



Development of Empirical Yield Curves For the PJ1, SP1 and SB1 Standard Forest Units

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Research Partnership Agreement

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1 Introduction

Yield curves are an integral part of forest management planning. This report presents preliminary results for the PJ1, SB1 and SP1 forest units. The results are presented in the context of the Romeo Malette Management Unit.

2 Objective

The purpose of this project is to develop statistically defensible yield curves for the analysis of wood supply. These curves should represent a range of current and potential management intensities (Table 1) for the standard northeast forest units (Watt et al. 2001) and southcentral (draft) forest units. The curves should be compatible with SFMM and be applicable to Tembec’s operating area.

3 Background

3.1 NEBIEs

For the purposes of this project, the management intensities for the various forest units have been put in a standard framework with Natural, Extensive, Basic, Intensive, and Elite (NEBIE) levels (Table 1). These management intensities focus on silvicultural manipulations to achieve a target. Site modification (e.g., drainage, fertilization) and tree improvement are two additional dimensions of management intensity. Site modification is not considered here. Tree improvement gains are available for jack pine and black spruce and are included as simple height gains in the “intensive” management level.

Table 1. The standard framework for the management intensities is given.

Level	Target/Focus	Planned Activity
Natural	Same conditions as natural	Present forest condition
Extensive	Manipulating species composition.	Natural regeneration (may include assisted natural regeneration (scarification and cone scattering))
Basic	Manipulating species composition Achieving full site occupancy.	Assisted natural regeneration and artificial regeneration (may include site prep and vegetation management) (e.g. SIP and planting with no other planned intervention after FTG)
Intensive	Manipulating species composition Achieving full site occupancy Controlling density to optimize individual tree growing space	Assisted natural regeneration and artificial regeneration featuring density regulation at a young age (may include site prep and vegetation management) (e.g. SIP and planting with planned spacing/thinning intervention after FTG stage)
Elite	Achieving higher product value	Practices designed to enhance the value or quality of the forest product (e.g. pruning, crop tree management)

Some management actions will result in a stand moving from one forest unit to another. In some cases, a low level of silvicultural investment will result in a conversion from a conifer unit to a mixedwood unit. In other cases, a higher level of silvicultural investment will result in the rehabilitation of a mixedwood unit to a conifer unit. Some

forest units will secede to another forest unit with age. This project focuses on the stand development within a forest unit. If a stand moves to another forest unit following harvest, the yield curve for the new forest unit should be used to predict development.

The management intensities for some of the northeast forest units are given in Table 2.

Table 2. Management intensities are given for the PJ1, SB1, and SP1 forest units.

FU	Intensity	Target	Silviculture
PJ1	Natural	Average of the forest unit Spp Pj ₈₂ Sb ₉ Po ₆ Bw ₄ , stocking = 0.89, SC = 1.7	Natural (unknown) origin
	Extensive	70% or greater jack pine, poorer stocking Spp Pj ₈₂ Sb ₉ Po ₆ Bw ₄ , stocking 90% of natural, SC = 1.7	Cut-origin
	Basic	Unmanaged Pj plantation Spp Pj ₈₂ Sb ₉ Po ₆ Bw ₄ , SC = 1.7	Scarification and plant 2000 stems/ha
	Intensive 1	Pine plantation with well-spaced trees	Plant Pj 2000 stems/ha, PCT every third row at age 20, CT 1/3 of BA at age 35
	Intensive 2	Same as intensive 1 + improved stock	3% first generation height gain
	Intensive 3 Elite	Same as intensive 1 + improved stock Increased value	8% gain from clonal orchard Pruning?
SB1	Natural	Average of the forest unit Spp Sb ₉₁ Ce ₂ La ₂ Po ₂ Bw ₂ , stocking = 0.59, SC = 1.4	Natural (unknown) origin
	Extensive	70% or greater jack pine, poorer stocking Spp Sb ₉₁ Ce ₂ La ₂ Po ₂ Bw ₂ , stocking 80% of natural, SC = 1.4	Cut-origin
	Basic	Well stocked Spp Sb ₉₁ Ce ₂ La ₂ Po ₂ Bw ₂ , stocking 120% of natural, SC = 1.4	CLAAG, HARP, fill planting, planting skid trails, seeding
	Intensive	Well spaced, natural origin Spp Sb ₉₁ Ce ₂ La ₂ Po ₂ Bw ₂ , stocking 120% of natural, SC = 1.4	Commercial thin 1/3 of BA at age 35
	Elite	Increased value	?????
	SP1	Natural	Average of the forest unit Spp Sb ₆₀ Bw ₁₄ Po ₉ Pj ₈ Bf ₆ Ce ₂ Sw ₂ , stocking = 0.65, SC = 1.1
Extensive		Similar to basic, poorer stocking Spp Sb ₆₀ Bw ₁₄ Po ₉ Pj ₈ Bf ₆ Ce ₂ Sw ₂ , stocking 80% of natural, SC = 1.1	Cut-origin
Basic		Well stocked Spp Sb ₆₀ Bw ₁₄ Po ₉ Pj ₈ Bf ₆ Ce ₂ Sw ₂ , stocking 120% of natural, SC = 1.1	Scarification
Intensive Sw		Sw plantation with well-spaced trees Spp Sw ₈₀ Bw ₁₀ Po ₁₀	Plant Sw 1800 stems/ha, PCT every third row at age 20, CT 1/3 of BA at age 35
Intensive 1 Sb		Sb plantation with well-spaced trees Spp Sb ₈₀ Bw ₁₀ Po ₁₀	Plant Sb 1800 stems/ha, CT 1/3 of BA at age 35
Intensive 2		Same as intensive 1 Sb + improved stock	9% first generation height gain
Intensive 3		Same as intensive 1 + improved stock	15% gain from clonal orchard
Elite		Increased value	Pruning?

4 DATA

The data are summarized in Table 3. The data come from the Ontario provincial data base as well as the Canadian Forest Service and the Quebec Forest Service. The raw data were compiled to a standard form described elsewhere.

The data analysis focuses on ensuring the model forms fit the data. It is also essential that the data reflect the population. In general, historic plots like the AmericanCan and Kimberly Clark plots were located on better sites with better stocking. They tend to represent better than average conditions. Experimental sites such as the Thunder Bay spacing trial and those from the Petwawa Research Forest tend to have above average growth due to complete site occupancy, above average protection, and better tending. It is important that these attributes be included as covariates in the model. The growth and yield plots are more representative of the range of sites in the population.

The Beckwith Roboelin plots at Limestone lake were removed because they occur on limestone soils, not representative of Tembec's license areas, and have significantly higher growth.

Table 3. The plots from the PJ1 forest unit are summarized. Means are followed by the data ranges in brackets.

FU	Origin	Plots	Msmts ¹	Age (years)	BA (m ² /ha)	Density (stems/ha)	Stocking ²	SI (m@age 50)	Volume (m ³ /ha)
PJ1	Natural	486	980 (368)	58 (7-152)	18.3 (0-49.6)	1313 (25-6537)	0.74 (0-1.8)	15.7 (5-33.7)	136 (0-471.8)
	Planted	125	291 (11)	26 (6-59)	16.7 (0-35.2)	2272 (17-6577)	0.76 (0-1.3)	20.1 (10.9-28.0)	107 (0-325)
SB1	Natural	1781 (1526)	3877 (2994)	96 (4-244)	17.3 (0-64.5)	1586 (2-14445)	0.52 (0-4.7)	9.9 (0-38.7)	100 (0-409)
SP1	Natural	733 (488)	1391 (751)	72 (5-211)	22.5 (0-71.8)	1953 (75-23752)	0.71 (0-6.68)	13.7 (0-36.0)	146 (0-415)
	Planted Sw	161 (6)	347 (8)	25 (6-48)	16.7 (0-50.8)	2473 (25-14575)	1.63 (0-4.47)	6.1 ³ (2.1-16.5)	80 (0-323)
	Planted Sb	172 (3)	336 (3)	26 (8-48)	15.6 (0.1-49.7)	3073 (100-10975)	1.3 (0.1-3.5)	14.0 (4.6-34.9)	69 (0-278)

4.1 Site index

The site index for jack pine was calculated using equation 22 of Carmean et al (2001) and top height was predicted using the equation 3 from the same source. For black and white spruce the site index curves were calculated from the equations in Appendix IV of Carmean (1996) and top height was predicted from Appendix III of the same source. Breast height age was calculated by subtracting 5 years from total age for plantations and 6 years from total age for natural stands.

Table 4. The correspondence between Carmean et al's site index equations (m @ breast height age 50) and Plonski's site classes is shown for Jack pine.

¹ The total number of measurements is followed by in brackets by the number of measurements from Quebec.

² See section 2.2 for an explanation of stocking.

³ m@bh age 15

Plonski Site Class	Carmean's Site index – natural origin	Carmean's Site index – planted	Carmean's Site index – natural origin	Plonski Site Class	Carmean's Site index – planted	Plonski Site class
X	22.6	22.4	20.0	0.84	20.0	0.77
1	19.5	19.3	17.5	1.65	17.5	1.58
2	16.4	16.2	15.0	2.45	15.0	2.40
3	13.3	13.2	12.5	3.26	12.5	3.23

4.2 Stocking

The stocking for each plot was calculated as the ratio of the actual basal area compared to that predicted by Plonski (1981) for a fully stocked stand. The Plonski basal area was predicted using Payandeh's (1991) formulation of Plonski's yield tables. For jack pine, Payandeh's equation to predict the Plonski basal area is as follows.

$$(1) \quad PlonskiBA = 5.050 \cdot SI^{0.596} \cdot (1 - e^{-0.071})^{1.511}$$

There was a noticeable tendency for the average stocking to increase with age in the PJ1 and to decrease with age in the SP1 (Figure 1). This may have several causes:

- Young stands may have a different definition of stocking. For example, the inventory stocking may come from silvicultural records and be based on stocked quadrats.
- In young stands, some trees may be below the lower dbh limit.
- Stand measurement protocols have changed. In general, the minimum dbh of tree measured has decreased. Some of the older measurements, in particular, may have had a minimum dbh of 10cm while the current standard is generally 2.5cm.
- In young stands, the Plonski basal area is rather small and smaller absolute differences in the actual basal area can lead to larger relative differences (stocking). For instance for PJ site class 3, a difference of 1m²/ha leads to a difference in stocking of 10% at age 20 but a difference of 4% at age 100.
- Historically, growth plots were sometimes abandoned if significant mortality occurs. The remaining growth plots tend to have higher than average basal areas and therefore stocking. This was partly compensated by a tendency toward harvesting the more productive plots.
- Stocking reductions with age are generally a result of tree mortality. For the SP1 there is a trend of decreasing site class with increase age so some of the older stands may be on less productive sites.

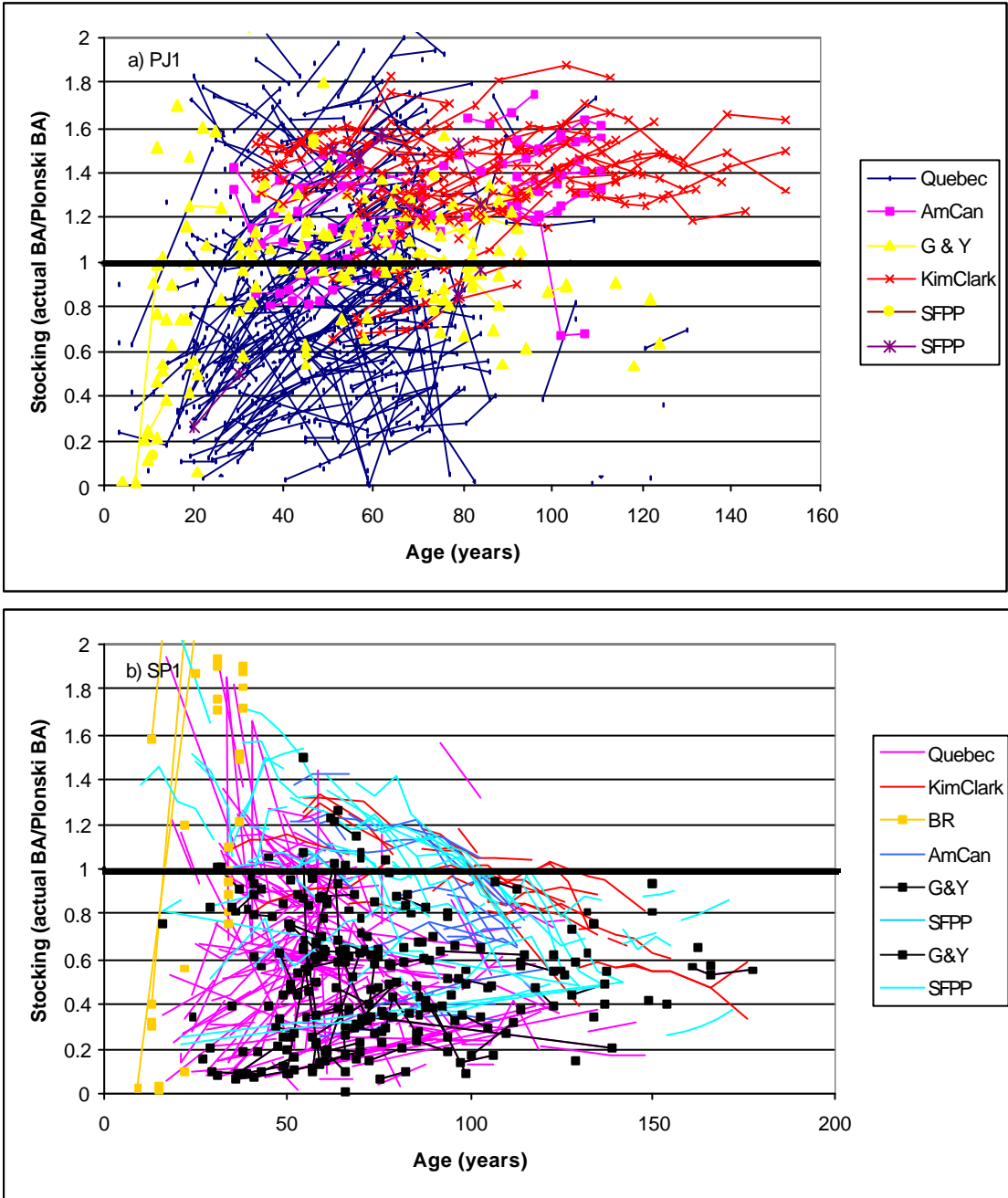


Figure 1. The trend of stocking with age is shown for the natural origin stands for the PJ1 forest unit (a) and for the SP1 forest unit (b).

Within the Romeo Malette management unit, there is a tendency of stocking to increase with age up to about 100 years and then start to decline (Figure 2). There are many other trends associated with overmature stands including declines in site index and changes in species composition.

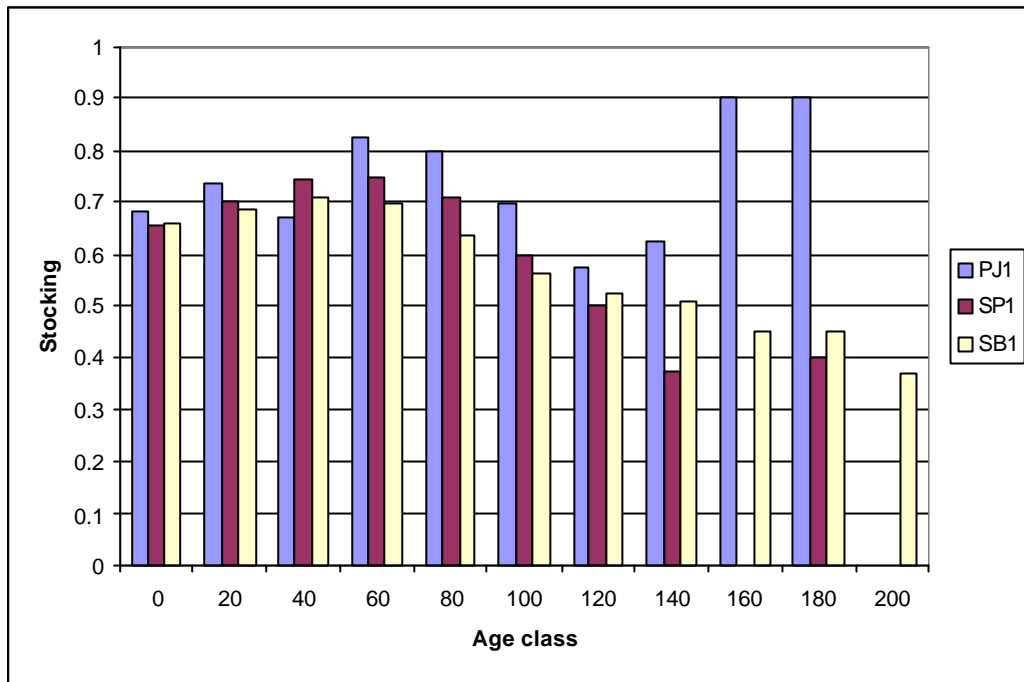


Figure 2. Average stocking is given by age class for the PJ1, SP1, and SB1 forest units in the Romeo Malette management unit. There is very little area in the PJ1 forest unit older than 120 years.

The following function was fit to the stocking-age data to produce a smooth stocking curve for the yield curves. The observations were weighted by stand area.

$$(2) \quad \text{stocking} = \frac{b_2}{\sqrt{2\pi} \cdot b_1} \cdot e^{-\frac{(age-b_0)^2}{2 \cdot b_1}}$$

This is a scaled normal probability density function. Examples of the fit are given in Figure 3. Stands younger than 40 years and older than 160 years were not included, as in SFMMTool.

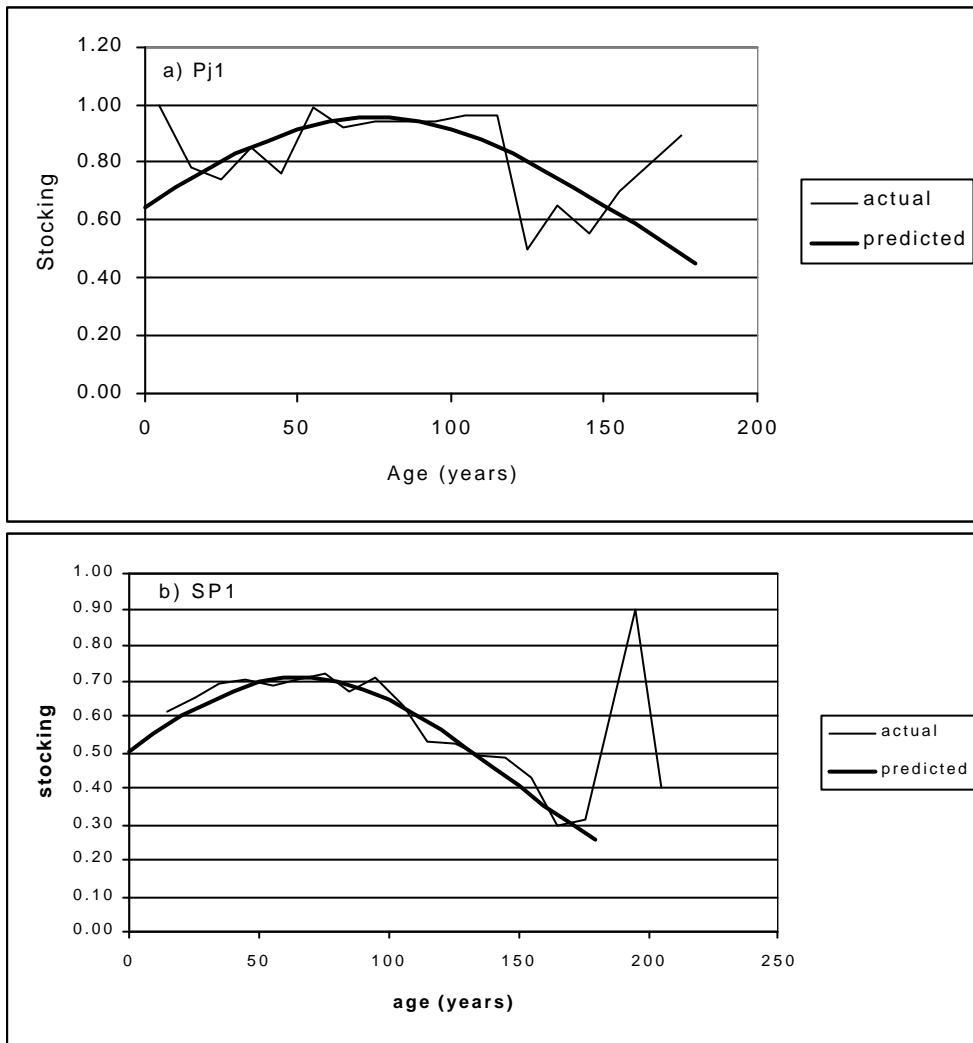


Figure 3. A comparison of the actual stocking and that predicted using equation (2).

5 Methods

Any yield curves must be compatible with the forest resources inventory (FRI) data. The FRI data for each stand consists of the species composition (to the nearest 10%), the age class, stocking, average height of dominant and codominant trees, and site class.

Various other classification variables are also available including ownership, site region, and site district. Generally, silvicultural history is not available as part of the FRI.

Yield and growth were modeled. The yield models should generally be appropriate for natural and extensive conditions with no management intervention. The yield curves may also be used to predict growth under unmanaged conditions assuming that stocking is constant over time. The yield curves are based on all the data including plots with a single measurement.

The growth curves are recommended for prediction of the growth of managed stands. They are based on the following hypothesis. For a wide range of thinning regimes, the growth rates in a thinned stand are identical to those in an unthinned stand with the same characteristics (e.g., SI, basal area, top height).

5.1 Yield

5.1.1 Basal area

Basal area was predicted using the following equation form.

$$(3) \quad BA_pred = stocking \cdot (a_0 + a_1 \cdot SI) \cdot (1 - e^{-b_0 \cdot age^{g_0}})$$

This equation should be a relatively good predictor of basal area since the stocking is the ratio between actual and theoretical (Plonski) basal area. In the FRI the stocking is generally estimated from aerial photography, not calculated.

5.1.2 Top height

Top height curves are an essential part of the yield curves developed here. Historically, height data has been expensive to collect and were highly variable and generally deficient for minor species. Top height curves were taken from the literature and evaluated against the observed height development patterns in the data. Uncertainties and errors in the site index curves are not included in the yield prediction intervals.

Top height for jack pine was predicted using the following equation from Carmean (2001) equation 3.

$$(4) \quad \text{topht_pred} = 1.3 + 4.1459 \cdot (SI - 1.3)^{0.6224} \cdot (1 - K^{(age - age2bh)/50})^{1.3723(SI - 1.3)^{-0.0802}}$$

$$K = 1 - \left(\frac{SI - 1.3}{4.1459 \cdot (SI - 1.3)^{0.6224}} \right)^{\frac{1}{1.3723(SI - 1.3)^{-0.0802}}}$$

Top heights for the remaining species were predicted using equations from Carmean (1996).

The age to reach breast height (*age2bh*) was assumed to be 6 years for natural stands and 5 years for plantations.

5.1.3 Density

The following equation form was used to predict density (stems/ha).

$$(5) \quad stems_pred = \frac{x_0}{SI} \cdot stocking^{x_1} \cdot BA_pred \cdot age^{x_2}$$

The variance of the residuals increased with predicted stems so the observations were weighted by $\frac{1}{BA_pred}$ resulting in a more homogenous variance for the residuals.

5.1.4 Volume

The following equation form was used to predict total stem volume (m³/ha).

$$(6) \quad vol_pred = z_0 \cdot BA_pred \cdot topht_pred$$

The variance of the residuals increased with predicted volume so the observations were weighted by $\frac{1}{BA_pred}$ resulting in a more homogenous variance for the residuals.

Merchantable volumes were calculated using the scaling manual (OMNR 1995) minimum standards. That is, a stump height of 30 cm and a top diameter of 16cm (white & red pine, hemlock, poplar, or white birch), 10 cm (other conifer), or 20 cm (other hardwood).

$$(7) \quad mvol_pred = z_3 \cdot (1 - e^{-z_4 \cdot age^2}) \cdot vol_pred$$

Net merchantable volume was obtained by fitting the following equation to the cull factors from OMNR (1978), by species. Cull was applied separately to each species in each forest unit.

$$(8) \quad cull = (1 - e^{-b_0 \cdot age})^{b_1}$$

For jack pine, Table 9 (for the central transition portion of the eastern ecological section) was used. For SB1, Table 5 for lowland (wet) sites in the boreal forest region was used. For SP1, Table 4 for upland sites was used except for white spruce (Intensive Sw) where Table 6 was used.

The fraction of the gross total volume in each of the products in Table 5 was estimated using the following equation.

$$product_fraction = (a_0 + a_1 \cdot topht) \cdot (1 - e^{-b \cdot dbh_q^c})$$

Table 5. The following SPF products were of interest for the PJ1, SP1, and SB1 forest units. The merchantable volume of all other species was considered pulp.

Product	Species	Small end diameter (cm)
SPF1	Pj, Sb, Sw, Bf, Sr, Sn	16+
SPF2	Pj, Sb, Sw, Bf, Sr, Sn	12-16
SPF3	Pj, Sb, Sw, Bf, Sr, Sn	10-12

5.2 Growth

Fewer data were available for estimating growth. The attributes at the start of a growth period were used to estimate the average annual growth during the growth period.

5.2.1 Basal area

Basal area was predicted using the following equation, which is the differential form of the Chapman-Richards growth function (Pienaar and Turnbull 1973).

$$(9) \quad \frac{dBA}{dt} = \mathbf{a} \cdot BA^b - \mathbf{g} \cdot BA$$

This model was proposed by Pienaar and Turnbull (1973) as a basis for basal area prediction in unthinned and thinned even-aged coniferous monocultures for a given site class. The first coefficient was expanded to be a function of site index as follows.

$$(10) \quad \frac{dBA}{dt} = (\mathbf{a}_0 + \mathbf{a}_1 \cdot SI) \cdot BA^b - \mathbf{g} \cdot BA$$

5.2.2 Top height

Height growth was predicted using the same site index equations as in section 5.1.2.

5.2.3 Density

For plantations, the target is often specified in terms of stems/ha rather than basal area so density is a relatively important attribute. The following model form was selected to predict the relative change in density.

$$(11) \quad \frac{dN/dt}{N} = x_0 + x_1 \cdot t + x_2 \cdot BA$$

N is density, t is years from planting and BA is basal area. There was a tendency for density to increase in the first 20 years due to ingrowth and upgrowth (trees crossing the dbh measurement threshold). This was particularly apparent in the plantations, possibly because they tended to be younger. In any case, the density change model is intended to predict stem survival and is a non-increasing function. Therefore, for plantations, the maximum stems/ha were used as the density estimate until mortality began and then the actual density was used.

5.2.4 Volume

Volume growth was predicted using the following equation.

$$(12) \quad \frac{dVol}{dt} = Vol \left[\frac{dH/dt}{H} + \frac{dBA/dt}{BA} \right]$$

This equation assumes the stand form factor (ratio between volume and $BA \times H$) is constant over time.

The merchantability and cull factors from section 5.1.4 were used to estimate gross merchantable and net merchantable volumes.

5.2.5 Stocking

There is a trend of increasing stocking with age for jack pine and decreasing stocking with age for spruce (Figure 1). This has not been modeled.

6 Results

Table 6. The yield model coefficients are given by forest unit.

FU	origin	a0	a1	b0	c0	x0	x1	x2	z0	z1	z2	z3
PJ1	N	9.321	1.057	0.021	1.294	38924.704	0.089	0.859	0.429	0.608	0.746	1.000
PJ1	P	10.340	0.970	0.025	1.262	113599.393	0.183	1.237	0.460	0.000	2.902	0.963
SB1	N	1.596	0.006	1.382	67800.464	0.452	0.951	0.405	0.007	1.314	0.741	1.596
SP1	N	2.087	0.001	1.887	218857.540	0.398	1.254	0.428	0.024	0.916	1.000	2.087

Table 7. The growth model coefficients are given by forest unit.

FU	origin	a0	a1	b0	c0	x0	x1	x2
PJ1	N	0.269	0.001	0.913	0.200	-0.008	0.000	-0.001
PJ1	P	1.207	0.000	0.189	0.071	-0.008	0.000	-0.001
SB1	N	0.302	0.006	0.366	0.040	-0.003	0.000	-0.001
SP1	P (Sb)	1.377	0.000	0.929	1.071	-0.023	0.001	-0.001
SP1	N	1.091	0.000	0.972	0.988	-0.004	0.000	-0.001
SP1	P (Sw)	0.751	0.000	0.343	0.059	-0.006	0.000	-0.001

6.1 PJ1

The results for the PJ1 forest unit are compared to the curves in the current management plan in the following figure.

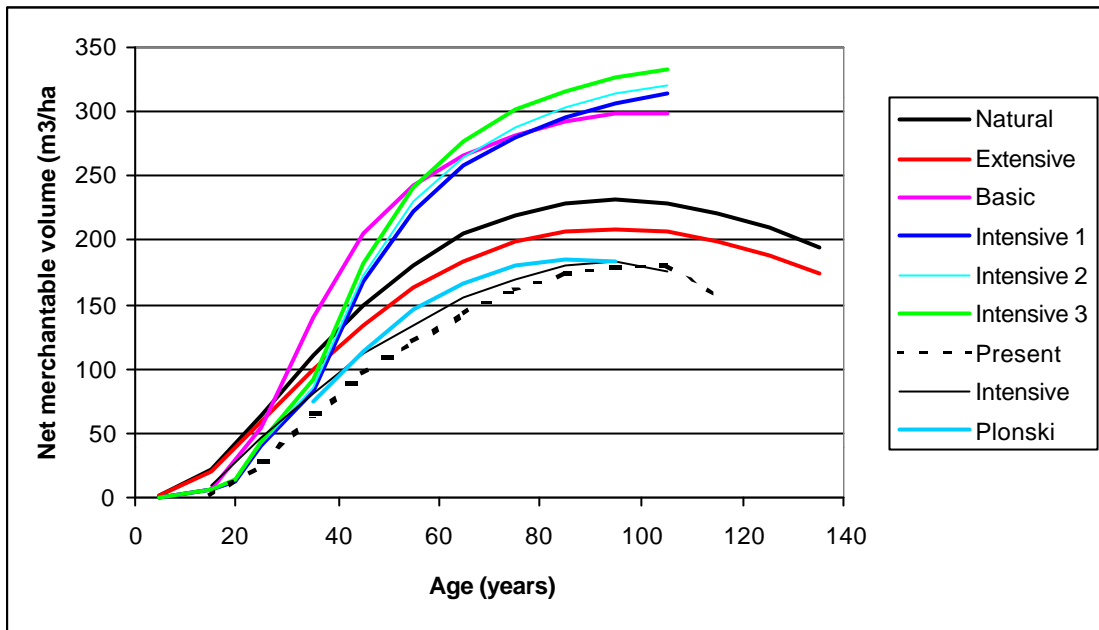


Figure 4. The yield curves for the PJ1 forest unit are compared against those in the current plan for the Romeo Malette management unit and those derived from Plonski. The management intensities are described in Table 2.

6.2 SP1

The results for the SP1 forest unit are compared to the curves in the current management plan in the following figure.

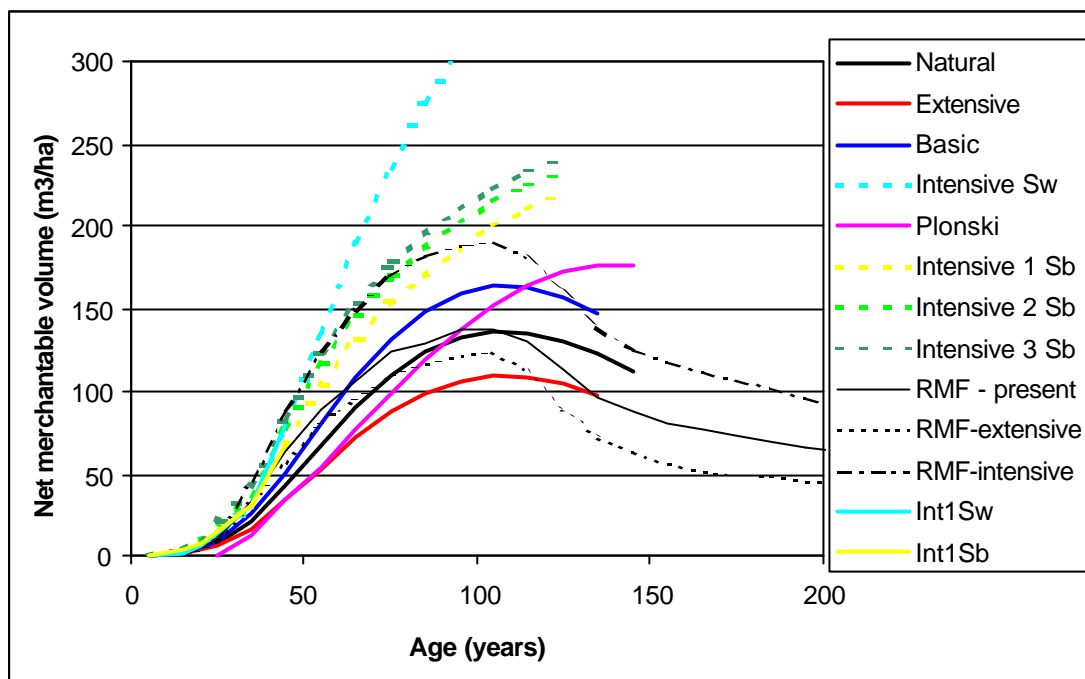


Figure 5. The yield curves for the SP1 forest unit within the Romeo Malette management unit. The management intensities are described in Table 2.

6.3 SB1

The results for the SB1 forest unit are compared to the curves in the current management plan in the following figure.

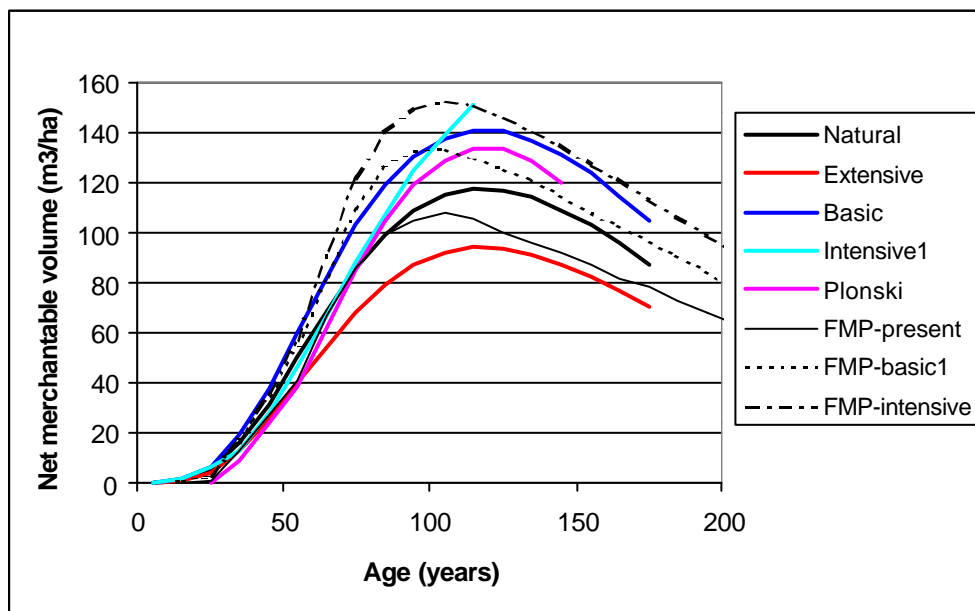


Figure 6. The yield curves for the SB1 forest unit within the Romeo Malette management unit are given for the management intensities described in Table 2.

7 Literature Cited

- Carnean, W.H. 1996. Site-quality evaluation, site-quality maintenance, and site-specific management for forest land in northwest Ontario. Ontario Ministry of Natural Resources, NWST Technical Report TR-105, Thunder Bay, ON. 121p.
- Carnean, W.H., G.P. Niznowski, G. Hazenberg. 2001. Polymorphic site index curves for jack pine in Northern Ontario. *For. Chron.* 77:141-150.
- OMNR, 1978. Cull Survey Tables (metric). Ontario Ministry of Natural Resources, Queen's Printer. 51p.
- OMNR, 1995. Scaling Manual, 1st ed. Ontario Ministry of Natural Resources, Queen's Printer. 124p.
- Payandeh, B. 1991. Plonski's (metric) yield tables formulated. *For. Chron.* 67:545-546.
- Pienaar, L.V. and K.J. Turnbull. 1973. The Chapman-Richards generalization of Von Bertalanffy's growth model for basal area growth and yield in even-aged stands. *For. Sci.* 19:2-22.
- Plonski, W.L. 1981. Normal yield tables (metric) for major forest species of Ontario. Ontario Min. Nat. Res., For. Res. Group. 40 p.
- Watt. W.R., J. Parton, H. Chen, G. Lucking, N. Houle, S. Levesque, and A. Luke. 2001. Standard forest units for northeastern Ontario boreal Forests. OMNR Northeast Science & Technology Info. Rep. Draft dated 14/02/01.

8 Appendix

8.1 Forest unit SQLs

Table A1. The SQL for the forest units is given.

REGION	FU Name	FU Description	Sort Order	Forest Unit SQL Syntax
NER	Pr1	Red Pine 1	1	Pr >= 0.7
NER	Pw1	Pw Mixed 1	2	Pw+Pr+Sw+He >= 0.4 and Pw >= 0.3
NER	Prw	Pr Mixed	3	Pw+Pr >= 0.4
NER	LH1	LowLand Hwd	4	LH >= 0.3
NER	TH1	Tolerant Hwd	5	LH+MH+UH >= 0.3
NER	BOG	Sb Bog	6	Sb+La >= 0.7 and Pw = 0 and SC = '4'
NER	Sb1	Sb LowLand	7	Sb >= 0.8 and MH+UH+Pr = 0 and Pw+Pj <= 0.1
NER	Pj1	Jack Pine	8	Pj >= 0.7 and Po+Bw+MH+UH+LH <= 0.2
NER	LC1	Sb / Ce / La	9	Ce+La+Sb >= 0.8 and MH+UH+Pr = 0 and Pw+Pj <= 0.1
NER	Pj2	P j /Sb	10	(Pj+Sb+Pr >= 0.7 or (Pj >= 0.5 and Pj+Sb+Bf+Sw+He+Pw+Pr+Ce+La >= 0.7 and Bf+Sw+He+Pw+Ce+La <= 0.2)) and Pj >= Sb
NER	SP1	Sb / Pj	11	Sb+Sw+Bf+Ce+La+Pw+Pj+Pr+He >= 0.7 and (Bf+Ce+Pw+La+Sw+He <= 0.2 or Pj >= 0.3)
NER	SF1	Sp / Bf / Ce	12	Sb+Sw+Bf+Ce+La+Pw+Pj+Pr+He >= 0.7
NER	Po1	Aspen	13	Po+Bw+MH+UH+LH >= 0.7 and Po >= 0.5
NER	Bw1	White Birch	14	Po+Bw+MH+UH+LH >= 0.7
NER	Mw1	Pj / Bw / Po	15	Pj+Pr >= 0.2
NER	Mw2	Sb / Po	16	What's Left
SCR	PW1	Pw-PwQr-US4	1	Pw>=Pr and Pw>=He and Pw>=Sw and Pw>=Pj and Pw>=Qr and (Pw+Pr>=.5 and Stk>=.7 or Pw+Pr+He+Sw+Pj+Qr>=.7)
SCR	PW2	PwUS2	2	Pw>=Pr and Pw>=He and Pw>=Sw and Pw>=Qr and Pw>=Sb and Pw>=Ce and Pw>=Pj and (Pw+Pr>=.3 and Pr+Pw+He+Sw+Qr+Sb+Ce+Pj>=.5 and Stk>=.6 or Pw+Pr+He+Sw+Qr+Sb+Ce+Pj>=.7)
SCR	PR3	Pr Plantations	3	Pr =1 and stk > 0.8 or (Pr >= 0.7 and (stype = 23 or stype = 28)) (modify)
SCR	PR1	PrUS2	4	Pr>Pw and Pr>=Sw and Pr>=Qr and Pr>=Pj and Pr>=Sb and (Pr+Pw>=.3 and Pr+Pw+Sw+Qr+Pj+Sb>=.4 and Stk>=.6 or Pr+Pw+Sw+Qr+Pj+Sb>=.7)
SCR	BY1	By US	5	Yb>=.4
SCR	HE1	He Sel	6	He>=.5
SCR	OR1	Qr-QrPine-US3	7	Qr>=Pw and Qr>=Pr and Qr>=He and Qr>=Sw and Qr>=.3 and Qr+Pw+Pr+He+Sw>=.5
SCR	LH1	Low Hdwd Sel	8	Ce+La+Sb+Ab+Ew>.5 and Ab+Ew+Ms+Yb>Sb+Ce+La+Bf
SCR	CE1	Ce Low	9	Ce+La+Sb+Ab+Ew>.5 and Ce>Sb+La+Bf
SCR	OC1	Other Con Low	10	Ce+La+Sb+Ab+Ew>.5 and Sb+La+Bf>=Ce
SCR	HD1	Tol Hdwd Sel	11	Mh+Ab+Aw+Bd+Be+Ch+Ew+lw+Qr+Yb+Ow+Ob+He>=.5 and Po+Bw+Bf<=.3 and (Sc = 'X' OR Sc = '1' OR Sc = '2') and Age>=80 and Stk>=.6

REGION	FU Name	FU Description	Sort Order	Forest Unit SQL Syntax
SCR	HD2	Tol Hd Fut Sel	12	Mh+Ab+Aw+Bd+Be+Ch+Ew+Iw+Qr+Yb+Ow+Ob+He>=.5 and Po+Bw+Bf<=.3 and (Sc = 'X' OR Sc = '1' OR Sc = '2') and (Age<80 and Stk>=.6 or Age>=80 and Stk<.6)
SCR	HD3	Tol Hdwd US	13	Mh+Ab+Aw+Bd+Be+Ch+Ew+Iw+Qr+Yb+Ow+Ob+He>=.5
SCR	CM1	Con Upld	14	Pw+Pr+Pj+Ps+Sb+Sw+Ce+La+Oc+He+Bf>=.7
SCR	PO1	Poplar 1	15	Po>=.7
SCR	INT	Poplar/Bw	16	Po+Bw+Ms>=.7
SCR	MW1	Mixedwood	17	FU='---'

8.2 Data

The raw data are plotted by forest unit.

8.2.1 PJ1

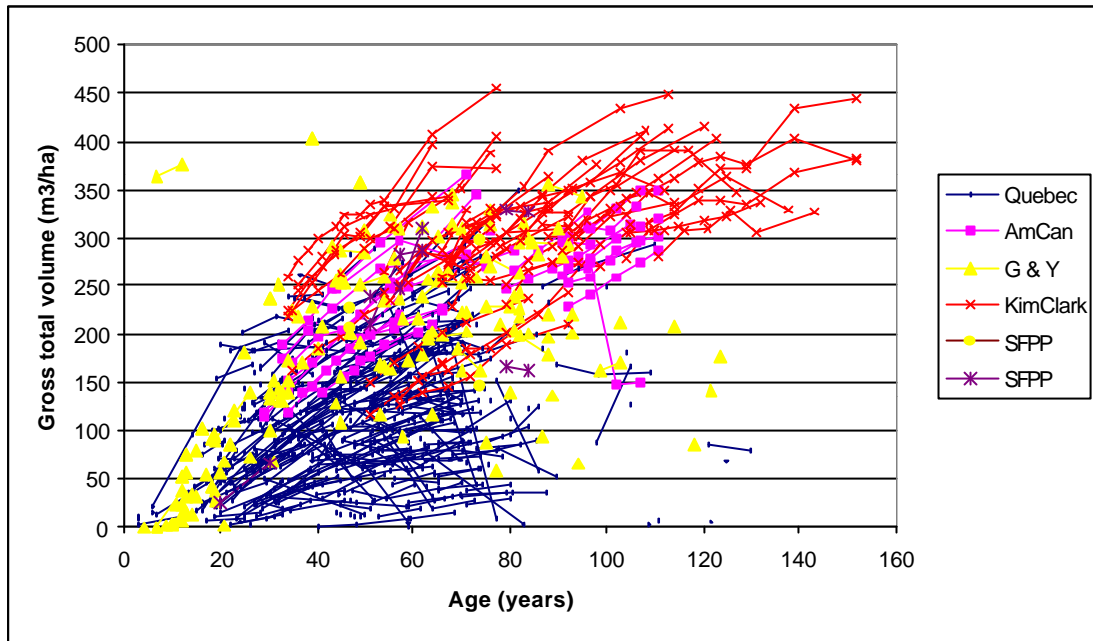


Figure 7. The data for natural stands in the PJ1 forest unit are plotted by data source.

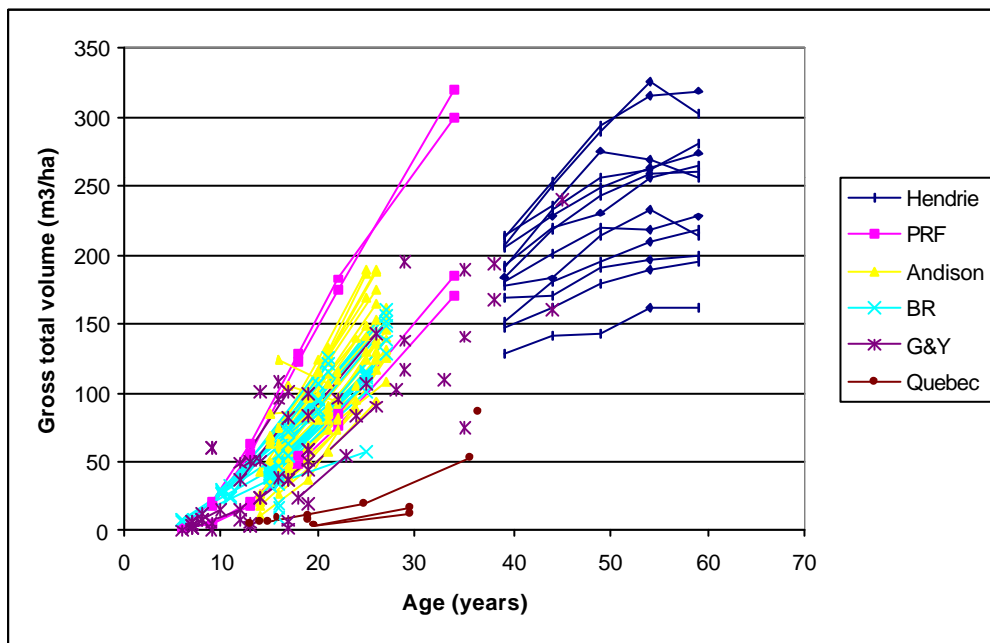


Figure 8. The data for plantations in the PJ1 forest unit are shown by data source. The Hendrie plantation was near Barrie, ON.

8.2.2 SP1

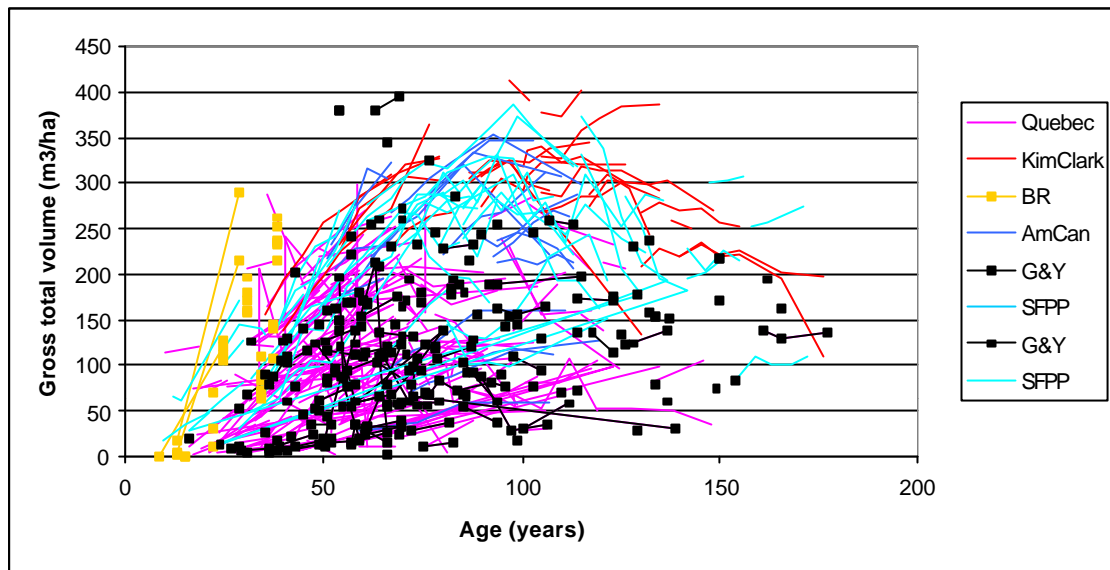


Figure 9. The data for natural-origin plots within the SP1 forest unit are plotted.

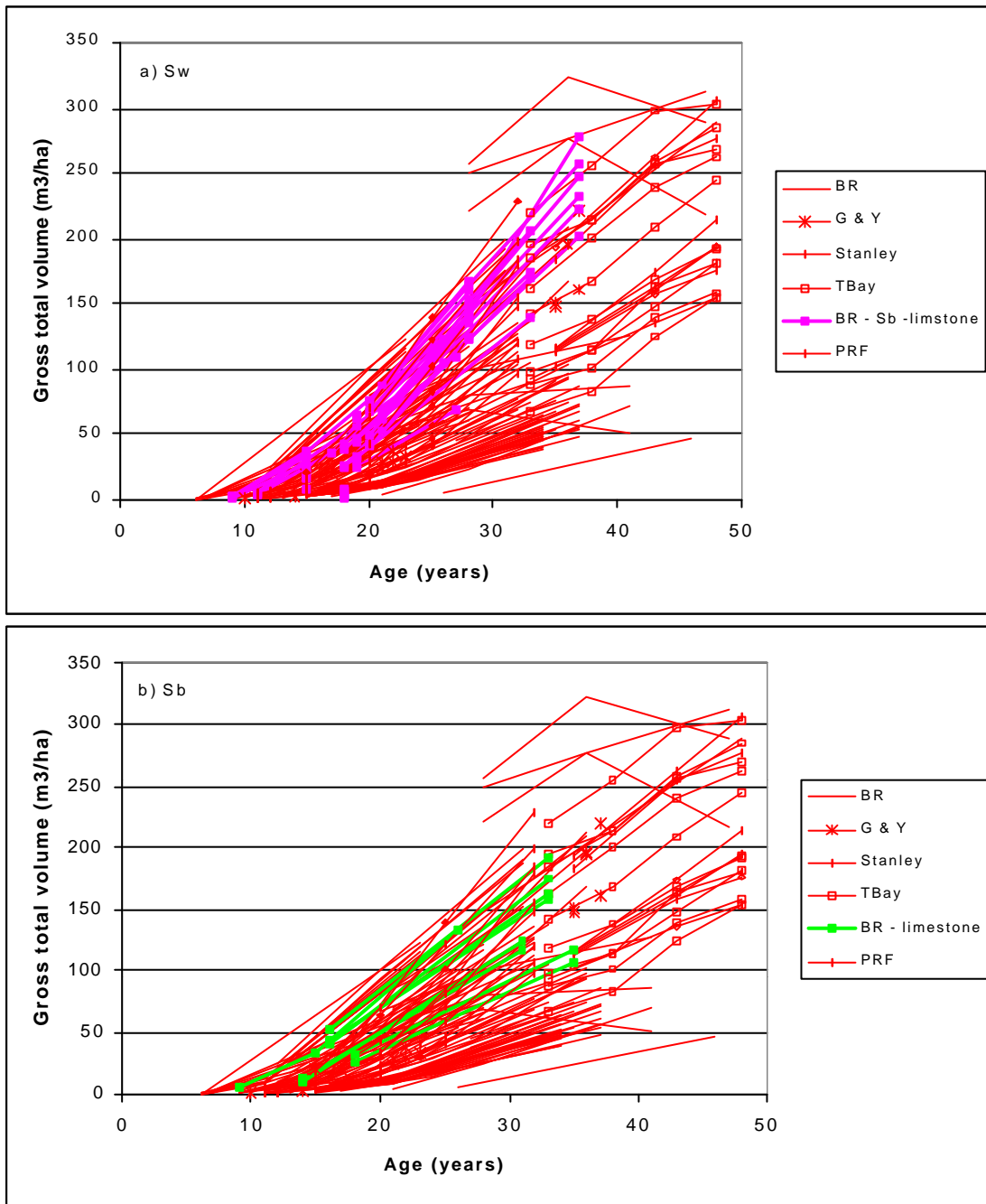


Figure 10. The data for plantation-origin plots within the SP1 forest unit are plotted. White spruce plantations are given in figure a) and black spruce plantations are given in figure b). The limestone plots were removed before any of the analysis.

8.2.3 SB1

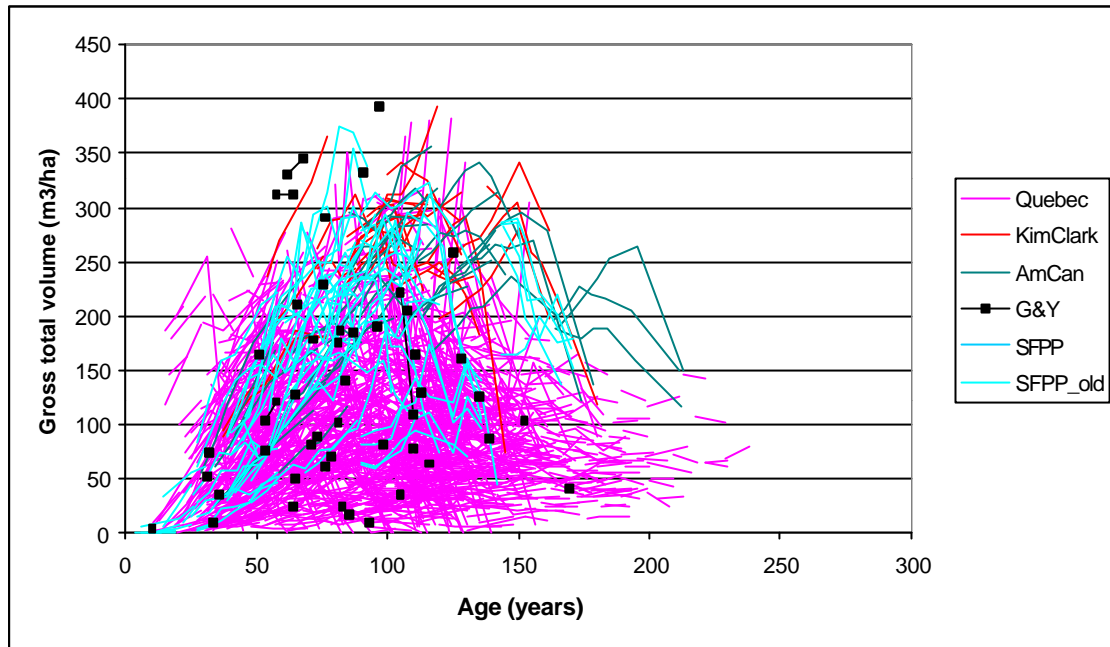


Figure 11. The data for natural-origin plots within the SB1 forest unit are plotted.