8	36.6	37.3
145	14.1	15.8	17.3	18.7	20.1	21.4	22.6	23.7	24.9	25.9	27.0	28.0	29.0	29.9	30.8	31.7	32.6	33.5	34.3	35.1	35.9	36.7	37.5
150	14.3	16.0	17.5	19.0	20.3	21.6	22.8	24.0	25.1	26.2	27.2	28.2	29.2	30.1	31.0	31.9	32.8	33.7	34.5	35.3	36.1	36.9	37.6
155	14.4	16.2	17.8	19.2	20.6	21.8	23.1	24.2	25.3	26.4	27.4	28.4	29.4	30.3	31.2	32.1	33.0	33.8	34.6	35.4	36.2	37.0	37.8
160	14.6	16.4	18.0	19.4	20.8	22.1	23.3	24.4	25.5	26.6	27.6	28.6	29.6	30.5	31.4	32.3	33.1	34.0	34.8	35.6	36.4	37.1	37.9
165	14.8	16.6	18.1	19.6	21.0	22.3	23.5	24.6	25.7	26.8	27.8	28.8	29.8	30.7	31.6	32.4	33.3	34.1	34.9	35.7	36.5	37.2	38.0
170	14.9	16.7	18.3	19.8	21.2	22.4	23.7	24.8	25.9	27.0	28.0	29.0	29.9	30.8	31.7	32.6	33.4	34.2	35.0	35.8	36.6	37.3	38.1
175	15.1	16.9	18.5	20.0	21.3	22.6	23.8	25.0	26.1	27.1	28.2	29.1	30.1	31.0	31.9	32.7	33.6	34.4	35.2	35.9	36.7	37.4	38.1
180	15.2	17.0	18.6	20.1	21.5	22.8	24.0	25.2	26.2	27.3	28.3	29.3	30.2	31.1	32.0	32.8	33.7	34.5	35.3	36.0	36.8	37.5	38.2

[1]See Figure 1 for the list of natural regions and their designation numbers.

2.4 BLACK SPRUCE

Black spruce height growth model:

$$[9] \quad H_2 = 1.3+(H_1-1.3)\left(\frac{1-\exp(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)}T_2)}{1-\exp(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)}T_1)}\right)^{b_3(H_1-1.3)^{b_4}T_1^{b_5}}$$

where:

H_2 = tree height (m) at time two

T_2 = breast height age (years) at time two

H_1 = tree height (m) at time one

T_1 = breast height age (years) at time one

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Black spruce site index model (which is a special variant of the height growth model [9] with H_1 replaced by the site index SI and T_1 replaced by the reference-age T_R, respectively):

$$[10] \quad H = 1.3+(SI-1.3)\left(\frac{1-\exp(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)}T_B)}{1-\exp(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)}T_R)}\right)^{b_3(SI-1.3)^{b_4}T_R^{b_5}}$$

where:

H = tree height (m) at T_B

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at T_R

T_R = reference-age (= 50 years breast height age)

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Table 18. Fit statistics for the black spruce height growth model [9].

Natural regions[1]	Parameter	Estimate	Std. error	n	MSE	R^2
All	b_0	0.011117	0.000420	13,136	2.392	0.915
(provincial)	b_1	0.030221	0.026528			
	b_2	1.010399	0.002726			
	b_3	0.573793	0.003683			
	b_4	-0.328092	0.005472			
	b_5	0.387445	0.003902			
7, 8, 9, 10, 11	b_0	0.018903	0.000474	8,026	2.186	0.924
	b_1	-0.377978	0.003144			
	b_2	1.043199	0.002076			
	b_3	0.631662	0.005350			
	b_4	-0.399756	0.006441			
	b_5	0.405907	0.005028			
1, 2, 3, 4, 5, 6, 12	b_0	0.012953	0.000871	5,110	2.622	0.903
13, 14, 15, 16	b_1	-0.018702	0.049503			
	b_2	1.001820	0.004629			
	b_3	0.572388	0.006533			
	b_4	-0.404984	0.012060			
	b_5	0.416184	0.007355			

[1]See Figure 1 for the list of natural regions and their designation numbers.

Black Spruce Site Index Curves

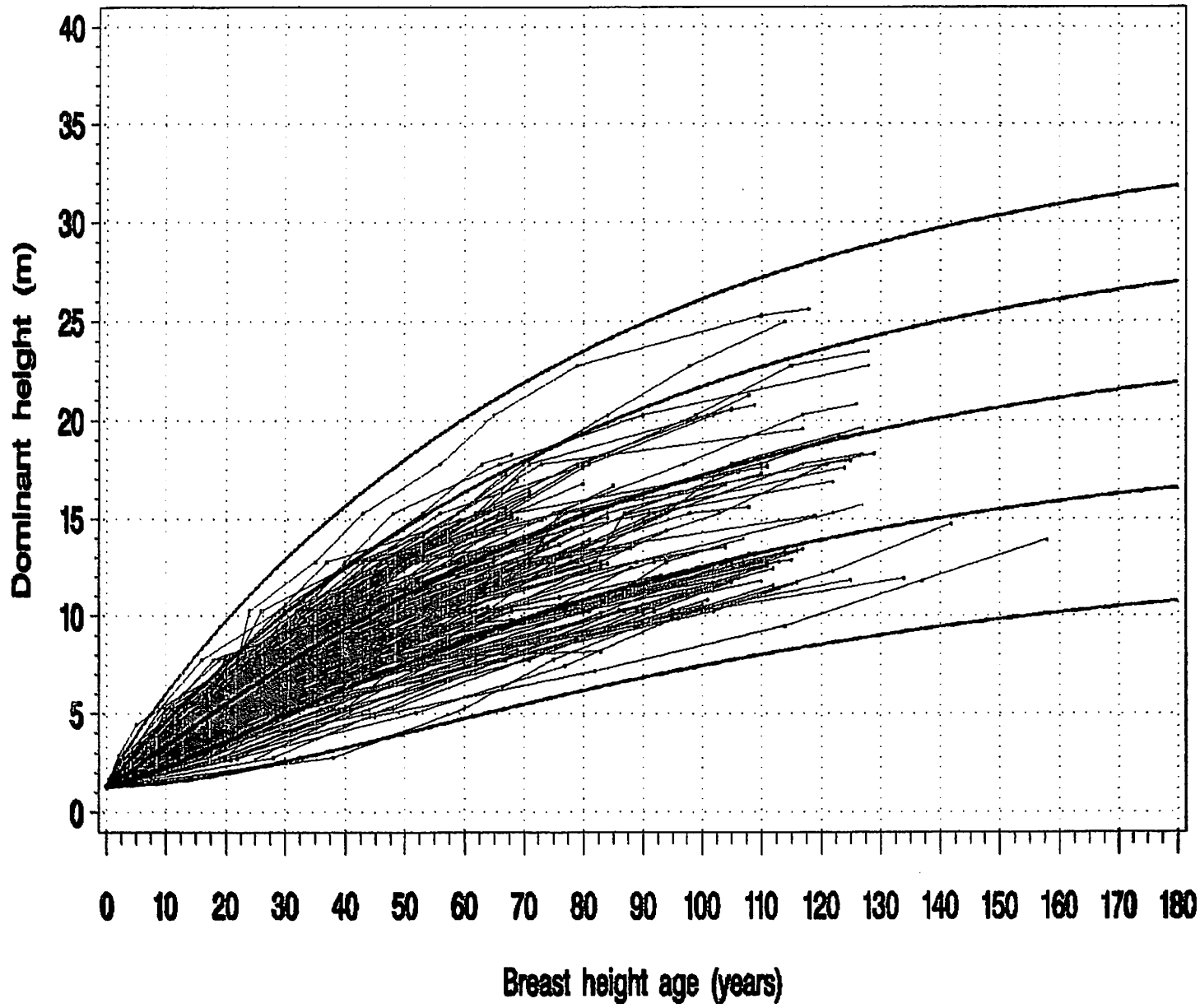

Figure 21. Black spruce site index curves for natural regions 1 to 6 and 12 to 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 4.0, 7.5, 11.0, 14.5 and 18.0 metres at a reference breast height age of 50 years.

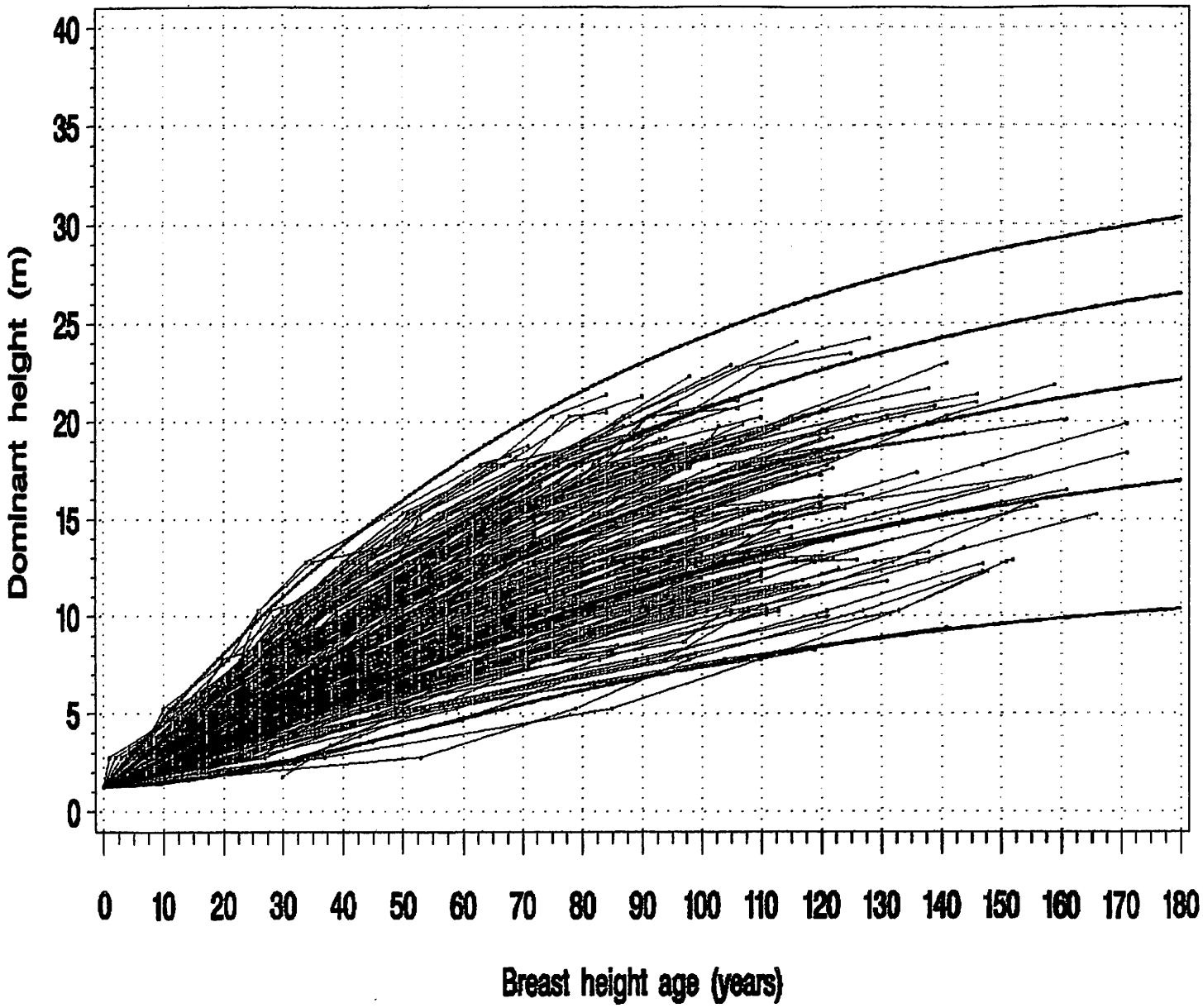

Figure 22. Black spruce site index curves for natural regions 7, 8, 9, 10 and 11, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 4.0, 7.0, 10.0, 13.0 and 16.0 metres at a reference breast height age of 50 years.

Black Spruce Site Index Tables

Table 19. Provincial black spruce height growth and site index table (natural regions: 1 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.9	4.1	4.3	4.6	4.8	5.1
10	1.4	1.5	1.7	1.8	2.0	2.3	2.5	2.8	3.1	3.4	3.7	4.0	4.4	4.7	5.1	5.5	5.8	6.2	6.6	7.0	7.4	7.9	8.3
15	1.5	1.7	2.0	2.3	2.6	3.0	3.3	3.7	4.1	4.6	5.0	5.5	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.5	10.0	10.6	11.1
20	1.6	2.0	2.3	2.8	3.2	3.7	4.2	4.7	5.2	5.7	6.3	6.9	7.4	8.0	8.6	9.2	9.8	10.5	11.1	11.7	12.4	13.0	13.7
25	1.8	2.2	2.7	3.3	3.8	4.4	5.0	5.6	6.3	6.9	7.5	8.2	8.9	9.6	10.2	10.9	11.6	12.4	13.1	13.8	14.5	15.3	16.0
30	2.0	2.6	3.2	3.8	4.5	5.2	5.8	6.6	7.3	8.0	8.7	9.5	10.2	11.0	11.8	12.6	13.3	14.1	14.9	15.7	16.5	17.3	18.1
35	2.2	2.9	3.6	4.4	5.1	5.9	6.7	7.5	8.3	9.1	9.9	10.7	11.5	12.4	13.2	14.1	14.9	15.8	16.6	17.5	18.3	19.2	20.1
40	2.5	3.3	4.1	4.9	5.8	6.6	7.5	8.3	9.2	10.1	11.0	11.9	12.8	13.7	14.6	15.5	16.4	17.3	18.2	19.1	20.0	20.9	21.9
45	2.7	3.6	4.5	5.5	6.4	7.3	8.3	9.2	10.1	11.1	12.0	13.0	13.9	14.9	15.8	16.8	17.7	18.7	19.6	20.6	21.6	22.5	23.5
50	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0
55	3.3	4.4	5.5	6.5	7.6	8.7	9.7	10.8	11.8	12.9	13.9	15.0	16.0	17.1	18.1	19.1	20.2	21.2	22.3	23.3	24.3	25.4	26.4
60	3.6	4.7	5.9	7.0	8.2	9.3	10.4	11.5	12.6	13.7	14.8	15.9	17.0	18.1	19.1	20.2	21.3	22.4	23.4	24.5	25.5	26.6	27.7
65	3.9	5.1	6.3	7.6	8.7	9.9	11.1	12.2	13.4	14.5	15.6	16.8	17.9	19.0	20.1	21.2	22.3	23.4	24.5	25.6	26.7	27.8	28.8
70	4.1	5.5	6.8	8.0	9.3	10.5	11.7	12.9	14.1	15.2	16.4	17.6	18.7	19.9	21.0	22.1	23.3	24.4	25.5	26.6	27.7	28.8	29.9
75	4.4	5.8	7.2	8.5	9.8	11.1	12.3	13.5	14.7	15.9	17.1	18.3	19.5	20.7	21.8	23.0	24.1	25.3	26.4	27.6	28.7	29.8	30.9
80	4.7	6.2	7.6	9.0	10.3	11.6	12.9	14.1	15.4	16.6	17.8	19.0	20.2	21.4	22.6	23.8	25.0	26.1	27.3	28.4	29.6	30.7	31.8
85	5.0	6.5	8.0	9.4	10.8	12.1	13.4	14.7	16.0	17.2	18.5	19.7	20.9	22.1	23.4	24.5	25.7	26.9	28.1	29.2	30.4	31.6	32.7
90	5.3	6.9	8.4	9.8	11.2	12.6	13.9	15.2	16.5	17.8	19.1	20.3	21.6	22.8	24.0	25.2	26.4	27.6	28.8	30.0	31.2	32.3	33.5
95	5.6	7.2	8.7	10.2	11.6	13.0	14.4	15.7	17.1	18.4	19.7	20.9	22.2	23.4	24.7	25.9	27.1	28.3	29.5	30.7	31.9	33.0	34.2
100	5.8	7.5	9.1	10.6	12.1	13.5	14.9	16.2	17.6	18.9	20.2	21.5	22.8	24.0	25.3	26.5	27.7	28.9	30.1	31.3	32.5	33.7	34.9
105	6.1	7.8	9.4	11.0	12.4	13.9	15.3	16.7	18.0	19.4	20.7	22.0	23.3	24.6	25.8	27.1	28.3	29.5	30.7	31.9	33.1	34.3	35.5
110	6.3	8.1	9.7	11.3	12.8	14.3	15.7	17.1	18.5	19.8	21.2	22.5	23.8	25.1	26.3	27.6	28.8	30.1	31.3	32.5	33.7	34.9	36.1
115	6.6	8.4	10.0	11.6	13.2	14.6	16.1	17.5	18.9	20.3	21.6	22.9	24.2	25.5	26.8	28.1	29.3	30.6	31.8	33.0	34.2	35.4	36.6
120	6.8	8.6	10.3	11.9	13.5	15.0	16.5	17.9	19.3	20.7	22.0	23.4	24.7	26.0	27.3	28.5	29.8	31.0	32.3	33.5	34.7	35.9	37.1
125	7.1	8.9	10.6	12.2	13.8	15.3	16.8	18.3	19.7	21.1	22.4	23.8	25.1	26.4	27.7	29.0	30.2	31.5	32.7	33.9	35.1	36.3	37.5
130	7.3	9.1	10.9	12.5	14.1	15.6	17.1	18.6	20.0	21.4	22.8	24.1	25.5	26.8	28.1	29.4	30.6	31.9	33.1	34.3	35.6	36.8	37.9
135	7.5	9.4	11.1	12.8	14.4	15.9	17.4	18.9	20.3	21.7	23.1	24.5	25.8	27.1	28.4	29.7	31.0	32.3	33.5	34.7	35.9	37.1	38.3
140	7.7	9.6	11.4	13.1	14.7	16.2	17.7	19.2	20.6	22.1	23.4	24.8	26.2	27.5	28.8	30.1	31.3	32.6	33.8	35.1	36.3	37.5	38.7
145	7.9	9.8	11.6	13.3	14.9	16.5	18.0	19.5	20.9	22.4	23.7	25.1	26.5	27.8	29.1	30.4	31.7	32.9	34.2	35.4	36.6	37.8	39.0
150	8.1	10.0	11.8	13.5	15.2	16.7	18.3	19.7	21.2	22.6	24.0	25.4	26.8	28.1	29.4	30.7	32.0	33.2	34.5	35.7	36.9	38.1	39.3
155	8.3	10.2	12.0	13.7	15.4	17.0	18.5	20.0	21.5	22.9	24.3	25.7	27.0	28.4	29.7	31.0	32.2	33.5	34.7	36.0	37.2	38.4	39.6
160	8.4	10.4	12.2	13.9	15.6	17.2	18.7	20.2	21.7	23.1	24.5	25.9	27.3	28.6	29.9	31.2	32.5	33.8	35.0	36.2	37.5	38.7	39.9
165	8.6	10.6	12.4	14.1	15.8	17.4	18.9	20.5	21.9	23.4	24.8	26.1	27.5	28.8	30.2	31.5	32.7	34.0	35.2	36.5	37.7	38.9	40.1
170	8.8	10.8	12.6	14.3	16.0	17.6	19.1	20.7	22.1	23.6	25.0	26.4	27.7	29.1	30.4	31.7	33.0	34.2	35.5	36.7	37.9	39.1	40.3
175	8.9	10.9	12.8	14.5	16.2	17.8	19.3	20.8	22.3	23.8	25.2	26.6	27.9	29.3	30.6	31.9	33.2	34.4	35.7	36.9	38.1	39.3	40.5
180	9.1	11.1	12.9	14.7	16.3	18.0	19.5	21.0	22.5	24.0	25.4	26.8	28.1	29.5	30.8	32.1	33.4	34.6	35.9	37.1	38.3	39.5	40.7

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 20. Regional black spruce height growth and site index table (natural regions: 7 to 11)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.3	1.4	1.5	1.5	1.6	1.8	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.3	3.5	3.8	4.0	4.3	4.6	4.9	5.2	5.5
10	1.4	1.5	1.6	1.8	2.0	2.2	2.5	2.7	3.0	3.3	3.7	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.9	7.3	7.8	8.3	8.8
15	1.5	1.7	1.9	2.2	2.5	2.9	3.2	3.6	4.1	4.5	5.0	5.4	5.9	6.4	7.0	7.5	8.0	8.6	9.2	9.8	10.4	11.0	11.6
20	1.6	1.9	2.3	2.7	3.1	3.6	4.1	4.6	5.1	5.7	6.2	6.8	7.4	8.0	8.7	9.3	10.0	10.6	11.3	12.0	12.7	13.4	14.1
25	1.8	2.2	2.7	3.2	3.7	4.3	4.9	5.5	6.2	6.8	7.5	8.2	8.9	9.6	10.3	11.0	11.7	12.5	13.3	14.0	14.8	15.6	16.4
30	2.0	2.5	3.1	3.7	4.4	5.1	5.8	6.5	7.2	7.9	8.7	9.4	10.2	11.0	11.8	12.6	13.4	14.2	15.0	15.9	16.7	17.6	18.4
35	2.2	2.9	3.6	4.3	5.1	5.8	6.6	7.4	8.2	9.0	9.8	10.7	11.5	12.4	13.2	14.1	14.9	15.8	16.7	17.6	18.5	19.4	20.3
40	2.5	3.2	4.0	4.9	5.7	6.6	7.4	8.3	9.2	10.0	10.9	11.8	12.7	13.6	14.6	15.5	16.4	17.3	18.3	19.2	20.1	21.1	22.0
45	2.7	3.6	4.5	5.4	6.4	7.3	8.2	9.2	10.1	11.0	12.0	12.9	13.9	14.9	15.8	16.8	17.7	18.7	19.7	20.6	21.6	22.6	23.6
50	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0
55	3.3	4.4	5.5	6.6	7.6	8.7	9.8	10.8	11.9	12.9	14.0	15.0	16.0	17.1	18.1	19.1	20.2	21.2	22.2	23.3	24.3	25.3	26.3
60	3.5	4.8	5.9	7.1	8.2	9.4	10.5	11.6	12.7	13.8	14.9	15.9	17.0	18.1	19.2	20.2	21.3	22.3	23.4	24.4	25.4	26.5	27.5
65	3.8	5.1	6.4	7.6	8.8	10.0	11.2	12.3	13.5	14.6	15.7	16.8	17.9	19.0	20.1	21.2	22.3	23.4	24.4	25.5	26.5	27.6	28.6
70	4.1	5.5	6.8	8.1	9.4	10.6	11.8	13.0	14.2	15.4	16.5	17.7	18.8	19.9	21.1	22.2	23.2	24.3	25.4	26.5	27.5	28.6	29.6
75	4.3	5.8	7.3	8.6	9.9	11.2	12.5	13.7	14.9	16.1	17.3	18.5	19.6	20.8	21.9	23.0	24.1	25.2	26.3	27.4	28.5	29.5	30.6
80	4.6	6.2	7.7	9.1	10.5	11.8	13.1	14.4	15.6	16.8	18.1	19.2	20.4	21.6	22.7	23.9	25.0	26.1	27.2	28.3	29.3	30.4	31.4
85	4.8	6.5	8.1	9.5	11.0	12.3	13.7	15.0	16.3	17.5	18.7	20.0	21.2	22.3	23.5	24.6	25.8	26.9	28.0	29.0	30.1	31.2	32.2
90	5.1	6.8	8.5	10.0	11.5	12.9	14.2	15.6	16.9	18.2	19.4	20.6	21.8	23.0	24.2	25.3	26.5	27.6	28.7	29.8	30.9	31.9	33.0
95	5.3	7.1	8.8	10.4	11.9	13.4	14.8	16.1	17.5	18.8	20.0	21.3	22.5	23.7	24.9	26.0	27.2	28.3	29.4	30.5	31.5	32.6	33.6
100	5.5	7.4	9.2	10.8	12.3	13.8	15.3	16.7	18.0	19.3	20.6	21.9	23.1	24.3	25.5	26.7	27.8	28.9	30.0	31.1	32.2	33.2	34.3
105	5.7	7.7	9.5	11.2	12.8	14.3	15.7	17.2	18.5	19.9	21.2	22.4	23.7	24.9	26.1	27.2	28.4	29.5	30.6	31.7	32.8	33.8	34.8
110	5.9	8.0	9.8	11.5	13.2	14.7	16.2	17.6	19.0	20.4	21.7	23.0	24.2	25.4	26.6	27.8	28.9	30.1	31.2	32.2	33.3	34.3	35.4
115	6.1	8.2	10.1	11.9	13.5	15.1	16.6	18.1	19.5	20.9	22.2	23.5	24.7	26.0	27.1	28.3	29.5	30.6	31.7	32.8	33.8	34.8	35.8
120	6.2	8.4	10.4	12.2	13.9	15.5	17.0	18.5	19.9	21.3	22.6	23.9	25.2	26.4	27.6	28.8	29.9	31.1	32.2	33.2	34.3	35.3	36.3
125	6.4	8.7	10.7	12.5	14.2	15.9	17.4	18.9	20.4	21.7	23.1	24.4	25.7	26.9	28.1	29.3	30.4	31.5	32.6	33.7	34.7	35.7	36.7
130	6.5	8.9	10.9	12.8	14.6	16.2	17.8	19.3	20.7	22.1	23.5	24.8	26.1	27.3	28.5	29.7	30.8	31.9	33.0	34.1	35.1	36.1	37.1
135	6.7	9.1	11.2	13.1	14.9	16.5	18.1	19.7	21.1	22.5	23.9	25.2	26.5	27.7	28.9	30.1	31.2	32.3	33.4	34.5	35.5	36.5	37.5
140	6.8	9.3	11.4	13.4	15.2	16.9	18.5	20.0	21.5	22.9	24.3	25.6	26.9	28.1	29.3	30.5	31.6	32.7	33.8	34.8	35.8	36.8	37.8
145	6.9	9.4	11.6	13.6	15.4	17.2	18.8	20.3	21.8	23.2	24.6	25.9	27.2	28.4	29.6	30.8	31.9	33.0	34.1	35.1	36.1	37.1	38.1
150	7.0	9.6	11.8	13.8	15.7	17.4	19.1	20.6	22.1	23.6	24.9	26.3	27.5	28.8	30.0	31.1	32.3	33.3	34.4	35.4	36.4	37.4	38.4
155	7.1	9.7	12.0	14.1	15.9	17.7	19.4	20.9	22.4	23.9	25.2	26.6	27.8	29.1	30.3	31.4	32.6	33.6	34.7	35.7	36.7	37.7	38.6
160	7.2	9.9	12.2	14.3	16.2	17.9	19.6	21.2	22.7	24.1	25.5	26.9	28.1	29.4	30.6	31.7	32.8	33.9	35.0	36.0	37.0	37.9	38.9
165	7.3	10.0	12.4	14.5	16.4	18.2	19.9	21.5	23.0	24.4	25.8	27.1	28.4	29.6	30.8	32.0	33.1	34.2	35.2	36.2	37.2	38.2	39.1
170	7.4	10.2	12.5	14.7	16.6	18.4	20.1	21.7	23.2	24.7	26.1	27.4	28.7	29.9	31.1	32.2	33.3	34.4	35.5	36.5	37.4	38.4	39.3
175	7.5	10.3	12.7	14.8	16.8	18.6	20.3	21.9	23.5	24.9	26.3	27.6	28.9	30.1	31.3	32.5	33.6	34.6	35.7	36.7	37.6	38.6	39.5
180	7.5	10.4	12.8	15.0	17.0	18.8	20.5	22.1	23.7	25.1	26.5	27.9	29.1	30.4	31.6	32.7	33.8	34.9	35.9	36.9	37.8	38.8	39.7

[1]See Figure 1 for the list of natural regions and their designation numbers.

Table 21. Regional black spruce height growth and site index table (natural regions: 1 to 6, 12 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.9	2.0	2.2	2.4	2.6	2.8	3.1	3.3	3.5	3.8	4.1	4.4	4.6	4.9	5.2	5.6	5.9
10	1.4	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.3	3.6	4.0	4.3	4.7	5.1	5.5	5.9	6.4	6.8	7.3	7.7	8.2	8.6	9.1
15	1.5	1.7	2.0	2.3	2.7	3.0	3.5	3.9	4.3	4.8	5.3	5.8	6.3	6.8	7.3	7.9	8.4	9.0	9.6	10.1	10.7	11.3	11.9
20	1.6	1.9	2.3	2.8	3.3	3.8	4.3	4.8	5.4	6.0	6.6	7.2	7.8	8.4	9.0	9.7	10.3	11.0	11.6	12.3	13.0	13.6	14.3
25	1.8	2.2	2.7	3.3	3.9	4.5	5.1	5.8	6.4	7.1	7.8	8.5	9.2	9.9	10.6	11.3	12.1	12.8	13.5	14.3	15.0	15.8	16.5
30	2.0	2.6	3.2	3.8	4.5	5.2	6.0	6.7	7.4	8.2	8.9	9.7	10.5	11.3	12.1	12.9	13.7	14.5	15.3	16.1	16.9	17.7	18.5
35	2.2	2.9	3.6	4.4	5.2	6.0	6.8	7.6	8.4	9.2	10.0	10.9	11.7	12.6	13.4	14.3	15.1	16.0	16.9	17.7	18.6	19.5	20.4
40	2.5	3.3	4.1	4.9	5.8	6.7	7.5	8.4	9.3	10.2	11.1	12.0	12.9	13.8	14.7	15.6	16.5	17.4	18.3	19.3	20.2	21.1	22.0
45	2.7	3.6	4.5	5.5	6.4	7.3	8.3	9.2	10.2	11.1	12.1	13.0	14.0	14.9	15.9	16.8	17.8	18.8	19.7	20.7	21.6	22.6	23.6
50	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0
55	3.3	4.4	5.5	6.5	7.6	8.6	9.7	10.7	11.8	12.8	13.9	14.9	16.0	17.0	18.0	19.1	20.1	21.2	22.2	23.2	24.3	25.3	26.3
60	3.6	4.8	5.9	7.0	8.1	9.2	10.3	11.4	12.5	13.6	14.7	15.8	16.9	17.9	19.0	20.1	21.2	22.2	23.3	24.4	25.4	26.5	27.5
65	3.9	5.1	6.3	7.5	8.7	9.8	11.0	12.1	13.2	14.4	15.5	16.6	17.7	18.8	19.9	21.0	22.1	23.2	24.3	25.4	26.5	27.6	28.7
70	4.2	5.5	6.7	8.0	9.2	10.4	11.6	12.7	13.9	15.1	16.2	17.4	18.5	19.6	20.8	21.9	23.0	24.2	25.3	26.4	27.5	28.6	29.7
75	4.5	5.8	7.2	8.4	9.7	10.9	12.1	13.3	14.5	15.7	16.9	18.1	19.3	20.4	21.6	22.7	23.9	25.0	26.2	27.3	28.5	29.6	30.7
80	4.8	6.2	7.5	8.9	10.2	11.4	12.7	13.9	15.1	16.4	17.6	18.8	20.0	21.2	22.3	23.5	24.7	25.8	27.0	28.2	29.3	30.5	31.6
85	5.1	6.5	7.9	9.3	10.6	11.9	13.2	14.5	15.7	17.0	18.2	19.4	20.6	21.8	23.0	24.2	25.4	26.6	27.8	29.0	30.1	31.3	32.5
90	5.3	6.9	8.3	9.7	11.0	12.4	13.7	15.0	16.2	17.5	18.8	20.0	21.2	22.5	23.7	24.9	26.1	27.3	28.5	29.7	30.9	32.1	33.3
95	5.6	7.2	8.6	10.1	11.4	12.8	14.1	15.4	16.7	18.0	19.3	20.6	21.8	23.1	24.3	25.5	26.8	28.0	29.2	30.4	31.6	32.8	34.0
100	5.9	7.5	9.0	10.4	11.8	13.2	14.6	15.9	17.2	18.5	19.8	21.1	22.4	23.6	24.9	26.1	27.4	28.6	29.8	31.1	32.3	33.5	34.7
105	6.2	7.8	9.3	10.8	12.2	13.6	15.0	16.3	17.7	19.0	20.3	21.6	22.9	24.2	25.4	26.7	28.0	29.2	30.4	31.7	32.9	34.1	35.4
110	6.4	8.0	9.6	11.1	12.5	14.0	15.4	16.7	18.1	19.4	20.8	22.1	23.4	24.7	25.9	27.2	28.5	29.7	31.0	32.2	33.5	34.7	36.0
115	6.6	8.3	9.9	11.4	12.9	14.3	15.7	17.1	18.5	19.8	21.2	22.5	23.8	25.1	26.4	27.7	29.0	30.3	31.5	32.8	34.0	35.3	36.5
120	6.9	8.6	10.2	11.7	13.2	14.6	16.1	17.5	18.9	20.2	21.6	22.9	24.2	25.6	26.9	28.2	29.5	30.7	32.0	33.3	34.5	35.8	37.1
125	7.1	8.8	10.4	12.0	13.5	15.0	16.4	17.8	19.2	20.6	22.0	23.3	24.6	26.0	27.3	28.6	29.9	31.2	32.5	33.7	35.0	36.3	37.5
130	7.3	9.0	10.7	12.2	13.8	15.2	16.7	18.1	19.5	20.9	22.3	23.7	25.0	26.4	27.7	29.0	30.3	31.6	32.9	34.2	35.5	36.7	38.0
135	7.5	9.3	10.9	12.5	14.0	15.5	17.0	18.4	19.9	21.3	22.6	24.0	25.4	26.7	28.1	29.4	30.7	32.0	33.3	34.6	35.9	37.2	38.4
140	7.7	9.5	11.1	12.7	14.3	15.8	17.3	18.7	20.1	21.6	23.0	24.3	25.7	27.1	28.4	29.7	31.1	32.4	33.7	35.0	36.3	37.6	38.8
145	7.9	9.7	11.3	12.9	14.5	16.0	17.5	19.0	20.4	21.8	23.2	24.6	26.0	27.4	28.7	30.1	31.4	32.7	34.0	35.3	36.6	37.9	39.2
150	8.1	9.9	11.5	13.2	14.7	16.3	17.8	19.2	20.7	22.1	23.5	24.9	26.3	27.7	29.0	30.4	31.7	33.0	34.4	35.7	37.0	38.3	39.6
155	8.3	10.0	11.7	13.4	14.9	16.5	18.0	19.5	20.9	22.4	23.8	25.2	26.6	27.9	29.3	30.7	32.0	33.3	34.7	36.0	37.3	38.6	39.9
160	8.4	10.2	11.9	13.5	15.1	16.7	18.2	19.7	21.2	22.6	24.0	25.4	26.8	28.2	29.6	30.9	32.3	33.6	35.0	36.3	37.6	38.9	40.2
165	8.6	10.4	12.1	13.7	15.3	16.9	18.4	19.9	21.4	22.8	24.3	25.7	27.1	28.5	29.8	31.2	32.6	33.9	35.2	36.6	37.9	39.2	40.5
170	8.7	10.5	12.2	13.9	15.5	17.1	18.6	20.1	21.6	23.0	24.5	25.9	27.3	28.7	30.1	31.4	32.8	34.2	35.5	36.8	38.2	39.5	40.8
175	8.9	10.7	12.4	14.0	15.7	17.2	18.8	20.3	21.8	23.2	24.7	26.1	27.5	28.9	30.3	31.7	33.0	34.4	35.7	37.1	38.4	39.7	41.0
180	9.0	10.8	12.5	14.2	15.8	17.4	18.9	20.5	21.9	23.4	24.9	26.3	27.7	29.1	30.5	31.9	33.2	34.6	36.0	37.3	38.6	40.0	41.3

[1]See Figure 1 for the list of natural regions and their designation numbers.

2.5 JACK PINE

Jack pine height growth model:

$$[11] \quad H_2 = 1.3+(H_1-1.3)\left(\frac{1-\exp\left(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)}T_2\right)}{1-\exp\left(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)}T_1\right)}\right)^{b_3(H_1-1.3)^{b_4}T_1^{b_5}}$$

where:

H_2 = tree height (m) at time two

T_2 = breast height age (years) at time two

H_1 = tree height (m) at time one

T_1 = breast height age (years) at time one

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Jack pine site index model (which is a special variant of the height growth model [11] with H_1 replaced by the site index SI and T_1 replaced by the reference-age T_R, respectively):

$$[12] \quad H = 1.3+(SI-1.3)\left(\frac{1-\exp\left(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)}T_B\right)}{1-\exp\left(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)}T_R\right)}\right)^{b_3(SI-1.3)^{b_4}T_R^{b_5}}$$

where:

H = tree height (m) at T_B

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at T_R

T_R = reference-age (= 50 years breast height age)

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Table 22. Fit statistics for the jack pine height growth model [11].

Natural regions[1]	Parameter	Estimate	Std. error	n	MSE	R^2
All (provincial)	b_0	0.023405	0.000840	5566	2.137	0.941
	b_1	-0.371557	0.027932			
	b_2	1.048011	0.002844			
	b_3	0.715449	0.005762			
	b_4	-0.503105	0.008628			
	b_5	0.444505	0.004892			

[1]See Figure 1 for the list of natural regions and their designation numbers.

Jack Pine Site Index Curves

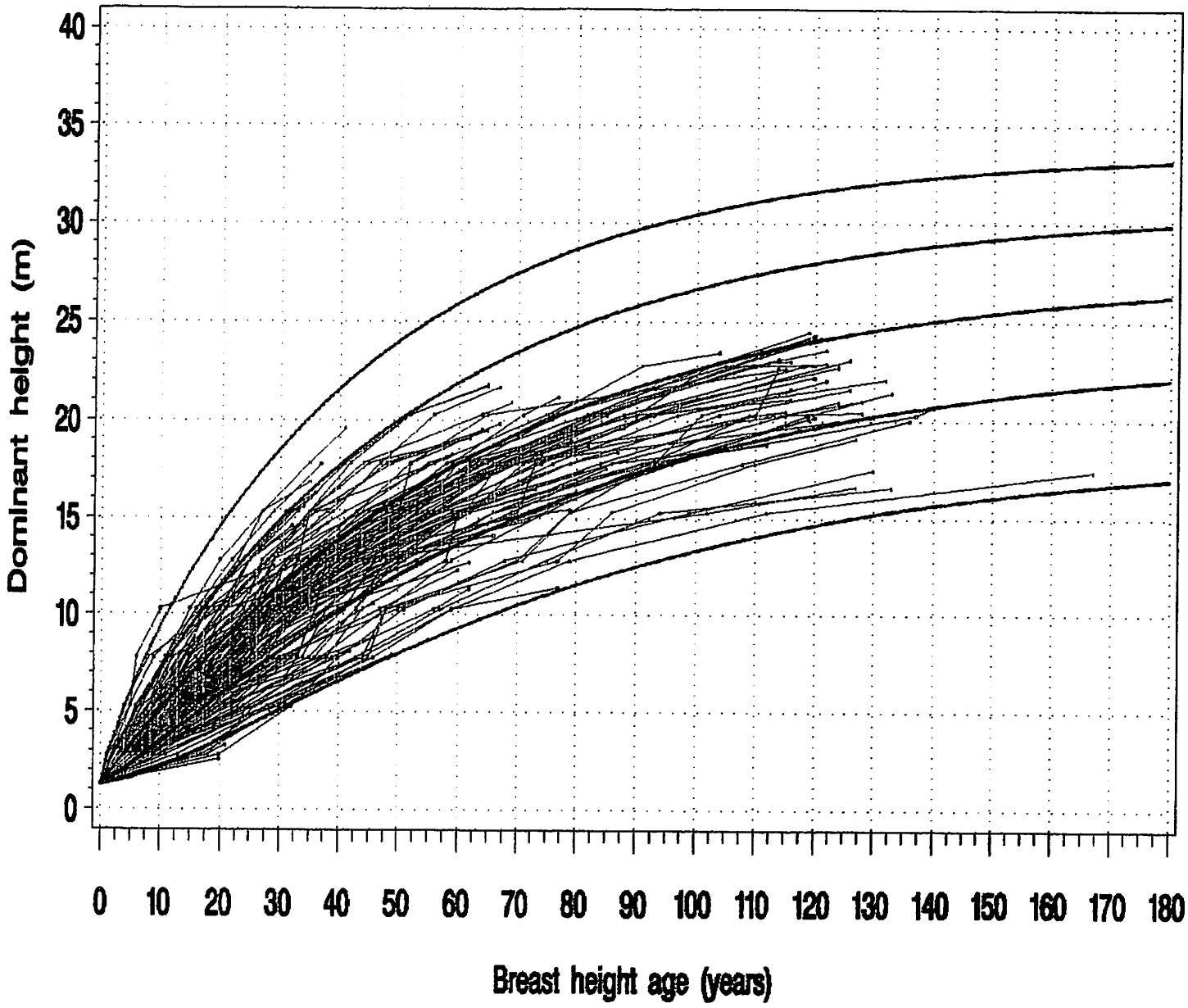

Figure 23. Jack pine site index curves for natural regions 1 to 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 8.0, 12.0, 16.0, 20.0 and 24.0 metres at a reference breast height age of 50 years.

Jack Pine Site Index Table

Table 23. Provincial jack pine height growth and site index table (natural regions: 1 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.9	2.1	2.2	2.4	2.7	2.9	3.2	3.5	3.8	4.1	4.4	4.8	5.2	5.6	6.0	6.4	6.8
10	1.4	1.5	1.7	1.9	2.2	2.4	2.7	3.1	3.4	3.8	4.2	4.6	5.1	5.5	6.0	6.5	7.0	7.6	8.1	8.7	9.3	9.9	10.6
15	1.6	1.8	2.1	2.4	2.8	3.2	3.7	4.1	4.6	5.1	5.7	6.2	6.8	7.4	8.0	8.7	9.3	10.0	10.7	11.4	12.1	12.9	13.6
20	1.8	2.2	2.6	3.0	3.5	4.1	4.6	5.2	5.8	6.4	7.1	7.8	8.5	9.2	9.9	10.6	11.4	12.1	12.9	13.7	14.5	15.4	16.2
25	2.1	2.6	3.1	3.7	4.3	4.9	5.6	6.3	7.0	7.7	8.4	9.2	10.0	10.8	11.6	12.4	13.2	14.0	14.9	15.8	16.7	17.5	18.5
30	2.4	3.0	3.7	4.4	5.1	5.8	6.5	7.3	8.1	8.9	9.7	10.5	11.4	12.2	13.1	14.0	14.9	15.7	16.7	17.6	18.5	19.4	20.4
35	2.8	3.5	4.3	5.0	5.8	6.6	7.5	8.3	9.2	10.0	10.9	11.8	12.7	13.6	14.5	15.4	16.3	17.3	18.2	19.2	20.1	21.1	22.1
40	3.2	4.0	4.8	5.7	6.6	7.5	8.3	9.3	10.2	11.1	12.0	12.9	13.9	14.8	15.8	16.7	17.7	18.6	19.6	20.6	21.6	22.6	23.5
45	3.6	4.5	5.4	6.4	7.3	8.2	9.2	10.1	11.1	12.1	13.0	14.0	15.0	16.0	16.9	17.9	18.9	19.9	20.9	21.9	22.9	23.9	24.9
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.4	5.5	6.6	7.6	8.7	9.7	10.8	11.8	12.8	13.9	14.9	15.9	16.9	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0
60	4.8	6.0	7.1	8.2	9.3	10.4	11.5	12.6	13.6	14.7	15.7	16.8	17.8	18.8	19.9	20.9	21.9	22.9	23.9	24.9	25.9	26.9	27.9
65	5.2	6.4	7.6	8.8	9.9	11.1	12.2	13.3	14.3	15.4	16.5	17.5	18.6	19.6	20.7	21.7	22.7	23.7	24.7	25.7	26.7	27.7	28.7
70	5.6	6.9	8.1	9.3	10.5	11.7	12.8	13.9	15.0	16.1	17.2	18.3	19.3	20.4	21.4	22.4	23.5	24.5	25.5	26.5	27.5	28.4	29.4
75	5.9	7.3	8.6	9.8	11.0	12.2	13.4	14.5	15.7	16.8	17.9	18.9	20.0	21.0	22.1	23.1	24.1	25.1	26.1	27.1	28.1	29.1	30.0
80	6.3	7.7	9.0	10.3	11.6	12.8	14.0	15.1	16.2	17.4	18.5	19.5	20.6	21.7	22.7	23.7	24.8	25.8	26.7	27.7	28.7	29.7	30.6
85	6.6	8.1	9.5	10.8	12.0	13.3	14.5	15.6	16.8	17.9	19.0	20.1	21.2	22.2	23.3	24.3	25.3	26.3	27.3	28.3	29.2	30.2	31.1
90	6.9	8.4	9.9	11.2	12.5	13.8	15.0	16.2	17.3	18.4	19.5	20.6	21.7	22.8	23.8	24.8	25.8	26.8	27.8	28.7	29.7	30.6	31.5
95	7.2	8.8	10.2	11.6	12.9	14.2	15.4	16.6	17.8	18.9	20.0	21.1	22.2	23.2	24.3	25.3	26.3	27.3	28.2	29.2	30.1	31.0	31.9
100	7.5	9.1	10.6	12.0	13.3	14.6	15.8	17.0	18.2	19.4	20.5	21.6	22.6	23.7	24.7	25.7	26.7	27.7	28.6	29.6	30.5	31.4	32.3
105	7.7	9.4	10.9	12.3	13.7	15.0	16.2	17.5	18.6	19.8	20.9	22.0	23.0	24.1	25.1	26.1	27.1	28.0	29.0	29.9	30.8	31.7	32.6
110	8.0	9.7	11.2	12.7	14.0	15.4	16.6	17.8	19.0	20.1	21.3	22.3	23.4	24.4	25.4	26.4	27.4	28.4	29.3	30.2	31.1	32.0	32.9
115	8.2	9.9	11.5	13.0	14.4	15.7	17.0	18.2	19.4	20.5	21.6	22.7	23.7	24.8	25.8	26.8	27.7	28.7	29.6	30.5	31.4	32.3	33.1
120	8.4	10.2	11.8	13.3	14.7	16.0	17.3	18.5	19.7	20.8	21.9	23.0	24.1	25.1	26.1	27.1	28.0	28.9	29.9	30.8	31.6	32.5	33.3
125	8.6	10.4	12.0	13.5	15.0	16.3	17.6	18.8	20.0	21.1	22.2	23.3	24.3	25.4	26.4	27.3	28.3	29.2	30.1	31.0	31.8	32.7	33.5
130	8.8	10.6	12.3	13.8	15.2	16.6	17.8	19.1	20.3	21.4	22.5	23.6	24.6	25.6	26.6	27.6	28.5	29.4	30.3	31.2	32.0	32.9	33.7
135	9.0	10.8	12.5	14.0	15.5	16.8	18.1	19.3	20.5	21.6	22.7	23.8	24.8	25.9	26.8	27.8	28.7	29.6	30.5	31.4	32.2	33.1	33.9
140	9.1	11.0	12.7	14.2	15.7	17.0	18.3	19.6	20.7	21.9	23.0	24.0	25.1	26.1	27.0	28.0	28.9	29.8	30.7	31.5	32.4	33.2	34.0
145	9.3	11.2	12.9	14.4	15.9	17.3	18.6	19.8	21.0	22.1	23.2	24.3	25.3	26.3	27.2	28.2	29.1	30.0	30.8	31.7	32.5	33.3	34.1
150	9.4	11.3	13.1	14.6	16.1	17.5	18.8	20.0	21.2	22.3	23.4	24.4	25.5	26.5	27.4	28.3	29.2	30.1	31.0	31.8	32.7	33.5	34.2
155	9.5	11.5	13.2	14.8	16.3	17.6	18.9	20.2	21.4	22.5	23.6	24.6	25.6	26.6	27.6	28.5	29.4	30.3	31.1	32.0	32.8	33.6	34.3
160	9.6	11.6	13.4	15.0	16.4	17.8	19.1	20.4	21.5	22.7	23.7	24.8	25.8	26.8	27.7	28.6	29.5	30.4	31.2	32.1	32.9	33.7	34.4
165	9.7	11.7	13.5	15.1	16.6	18.0	19.3	20.5	21.7	22.8	23.9	24.9	25.9	26.9	27.8	28.8	29.6	30.5	31.3	32.2	33.0	33.7	34.5
170	9.8	11.9	13.6	15.3	16.7	18.1	19.4	20.7	21.8	23.0	24.0	25.1	26.1	27.0	28.0	28.9	29.8	30.6	31.4	32.3	33.0	33.8	34.6
175	9.9	12.0	13.8	15.4	16.9	18.3	19.6	20.8	22.0	23.1	24.2	25.2	26.2	27.2	28.1	29.0	29.9	30.7	31.5	32.3	33.1	33.9	34.6
180	10.0	12.1	13.9	15.5	17.0	18.4	19.7	20.9	22.1	23.2	24.3	25.3	26.3	27.3	28.2	29.1	29.9	30.8	31.6	32.4	33.2	34.0	34.7

[1]See Figure 1 for the list of natural regions and their designation numbers.

2.6 BALSAM POPLAR

Balsam poplar height growth model:

$$[13] \quad H_2 = 1.3+(H_1-1.3)\left(\frac{1-\exp\left(-b_0\left(H_1-1.3\right)^{b_1}b_2^{\left(H_1-1.3\right)}T_2\right)}{1-\exp\left(-b_0\left(H_1-1.3\right)^{b_1}b_2^{\left(H_1-1.3\right)}T_1\right)}\right)^{b_3\left(H_1-1.3\right)^{b_4}T_1^{b_5}}$$

where:

H_2 = tree height (m) at time two

T_2 = breast height age (years) at time two

H_1 = tree height (m) at time one

T_1 = breast height age (years) at time one

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Balsam poplar site index model (which is a special variant of the height growth model [13] with H_1 replaced by the site index SI and T_1 replaced by the reference-age T_R, respectively):

$$[14] \quad H = 1.3+(SI-1.3)\left(\frac{1-\exp\left(-b_0\left(SI-1.3\right)^{b_1}b_2^{\left(SI-1.3\right)}T_B\right)}{1-\exp\left(-b_0\left(SI-1.3\right)^{b_1}b_2^{\left(SI-1.3\right)}T_R\right)}\right)^{b_3\left(SI-1.3\right)^{b_4}T_R^{b_5}}$$

where:

H = tree height (m) at T_B

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at T_R

T_R = reference-age (= 50 years breast height age)

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Table 24. Fit statistics for the balsam poplar height growth model [13].

Natural regions[1]	Parameter	Estimate	Std. error	n	MSE	R^2
All (provincial)	b_0	0.041208	0.001329	7704	3.012	0.916
	b_1	-0.559626	0.024970			
	b_2	1.038923	0.002852			
	b_3	0.832609	0.006363			
	b_4	-0.627227	0.008599			
	b_5	0.526901	0.005116			

[1]See Figure 1 for the list of natural regions and their designation numbers.

Balsam Poplar Site Index Curves

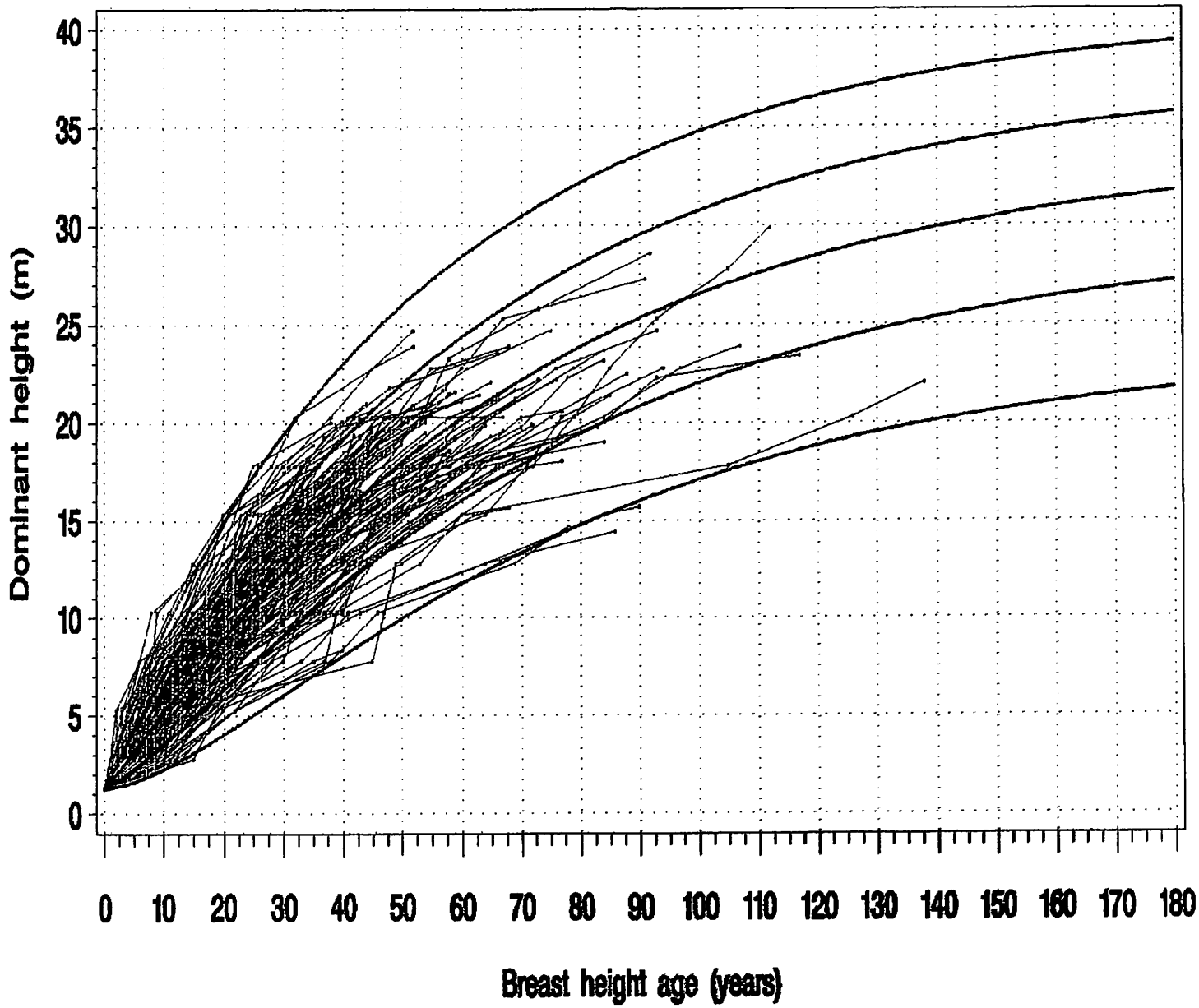

Figure 24. Balsam poplar site index curves for natural regions 1 to 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 10.0, 14.0, 18.0, 22.0 and 26.0 metres at a reference breast height age of 50 years.

Balsam Poplar Site Index Table

Table 25. Provincial balsam poplar height growth and site index table (natural regions: 1 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.9	2.1	2.2	2.4	2.7	2.9	3.2	3.4	3.7	4.0	4.4	4.7	5.1	5.4	5.8	6.2	6.7
10	1.5	1.7	1.8	2.0	2.3	2.6	2.8	3.2	3.5	3.9	4.3	4.7	5.1	5.6	6.1	6.6	7.1	7.6	8.2	8.7	9.3	9.9	10.5
15	1.8	2.1	2.4	2.7	3.1	3.5	4.0	4.4	4.9	5.4	6.0	6.5	7.1	7.7	8.3	8.9	9.6	10.2	10.9	11.6	12.3	13.0	13.7
20	2.3	2.6	3.1	3.5	4.0	4.6	5.1	5.7	6.3	7.0	7.6	8.3	9.0	9.7	10.4	11.1	11.8	12.6	13.4	14.1	14.9	15.7	16.5
25	2.8	3.3	3.8	4.4	5.0	5.7	6.3	7.0	7.7	8.5	9.2	10.0	10.7	11.5	12.3	13.1	13.9	14.7	15.6	16.4	17.3	18.1	19.0
30	3.4	4.0	4.6	5.3	6.1	6.8	7.5	8.3	9.1	9.9	10.7	11.5	12.4	13.2	14.1	14.9	15.8	16.7	17.6	18.5	19.4	20.3	21.2
35	4.0	4.7	5.5	6.3	7.1	7.9	8.7	9.6	10.4	11.3	12.2	13.0	13.9	14.8	15.7	16.7	17.6	18.5	19.4	20.4	21.3	22.2	23.2
40	4.7	5.5	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	14.5	15.4	16.3	17.3	18.2	19.2	20.1	21.1	22.1	23.0	24.0	25.0
45	5.3	6.2	7.2	8.1	9.1	10.0	11.0	11.9	12.9	13.8	14.8	15.8	16.7	17.7	18.7	19.7	20.6	21.6	22.6	23.6	24.6	25.6	26.6
50	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0
55	6.7	7.7	8.8	9.9	10.9	12.0	13.0	14.0	15.1	16.1	17.1	18.1	19.2	20.2	21.2	22.2	23.2	24.3	25.3	26.3	27.3	28.3	29.3
60	7.3	8.4	9.6	10.7	11.8	12.9	13.9	15.0	16.1	17.1	18.2	19.2	20.3	21.3	22.3	23.4	24.4	25.4	26.4	27.4	28.5	29.5	30.5
65	7.9	9.1	10.3	11.5	12.6	13.7	14.8	15.9	17.0	18.1	19.2	20.2	21.3	22.3	23.4	24.4	25.4	26.5	27.5	28.5	29.5	30.5	31.5
70	8.5	9.8	11.0	12.2	13.4	14.5	15.7	16.8	17.9	19.0	20.1	21.1	22.2	23.3	24.3	25.4	26.4	27.4	28.5	29.5	30.5	31.5	32.5
75	9.0	10.4	11.6	12.9	14.1	15.3	16.4	17.6	18.7	19.8	20.9	22.0	23.1	24.1	25.2	26.2	27.3	28.3	29.3	30.4	31.4	32.4	33.4
80	9.5	10.9	12.3	13.5	14.8	16.0	17.2	18.3	19.5	20.6	21.7	22.8	23.9	24.9	26.0	27.1	28.1	29.1	30.2	31.2	32.2	33.2	34.2
85	10.0	11.5	12.8	14.1	15.4	16.6	17.8	19.0	20.2	21.3	22.4	23.5	24.6	25.7	26.8	27.8	28.9	29.9	30.9	31.9	32.9	33.9	34.9
90	10.5	12.0	13.4	14.7	16.0	17.3	18.5	19.7	20.8	22.0	23.1	24.2	25.3	26.4	27.5	28.5	29.5	30.6	31.6	32.6	33.6	34.6	35.6
95	10.9	12.4	13.9	15.3	16.6	17.8	19.1	20.3	21.5	22.6	23.7	24.9	25.9	27.0	28.1	29.1	30.2	31.2	32.2	33.2	34.2	35.2	36.2
100	11.3	12.9	14.3	15.8	17.1	18.4	19.6	20.8	22.0	23.2	24.3	25.4	26.5	27.6	28.7	29.7	30.8	31.8	32.8	33.8	34.8	35.7	36.7
105	11.6	13.3	14.8	16.2	17.6	18.9	20.1	21.4	22.6	23.7	24.9	26.0	27.1	28.2	29.2	30.3	31.3	32.3	33.3	34.3	35.3	36.2	37.2
110	11.9	13.6	15.2	16.6	18.0	19.3	20.6	21.9	23.1	24.2	25.4	26.5	27.6	28.7	29.7	30.8	31.8	32.8	33.8	34.8	35.8	36.7	37.7
115	12.2	14.0	15.6	17.0	18.4	19.8	21.1	22.3	23.5	24.7	25.8	27.0	28.1	29.1	30.2	31.2	32.2	33.2	34.2	35.2	36.2	37.1	38.1
120	12.5	14.3	15.9	17.4	18.8	20.2	21.5	22.7	23.9	25.1	26.3	27.4	28.5	29.6	30.6	31.6	32.7	33.7	34.6	35.6	36.6	37.5	38.4
125	12.8	14.6	16.2	17.7	19.2	20.6	21.9	23.1	24.3	25.5	26.7	27.8	28.9	30.0	31.0	32.0	33.0	34.0	35.0	36.0	36.9	37.9	38.8
130	13.0	14.8	16.5	18.1	19.5	20.9	22.2	23.5	24.7	25.9	27.0	28.2	29.2	30.3	31.4	32.4	33.4	34.4	35.4	36.3	37.3	38.2	39.1
135	13.2	15.1	16.8	18.4	19.8	21.2	22.5	23.8	25.0	26.2	27.4	28.5	29.6	30.7	31.7	32.7	33.7	34.7	35.7	36.6	37.6	38.5	39.4
140	13.4	15.3	17.0	18.6	20.1	21.5	22.8	24.1	25.4	26.5	27.7	28.8	29.9	31.0	32.0	33.0	34.0	35.0	36.0	36.9	37.8	38.7	39.6
145	13.6	15.5	17.3	18.9	20.4	21.8	23.1	24.4	25.6	26.8	28.0	29.1	30.2	31.3	32.3	33.3	34.3	35.3	36.2	37.2	38.1	39.0	39.9
150	13.7	15.7	17.5	19.1	20.6	22.0	23.4	24.7	25.9	27.1	28.3	29.4	30.5	31.5	32.5	33.6	34.5	35.5	36.5	37.4	38.3	39.2	40.1
155	13.9	15.9	17.7	19.3	20.8	22.3	23.6	24.9	26.2	27.3	28.5	29.6	30.7	31.8	32.8	33.8	34.8	35.7	36.7	37.6	38.5	39.4	40.3
160	14.0	16.0	17.8	19.5	21.0	22.5	23.8	25.1	26.4	27.6	28.7	29.8	30.9	32.0	33.0	34.0	35.0	36.0	36.9	37.8	38.7	39.6	40.5
165	14.1	16.2	18.0	19.7	21.2	22.7	24.0	25.3	26.6	27.8	28.9	30.1	31.1	32.2	33.2	34.2	35.2	36.1	37.1	38.0	38.9	39.8	40.6
170	14.2	16.3	18.1	19.8	21.4	22.9	24.2	25.5	26.8	28.0	29.1	30.3	31.3	32.4	33.4	34.4	35.4	36.3	37.2	38.2	39.0	39.9	40.8
175	14.3	16.4	18.3	20.0	21.6	23.0	24.4	25.7	27.0	28.2	29.3	30.4	31.5	32.6	33.6	34.6	35.5	36.5	37.4	38.3	39.2	40.1	40.9
180	14.4	16.5	18.4	20.1	21.7	23.2	24.6	25.9	27.1	28.3	29.5	30.6	31.7	32.7	33.7	34.7	35.7	36.6	37.5	38.4	39.3	40.2	41.0

[1]See Figure 1 for the list of natural regions and their designation numbers.

2.7 BALSAM FIR

Balsam fir height growth model:

$$[15] \quad H_2 = 1.3+(H_1-1.3)\left(\frac{1-\exp\left(-b_0\left(H_1-1.3\right)^{b_1}b_2^{(H_1-1.3)/T_1}T_2\right)}{1-\exp\left(-b_0\left(H_1-1.3\right)^{b_1}b_2^{(H_1-1.3)/T_1}T_1\right)}\right)^{b_3(H_1-1.3)^{b_4}T_1^{b_5}}$$

where:

H_2 = tree height (m) at time two

T_2 = breast height age (years) at time two

H_1 = tree height (m) at time one

T_1 = breast height age (years) at time one

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Balsam fir site index model (which is a special variant of the height growth model [15] with H_1 replaced by the site index SI and T_1 replaced by the reference-age T_R, respectively):

$$[16] \quad H = 1.3+(SI-1.3)\left(\frac{1-\exp\left(-b_0\left(SI-1.3\right)^{b_1}b_2^{(SI-1.3)/T_R}T_B\right)}{1-\exp\left(-b_0\left(SI-1.3\right)^{b_1}b_2^{(SI-1.3)/T_R}T_R\right)}\right)^{b_3(SI-1.3)^{b_4}T_R^{b_5}}$$

where:

H = tree height (m) at T_B

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at T_R

T_R = reference-age (= 50 years breast height age)

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Table 26. Fit statistics for the balsam fir height growth model [15].

Natural regions[1]	Parameter	Estimate	Std. error	n	MSE	R^2
All (provincial)	b_0	0.010190	0.000930	3042	3.454	0.908
	b_1	0.013957	0.027260			
	b_2	3.876735	1.553777			
	b_3	0.647527	0.019709			
	b_4	-0.274343	0.019386			
	b_5	0.378078	0.016011			

[1]See Figure 1 for the list of natural regions and their designation numbers.

Balsam Fir Site Index Curves

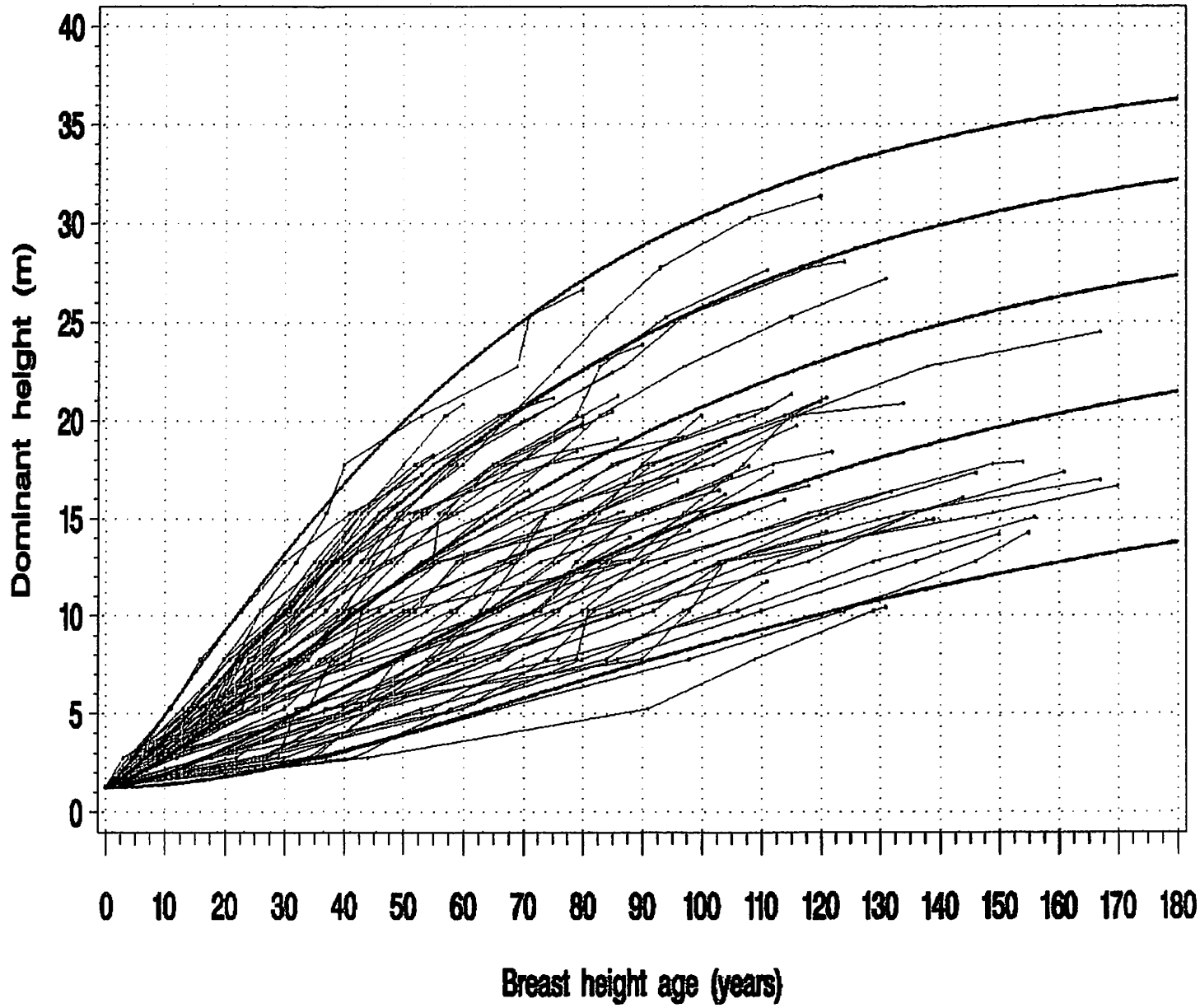

Figure 25. Balsam fir site index curves for natural regions 1 to 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 4.0, 8.0, 12.0, 16.0 and 20.0 metres at a reference breast height age of 50 years.

Balsam Fir Site Index Table

Table 27. Provincial balsam fir height growth and site index table (natural regions: 1 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.7	1.8	1.8	1.9	2.1	2.2	2.3	2.4	2.6	2.7	2.9	3.1	3.2	3.4	3.6	3.8
10	1.4	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.5	2.7	3.0	3.2	3.5	3.7	4.0	4.3	4.6	4.9	5.3	5.6	5.9	6.3	6.7
15	1.4	1.6	1.8	2.0	2.3	2.5	2.8	3.1	3.5	3.8	4.2	4.5	4.9	5.3	5.7	6.2	6.6	7.1	7.5	8.0	8.5	9.0	9.5
20	1.6	1.8	2.1	2.5	2.8	3.2	3.6	4.1	4.5	5.0	5.4	5.9	6.4	7.0	7.5	8.0	8.6	9.2	9.8	10.4	11.0	11.6	12.2
25	1.7	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.6	6.2	6.7	7.3	8.0	8.6	9.2	9.9	10.6	11.2	11.9	12.6	13.3	14.1	14.8
30	1.9	2.4	3.0	3.5	4.1	4.7	5.4	6.0	6.7	7.4	8.1	8.8	9.5	10.2	10.9	11.7	12.4	13.2	14.0	14.8	15.6	16.4	17.2
35	2.1	2.8	3.4	4.1	4.8	5.5	6.3	7.0	7.8	8.6	9.3	10.1	10.9	11.7	12.6	13.4	14.2	15.1	15.9	16.8	17.6	18.5	19.4
40	2.4	3.2	3.9	4.7	5.5	6.4	7.2	8.0	8.9	9.7	10.6	11.5	12.3	13.2	14.1	15.0	15.9	16.8	17.7	18.6	19.6	20.5	21.4
45	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.0	10.0	10.9	11.8	12.8	13.7	14.7	15.6	16.6	17.5	18.5	19.4	20.4	21.4	22.3	23.3
50	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0
55	3.3	4.4	5.5	6.6	7.7	8.8	9.9	10.9	12.0	13.1	14.1	15.2	16.2	17.3	18.3	19.4	20.4	21.4	22.5	23.5	24.5	25.5	26.6
60	3.7	4.9	6.1	7.3	8.4	9.6	10.7	11.9	13.0	14.1	15.2	16.3	17.4	18.5	19.6	20.6	21.7	22.8	23.8	24.9	25.9	27.0	28.0
65	4.0	5.4	6.6	7.9	9.2	10.4	11.6	12.8	13.9	15.1	16.2	17.4	18.5	19.6	20.7	21.8	22.9	24.0	25.1	26.1	27.2	28.2	29.3
70	4.4	5.8	7.2	8.5	9.8	11.1	12.4	13.6	14.8	16.0	17.2	18.4	19.5	20.7	21.8	22.9	24.0	25.1	26.2	27.3	28.4	29.4	30.5
75	4.7	6.3	7.7	9.1	10.5	11.8	13.1	14.4	15.7	16.9	18.1	19.3	20.5	21.7	22.8	24.0	25.1	26.2	27.3	28.4	29.4	30.5	31.5
80	5.1	6.7	8.3	9.7	11.2	12.5	13.9	15.2	16.5	17.8	19.0	20.2	21.4	22.6	23.8	24.9	26.1	27.2	28.3	29.4	30.4	31.5	32.5
85	5.5	7.2	8.8	10.3	11.8	13.2	14.6	16.0	17.3	18.6	19.8	21.1	22.3	23.5	24.7	25.8	27.0	28.1	29.2	30.3	31.3	32.4	33.4
90	5.8	7.6	9.3	10.9	12.4	13.9	15.3	16.7	18.0	19.3	20.6	21.9	23.1	24.3	25.5	26.6	27.8	28.9	30.0	31.1	32.1	33.2	34.2
95	6.2	8.1	9.8	11.4	13.0	14.5	15.9	17.3	18.7	20.0	21.3	22.6	23.9	25.1	26.2	27.4	28.5	29.7	30.8	31.8	32.9	33.9	34.9
100	6.6	8.5	10.3	12.0	13.6	15.1	16.6	18.0	19.4	20.7	22.0	23.3	24.6	25.8	27.0	28.1	29.3	30.4	31.5	32.5	33.6	34.6	35.6
105	6.9	8.9	10.8	12.5	14.1	15.7	17.2	18.6	20.0	21.4	22.7	24.0	25.2	26.4	27.6	28.8	29.9	31.0	32.1	33.2	34.2	35.2	36.2
110	7.3	9.3	11.2	13.0	14.6	16.2	17.7	19.2	20.6	22.0	23.3	24.6	25.8	27.0	28.2	29.4	30.5	31.6	32.7	33.7	34.8	35.8	36.7
115	7.6	9.7	11.6	13.4	15.1	16.7	18.3	19.7	21.1	22.5	23.9	25.1	26.4	27.6	28.8	29.9	31.1	32.2	33.2	34.3	35.3	36.3	37.2
120	8.0	10.1	12.1	13.9	15.6	17.2	18.8	20.2	21.7	23.1	24.4	25.7	26.9	28.1	29.3	30.5	31.6	32.7	33.7	34.7	35.8	36.7	37.7
125	8.3	10.5	12.5	14.3	16.0	17.7	19.2	20.7	22.2	23.6	24.9	26.2	27.4	28.6	29.8	30.9	32.1	33.1	34.2	35.2	36.2	37.1	38.1
130	8.6	10.8	12.9	14.7	16.5	18.1	19.7	21.2	22.6	24.0	25.4	26.6	27.9	29.1	30.3	31.4	32.5	33.6	34.6	35.6	36.6	37.5	38.5
135	8.9	11.2	13.2	15.1	16.9	18.5	20.1	21.6	23.1	24.5	25.8	27.1	28.3	29.5	30.7	31.8	32.9	33.9	35.0	36.0	36.9	37.9	38.8
140	9.2	11.5	13.6	15.5	17.3	18.9	20.5	22.0	23.5	24.9	26.2	27.5	28.7	29.9	31.1	32.2	33.3	34.3	35.3	36.3	37.3	38.2	39.1
145	9.5	11.9	13.9	15.9	17.6	19.3	20.9	22.4	23.9	25.3	26.6	27.9	29.1	30.3	31.4	32.5	33.6	34.6	35.6	36.6	37.5	38.5	39.4
150	9.8	12.2	14.3	16.2	18.0	19.7	21.3	22.8	24.2	25.6	26.9	28.2	29.4	30.6	31.8	32.8	33.9	34.9	35.9	36.9	37.8	38.7	39.6
155	10.1	12.5	14.6	16.5	18.3	20.0	21.6	23.1	24.6	26.0	27.3	28.5	29.8	30.9	32.1	33.1	34.2	35.2	36.2	37.1	38.1	39.0	39.8
160	10.3	12.7	14.9	16.8	18.6	20.3	21.9	23.5	24.9	26.3	27.6	28.9	30.1	31.2	32.3	33.4	34.5	35.5	36.4	37.4	38.3	39.2	40.0
165	10.6	13.0	15.2	17.1	18.9	20.6	22.2	23.8	25.2	26.6	27.9	29.1	30.3	31.5	32.6	33.7	34.7	35.7	36.7	37.6	38.5	39.4	40.2
170	10.8	13.3	15.4	17.4	19.2	20.9	22.5	24.0	25.5	26.8	28.2	29.4	30.6	31.7	32.8	33.9	34.9	35.9	36.9	37.8	38.7	39.5	40.4
175	11.1	13.5	15.7	17.7	19.5	21.2	22.8	24.3	25.7	27.1	28.4	29.6	30.8	32.0	33.1	34.1	35.1	36.1	37.0	38.0	38.8	39.7	40.5
180	11.3	13.8	16.0	17.9	19.8	21.5	23.1	24.6	26.0	27.4	28.6	29.9	31.1	32.2	33.3	34.3	35.3	36.3	37.2	38.1	39.0	39.8	40.6

[1]See Figure 1 for the list of natural regions and their designation numbers.

2.8 DOUGLAS-FIR

Douglas-fir height growth model:

$$[17] \quad H_2 = 1.3+(H_1-1.3)\left(\frac{1-\exp\left(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)/T_1}T_2\right)}{1-\exp\left(-b_0(H_1-1.3)^{b_1}b_2^{(H_1-1.3)/T_1}T_1\right)}\right)^{b_3(H_1-1.3)^{b_4}T_1^{b_5}}$$

where:

H_2 = tree height (m) at time two

T_2 = breast height age (years) at time two

H_1 = tree height (m) at time one

T_1 = breast height age (years) at time one

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Douglas-fir site index model (which is a special variant of the height growth model [17] with H_1 replaced by the site index SI and T_1 replaced by the reference-age T_R, respectively):

$$[18] \quad H = 1.3+(SI-1.3)\left(\frac{1-\exp\left(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)/T_R}T_B\right)}{1-\exp\left(-b_0(SI-1.3)^{b_1}b_2^{(SI-1.3)/T_R}T_R\right)}\right)^{b_3(SI-1.3)^{b_4}T_R^{b_5}}$$

where:

H = tree height (m) at T_B

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at T_R

T_R = reference-age (= 50 years breast height age)

b_0, b_1, b_2, b_3, b_4 and b_5 = estimated coefficients.

Table 28. Fit statistics for the Douglas-fir height growth model [17].

Natural regions[1]	Parameter	Estimate	Std. error	n	MSE	R^2
All	b_0	0.007932	0.001153	3292	1.544	0.940
(provincial)	b_1	0.011994	0.034613			
	b_2	7.053999	2.295547			
	b_3	0.617157	0.009338			
	b_4	-0.365916	0.015229			
	b_5	0.405321	0.010738			

[1]See Figure 1 for the list of natural regions and their designation numbers.

Douglas-Fir Site Index Curves

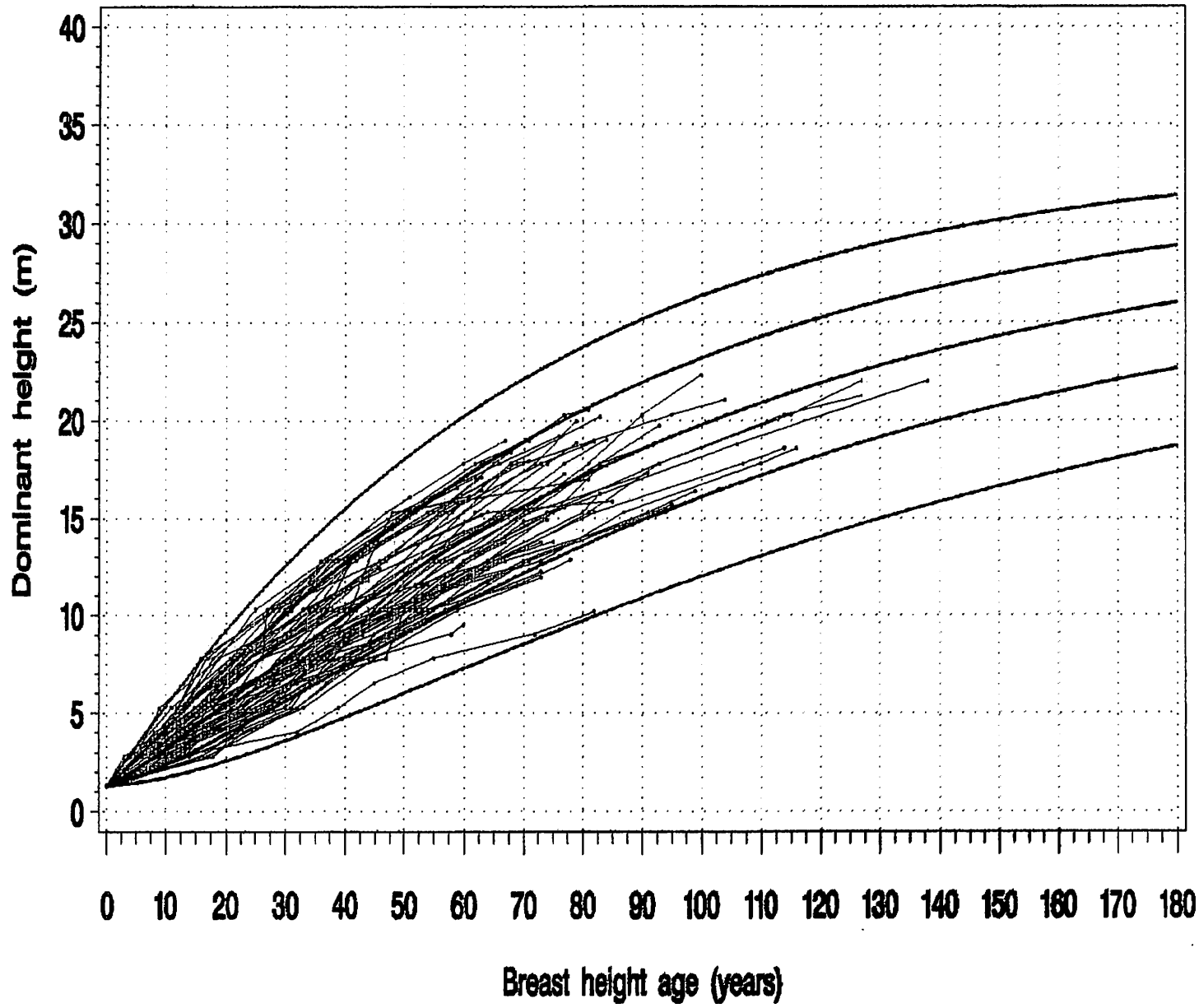

Figure 26. Douglas-fir site index curves for natural regions 1 to 16, overlaid with actual sectioned tree growth trajectories. The site index curves are generated using site index values of 6.0, 9.0, 12.0, 15.0 and 18.0 metres at a reference breast height age of 50 years.

Douglas-Fir Site Index Table

Table 29. Provincial Douglas-fir height growth and site index table (natural regions: 1 to 16)[1].

DATE: August 28, 1994

BHAge (yrs)	Site index (m)																						
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Dominant/codominant height (m)																						
0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5	1.3	1.4	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.3	2.5	2.6	2.8	3.1	3.3	3.5	3.8	4.1	4.4	4.7	5.0	5.3	5.6
10	1.4	1.6	1.7	1.9	2.1	2.3	2.6	2.9	3.2	3.5	3.8	4.2	4.5	4.9	5.3	5.8	6.2	6.7	7.1	7.6	8.1	8.7	9.2
15	1.6	1.8	2.1	2.4	2.7	3.1	3.5	3.9	4.3	4.8	5.2	5.7	6.2	6.8	7.3	7.9	8.4	9.0	9.7	10.3	10.9	11.6	12.3
20	1.8	2.2	2.5	3.0	3.4	3.9	4.4	4.9	5.5	6.0	6.6	7.2	7.9	8.5	9.2	9.8	10.5	11.2	11.9	12.7	13.4	14.2	15.0
25	2.1	2.5	3.0	3.6	4.1	4.7	5.3	6.0	6.6	7.3	8.0	8.7	9.4	10.1	10.9	11.7	12.4	13.2	14.0	14.9	15.7	16.5	17.4
30	2.4	3.0	3.6	4.2	4.9	5.6	6.3	7.0	7.8	8.5	9.3	10.1	10.9	11.7	12.5	13.4	14.2	15.1	15.9	16.8	17.7	18.6	19.5
35	2.8	3.4	4.2	4.9	5.7	6.5	7.3	8.1	8.9	9.7	10.6	11.4	12.3	13.2	14.0	14.9	15.8	16.7	17.7	18.6	19.5	20.5	21.4
40	3.1	3.9	4.8	5.6	6.5	7.3	8.2	9.1	10.0	10.9	11.8	12.7	13.6	14.5	15.5	16.4	17.3	18.3	19.2	20.2	21.2	22.2	23.1
45	3.6	4.5	5.4	6.3	7.2	8.2	9.1	10.1	11.0	12.0	12.9	13.9	14.8	15.8	16.8	17.7	18.7	19.7	20.7	21.7	22.7	23.7	24.6
50	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
55	4.5	5.5	6.6	7.7	8.8	9.8	10.9	11.9	13.0	14.0	15.0	16.1	17.1	18.1	19.1	20.2	21.2	22.2	23.2	24.2	25.2	26.2	27.2
60	4.9	6.1	7.3	8.4	9.5	10.6	11.7	12.8	13.9	14.9	16.0	17.1	18.1	19.2	20.2	21.2	22.3	23.3	24.3	25.3	26.3	27.3	28.3
65	5.4	6.7	7.9	9.1	10.2	11.4	12.5	13.6	14.7	15.8	16.9	18.0	19.1	20.1	21.2	22.2	23.2	24.3	25.3	26.3	27.3	28.3	29.3
70	5.9	7.2	8.5	9.7	10.9	12.1	13.3	14.4	15.6	16.7	17.8	18.9	20.0	21.0	22.1	23.1	24.2	25.2	26.2	27.2	28.2	29.2	30.1
75	6.4	7.8	9.1	10.4	11.6	12.8	14.0	15.2	16.4	17.5	18.6	19.7	20.8	21.9	22.9	24.0	25.0	26.0	27.0	28.0	29.0	29.9	30.9
80	6.9	8.3	9.7	11.0	12.3	13.5	14.8	15.9	17.1	18.3	19.4	20.5	21.6	22.7	23.7	24.7	25.8	26.8	27.8	28.7	29.7	30.7	31.6
85	7.4	8.9	10.3	11.6	12.9	14.2	15.4	16.7	17.8	19.0	20.1	21.2	22.3	23.4	24.4	25.5	26.5	27.5	28.4	29.4	30.4	31.3	32.2
90	7.9	9.4	10.9	12.2	13.6	14.9	16.1	17.3	18.5	19.7	20.8	21.9	23.0	24.1	25.1	26.1	27.1	28.1	29.1	30.0	31.0	31.9	32.8
95	8.4	10.0	11.4	12.8	14.2	15.5	16.7	18.0	19.1	20.3	21.4	22.5	23.6	24.7	25.7	26.7	27.7	28.7	29.6	30.6	31.5	32.4	33.3
100	8.9	10.5	12.0	13.4	14.8	16.1	17.3	18.6	19.8	20.9	22.0	23.1	24.2	25.3	26.3	27.3	28.3	29.2	30.2	31.1	32.0	32.9	33.7
105	9.4	11.0	12.5	13.9	15.3	16.6	17.9	19.1	20.3	21.5	22.6	23.7	24.8	25.8	26.8	27.8	28.8	29.7	30.6	31.5	32.4	33.3	34.1
110	9.9	11.5	13.0	14.5	15.8	17.2	18.4	19.7	20.9	22.0	23.1	24.2	25.3	26.3	27.3	28.3	29.2	30.2	31.1	32.0	32.8	33.7	34.5
115	10.4	12.0	13.5	15.0	16.4	17.7	19.0	20.2	21.4	22.5	23.6	24.7	25.8	26.8	27.8	28.7	29.7	30.6	31.5	32.3	33.2	34.0	34.8
120	10.8	12.5	14.0	15.5	16.9	18.2	19.5	20.7	21.9	23.0	24.1	25.2	26.2	27.2	28.2	29.1	30.1	31.0	31.8	32.7	33.5	34.3	35.1
125	11.3	12.9	14.5	15.9	17.3	18.7	19.9	21.1	22.3	23.5	24.6	25.6	26.6	27.6	28.6	29.5	30.4	31.3	32.2	33.0	33.8	34.6	35.4
130	11.7	13.4	14.9	16.4	17.8	19.1	20.4	21.6	22.8	23.9	25.0	26.0	27.0	28.0	28.9	29.9	30.8	31.6	32.5	33.3	34.1	34.8	35.6
135	12.2	13.8	15.4	16.8	18.2	19.5	20.8	22.0	23.2	24.3	25.4	26.4	27.4	28.3	29.3	30.2	31.1	31.9	32.7	33.5	34.3	35.1	35.8
140	12.6	14.3	15.8	17.3	18.6	19.9	21.2	22.4	23.5	24.7	25.7	26.7	27.7	28.7	29.6	30.5	31.3	32.2	33.0	33.8	34.5	35.3	36.0
145	13.0	14.7	16.2	17.7	19.0	20.3	21.6	22.8	23.9	25.0	26.1	27.1	28.0	29.0	29.9	30.7	31.6	32.4	33.2	34.0	34.7	35.4	36.2
150	13.4	15.1	16.6	18.0	19.4	20.7	21.9	23.1	24.3	25.3	26.4	27.4	28.3	29.2	30.1	31.0	31.8	32.6	33.4	34.2	34.9	35.6	36.3
155	13.8	15.5	17.0	18.4	19.8	21.1	22.3	23.5	24.6	25.6	26.7	27.7	28.6	29.5	30.4	31.2	32.0	32.8	33.6	34.3	35.1	35.8	36.4
160	14.2	15.8	17.3	18.8	20.1	21.4	22.6	23.8	24.9	25.9	26.9	27.9	28.8	29.7	30.6	31.4	32.2	33.0	33.8	34.5	35.2	35.9	36.6
165	14.6	16.2	17.7	19.1	20.5	21.7	22.9	24.1	25.2	26.2	27.2	28.2	29.1	30.0	30.8	31.6	32.4	33.2	33.9	34.6	35.3	36.0	36.7
170	15.0	16.5	18.0	19.4	20.8	22.0	23.2	24.4	25.4	26.5	27.5	28.4	29.3	30.2	31.0	31.8	32.6	33.3	34.1	34.8	35.5	36.1	36.8
175	15.3	16.9	18.4	19.8	21.1	22.3	23.5	24.6	25.7	26.7	27.7	28.6	29.5	30.4	31.2	32.0	32.7	33.5	34.2	34.9	35.6	36.2	36.9
180	15.7	17.2	18.7	20.1	21.4	22.6	23.8	24.9	25.9	26.9	27.9	28.8	29.7	30.5	31.4	32.1	32.9	33.6	34.3	35.0	35.7	36.3	36.9

[1]See Figure 1 for the list of natural regions and their designation numbers.

3.0 THE AGE RELATIONSHIPS

This section presents the following age relationships for each of the major tree species in Alberta:

1. Stump age and breast height age;
2. Total age and stump age;
3. Stump age, breast height age and site index; and
4. Number of years to reach breast height and site index.

All models were developed using the procedures described in Ecologically Based Reference-Age Invariant Polymorphic Height Growth and Site Index Curves for White Spruce in Alberta (Huang 1994a). Methods on how to use the models are briefly discussed in Section 4.0 of this document. The least squares fit statistics and residual plots are shown in Ecologically Based Reference-Age Invariant Polymorphic Height Growth and Site Index Curves for Major Alberta Tree Species: Least Squares Fit Statistics and Residual Plots (Huang 1994b). The coefficient of determination (R^2) and the root mean squared error (RMSE) for the age relationships are calculated according to the following formulas:

$$[19] \qquad R^2 = 1 - \frac{\sum_{i=1}^{n} (y_i - \hat{y}_i)^2}{\sum_{i=1}^{n} (y_i - \bar{y})^2}$$

$$[20] \qquad RMSE = \sqrt{\frac{\sum_{i=1}^{n} (y_i - \hat{y}_i)^2}{n-m}}$$

where: y_i = observed value of the dependent variable

$\hat{y}_i$ = predicted value of the dependent variable

$\bar{y}_i$ = observed average value of the dependent variable

n = number of observations

m = number of parameters.

3.1 The Breast Height Age, Stump Age and Total Age Relationship

The following simple linear model was found appropriate for describing the relationship between stump age and breast height age:

$$[21] \quad T_S = a + bT_B$$

where: T_S = stump age (years) at 0.3 m above ground

T_B = breast height age (years) at 1.3 m above ground

a and b = parameters to be estimated.

A summary of the fit statistics on the provincial data and by natural regions is shown in Table 30. More detailed fit statistics and residual plots are provided in Huang (1994b).

Table 30. Coefficients for the stump age-breast height age model [21].

Species	Natural regions[1]	Estimated coefficients		n	R^2	RMSE
		a	b			
White spruce	9, 11, 14	6.761126	1.010854	571	0.9819	3.9580
	7, 8, 10	8.609413	1.014316	208	0.9775	7.5058
	1 to 6, 12, 13, 15, 16	7.307203	1.018407	427	0.9790	4.5910
	Provincial	7.088489	1.015918	1206	0.9797	5.0198
Lodgepole pine	7, 8	5.531145	1.015944	166	0.9868	4.2859
	6, 9, 11, 14	4.434223	1.007110	582	0.9819	4.1268
	4, 10	4.817917	1.023071	610	0.9735	5.3540
	1, 2, 3, 5, 12, 13, 15, 16	4.832483	1.004492	59	0.9923	3.0250
	Provincial	5.063696	1.011135	1417	0.9792	4.7639
Aspen	2, 14, 15, 16	3.810814	0.999500	104	0.9807	2.3709
	9, 11	3.253466	1.032779	255	0.9803	3.7601
	7, 8, 10	2.614878	1.041429	60	0.9567	3.8045
	1, 3, 4, 5, 6, 12, 13	2.138643	1.054054	338	0.9674	4.3307
	Provincial	2.611119	1.042112	757	0.9752	3.8937
Black spruce	7, 8, 9, 10, 11	9.256627	1.030049	228	0.9568	7.3043
	1 to 6, 12, 13, 14, 15, 16	10.808959	0.994188	166	0.9496	6.5624
	Provincial	9.276023	1.023525	394	0.9569	7.0445
Jack pine	Provincial	4.527348	1.015997	123	0.9896	3.9264
Balsam poplar	Provincial	1.304441	1.064151	148	0.9777	3.2273
Balsam fir	Provincial	10.801880	1.037830	59	0.9178	10.1462
Douglas-fir	Provincial	8.025792	1.008700	66	0.9477	5.3505

[1]See Figure 1 for the list of natural regions and their designation numbers.

The relationship between total age and stump age is defined by:

[22] $$T_T = T_S + T_{0.3}$$

where: T_T = total age (years) of the tree

T_S = stump age (years) at 0.3 m above ground

$T_{0.3}$ = number of years needed to reach stump height of 0.3 m above ground.

The number of years needed to reach stump height of 0.3 m above ground from the point of germination, $T_{0.3}$, can be approximated from the monitor plot data (Gilday 1990), the juvenile stand survey data (Alberta Forest Service 1993) and the managed stand yield survey data (The Forestry Corp. 1994). Table 31 lists the provincial average number of years needed to reach stump height of 0.3 m for various species. The numbers are distinguished by naturally seeded or planted stocks. They may not be accurate for some locations. To adjust for local conditions, one can substitute them with appropriate localized observed number of years to reach stump height.

Table 31. Number of years to reach stump height of 0.3 metres above ground.

Species	Species code	Year to stump height (years)	
		Naturally seeded	Planted[b]
White spruce	Sw	8	4 to 5
Tamarack	Lt	6	
Engelmann spruce	Se	8	4 to 5
Jack pine	Pj	5	3 to 4
Lodgepole pine	Pl	5	3 to 4
Aspen	Aw	1[a]	
Balsam poplar	Pb	1[a]	
White birch	Bw	2	
Black spruce	Sb	8	
Balsam fir	Fb	8	
Alpine fir	Fa	9	
Douglas-fir	Fd	8	6 to 7

[a]Less than one year for suckers.
[b]Includes nursery production time.

3.2 The Site Effect on the Age Relationship

The relationship among breast height age, stump age and total age can be expanded to account for the site factor. An equation that incorporates site index into the stump age and breast height age model [21] was found to be:

$$[23] \qquad T_S = a + bT_B + c/SI$$

where:

T_S = stump age (years) of the tree

T_B = breast height age (years) of the tree

SI = site index, which is the tree height (m) at 50 years breast height age

a, b and c = parameters to be estimated.

A summary of the estimated coefficients and associated fit statistics for [23] is shown in Table 32. Additional fit statistics and residual plots can be found in Huang (1994b). Compared to the results shown in Table 30, the amount of additional variation explained by the inclusion of site index is very small (see Table 32). Therefore, for many practical purposes, either [21] or [23] can be used for making age conversions. Equation [21] may be less accurate but it is more convenient to use since it does not require a prior knowledge of site index. Equation [23] can be used if the site factor needs to be accounted for in making conversions among total age, stump age and breast height age. The procedures and the examples for doing this are presented in Huang (1994a). Appendix 2 shows the mathematical computations involved.

Table 32. Coefficients for the stump age-breast height age-site index model [23].

Species	Natural regions[1]	Estimated coefficients			n	R^2	RMSE
		a	b	c			
White spruce	9, 11, 14	5.475166	1.002372	32.265943	571	0.9822	3.9334
	7, 8, 10	5.038451	0.985319	73.661862	208	0.9809	6.9254
	1 to 6, 12, 13, 15, 16	3.490307	1.006681	72.785749	427	0.9802	4.4587
	Provincial	4.535688	0.995279	64.271929	1206	0.9816	4.7768
Lodgepole pine	7, 8	4.882055	1.010452	12.043772	166	0.9868	4.2909
	6, 9, 11, 14	2.170668	1.003163	41.349472	582	0.9824	4.0782
	4, 10	1.192369	0.994073	79.701670	610	0.9765	5.0493
	1, 2, 3, 5, 12, 13, 15, 16	-2.132813	0.992875	105.551289	59	0.9945	2.5942
	Provincial	1.572173	0.997979	63.737752	1417	0.9810	4.5463
Aspen	2, 14, 15, 16	5.090754	0.998951	-23.755715	104	0.9807	2.3780
	9, 11	3.657640	1.033880	-8.310435	255	0.9803	3.7666
	7, 8, 10	-4.164498	1.055620	85.876024	60	0.9623	3.5794
	1, 3, 4, 5, 6, 12, 13	0.677457	1.048765	32.988284	338	0.9676	4.3273
	Provincial	1.456670	1.038333	24.688558	757	0.9753	3.8876
Black spruce	7, 8, 9, 10, 11	2.432181	0.996387	85.222810	228	0.9646	6.6262
	1 to 6, 12, 13, 14, 15, 16	4.557968	0.964368	80.904479	166	0.9549	6.2319
	Provincial	2.707040	0.992274	83.268451	394	0.9634	6.5026
Jack pine	Provincial	0.374174	1.017944	51.807726	123	0.9904	3.7944
Balsam poplar	Provincial	-1.289679	1.046272	62.504392	148	0.9785	3.1800
Balsam fir	Provincial	10.221936	0.965515	76.063216	59	0.9230	9.9081
Douglas-fir	Provincial	5.094826	1.003264	38.293220	66	0.9486	5.3457

[1]See Figure 1 for the list of natural regions and their designation numbers.

3.3 Number of Years to Reach Breast Height

The following simple linear model was used to describe the relationship between number of years to reach breast height and site index:

$$[24] \quad Y2BH = a + b/SI$$

where:

Y2BH = number of years required to reach breast height (1.3 m) from stump height (0.3 m)

SI = site index, which is the tree height (m) at 50 years breast height age

a and b = parameters to be estimated.

A summary of the fit statistics for model [24] is shown in Table 33. Additional fit statistics and residual plots can be found in Huang (1994b). As seen from Table 33, the relationship between number of years to reach breast height and site index is very poor. Only the provincial coefficients were estimated. The poor performance of the models is consistent with those found in earlier studies (Alberta Forest Service 1985b) and can be explained by a number of reasons that are discussed in Huang (1994a).

Table 33. Coefficients for the Y2BH-site index model [24].

Species	Natural regions[1]	Estimated coefficients		n	R^2	RMSE
		a	b			
White spruce	Provincial	4.347300	59.908359	1205	0.1069	4.5883
Lodgepole pine	Provincial	1.740006	58.838910	1415	0.1094	3.9168
Aspen	Provincial	2.184066	50.788746	757	0.0197	3.9768
Black spruce	Provincial	2.288325	80.774008	394	0.1589	6.4986
Jack pine	Provincial	1.872138	49.555513	123	0.0663	3.8385
Balsam poplar	Provincial	-1.196472	104.124205	148	0.1151	3.2687
Balsam fir	Provincial	8.299433	59.302950	59	0.0703	9.8555
Douglas-fir	Provincial	5.276585	38.968242	66	0.0185	5.3043

[1]See Figure 1 for the list of natural regions and their designation numbers.

4.0 APPLICATIONS

The ecologically based, reference-age invariant polymorphic height growth and site index models and the age relationships described in previous sections have a number of distinct characteristics, and can be used for many purposes (see Huang 1994a). A brief summary of some of their usages is presented in the following sections.

4.1 Predicting and Comparing Height Growth at Any Age

Given current height and breast height age, future height at any age can be predicted from the height growth model. The most obvious benefit of this predictability is that inventory surveys conducted at any time can be used to predict and compare height growth in different natural regions, and on different sites.

It is also obvious that if the site index value (tree height at 50 years breast height age) is known, tree height at any other age can also be predicted from the site index model, which is a special variant of the height growth model with H_1 and T_1 replaced by SI and T_R, respectively. Ecologically based, reference-age invariant polymorphic height growth and site index curves can be constructed from the site index model.

4.2 Estimating Site Index From Height and Breast Height Age

Given total height and breast height age (or stump age, total age), site index can be predicted from the site index model, even though the site index is not a dependent variable. The computation requires a simple mathematical iteration procedure for solving SI from the site index model. Appendices 1 and 2 provide the example Statistical Analysis System (SAS) programs used for calculating site index from observed total height and breast height age (or stump age, total age). A more detailed description of the program logic and the ways that the site index value for individual trees and stands should be computed are provided in Section 5.0 of this document and in Huang (1994a).

4.3 The Height Growth and Site Index Tables and Site Classes

The height growth and site index tables shown in this document are designed to facilitate the field use of the height growth and site index models. The tables can be used to estimate height or height growth from site index and breast height age, or site index from height and breast height age (Huang 1994a). The height growth and site index estimations are compatible, meaning that the same height growth and site index equation is used for both height growth and site index estimations. Estimated site index can also be used for site class determination. The site classes used by the Alberta Land and Forest Services are defined according to the following site index ranges (Alberta Forest Service 1985c; 1991).

Table 34. Site classes for major Alberta tree species.

Species	Site class	Site index range (m)	Average site index value at reference BHAge 50 (m)
Sw/Fb/Fd/Fa/Se	Good (G)	> 15.5	18.0
	Medium (M)	> 10.5 and ≤ 15.5	13.0
	Poor/Fair/Low (P/F/L)	> 6.0 and ≤ 10.5	8.0
	Unproductive (U)	≤ 6.0	
Pl/Pj	Good (G)	> 16.0	18.0
	Medium (M)	> 12.0 and ≤ 16.0	14.0
	Poor/Fair/Low (P/F/L)	> 7.0 and ≤ 12.0	10.0
	Unproductive (U)	≤ 7.0	
Aw/Pb/Bw	Good (G)	> 18.0	20.0
	Medium (M)	> 14.0 and ≤ 18.0	16.0
	Poor/Fair/Low (P/F/L)	> 10.0 and ≤ 14.0	12.0
	Unproductive (U)	≤ 10.0	
Sb/Lt	Good (G)	> 10.0	13.0
	Medium (M)	> 7.0 and ≤ 10.0	8.0
	Poor/Fair/Low (P/F/L)	> 6.0 and ≤ 7.0	6.5
	Unproductive (U)	≤ 6.0	

[1]See Appendix 4 for the list of species and species codes.

Applications of the height growth and site index tables can be illustrated using Table 2.

(1) Estimate total height or height growth from site index and breast height age. For instance, if the site index is 10.0 m, heights at ages 45 and 80 from Table 2 are 9.0 m and 15.7 m, respectively. Height growth between ages 45 and 80 is: (15.7 - 9.0) = 6.7 m.

(2) Estimate site index from height and breast height age. For instance, the site index of a white spruce, which is 22.5 m tall at 80 years breast height age, can be found by entering Table 2 at BHAge 80 and moving right until 22.5 m is located between entries 22.0 and 23.1 under site indices of 15 and 16, respectively. By interpolation, the site index of this tree is 15.5 m. Having this site index value, height at any age can be read or interpolated from Table 2.

(3) Estimate site class from site index. For white spruce in Alberta, site classes are defined according to the site index values shown in Table 34. Therefore, a site index value of 15.5 m indicates a medium (M) site class.

(4) Each table is used for individual tree predictions. The average site index value for a pure or mixed species stand can be obtained by averaging the site indices of a number of site trees selected from the stand. More detailed discussions on this topic are provided in Section 5.0 of this document.

(5) The height growth and site index table can also be used in conjunction with the age relationships, which are discussed in Sections 3.0 and 4.6 of this document. The age relationships among total age, stump age and breast height age allow easy conversions among these commonly used age types, and enable the above height growth and site index predictions to be made from the height growth and site index table, as long as any one type of age is available.

4.4 Estimating Years Needed to Grow to Any Specified Height

The number of years needed for a tree to grow to any specified height can be calculated by rearranging the height growth model, expressing T_2 as a function of H_2, T_1 and H_1. If the current height and breast height age (H_1 and T_1) are specified, then the number of years needed (T_2) to grow to any future height (H_2) can be computed using appropriate species-specific provincial- or natural region-based coefficients.

The number of years needed for a tree to grow to any specified height can also be calculated by rearranging the site index model, expressing T_B as a function of H, T_R and SI. Given site index SI at reference-age T_R, the number of years needed (T_B) to grow to any specified height (H) can be computed using appropriate species-specific provincial- or natural region-based coefficients.

4.5 The Height Growth Intercept

Height growth intercept is the periodic height increment above a defined base height (i.e., stump height, breast height, 1.5 m, or 2.0 m). It is often used to estimate site productivity in young and regenerated stands. The height growth and site index models developed in this study can be used to compute and compare height growth intercepts. See examples and cautionary notes presented in Huang (1994a). A separate manuscript on how to relate site index to height growth intercept is being prepared at this time. Interested readers may contact the Forest Resource Information Branch of the Alberta Land and Forest Services for more details (Phone: 403 - 427 - 8401, Fax: 427 - 0084).

4.6 The Age Relationships

Although most results and discussions were based on breast height age, the relationships among total age, stump age, breast height age, number of years to reach breast height and site index were established so that height growth and site index estimations can be made from any point of age determination. Results of the estimations are identical regardless of the types of age used.

The age conversions can be made in two ways (examples are shown in Huang 1994a):

(I). Using equations [21] and [22], estimate 1) stump age and total age from breast height age; 2) breast height age and total age from stump age; and 3) breast height age and stump age from total age. The estimations are made directly from the equations, or by rearranging the equations.

(II) Using equations [22] and [23], estimate 1) site index, stump age and total age from height and breast height age; 2) site index, breast height age and total age from height and stump age; and 3) site index, breast height age and stump age from height and total age. The estimations are made directly from the equations or from the iteration procedure shown in Appendix 2.

Each approach has its advantages and disadvantages. The first approach may be less accurate but is more convenient to use since it does not require a prior knowledge of site index. The second approach is slightly more accurate but requires additional computations since site index is accounted for. For many practical purposes, either approach can be used for making age conversions. The conversions can be made for the province as a whole, or for groups of natural regions. Since the height growth and site index models were developed using breast height age, the conversions are mainly used to convert stump age or total age into breast height age.

The weak relationship between number of years to reach breast height and site index (equation [24]) suggests that height growth below breast height is affected by a number of "non-site" factors (e.g., competition) and is poorly associated with site index and subsequent height growth. This explains why breast height age is preferred in site index studies. The use of equation [24] should be restricted to where only a very rough approximation of the number of years to reach breast height is required. See Huang (1994a) for more detailed discussions on this topic.

The number of years needed to reach the stump height of 0.3 m above ground, $T_{0.3}$ in [22], may also be modified to account for site index. However, such modifications for very young trees are less important and may not be accurate or reliable for any particular location. The provincial average values listed in Table 31 should be sufficient for many practical purposes.

5.0 SELECTING SITE TREES AND ESTIMATING STAND SITE INDEX

The recommended method for selecting site trees in Alberta is to use the largest diameter trees per unit area, which is similar to the use of top height (defined as the average height of the 100 largest diameter trees per hectare of the same species). The recommended approach for selecting site trees may provide more consistent results than the use of subjectively chosen dominant and codominant trees. A three-step field procedure has been developed to demonstrate how the site trees should be chosen:

(1) In a forest stand of the same cover type with uniform site conditions (see forest cover type specifications in Alberta Forest Service 1985d), establish a total of at least three 0.016 ha circular or square plots (7.14 m in radius or 12.65 m × 12.65 m). The exact sample intensity, in terms of the minimum number of sample plots required, may be adjusted according to the variability of the stand, the purposes of the study (i.e., the required precision) and the available resources.

(2) In a pure species stand, select the largest diameter tree in each plot, and obtain the breast height age and total height of the selected tree. The selected trees should be free growing, without broken or multiple tops, healthy and undamaged, and show no signs of suppression, decay, insect or disease. They should not be too old (e.g., > 180 years breast height age) or too young (e.g., < 20 years breast height age). The preferred age range for coniferous species is 30 to 150 years breast height age, and for deciduous species is 30 to 120 years breast height age. All selected largest diameter trees must also be dominant or codominant trees, and must not be the so-called "wolf", "veteran", or "superdominant" trees. If a tree is uncharacteristic of the general stand condition, or is in an uncharacteristic opening of the stand, it should be excluded from site index estimation. Another largest diameter tree should be selected from an adjacent plot in the stand. Trees should also be excluded from extremely dense stands where density related stagnation is apparent, or from stands where thinning from above has been made.

(3) In a mixed species stand (basal area for each species $\geq$20 percent of the total stand basal area), select the largest diameter tree for each species in the same sample plot, and obtain the breast height age and total height of the selected trees. The selected trees should meet the criteria described in (2). Preferably, a plot should include all species composing the stand so that the largest diameter trees for different species from the same location can be used for growth comparison purposes. However, because of the uneven spatial and numerical distribution of the species in mixed species stands, there are cases where a particular species may not appear in all of the sample plots. If this happens, additional plots should be established to make sure that at least three largest diameter trees are selected for each species. The complexity of the mixed species stands justifies the need for more sample plots.

Once the site trees are selected, the SAS program shown in Appendix 1 can be used to estimate site index for each site tree from measured total height and breast height age. For a pure species stand, averaging the site index values from all selected largest diameter trees provides an average site index for the stand. For a mixed species stand, averaging the site index values from selected largest diameter trees by species provides species-specific site indices for the stand. The overall site index value of the mixed species stand and its interpretations are more complicated and are not very meaningful (Huang 1994a). Some site index conversion equations among different species may be required so that a common measure of site index for mixed species stands can be derived.

Although the field procedures for selecting site trees and the methods for estimating site index appear relatively simple and straightforward, the recommended approach as described involves a number of rather sophisticated statistical concepts and problems. The selection of only one largest diameter tree in a 0.016-ha plot eliminates the potential biases as described by a number of researchers. Interested readers may refer to Huang (1994a) for more discussion on this topic.

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APPENDICES

Appendix 1.

An Iteration Procedure for Calculating Site Index

For each site tree with observed height and breast height age, this iteration procedure solves for the site index SI from the site index equation. The logic of the computation is described in Huang (1994a).

*This example Statistical Analysis System (SAS) program calculates site index from tree height and breast height age, using the provincial coefficients listed in Table 1 for white spruce;
*Data input, where H = tree height (m), TB = breast height age (years) of the tree;

```
01      DATA V1;
02      INPUT   H       TB;
03      CARDS;
04      15.6    70
05      25.8    88
06       :       :
07       ;
08      RUN;
09
10      DATA V2; SET V1;
11      TR = 50;                                                    /*TR = reference-age (= 50 years breast height age)*/;
12      B0 = 0.010168;   B1 =  0.004801;   B2 = 4.997735;           /*B0 - B5 = estimated coefficients for white spruce*/;
13      B3 = 0.802776;   B4 = -0.243297;   B5 = 0.325438;
```

*Set up the initial site index value;

```
14      SI0 = 10.0;
```

*The iteration procedure;

```
15      do until(abs(SI0-SI1) < 0.00000001);
16      c = b3*(SI0-1.3)**b4*TR**b5;
17      SI1=1.3+(H-1.3)/((1-exp(-b0*(SI0-1.3)**b1*b2**((SI0-1.3)/TR)*TB))/(1-exp(-b0*(SI0-1.3)**b1*b2**((SI0-1.3)/TR)*TR)))**c;
18      SI0 = (SI0+SI1)/2;
19      end;
20      keep SI0 SI1 H TB TR;
```

*SI0 or SI1 is the calculated site index of the tree;

```
21      PROC PRINT;
22      RUN;
```

*The above SAS statements are appropriate for white spruce, balsam fir and Douglas-fir;
*For lodgepole pine, jack pine, aspen, balsam poplar and black spruce, line 17 is replaced by line 23:

```
23      SI1 = 1.3+(H-1.3) / ((1-exp(-b0*(SI0-1.3)**b1*b2**(SI0-1.3)*TB)) / (1-exp(-b0*(SI0-1.3)**b1*b2**(SI0-1.3)*TR)))**c;
```

Appendix 2.

An Iteration Procedure for Calculating Breast Height Age and Site Index

This iteration procedure computes breast height age and site index from tree height and stump age. The logic of computation is described in Huang (1994a).

*This example Statistical Analysis System (SAS) program calculates breast height age and site index from tree height and stump age, using the provincial coefficients listed in Tables 1 and 32 for white spruce;
*Data input, where H = tree height (m), TS = stump age (years) of the tree;

```
01      DATA V1;
02      INPUT   H       TS;
03      CARDS;
04      15.6    70
05      25.8    88
06       :       :
07       ;
08      RUN;
09
10      DATA V2; SET V1;
11      TR = 50;                                                    /*TR = reference-age (= 50 years breast height age)*/;
12      a1  = 4.535688;   a2 = 0.995279;   a3 = 64.271929;          /*a1 - a3 = estimated coefficients from Table 32*/;
13      B0 = 0.010168;    B1 =  0.004801;  B2 = 4.997735;           /*B0 - B5 = estimated coefficients from Table 1*/;
14      B3 = 0.802776;    B4 = -0.243297;  B5 = 0.325438;
```

*Setting up the initial site index value;

```
15      SI0 = 10.0;
```

*The iteration procedure;

```
16      do until(abs(SI0-SI1)<0.00000001);
17      TB = (1/a2)*(TS-a1-a3/SI0);                                 /*TB is rearranged from equation [23]*/;
18      c = b3*(SI0-1.3)**b4*TR**b5;
19      SI1=1.3+(H-1.3)/((1-exp(-b0*(SI0-1.3)**b1*b2**((SI0-1.3)/TR)*TB))/(1-exp(-b0*(SI0-1.3)**b1*b2**((SI0-1.3)/TR)*TR)))**c;
20      SI0 = (SI0+SI1)/2;
21      end;
22      keep SI0 SI1 H TS TR TB;
```

*Resulted TB is the calculated breast height age, SI0 or SI1 is the calculated site index;

```
23      PROC PRINT;
24      RUN;
```

*The above SAS statements are appropriate for white spruce, balsam fir and Douglas-fir;
*For lodgepole pine, jack pine, aspen, balsam poplar and black spruce, line 19 is replaced by line 25:

```
25      SI1 = 1.3+(H-1.3) / ((1-exp(-b0*(SI0-1.3)**b1*b2**(SI0-1.3)*TB)) / (1-exp(-b0*(SI0-1.3)**b1*b2**(SI0-1.3)*TR)))**c;
```

Appendix 3.

List of Natural Regions of Alberta

Natural region 1 — Central Mixedwood

Natural region 2 — Dry Mixedwood

Natural region 3 — Wetland Mixedwood

Natural region 4 — Sub-Arctic

Natural region 5 — Peace River Lowlands

Natural region 6 — Boreal Highlands

Natural region 7 — Alpine

Natural region 8 — Sub-Alpine

Natural region 9 — Montane

Natural region 10 — Upper Foothills

Natural region 11 — Lower Foothills

Natural region 12 — Athabasca Plain

Natural region 13 — Kazan Upland

Natural region 14 — Foothills Parkland

Natural region 15 — Peace River Parkland

Natural region 16 — Central Parkland

Natural region 17 — Dry Mixedgrass

Natural region 18 — Foothills Fescue

Natural region 19 — Northern Fescue

Natural region 20 — Mixedgrass

Appendix 4.

List of Major Alberta Tree Species and Their Species Code

SPECIES	SPECIES CODE	SCIENTIFIC NAME
White spruce	Sw	*Picea glauca* (Moench) Voss
Tamarack	Lt	*Larix laricina* (Du Roi) K. Koch
Engelmann spruce	Se	*Picea engelmannii* Parry ex Engelm.
Lodgepole pine	Pl	*Pinus contorta* var. *latifolia* Engelm.
Jack pine	Pj	*Pinus banksiana* Lamb.
Aspen	Aw	*Populus tremuloides* Michx.
White birch	Bw	*Betula papyrifera* Marsh.
Balsam poplar	Pb	*Populus balsamifera* L.
Black spruce	Sb	*Picea mariana* (Mill.) B.S.P.
Balsam fir	Fb	*Abies balsamea* (L.) Mill.
Alpine fir	Fa	*Abies lasiocarpa* (Hook.) Nutt.
Douglas-fir	Fd	*Pseudotsuga menziesii* (Mirb.) Franco

Appendix 5.

Metric Conversion Chart

1 cm	= 0.39370 in.
1 m	= 3.28083 ft.
1 ha	= 2.47105 acres
1 m^2	= 10.76385 sq. ft.
1 m^3	= 35.31435 cu. ft
1 km	= 0.62137 miles
1 m^2/ha	= 4.3560 sq. ft/acre
1 m^3/ha	= 14.2913 cu. ft/acre

1 in.	= 2.5400 cm
1 ft.	= 0.3048 m
1 acre	= 0.4047 ha
1 sq. ft.	= 0.09290 m^2
1 cu. ft.	= 0.02832 m^3
1 mile	= 1.6093 km
1 fbm	= 1 ft. × 1 ft. × 1 in.
1 Mfbm	= 1000 foot board measure (fbm)

1 m^3 log	≈233 board feet lumber (provincial average conversion factor)
1 Mfbm	≈4.3 m^3 log (provincial average conversion factor)