TREE BIOMASS EQUATIONS FOR YOUNG PLANTATION-GROWN RED PINE (*PINUS RESINOSA*) IN THE MARITIME LOWLANDS ECOREGION

BY

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Information Report M-X-147

Canadian Forestry Service
Department of the Environment

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1983

Catalogue no. Fo46-19/147E
ISBN 0-662-12855-9
ISSN 0704-769X

Copies of this report may be obtained from

Maritimes Forest Research Centre
Canadian Forestry Service
P.O. Box 4000
Fredericton, N.B. Canada E3B 5P7

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ABSTRACT

Prediction equations were developed for young (1-20 years) plantation-grown red pine (Pinus resinosa Ait.) based on dimensional relations. The estimator varied according to age class and biomass component but dbh^2 was the best overall estimator. Biomass yields (kg/ha) from the plantations sampled tended to be lower than those reported in the literature. Reasons for this are discussed.

RESUME

Des équations de prédiction, basées sur des rapports de dimensions ont été développées pour de jeunes (1-20 ans) pins rouges (Pinus resinosa Ait.) en plantation. Le facteur d'estimation variait selon la classe d'âge et la composante biomasse, mais le dhp^2 fut en définitive le meilleur. La production de biomasse (kg/ha) des plantations échantillonnées avait tendance à être moins élevée que celle rapportée dans la littérature. L'auteur en discute les raisons.

FOREWORD

ENFOR is the acronym for the Canadian Government's ENergy from the FORest (ENergie de la FORêt) program of research and development aimed at securing the knowledge and technical competence to facilitate in the medium to long-term a greatly increased contribution from forest biomass to our nation's primary energy production. This program is part of a much larger federal government initiative to promote the development and use of renewable energy as a means of reducing dependence on petroleum and other non-renewable energy sources.

The Canadian Forestry Service (CFS) administers the ENFOR Biomass Production program component which deals with such forest-oriented subjects as inventory, harvesting technology, silviculture and environmental impacts. (The other component, Biomass Conversion deals with the technology of converting biomass to energy or fuels, and is administered by the Renewable Energy Branch of the Department of Energy, Mines, and Resources.) Most Biomass Production projects, although developed by CFS scientists in the light of ENFOR program objectives, are carried out under contract by forestry consultants and research specialists. Contractors are selected in accordance with science procurement tendering procedures of the Departmnet of Supply and Services. For further information on the ENFOR Biomass Production program, contact....

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This report, on ENFOR project P-158, was produced under contract (DSS File No. 07SC-KL003-0-0008) by the Department of Forest Resources, University of New Brunswick, Fredericton, New Brunswick.

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INTRODUCTION

Estimating net biological production and forecasting tree and stand structure and growth are central activities in silviculture and forest management. An essential step in the process is developing dimensional relations between easily measurable variables such as diameter and the biomass of tree components.

Since the upper limits of resource potential, in terms of productivity, will be realized by intensively managed plantations, it is of interest to determine the dimensional relations of plantation-grown trees where density is controlled and above-ground competition is minimized, at least during the early years. Furthermore, as Crow (1983) has pointed out, plantation data are more likely to yield generalized biomass equations, particularly with a species such as red pine (Pinus resinosa Ait.) that exhibits little genetic variation (Fowler and Lester 1970). Red pine is also considered to have the highest potential biomass production of the generally available plantation species in eastern Canada except for the hybrid poplars (Populus spp.). However, the latter species have stringent cultural requirements because of their lack of ability to compete and high nutrient requirements. Red pine is the highest yielding species in Ontario (Plonski 1974), and along with white spruce (Picea glauca (Moench) Voss) is considered the most productive species in Quebec (Popovich 1978), significantly exceeding jack pine (Pinus banksiana Lamb.) (Bolghari 1976). In a study in Minnesota of biomass and nutrient distribution, Alban et al. (1978) found that red pine out-produced jack pine, white spruce, and aspen (Populus tremuloides Michx., P. grandidentata Michx.) on very fine sandy loams while on northern hardwood sites in Michigan, red pine at 37 years of age produced more dry weight biomass than adjacent second growth sugar maple (Acer saccharum Marsh.) at 58 years of age (Frederick and Coffman 1978).

Dimensional relations may or may not vary over a range of stand conditions. For example, Baskerville (1965) found the allometric relation between component biomass and diameter was unaffected by stand density of naturally regenerated balsam fir (Abies balsamea (L.) Mill.), but in a later study Baskerville (1983) found that the relationship changes systematically with age. On the other hand, Crow (1983) found that the allometric regressions for red maple (Acer rubrum L.) did not differ by age, while Stiell and Berry (1977) determined that spacing of plantation red pine did affect dimensional relations. Uncertainty still exists, therefore, with respect to the sensitivity of dimensional relations to stand conditions.

The purpose of this study was to develop prediction equations for young, plantation-grown, red pine based on dimensional relations expressed by five-year age classes under relatively constant spacing of 2 x 2 m.

SAMPLING METHODS

Considerable difficulty was experienced in locating suitable stands that would meet the objectives of the study. Few of the stands had been tended so that problems with planting stock and planting methods were compounded by uncontrolled competition, girdling by porcupines, and snow damage. This necessitated sampling over a wide geographic area within the Maritime Lowlands Ecoregion (Loucks 1959-60) to obtain sufficient stands over the required age range of 1 to 20 years. The net result was a wide variation in stand density and growth performance both within and between plantations (Table 1).

A total of 18 red pine plantations was sampled over the age range; four in the 1 to 5, five in the 6 to 10, six in the 11 to 15, and three in the 16 to 20

Table 1. Basic statistics and locations of sampled stands

Stand No.*	Density stems/ha	Height (m)		Diameter (cm)		Location
		Mean	Range	Mean	Range	
P-1-62	2725	7.7	3.7-9.3	11.3	3.3-16.4	Barnaby River basin
P-3-66	2450	4.5	1.7-5.8	6.7	1.2-10.5	Barnaby River basin
P-10-78	2425	0.4	0.1-0.6	-	-	Pocologan
P-19-78	2225	0.5	0.3-0.8	-	-	So. Oromocto Lake
P-18-78	2025	0.3	0.1-0.6	-	-	McDougall
P-1-63	2000	7.3	2.4-9.0	10.5	3.7-14.9	Barnaby River
P-3-68	1950	5.0	2.2-5.9	9.1	3.0-13.1	Pisiquit Brook
P-4-74	1800	1.8	0.8-3.0	1.8	0.0-4.0	Big Hole Brook
P-1-74	1775	1.0	0.3-2.0	0.2	0.0-2.5	Beaver Brook East
NS-62	1675	5.4	2.3-7.6	10.5	2.0-16.3	Debert, NS
P-10-69	1575	3.1	1.7-4.9	4.7	2.1-8.1	Brockway
P-1-67	1417	5.0	2.5-6.0	10.0	2.5-14.3	Escuminac
P-8-67	1283	2.7	0.8-4.0	3.4	0.0-8.2	Rogersville
P-8-74	1175	1.0	0.4-1.9	0.4	0.0-2.2	Pisiquit River
P-1-63	998	7.3	2.4-9.0	10.5	3.7-14.9	Barnaby River basin
P-20-78	975	0.5	0.2-0.8	-	-	W. Long Lake
TP-1-71	650	0.8	0.5-1.3	0.1	0.0-1.5	Bartibog
P-4-72	531	1.5	0.7-2.4	1.3	0.0-3.5	Six Mile Brook
P-2-63	425	4.1	1.7-5.4	7.2	2.0-13.0	Allardville basin
TP-1-71	350	1.0	0.7-1.5	0.3	0.0-2.1	Bartibog
P-2-63	35	4.3	1.6-6.3	8.1	3.2-14.0	Allardville basin

*Last two number represent the year of planting.

year age class. One stand in each of the three latter age classes was sampled in two different locations because of obvious differences in stand development.

One or more 0.04-hectare plots were established in each stand to sample 80 or more trees. For each tree the following descriptors were recorded: diameter at breast height (dbh), crown width (cw), crown length (cl), and total height (h). Diameter measurements were taken to the nearest 0.01 cm with hand calipers or diameter tape at 1.3 m above the ground. Crown width was obtained by projection (average of two perpendicular measurements) to the nearest 0.01 m, and crown length by subtracting the height of the base of the crown from total height.

Five trees were selected from across the diameter range in each plot, felled at ground level, and the following measurements were taken: total height to the nearest 0.01 m, diameter at breast height to the nearest 0.01 cm, and crown width and crown length to the nearest 0.01 m. At the field station trees were divided into four components (stem wood, stem bark, branches, and needles), bagged, tagged, and returned to the laboratory for kiln drying.

Before drying, the stem was sectioned at 0, 0.2, 0.5, 0.9, 1.3 m and at every metre above this point to count the rings and determine height-age relationships. The dbh (1.3 m) disc was retained for further analysis of diameter growth.

Samples were placed in paper bags and dried in a kiln to equilibrium moisture content based on previously developed weight-loss curves. Branchwood, bark, and needles were dried at 95°C for 40 h and stemwood at 105°C for 60 h. Biomass was weighed on a 15 kg capacity electronic balance to the nearest 0.1 g.

DATA ANALYSIS

It has long been known that there is a linear relationship between volume and basal area for several conifer species (Hummel 1955), and since biomass is directly related to volume through density, and basal area is a function of the square of the diameter, there should exist a linear relationship between biomass and the square of the diameter. A few investigators have developed linear prediction equations based on this relationship (Smith 1972; Smith 1977; Zavitkovski and Stevens 1972; Krumlik and Kimmins 1973; Krumlik 1974; Kurucz 1969; Hakkila 1971) demonstrating its efficacy.

However, the vast majority of biomass prediction equations developed over the past two decades have involved logarithmic transformations of both simple and multiple regression equations (e.g., Stanek and State 1978), to linearize the allometric relation between an independent variable (usually diameter) and the biomass.

While these logarithmic transformations allow the use of standard least-squares regression techniques, avoid the more complex solutions associated with curvilinear relationships, and can homogenize the variance over the sample data, they have a number of disadvantages that tend to outweigh the advantages. These disadvantages include biased estimated, non-additivity due to variation in the exponent of different biomass components, assumptions of a multiplicative error term, difficulties in evaluating or comparing measures of goodness of fit such as the coefficient of determination and the standard error of estimate with those from untransformed models, and miscalculation of the correction factor (Alemdag 1981; Baskerville 1972; Draper and Smith 1966; Kozak 1970; Munro 1974; Payendeh 1981; Sprugel 1983; Whittaker and Marks 1975).

Given these problems, the essentially linear relationship between basal area and biomass, and the recommendation of Evert and Alemdag (1979) that equations be based on the squares and cross products of independent variables such as diameter and height, scatter diagrams were plotted of total biomass over several simple, squared, and combination independent variables. The variables were dbh, h, cw, and cl.

As expected, those on a single variable were curvilinear (Fig. 1), diameter breast height outside bark (dbhob), h, and cl being exponentional, and cw being of the power form to express the relatively early and sudden reduction in crown width measurement. The squared and combined variables (dbh^2, h^2 dbh.h, $dbh^2.h$, cw^2, $cw^2.cl$, cw.cl) yielded linear relationships (Figs. 2 and 3). It was therefore decided to use the general model:

$$Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3$$

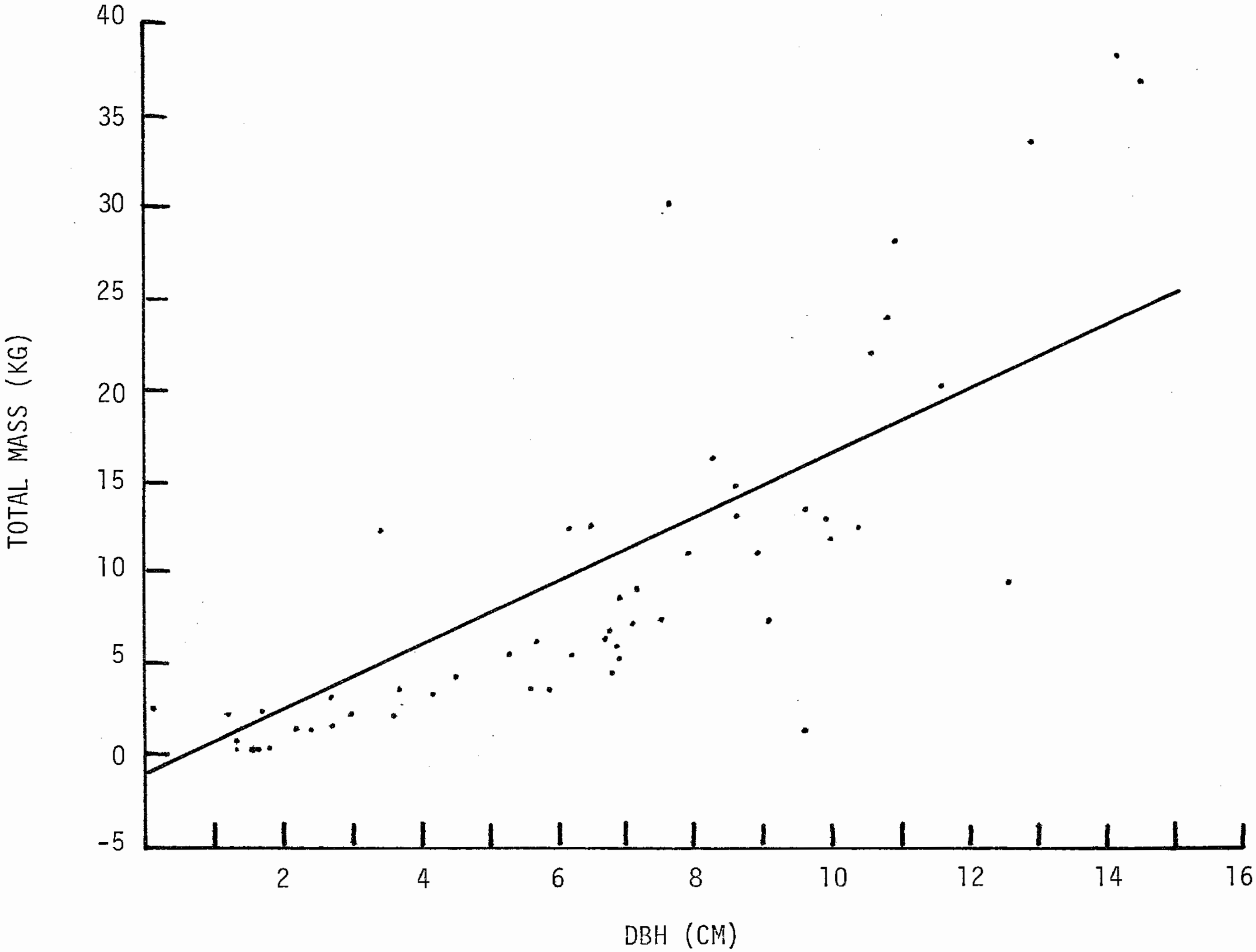

FIG. 1. Total above ground biomass of 1 to 20 year old plantation-grown red pine over the diameter at breast height.

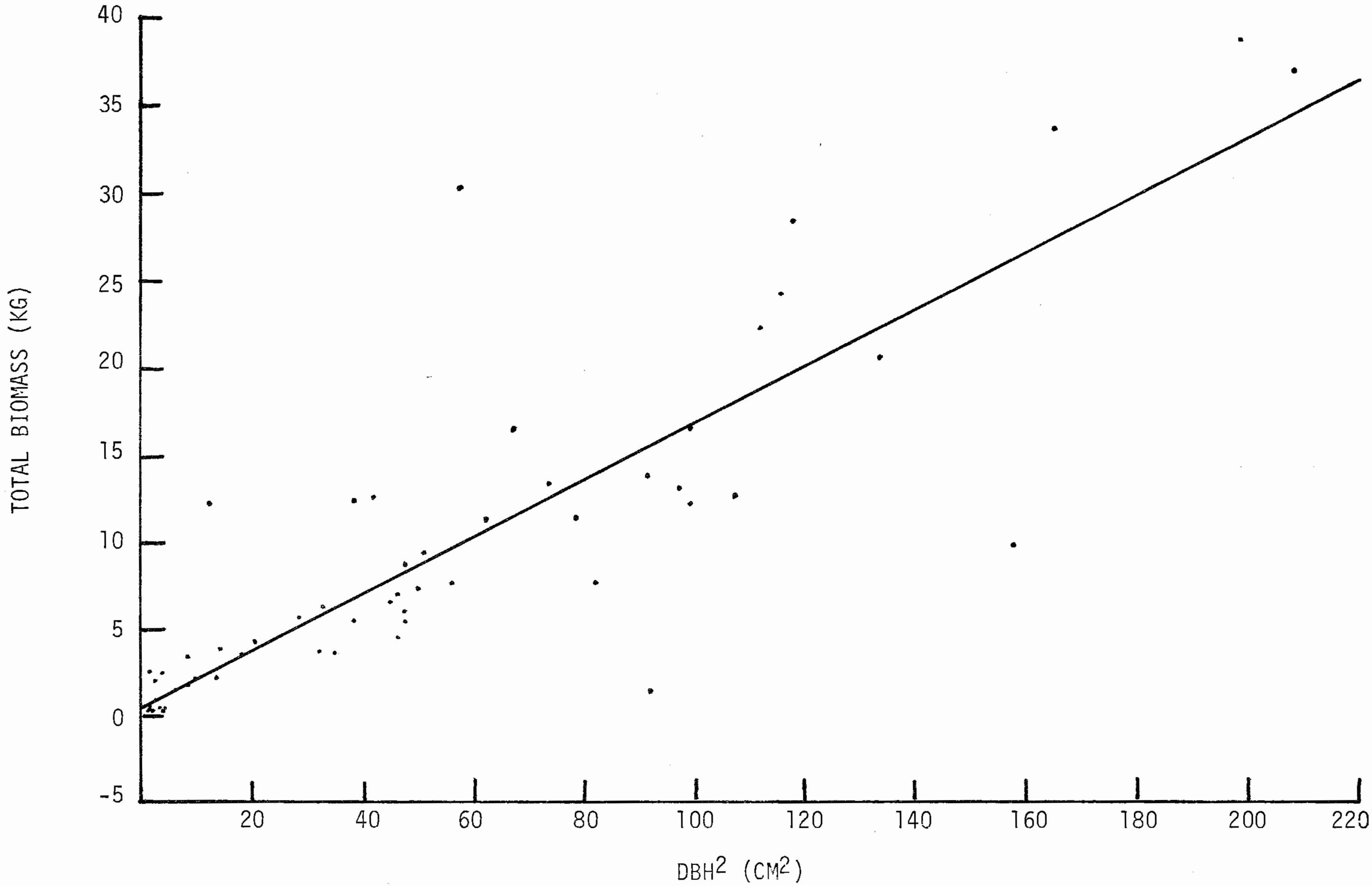

FIG. 2. Total above-ground biomass of 1 to 20 year old plantation-grown red pine over the diameter at breast height squared.

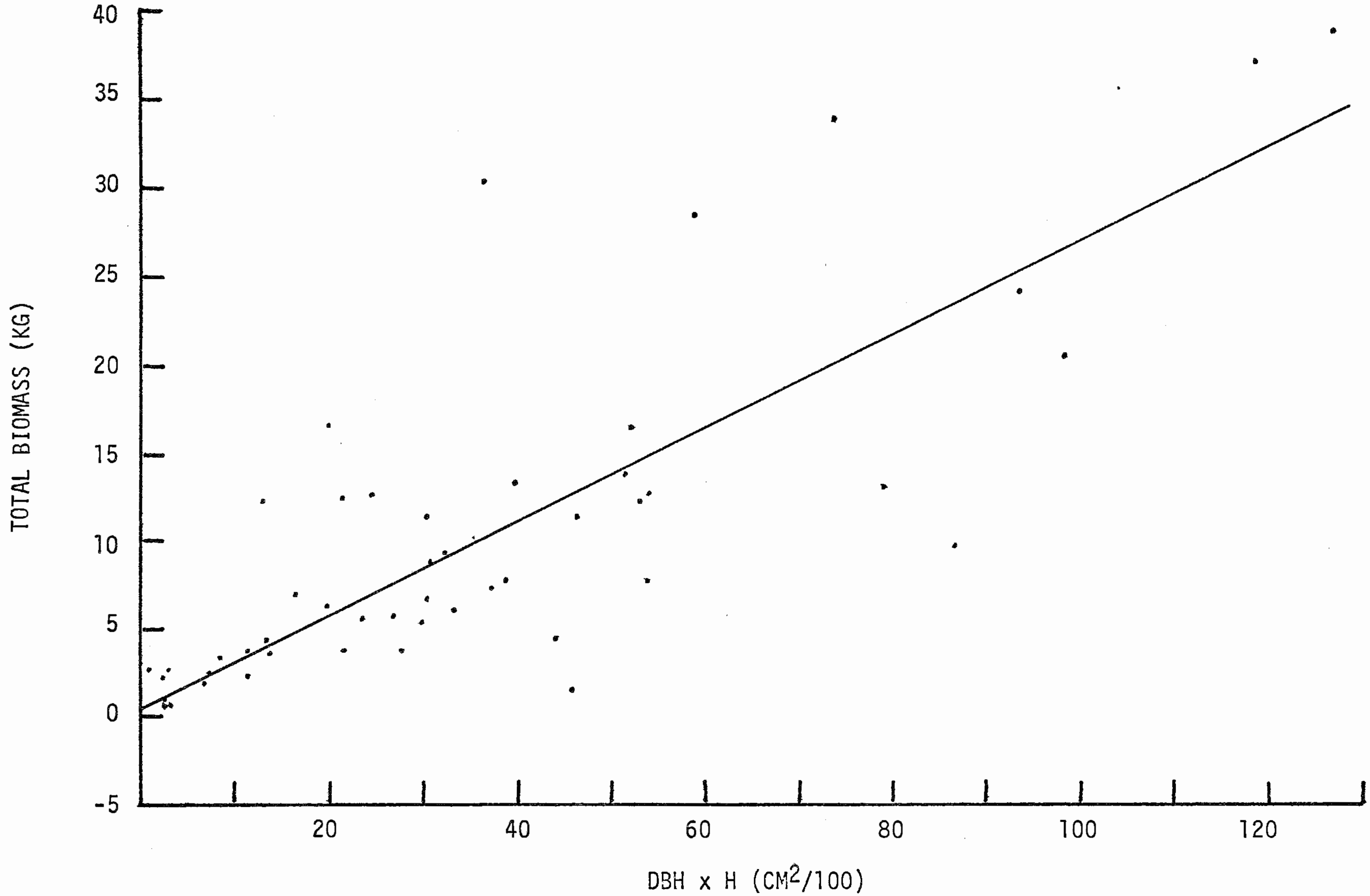

FIG. 3. Total above-ground biomass of 1 to 20 year old plantation-grown over diameter at breast height times total height.

where Y is the ovendry weight of one of the five biomass components and x_1 represents the independent variables or estimators in either squared or combination form. To decide on the estimators, the data were subjected to stepwise multiple regression until 95% of the variation had been accounted for.

Regression equations were developed separately for the age classes 1-5, 6-10, 11-15, and 16-20 years to determine the effect of age on dimensional relations. However, only the latter two classes, which had common independent variables or estimators, were subjected to covariance analysis.

RESULTS

The best estimator varied according to age class and biomass component, (Tables 2-6), but where dbh was always present (age classes 11-15, 16-20), dbh^2 was the best overall estimator. This agrees with other studies (e.g., Crow 1978; Green and Grigal 1978; Payendeh 1981) that biomass is primarily a function of dbh.

In the 1 to 5 year age class, all trees were below 1.3 m, and the best two estimators were cw^2 and $cw^2.cl$. In the 6 to 10 year age class, many trees were also below 1.3 m, and the best overall estimators were cl and h^2. In the 11 to 15 year age class, dbh^2 was the best estimator followed by $dbh^2.h$, while in the 16 to 20 age class, the position of these two estimators was reversed (Tables 2-5). The analysis of covariance between the two oldest age classes, using $dbh^2.h$ as the estimator, yielded mixed results among the various biomass components. There was no significant difference at the 0.05 probability level between the intercepts for all biomass component equations, and the slopes for the stem and bark equations. The slopes were significantly different for foliage, branch, and full tree equations. Therefore, the equations should not be combined for all components. However, given the improved $\underline{r}^2$s, and the desirability of a full set of equations, the data were combined (Tables 6 and 7). Table 7 presents the regression information for age classes 11-15, 16-20, and 1-20 using $dbh^2.h$ as the estimator. This is for three reasons: (1) to provide a common estimator for all components so as to realize the objective of additivity, (2) because regional inventories need two-way or standard equations giving mass by dbh and h, and (3) for forecasting growth, since growth in height is a vital part of overall growth (Alemdag 1981).

Table 8 shows the mean and range of biomass values for each component for the trees sampled, and the percent contribution of each biomass component to the full tree biomass. The values are derived from the combined age class equations based on $dbh^2.h$. The crowns composed half the biomass of the mean and maximum diameter trees and 70% of the biomass of the smallest trees.

The best estimators for each age class were applied to the stand table to develop a biomass stock table (Table 9), in which the actual biomass values in kilograms per hectare are shown for the stands sampled. Considerable variation was found with values ranging from 22 to 72 kg/ha for age class 1-5, 121 to 1 826 kg/ha for age class 6-10, 434 to 29 469 kg/ha for age class 11-15, and 19 710 to 61 786 kg/ha for age class 16-20.

DISCUSSION

In most cases, the data were derived from untended plantations where survival was often low, and growth poor due to one or more of the factors listed by Hughes (1978), such as competition from other vegetation, snow damage, species planted 'off-site', root-collar weevil (Hylobius radicis Buch.), and particularly root deformation resulting from faulty planting. This latter problem results in low vigor, and appears to increase the potential for snow damage,

Table 2. Prediction equations for ovendry biomass in grams for age class 1-5 using the two best estimators

$Y = b_0 + b_1 x$; Age class 1-5 (n = 20)

Biomass component (X)	Estimator (X)	Coefficient of determination r^2	Standard error % 100(Sy.x/y)	Intercept (b_0)	Regression coefficient (b_1)
Stem wood	(1) $cw^2 \cdot cl$	0.6422	48.1	0.363	303.381
	(2) cw^2	0.6171	49.1	-0.972	124.329
Stem bark	(1) $cw^2 \cdot cl$	0.6469	46.4	0.083	52.037
	(2) cw^2	0.6224	48.0	-0.146	21.342
Branches	(1) $cw \cdot cl$	0.6330	49.0	-0.224	181.581
	(2) cw^2	0.6088	50.6	-0.577	74.461
Foliage	(1) cw^2	0.6482	50.2	-3.196	302.014
	(2) $cw \cdot cl^2$	0.6250	51.8	0.450	709.281
Full tree	(1) cw^2	0.6485	48.5	-4.890	522.143
	(2) $cw^2 \cdot cl$	0.6459	48.7	1.120	1246.231

Table 3. Prediction equations for ovendry biomass in grams for age class 6-10 using the two best estimators

$Y = b_0 + b_1 x$; Age class 6-10 (n = 25)

Biomass component (X)	Estimator (X)	Coefficient of determination r^2	Standard error % 100(Sy.x/y)	Intercept (b_0)	Regression coefficient (b_1)
Stem wood	(1) cl	0.2916	106.17	-167.927	316.185
	(2) h^2	0.2716	107.65	-187.059	294.916
Stem bark	(1) h^2	0.5054	64.93	-0.270	33.988
	(2) cl	0.4918	65.80	-48.168	96.401
Branches	(1) $(dbh)^2$	0.4692	87.82	70.756	58.895
	(2) $(dbh)^2(h)$	0.4454	89.77	83.891	28.069
Foliage	(1) h^2	0.2786	88.33	52.940	153.507
	(2) cl	0.2721	88.73	-164.191	436.097
Full tree	(1) cl	0.3851	81.37	-572.249	1153.173
	(2) h^2	0.3736	82.13	21.604	395.055

Table 4. Prediction equations for ovendry biomass in grams for age class 11-15 using the two best estimators

$Y = b_0 + b_1x$; Age class 11-15 (n = 29)

Biomass component (X)	Estimator (X)	Coefficient of determination r^2	Standard error % 100(Sy.x/y)	Intercept (b_0)	Regression coefficient (b_1)
Stem wood	(1) $(dbh)^2h$	0.7510	44.94	540.693	11.052
	(2) $(dbh)^2$	0.7481	45.21	-187.478	63.477
Stem bark	(1) $(dbh)^2$	0.7262	36.14	141.077	10.570
	(2) dbh	0.7049	37.53	-289.481	146.476
Branches	(1) $(dbh)^2$	0.5974	62.85	-103.515	50.089
	(2) $(dbh)^2h$	0.5835	63.93	499.808	8.602
Foliage	(1) $(dbh)^2$	0.5961	49.26	556.644	45.390
	(2) $(dbh)^2h$	0.5373	52.73	1177.259	7.488
Full tree	(1) $(dbh)^2$	0.6864	47.5	410.603	166.548
	(2) $(dbh)^2h$	0.6680	48.9	2428.997	28.550

Table 5. Prediction equations for ovendry biomass in grams for age class 16-20 using the two best estimators

$Y = b_0 + b_1x$; Age class 16-20 (n = 15)

Biomass component (X)	Estimator (X)	Coefficient of determination r^2	Standard error % 100(Sy.x/y)	Intercept (b_0)	Regression coefficient (b_1)
Stem wood	(1) $(dbh)^2h$	0.6400	47.47	1937.083	8.493
	(2) (dbh)h	0.5532	52.88	-203.393	124.798
Stem bark	(1) $(dbh)^2h$	0.7693	31.82	417.080	1.351
	(2) (dbh)h	0.7331	34.22	14.080	20.846
Branches	(1) $(dbh)^2$	0.4658	53.29	972.492	31.500
	(2) $(dbh)^2h$	0.4529	54.21	1628.598	3.368
Foliage	(1) $(dbh)^2$	0.4489	48.94	1190.496	24.753
	(2) dbh	0.4335	49.62	-618.744	450.702
Full tree	(1) $(dbh)^2h$	0.5633	47.12	6080.582	15.480
	(2) $(dbh)^2$	0.5282	48.98	3746.969	137.443

Table 6. Prediction equations for ovendry biomass in grams for age class 1-20 using the two best estimators

$Y = b_0 + b_1 x$; Age class 1-20 (n = 89)

Biomass component (X)	Estimator (X)	Coefficient of determination r^2	Standard error % 100(Sy.x/y)	Intercept (b_0)	Regression coefficient (b_1)
Stem wood	(1) $(dbh)^2h$	0.8163	71.31	424.958	10.188
	(2) (dbh)h	0.7868	76.80	-106.081	122.146
Stem bark	(1) (dbh)h	0.8606	52.21	38.371	21.179
	(2) $(dbh)^2$	0.8512	53.97	51.440	12.533
Branches	(1) $(dbh)^2$	0.7210	81.49	147.671	41.597
	(2) dbh	0.6693	88.62	-273.865	456.888
Foliage	(1) dbh	0.7123	70.78	-64.696	433.003
	(2) $(dbh)^2$	0.6997	72.33	393.687	37.664
Full tree	(1) $(dbh)^2$	0.7912	67.45	564.353	163.139
	(2) (dbh)h	0.7439	74.70	595.668	265.815

root-collar weevil infestation, and even Armillaria root rot (Armillaria mellea (Vahl) Quel.) infection.

Not only do the above problems result in mortality, but surviving seedlings are often deformed and small, and therefore may be dimensionally "abnormal" or different from that expected from tended plantations. Furthermore, spacing also affects dimension relationships (Stiell and Berry 1977), and given the differences in mortality, and thus spacing, both within and between plantations, great variations can be expected in the dimensional relations of randomly sampled trees. Thus coefficients of determination were generally lower and standard error of estimates were higher than is often encountered in the literature (e.g., Alemdag 1981; Ker 1980).

The highest yielding plantation carried about 62 tonnes per hectare (Table 9) of total biomass which equates to only 30 tonnes of stem wood. According to Plonski (1974) and Berry (1977), a 20-year-old plantation on a site index of 21 m (at age 50) and spaced at 2.0 - 2.5 m, should yield about 115 m^3 of stem wood which, at 480 kg/m^3, is 55 tonnes or well in excess of that found. On two sites in Michigan, both of site index of 24 m (at age 50) red pine stands yielded in excess of 100 tonnes per hectare of bole biomass at 25 years (Frederick and Coffman 1978; Hannah 1969). This is further evidence that the stands measured in this study were undermanaged and yielding well below potential.

As an indication of the variation possible from prediction equations developed in different studies, those developed here were compared to those of Ker (1980). A sample of trees was taken from a height-diameter relation presented by Stiell and Berry (1977) for 20-year old red pine planted at 2.4 m. A comparison of sample means for paired observations demonstrated a highly significant difference (0.001) for foliage, stem wood, and full tree biomass and a significant difference (0.02) for branch biomass. Ker's equations gave consistently higher values for stem wood and full tree ($\bar{d}$ = +9.5 and +3.8 kg, respectively) and lower values for branches

Table 7. Common prediction equations for age classes 11-15, 16-20 and 1-20 based on the model $W = b_0 + b_1\ dbh^2.h$ where W is ovendry biomass in grams

Regression statistics	Stem wood	Stem bark	Branches	Foliage	Full tree
Age class 11-15 (n = 29)					
Intercept (b_0)	540.693	286.364	499.808	1177.259	2428.997
Regression coefficient (b_1)	11.052	1.740	8.602	7.488	28.550
Coefficient of determination r^2	0.7510	0.6521	0.5835	0.5373	0.6680
Standard error of estimate (SEE%)	44.9	40.8	63.9	52.7	48.9
Age class 16-20 (n = 15)					
Intercept (b_0)	1937.083	417.080	1628.598	1791.014	6080.582
Regression coefficient (b_1)	8.493	1.351	3.368	2.520	15.480
Coefficient of determination r^2	0.6400	0.7693	0.4529	0.3913	0.5633
Standard error of estimate (SEE%)	47.5	31.8	54.2	51.4	47.1
Age class 1-20 (n = 89)					
Intercept (b_0)	424.958	142.672	521.411	784.761	1857.606
Regression coefficient (b_1)	10.188	1.703	5.284	4.511	21.619
Coefficient of determination r^2	0.8163	0.8299	0.6143	0.5301	0.7338
Standard error of estimate (SEE%)	71.3	57.7	95.8	90.5	76.2

Biomass component: Stem wood, Stem bark, Branches, Foliage, Full tree.

Table 8. Ovendry weights and percent contributions of biomass components for the minimum, maximum and mean dbh trees measured. Values based on the prediction equation for all age classes: $W = b_0 + b_1\ dbh^2 .h$

	Ovendry weight					
	Minimum		Mean		Maximum	
Component	kg	%	kg	%	kg	%
Stem wood	0.43	23	3.31	41	23.85	46
Stem bark	0.14	7	0.62	8	4.06	8
Branches	0.52	28	2.02	25	12.67	24
Foliage	0.78	42	2.06	26	11.16	22
Full tree	1.86	100	7.97	100	51.56	100

dbh: Maximum 16.35 cm; Minimum 0.4 cm; Mean 7.63 cm.

h: Maximum 8.60 m; Minimum 1.5 m; Mean 4.86 m.

and foliage ($\bar{d}$= -1.1 and -3.0 kg, respectively). These differences are probably a consequence of the range of tree sizes used in developing the equations. In this study, the diameters ranged from 0.40 to 16.35 cm with the ratio of stem to crown being 50:50, while those from Ker's study ranged from 2.3 to 34.3 cm with the ratio of stem to crown begin 75:25.

Biomass prediction equations, therefore, should not be derived from or applied to a range of tree sizes in which component proportions change radically.

Finally, it must be emphasized that the prediction equations developed here are derived from young (1-20 years), untended plantations, some with high mortality and varied spacing, and thus may not be applicable to intensively managed plantations. However, they do reflect the current reality.

ACKNOWLEDGEMENTS

I gratefully acknowledge the cooperation of the Mr. R. Speers, New Brunswick Department of Natural Resources, for allowing access to their plantation record, and the contribution of Mr. A. Wood of the Faculty of Forestry, U.N.B., who did the computer programming associated with the data analyses.

Table 9. Biomass stock table in kilograms per hectare for stands sampled, based on stand table and best estimator for each age class

Age Class (years)	Stand No.	Plot No.	Diameter Class (cm) 0	2	4	6	8	10	12	14	16	Total
1-5	2078	1	36	0	0	0	0	0	0	0	0	37
	1978	1	71	0	0	0	0	0	0	0	0	72
	1878	1	21	0	0	0	0	0	0	0	0	22
	1078	1	29	0	0	0	0	0	0	0	0	30
6-10	P472	1	101	404	23	0	0	0	0	0	0	530
	P474	1	60	1397	368	0	0	0	0	0	0	1826
	P174	1	389	247	0	0	0	0	0	0	0	637
	T171	2	121	15	0	0	0	0	0	0	0	137
	T171	1	60	59	0	0	0	0	0	0	0	121
	P874	1	218	256	0	0	0	0	0	0	0	475
11-15	P366	1	0	169	1525	5975	8657	4370	0	0	0	20698
	P867	1	13	708	1318	1431	191	0	0	0	0	3664
	P167	1	0	24	55	1179	2272	7021	10663	4681	0	25898
	P263	1	0	0	19	46	147	79	38	103	0	434
	P263	2	0	59	138	464	1985	478	1323	0	0	4450
	P368	1	0	47	459	1297	5215	13450	8273	724	0	29469
	1069	1	0	512	2028	3921	515	0	0	0	0	6979
16-20	P163	2	0	309	734	1213	4193	8179	16241	6989	1885	39748
	P163	1	0	0	274	710	2420	3806	6197	6301	0	19710
	P162	1	0	0	574	1865	3039	10345	22505	17428	6027	61786
	NS	1	0	0	574	1865	3039	10345	22505	17428	6027	28336

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