Yield Prediction Table and Estimation of Site-Class by Site-Class Indicators on *Acacia mangium* in SAFODA Plantation.

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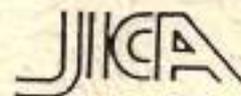Forestry and Forest Products Research Institute, Hokkaido Japan)

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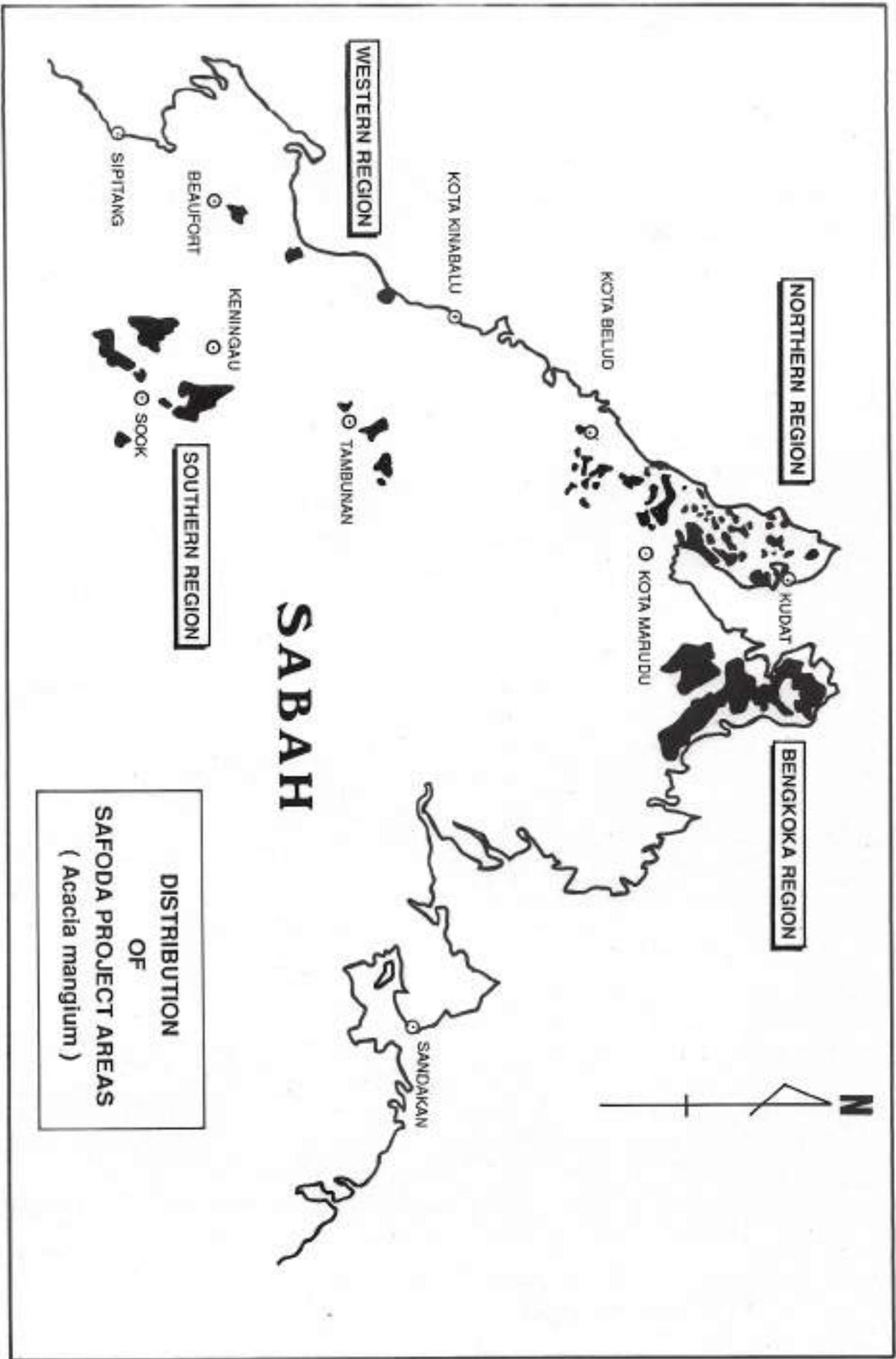17th Dec., 1991.

SAFODA
Sabah Forestry Development
Authority

JICA
Japan International Cooperation
Agency

**Sabah Re-Afforestation Technical Development
And Training Project**

Contents

DISTRIBUTION
OF
SAFODA PROJECT AREAS
(Acacia mangium)

SABAH

WESTERN REGION

NORTHERN REGION

SOUTHERN REGION

BENGKOKA REGION

SIPITANG

BEAUFORT

KENINGAU

SOOK

TAMBUNAN

KOTA KINABALU

KOTA BELUD

KOTA MARUDU

KUDAT

SANDAKAN

N
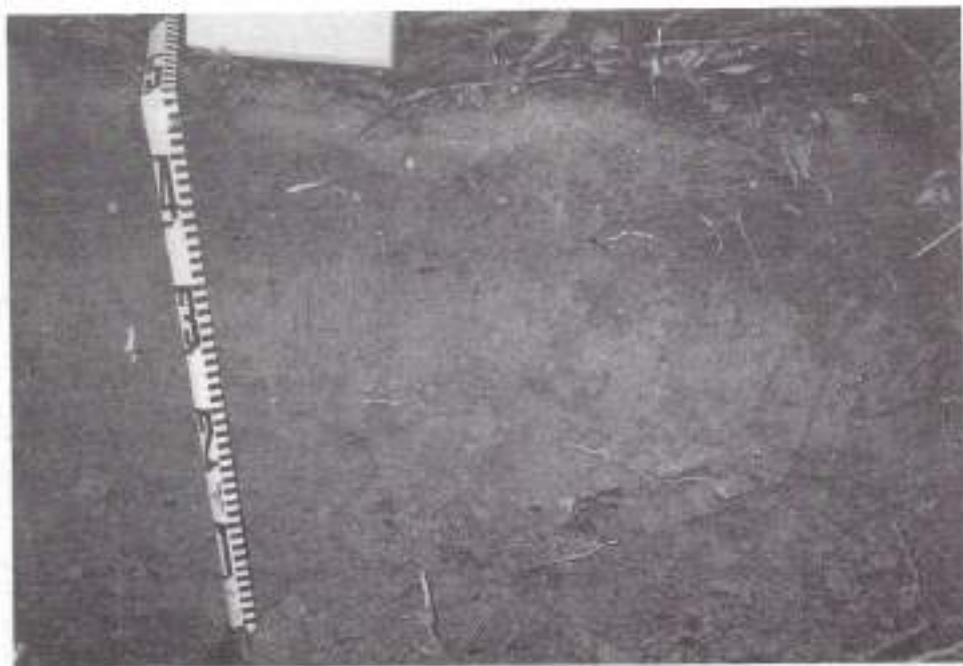
PLOT No. 56   ULU KUKUT   AGE 8.0
                            DOMINANT TREE HEIGHT 26.7 m
                            SITE CLASS 1
                            SOIL TYPE RAB (Dystric Cambisol)
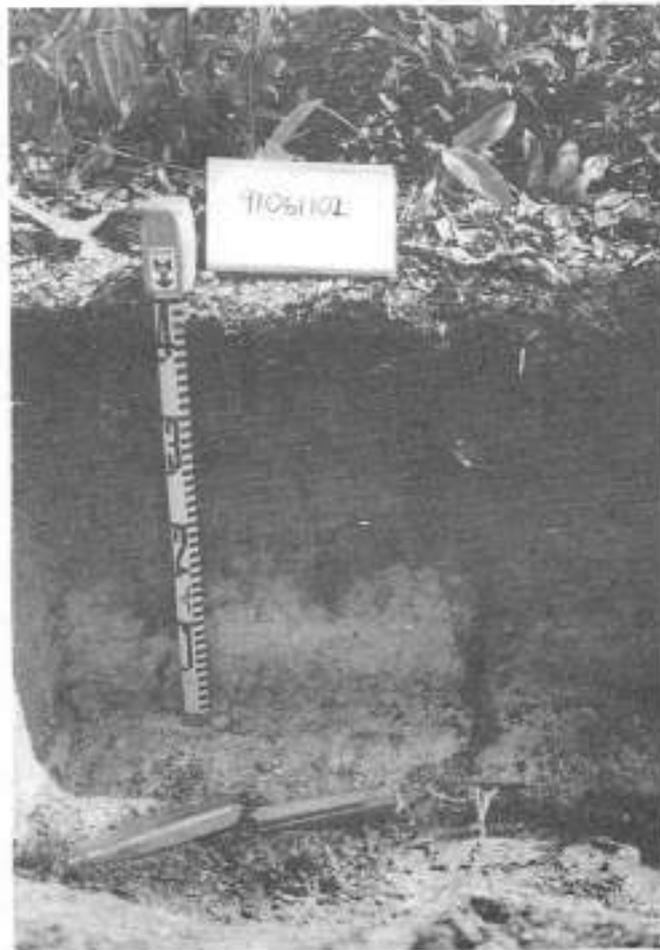
PLOT No. 9   MALIMA B80   AGE 10.3
                              DOMINANT TREE HEIGHT 21.9 m
                              SITE CLASS 2
                              SOIL TYPE   KMT (Humic Podozol)

1. Introduction.

In Sabah State of Malaysia, *Acacia mangium* has been planted by SAFODA (Sabah Forestry Development Authority) to convert wasteland and marginal agricultural land to productive forestry use. Mainly it will be expected for pulp wood in the future.

Forest plantations have become increasingly important due to the need in providing alternative wood materials to the growing timber markets as supply from the natural resources was envisaged to decline. But at present there are few old forest plantation over 15 years old. Mostly, forest plantation on *Acacia mangium* are consisting of young aged forest.

Therefore, it is very important for the plantation management to predict the yield as the basic information for forest planning. The yield prediction table is one of the useful information to estimate future resources, and to decide the adequate management target, the rotation age in plantation, the suitable tending formation etc.

In this report, the site index curve and yield prediction table were analyzed by using the Permanent Sample Plot (P.S.P) and Tentative Sample Plot (T.S.P) data. Furthermore, the Candidate Items as Site-Class indicator were analyzed by using the Quantification Method I.

We are sure that, these results are enough for actual use and that it can be used for the plantation management on *Acacia mangium* efficiently.

2. Methods and Materials.

The List of the data was shown on Table 1. It consisted of 32 P.S.P. plots (243 periodical data) collected by SAFODA Research Section and 83 T.S.P. data collected by SAFODA-JICA Kinarut Project. Especially P.S.P. data were very important materials. To estimate the site-class indicators, 89 sampling survey plots data were selected.

Analyzing methods are shown as follows:-

The Mitscherlich equation was adopted for the site index curve. The relationship between age, mean diameter at breast height, mean top height, mean piece volume, volume per hectare and basal area per hectare were analyzed by statistical method. By these results, we decided the most suitable path, which contained minimum error and made it possible to predict the yield easily. The Quantification method I was applied to estimate the site class indicator such as soil profile, floor vegetation, terrain and other related items.

3. Results and discussion.

3.1 Site Index Curve.

There are many forest stand parameters to estimate the site index such as stand volume, basal area, mean diameter, mean tree height. Among all these parameters the dominant tree

height (top tree height) is the most suitable to estimate the site index. Other parameters are affected by the stand density and the tending method carried out, whereas dominant tree height is independent from these factors.

Dominant tree height is a better index of site compared to parameters such as the mean height. For this main reason we adopted dominant tree height as a site index. Dominant tree height is defined as an average height of 100 highest trees per hectare.

3.1.1 Materials.

To estimate the guide curve of site index and standard deviation curve, 243 PSP data were used.

To see the tendencies of top tree height growth, the relationship between stand age and the top tree height were shown on Fig. 1, (a), (b), (c), (d).

In Fig. 1, we could find that top tree heights of several data become smaller in older age. As these tendencies were not normal, we rejected these data (16 numbers of data), and finally 227 numbers of data were selected.

3.1.2 Guide Curve and Standard Deviation Curve.

By using the above mentioned data, the relationship between stand age and top tree height (DTH) was plotted as shown in Fig. 2(a).

To estimate the growth curve, some non-linear models were reported. In this report, Mitscherlich curve (M), Gompertz curve (G) and Chapman Richards curve (C) were applied as growth curve. The equations of these non-linear models were as follows.

$$M : \quad DTH(A) = 31.0291 [1 - 1.009 \, Exp(-0.1642A)] \quad \text{————————} \quad (1)$$

$$G : \quad Log \, DTH(A) = 1.4286 [1 - 0.6865 \, Exp(-0.3273A)] \quad \text{————————} \quad (2)$$

$$C : \quad DTH(A) = 31.3648 [1 - Exp(-0.1582A)]^{0.9802} \quad \text{————————} \quad (3)$$

A : age, DTH(A) : top tree height at age A.

We found that Mitscherlich Curve had the least sum of residuals. So, in this report, Mitscherlich Curve was selected as the growth curve of Acacia mangium.

The standard deviation curve for each year was shown in Fig. 2(b).

As the same method in case of growth curve, Mitscherlich Curve was applied as standard deviation curve (SD).

The equation was as follows:-

$$SD(A) = 3.0645 [1 - 2.2595 \, Exp(-1.301A)] \quad \text{————————————} \quad (4)$$

3.1.3   Site Index Curve and Site Class.

In this report, site index was defined as the top tree height at the base age. The rotation age is often used as the base age. *Acacia mangium* plantations are supposed to be rotated around 8 years in Sabah. Therefore, 8 years was adopted as the base age.

DTH at each site index and age was estimated by the following equation (5).

$$DTH(A) = f1(A) + \frac{f2(A)}{f2(8)} [SI - f1(8)] \quad\text{------------------------------------}\quad (5)$$

f1(A)	:	equation (1) at age A
f2(A)	:	equation (4) at age A
8	:	base age
SI	:	site index

DTH at each site index and age estimated by equation (5) were shown in Fig. 3 and Table 2. Ranges of SI and Age were from 17 to 29 and from year 1 to year 15 respectively.

The site index distribution of collected data was already shown in Fig. 2(a) and Fig. 3. As the site index were distributed from 17 to 29, we divided it into three parts of site classes as follows:-

Site I	: above 25
Site II	: 21 - 24.9
Site III	: below 20.9

Therefore, the center curves of site index of Site I, Site II, Site III were 27, 23, and 19 respectively.

The ranges of centre curve of site classes were shown in Fig. 4.

3.2   Yield Prediction Table.

The Yield Prediction Table in this study corresponds to the simplified Yield Table and it is useful for the following purposes:-

(1)   Estimation of stand volume.
(2)   Estimation of stand volume increment.
(3)   Estimation of site class.
(4)   Yield Prediction etc.

Therefore, it is very important for the plantation management to predict the yield as the basic information for forest planning.

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3.2.1 Classification of data into site class.

P.S.P and T.S.P data were classified according to the above mentioned method (refer to the paragraph 1) using stand age near 8 years and measured dominant tree height at the same age.

But in case of P.S.P data, some data in the same plot did not belong to the sme site class. So, we decided the site classes of these plots depending on the data near 8 years. Consequently, the data which did not belong to the decided site class were omitted. Finally, 252 data were selected, excluding the abnormal data rejected by the following analysis.

3.2.2 Analysis of the Yield Prediction Table Items.

Yield prediction table is a table which describes the expected volume per hectare in each age class. The table normally consists of additional items such as mean D.B.H., mean height, stand density, basal area, etc. There are also several paths for estimation of these items. In this report, fifteen relations were examined; and these relationships were very useful for the rejection of abnormal data (these data were omitted already).

For this purpose, the relations between some important items were examined as follows:-

(1) Relation between stand age (A) and mean D.B.H (D) (Fig. 5).
     The relation between A and D was comparatively clear.

(2) Relation between A and tree number per hectare (N) (Fig. 6).
     As shown in Fig. 6, the relation between A and N was not clear. It seems that Acacia mangium has strong character and can withstand against the tree competition and also if suppressed by other trees. Furthermore, as the initial planted tree number was not so many, the effect of stand density was still not clear.

(3) Relation between A and total basal area (G) (Fig. 7).
     The relation between A and G was not clear because of different stand densities among plots.

(4) Relation between A and mean tree height (H) (Fig. 8).
     The relation between A and H was not so clear compared to the relation between A and DTH.

(5) Relation between A and stand volume per hectare (V) (Fig. 9).
     The relation between A and V was not clear. It will be very difficult to estimate V from A directly.

(6) Relation between A and mean piece volume (v) (Fig. 10).

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The relation between A and v was not so clear.

(7) Relation between D and N (Fig. 11).
It was observed that N decreased in proportion to the increase of D.

(8) Relation between D and v (Fig. 12).
The relation between D and v was quite strong.

(9) Relation between G and N (Fig. 13).
The relation between G and N was not clear at all.

(10) Relation between H and D (Fig. 14).
The relation between H and D was quite clear.

(11) Relation between H and v (Fig. 15).
The relation between H and v was clear, whereas it was observed that the variance of v increased in proportion to the increase of H.

(12) Relation between DTH and H(Fig. 16).
Relation between DTH and H was quite strong.

(13) Relation between V and N (Fig. 17).
Relation between V and N was not clear at all.

(14) Relation between N and v (Fig. 18).
Relation between N and v was not clear. But it could be observed that v decreased in proportion to the increase of N.

(15) Relation between D and H (Fig. 19).
Relation between D and H was quite clear. We could estimate H from D.

3.2.3 Preparation for the Yield Prediction Table.

The following procedures were adopted as the most suitable path of yield prediction from the examination of fifteen pairs of relations.

(1) Estimation of H from DTH.

H was estimated from DTH with the following equation:-

$$H = a + b \; DTH \tag{5}$$

The coefficients a and b were calculated in each site class at first (see Table 3).

In this case, it was found out that there were no significant differences

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among Site I, Site II and Site III. Therefore, we calculate again the coefficients a and b by using all data of three site classes (see Table 3).

(2) Estimation of D from H.

D was estimated from H with the following equation:-

$$H = 1.3 + D^2/(-1.862 - 0.1385D)^2, \text{ then,}$$

$$D = 1.862 \sqrt{H - 1.3} / (1 - 0.1385 \sqrt{H - 1.3}) \quad\text{————————————}\quad (6)$$

(3) Estimation of N from D.

Relation between D and N was not so clear, but it was observed that N decreased in proportion to the increase of D. In this case, N was estimated from D with the following equation (see table 3):-

$$N = a D^{-b} \quad\text{————————————————————————}\quad (7)$$

$$a = 9068.6, \quad b = 0.9042 \quad (\text{SITE I})$$

here,

$$a = 6709.7, \quad b = 0.8072 \quad (\text{SITÉ II and SITE III})$$

(4) Estimation of v from D and H.

v was estimated from D with the following equation at first.

$$v = a D^b \quad\text{————————————————————————}\quad (8)$$

The coefficients a and b were calculated in each site class and also in all the classes (see table 3).

v was also estimated from D, H with the following equation:-

$$v = 0.000058806 \, D^{1.71772} \, H^{1.0809} \quad\text{————————————————}\quad (9)$$

In this case, the value of correlation coefficient (R^2) was more higher than the value of correlation coefficient (R^2) calculated by equation (8) (see Table 3). Equation (9) was selected as the suitable way for the estimation of v.

3.2.4 Yield Prediction Table.

By using the above mentioned final results, we made the Yield Prediction Table according to the following procedure.

(1) Calculate dominant tree height (DTH) from stand age (A) and site index (SI).

(2) Calculate mean tree height (H) from DTH.

(3) Calculate mean DBH (D) from H.

(4) Calculate mean piece volume (v) from H and D.

(5) Calculate tree number per hectare (N) from D.

(6) Calculate basal area per hectare (G) from D and N.

(7) Calculate volume per hectare (V) from v and N.

The flow chart of these procedure is shown below:-

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┌─────────┐
│  S I, A │
└─────────┘
     │
     ▼
┌─────────┐
│   DTH   │
└─────────┘
     │
     ▼
┌─────────┐              ┌─────────┐
│    H    │─────────────▶│    D    │──────────┐
└─────────┘              └─────────┘          │        ┌─────────┐
     │  ◀───────────────────┘  │              ├───────▶│    G    │
     ▼                         ▼              │        └─────────┘
┌─────────┐              ┌─────────┐          │
│    v    │              │    N    │──────────┘
└─────────┘              └─────────┘
     │                         │
     └───────────┬─────────────┘
                 ▼
            ┌─────────┐
            │    V    │
            └─────────┘
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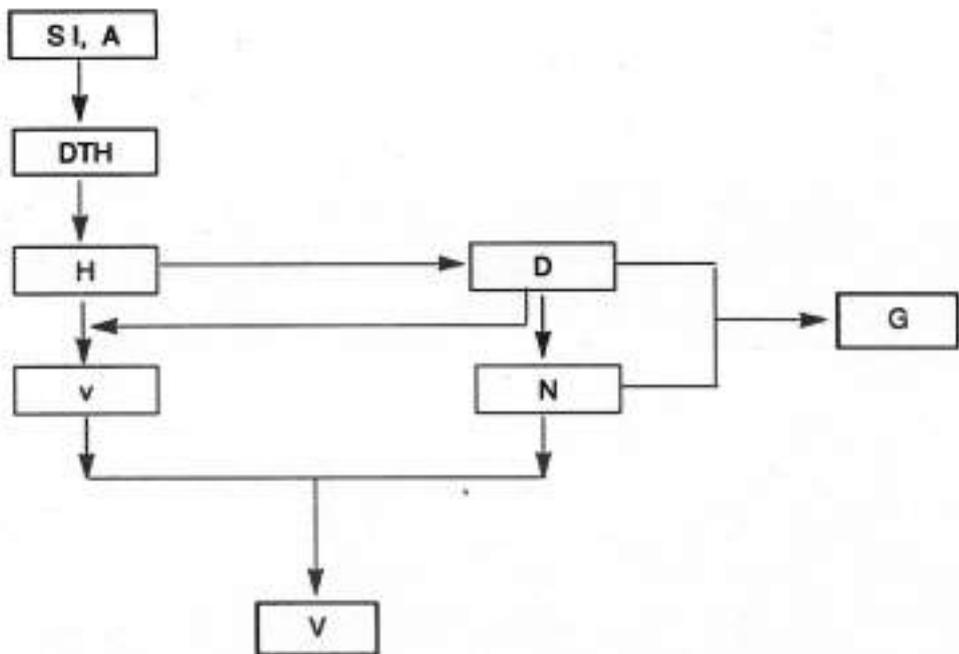
The Yield Prediction Table calculated by these procedures were shown in Table 4, 5, 6.

The Yield Prediction of Site I was shown in Table 4. In this prediction D, N and V reached 35cm, 360 trees/ha., 365 m^3/ha. respectively. Mean annual increment of volume became maximum around 7 - 8 years.

In case of Site II, it was shown in Table 5. D, N and V reached 28cm, 454 trees/ha., 268 m^3/ha. respectively. Mean annual increment of volume became maximum around 9 - 10 years, which was two years later than the Site I.

In case of Site III, it was shown in Table 6. D, N and V reached 22cm, 550 trees, 185 m^3/ha. respectively. Mean annual increment of volume became maximum around 10 - 11 years, one year later than Site II.

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These results were reasonable and this Yield Prediction Table would be suitable for actual use.

3.3 . Estimation of site class from environmental factors.

The site class of a plantation already established can be estimated by measuring the dominant tree height as mentioned before. This method can not be applied to a site before planting. The fertility of a site, the site class in other words, can generally be described by some environmental factors. In this section, it was examined to estimate site class from environmental factors.

3.3.1 Materials.

The field survey on environmental factors were carried out in some of PSPs and TSPs. The collected 89 data were shown in Table 7. The surveyed items were on soil, terrain, and vegetation.

3.3.2 Site index of the plots.

The site index of each plot was defined as the dominant tree height at base age, 8 years old. For the plots without data at 8 years old, the site indexes (SI) were estimated with the following equation.

$$SI = f1(8) + \frac{f2(8)}{f2(A)} \ [DTH - f1(A)] \ \text{——————————————— (10)}$$

A : stand age.

f1(A) : guide curve of site index curves.

f2(A) : standard deviation curve.

B : base age.

The site indexes of the plots estimated with equation (10) were shown in Table 7.

3.3.3 Environmental factors.

Eight items, i.e. soil depth, humus content of A layer, texture of B layer, soil type, terrain, slope, vegetation type, and climate type, were selected for analysis from various environmental factors supposed to affect tree growth. The categories of each item were shown in Table 8.

The multiple correlation coefficient generally becomes higher with more items and more categories. In case the number of data is small, such a high multiple correlation coefficient doesn't have enough reliability. In this analysis, the minimum number of data was limited to three for each category. After deleting and combining the categories three times, thirty-one categories in total were selected finally.

3.3.4 Estimation of site index by Quantification method I.

Site index is a quantitative data, i.e. dominant tree height at the base age. On environmental factors, some of them are quantitative data such as soil depth and slope inclination, the others, most of them, are qualitative data such as soil texture and soil type. If all the factors are quantitative, multiple regression will be applied for analysis. But, in this case with qualitative data, another method becomes necessary.

An estimation method of a quantitative dependent variable from categorized (qualitative) independent variables was established by Dr. Chikio Hayashi in 1949. This method was not used widely at that time, because computer systems were not developed yet. But, recently, it has become one of the most important analysis method in various fields such as medical science, sociology, and natural science, with the development and the wide spread of computers.

The theory of this method can be briefly described as follows. First, a dependent variable, called outsider (site index), and some independent variables, affecting this outsider (Items), are prepared. Second, the independent variables, some of which are qualitative, are divided into some categories. Third, a certain quantity is given to each category. Fourth, the correlation between the outsider and the sum of the given quantities in all items is calculated. Through repeating third and fourth procedure, the highest correlation will be finally given.

This procedure can be described as following equations.

$$\hat{Y} = a + X_1 + X_2 + \text{------} + X_n \qquad \text{------} \qquad (10)$$

$\hat{Y}$: estimated value of dependent variable.

X_n : categorized independent variable for item n.

a : constant.

The estimation error between real value (Y) and estimated value ($\hat{Y}$) are made minimum by least square method.

$$E[(\hat{Y} - Y)^2] = \min \text{------} \qquad (11)$$

E : expectation value.

To each category C_{jk} (j: Number of Item, k: Number of category), a certain value (t_{jk}^*) is given with the highest correlation by Equation (11). Estimated value of dependent variable ($\hat{Y}$) is given by equation (10).

This computing procedure can be carried out by Quantification method I. In this report the detailed explanation for calculation theory is omitted. As a result, a certain value t_{jk}^* satisfying equation (11), is given to each independent variable $X_1, X_2, \ldots \ldots X_n$. The estimated Y is given by inputting a category (t_{jk}^*) of each item to equation (10).

The following was the procedure of calculation in this study.

(1)   Preparation of reaction pattern table.

A reaction pattern table, which showed reaction patterns of all items in 89 plots, were prepared as shown in Table 9.

(2)   Preparation of cross table.

The calculation of quantification method I was carried out based on this reaction pattern table. As the first procedure of calculation, a cross table was prepared, according to the reaction pattern, as shown table 10. The cross table, which shows the distribution of the categories in each variable (item), was used for checking bias of data. The way of combining and dividing among categories were examined with the cross table. The cross table was also useful to check the different reaction among the categories. The categories with the same reaction pattern should be made into one category. Table 11 showed the frequencies of categories in each variable (Item). Some categories had only a few data.

(3)   Result of calculation.

Table 12 showed the result of calculation by the quantification method I. Numerical order among categories in each item was almost same as the order supposed through field observations. For example, the deeper soil got the higher score in Item 1 (soil depth) and the category assumed to indicate high site productivity got the high score in Item for vegetation type. The multiple correlation coefficient and the standard error was 0.78 (R^2 = 0.61) and 1.72 respectively. The accuracy would be enough for the practical site-class estimation. The correlation matrix among variables was shown in Table 13 for reference. No abnormally high correlation was found. This means the selection of variables was reasonable.

The following was the equation for estimation. (See Table 12).

$$Y = 22.18 + X1 + X2 + X3 + X4 + X5 + X6 + X7 + X8 \quad \text{------ (12)}$$

A site index can be estimated by inputting the quantities of corresponding environmental factors to equation (12). This estimation will be useful for deciding site class.

4.   Conclusion.

Final results are shown as follows:

(1)   **Site Index.**

Guide curve and standard deviation curve were adapted by Mitscherlich curve.

Site index curves were estimated by above mentioned two curves (the base age is 8 years).

By these results site classes were divided into three classes as follows:

Site I   :   above 25 (center curve is 27)
Site II   :   21 - 24.9 (center curve is 23)
Site III   :   below 20.9 (center curve is 19)

(2)   Yield prediction table.

The relations between some important items such as D.B.H., mean height, stand density, total volume, mean piece volume were examined.

By these results, four relations were selected as follows:
(1)   Relation between DTH and H.
(2)   Relation between H and D.
(3)   Relation between D and N.
(4)   Relation between H, D and V.

Finally, yield prediction tables were calculated by the following procedure.

(1) A, SI → DTH,   (2) DTH→ H,   (3) H→ D,   (4) H, D→V,   (5) D→ N,
(6) D,N → G,   (7) N,V→ V

These results were reasonable and this yield prediction tables would be suitable for actual use in the plantations without thinning.

(3)   Estimation of site index.

By using Quantification method I, the relation between outsider (Y: site index) and soil depth (X1), humus content (X2), texture of soil (X3), soil type (X4), terrain (X5), slope (X6), vegetation type (X7), climate (X8) were examined.

The site index is estimated by the following equation.

$$Y = 22.2 + X1 + X2 + X3 + X4 + X5 + X6 + X7 + X8$$
$$(R = 0.78, s.d = 1.71)$$

These results were reasonable and this equation would be suitable for actual use.

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5.   Recommendation.

5.1   Site Index.

(1)   In this report, data of age below 11 years were mostly used to make site index curve. For this reason, site index curve is estimated till 15 years. To estimate the site index of higher age, we have to collect more data over 11 years in future.

(2)   In some P.S.P plots, dominant tree height became smaller in older age. This tendency is not normal. For this reason, it is needed to check with the former data when taking measurements.

5.2   Yield prediction table.

(1)   In this report, yield prediction table is estimated till 15 years because of the age of site index curve. But, it will be needed to make a yield prediction table much higher age in the near future. For this purpose, much more data from old-aged stands are requested.

(2)   This yield prediction table was made from data of unthinned stands. Therefore, we estimated about only main tree (or residual tree) this time. When data of thinning are collected, we can make a yield prediction table considering the thinning effect.

5.3   Site class.

In this report, 8 items and 31 categories were selected to calculate the score by Quantification I. But, more data are necessary to estimate the site class more accurately. At least 5 data per category may be needed.

5.4   Others.

(1)   In this report all data were taken from stands with 3m x 3m spacing. The data did not show the competition - density effect clearly. This means that the closer spacing has a possibility to increase the volume per hectare without much decrease of piece volume. Some spacing trials with closer spacing, like 2.5m x 2.5m and 2.5m x 2.0m, will be necessary to understand the relation between stand density and tree growth.

(2)   In this report, PSP data were very important to estimate relations among all items. It is very important to maintain the PSP's properly. At the same time, a PSP suffered from damage, like fire, pest and disease, should not be assessed any more because data collected from such PSP is misleading for the study.

(3)   For the stand measurement in a plot, it is basically necessary to measure DBH and height of every tree. In case the following rules are followed properly, some height measurements can be omitted.

(a)   Height measurements should be taken systematically for every three trees. The standard error of height estimation can be done based on the

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systematically sampled data.

(b) Four highest trees at least should be measured in case of 0.04 ha plot because the dominant tree height is often defined as 100 highest trees per hectare.

(4) For proper forest management, combinations of some rotations are required, like short (around 10 years), middle (30 to 50 years), and long (around 70 years) rotations. In addition, monoculture of *Acacia mangium* may not give good effects in the future, in view of susceptibility to pests and disease. For these reasons, other tree species should be selected to plant, even though *Acacia mangium* continues paying an important role as the main tree species. Especially the selection of indigenous species are recommended.

(5) Trials for timber production of *Acacia mangium*, such as pruning trial and thinning trial, should be continued and developed. The possibility of timber production still remains at present stage. It is worth while to make efforts for further heart-rot study and growth study from the trials mentioned above.

(6) For forest management of *Acacia mangium*, the idea of running cost is needed in the future. For this purpose, we have to collect much more information on supply and demand of pulplogs and sawlogs.

6.   Acknowledgements.

7.   Reference.

Nishizawa M., Mashimo I., and Kawabata K. (1965) Estimation method of site index by Quantification. Research report of F.F.P.R.I (No. 176).

SAFODA (1987) Semi-Detail Soil Survey of 15000 hectares, Final report, SAFODA/ARAB.

SAFODA (1989) Semi-Detail Soil Survey of 4000 hectares, Final report, SAFODA/ARAB.

The method of field survey.

The field survey consisted three parts; plot establishment, stand measurement, and survey of environmental factors.

1. Plot establishment.

Permanent sample plots (PSP) were established by SAFODA research section with the size of 0.04 to 0.06 ha. and the shape of rectangular or square. Temporary sample plots (TSP) were established with the size of 0.04 ha and the shape of square.

2. Stand measurement.

DBH and height of all trees were measured in PSP's, whereas DBH of all trees and height of six or seven trees were measured in TSP's. The heights of the other trees in TSP's were estimated applying the following equation.

$$H = D^2/(a+b\,D)^2 + 1.3$$

The volume calculation was based on Hayward's volume equation in 1988.

3. Survey of environmental factors.

(1) Soil.

A soil pit was made at the center of each survey plot. The soil profile was recorded in the field and soil samples were collected to examine texture, color, and pH in the laboratory.

(2) Terrain.

The average slope inclination was recorded in degree. The terrain was described based on the following classification.
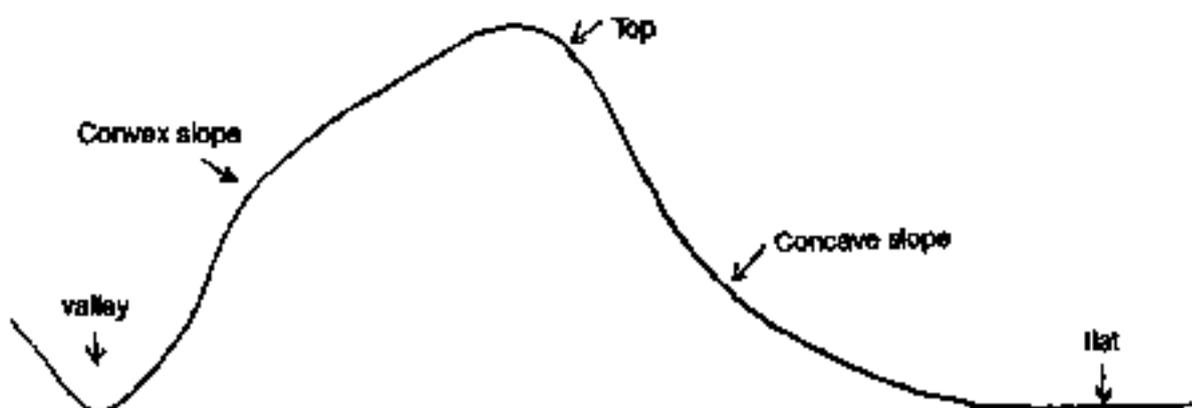
(3) Vegetation.

The coverage of the floor vegetation was recorded in each survey plot. The surveyed data were classified into the following types.

Type 1 (indicate high productivity) has one of the following conditions.

(1) The coverage of *Eupatorium odrutum* is above 25%.

(2) The coverage of *Scleria sumatrensis, Nephrolepis biserrata,* or bamboo is above 5%.

Type 3 (indicate low productivity) has one of the following conditions.

(1) The coverage of *Pteridium caudatum* or *Dicranopteris linearis* is above 10%.

(2) The coverage of *Dillenia spp., Fimbristylis accuminata, Rhynocospere spp., Gahnia tristis,* or *Eriachne pallescens* is above 5%.

All other types of Type 1 and Type 2 belong to Type 2.

4. Climate.

The climate was divided into four types: northern coastal, central coastal, southern coastal, and interior area.

(a) Northern coastal area.

This area has clear difference between dry season and rainy season. Annual rainfall is moderate (around 2,500 mm). The SAFODA plantations in Bongkol, Kota Marudu, Kudat and Kota Belud belong to this type.

(b) Central coastal area.

This area doesn't have clear dry season or has a short dry season. Annual rainfall is moderate (around 2,500 mm). Kinarut project locates in this area.

(c) Southern coastal area.

This area doesn't have clear dry season. Annual rainfall is high (around 3,000 mm). Lumat project locates in this area.

(d) Interior area.

Annual rainfall in this area is low (around 1,500 mm) and even through all over the month. Annual temperature, 30 degrees in maximum and 20 degrees in minimum, is much lower compared to the coastal areas.
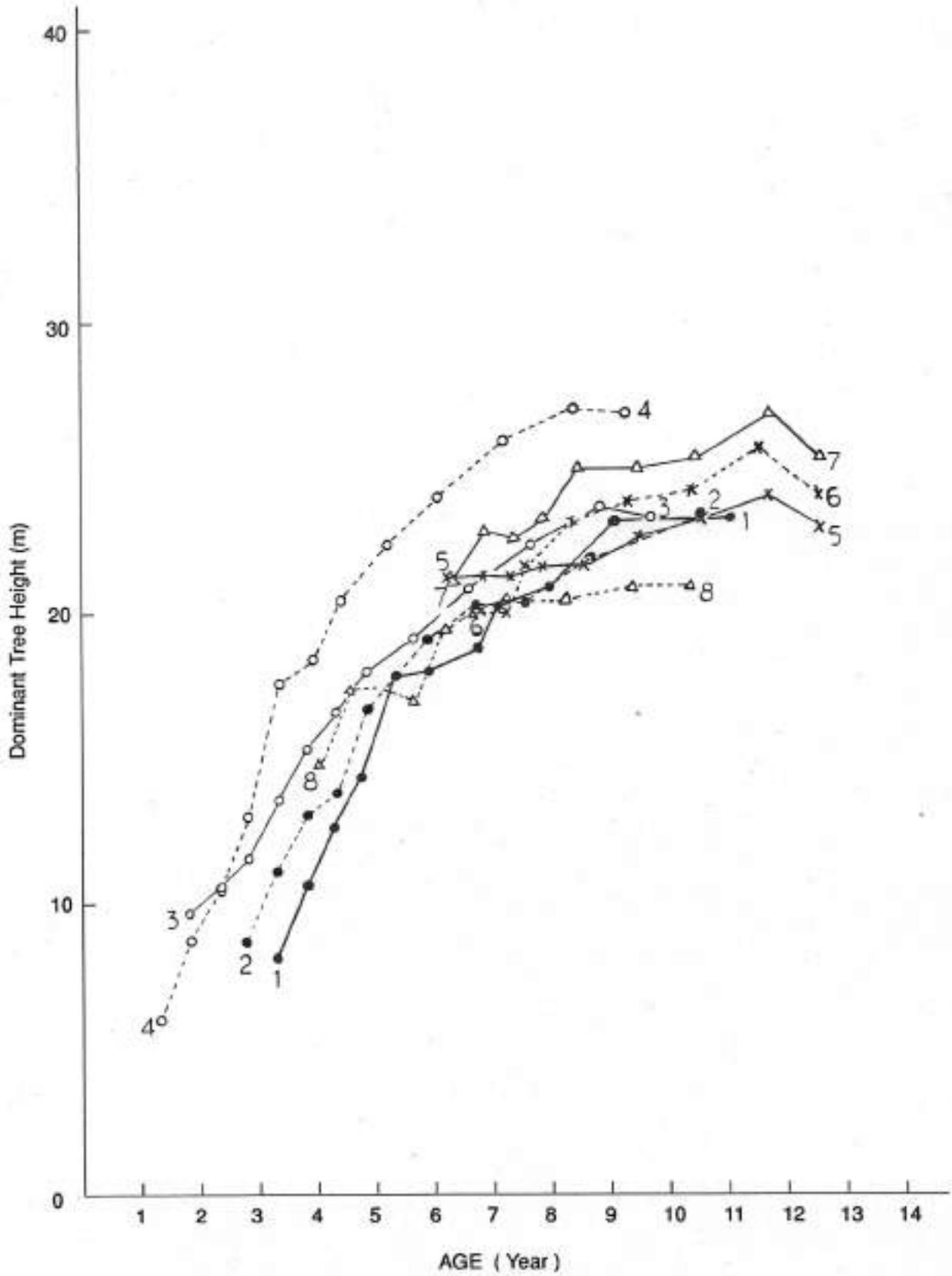
Fig. 1, a) Annual Transition Of Dominant Tree Height (PSP)

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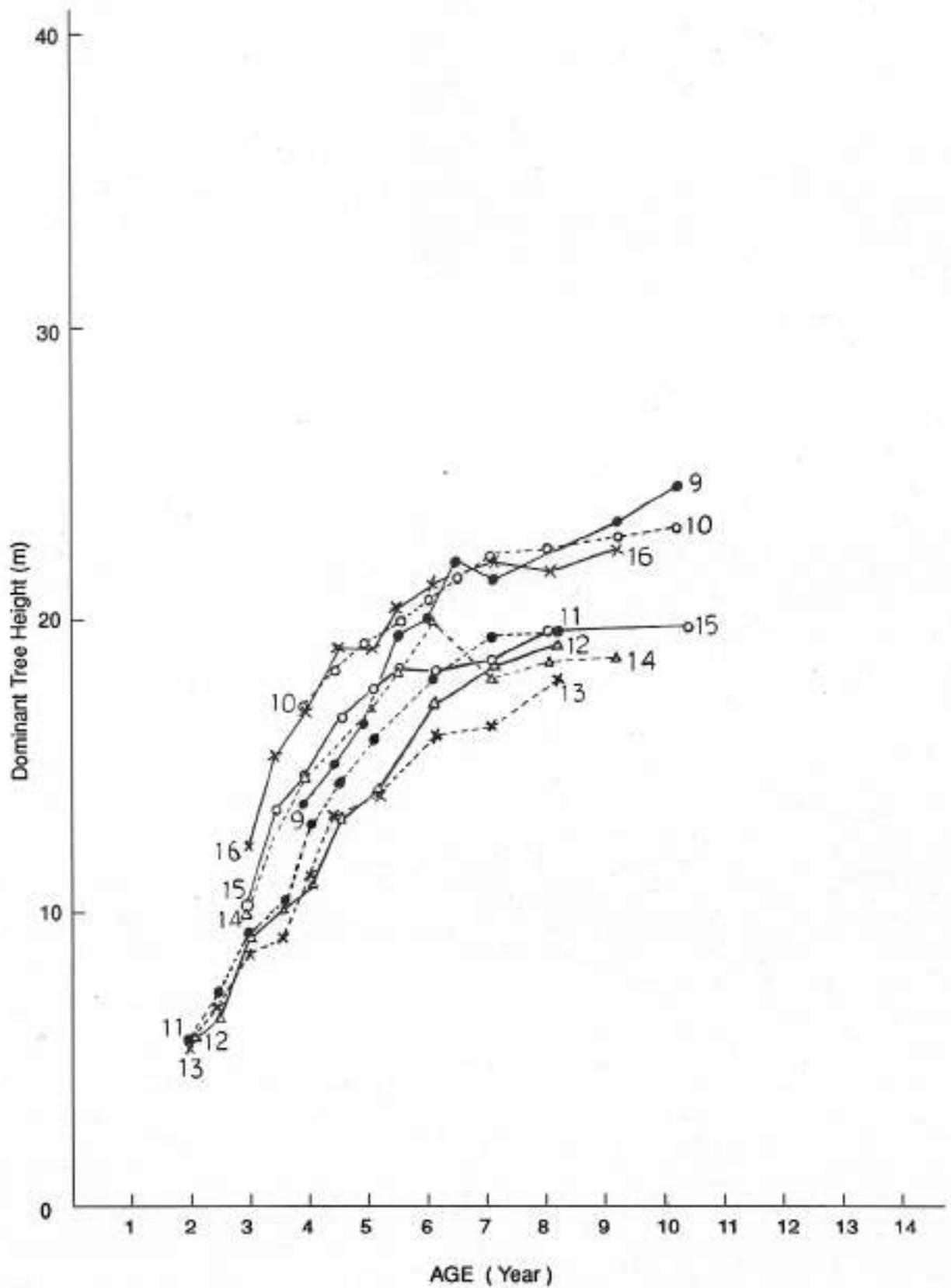
Fig. 1, b) Annual Transition Of Dominant Tree Height (PSP)

17
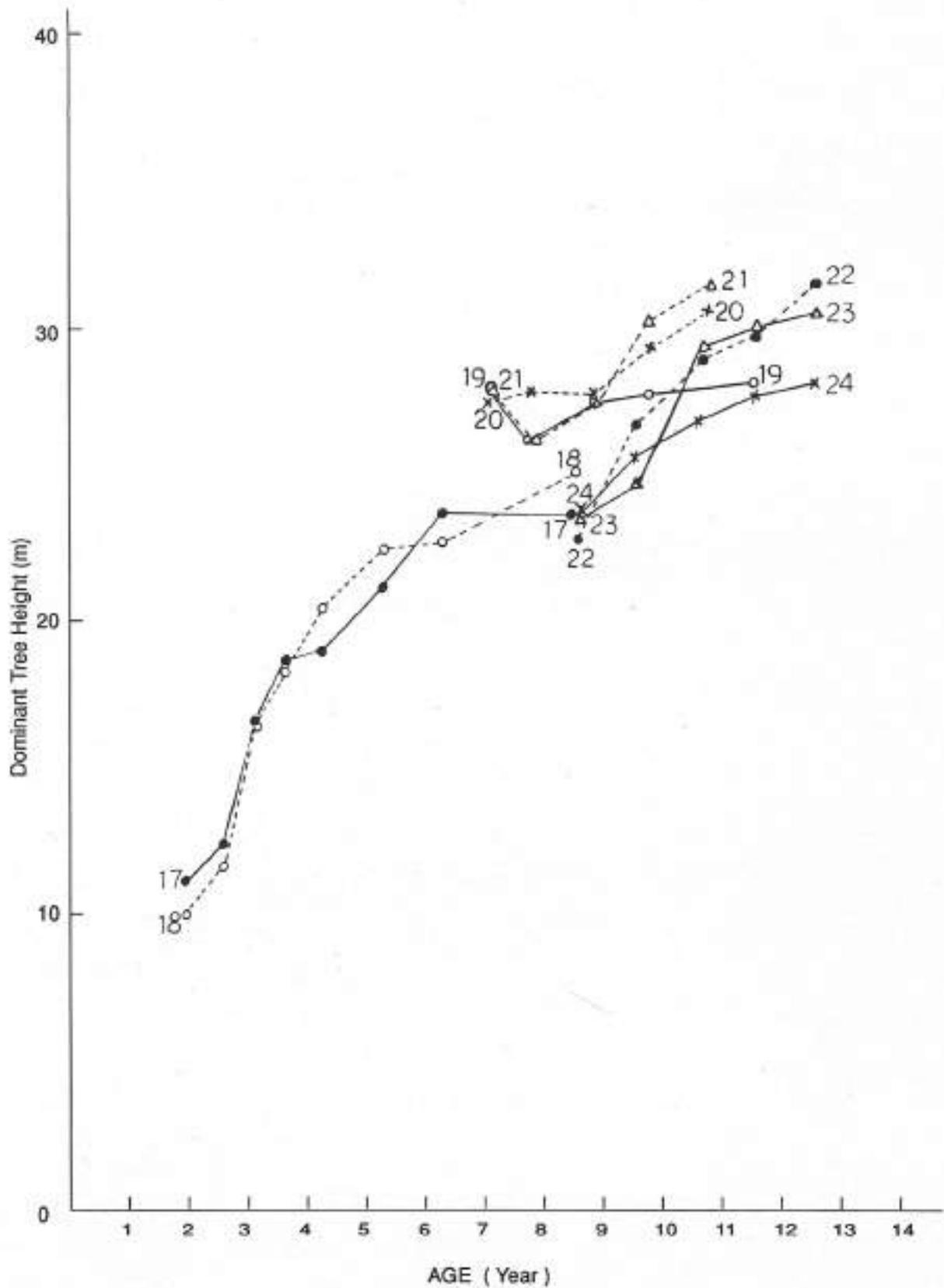
Fig. 1, c) Annual Transition Of Dominant Tree Height (PSP)
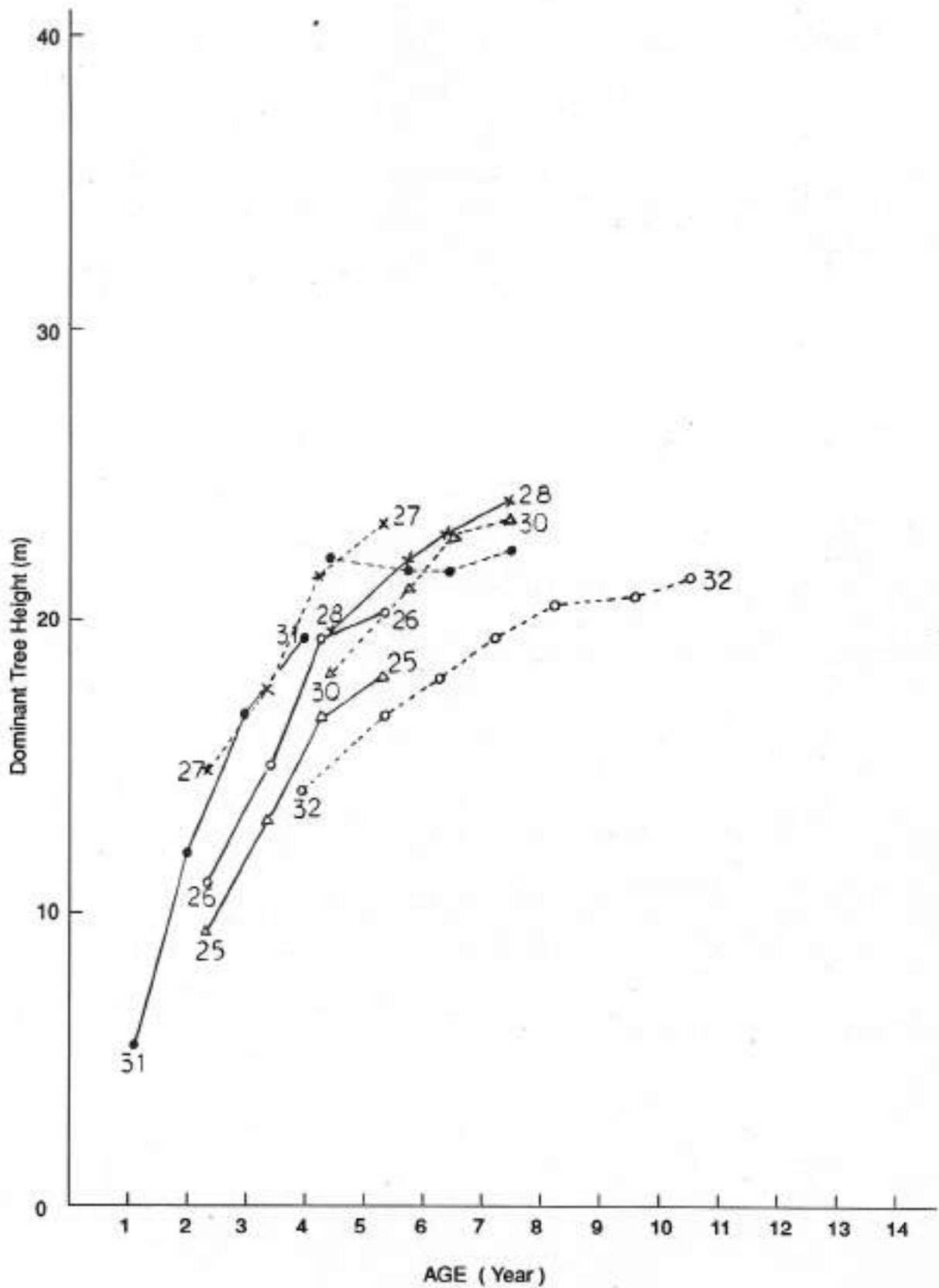
Fig. 1. d) Annual Transition Of Dominant Tree Height (PSP)
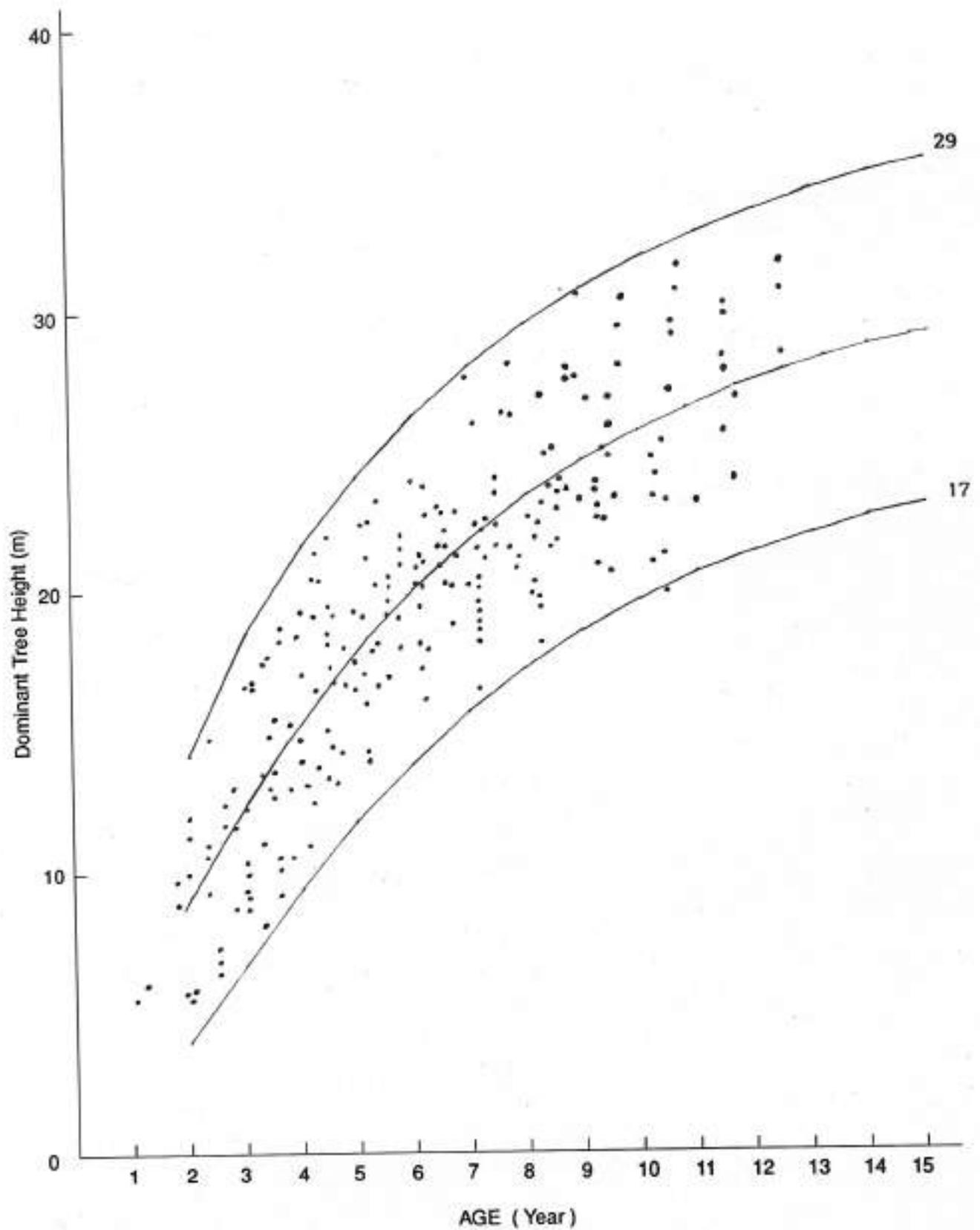
Fig. 2, a) Relationship Between Age and Dominant Tree Height

20
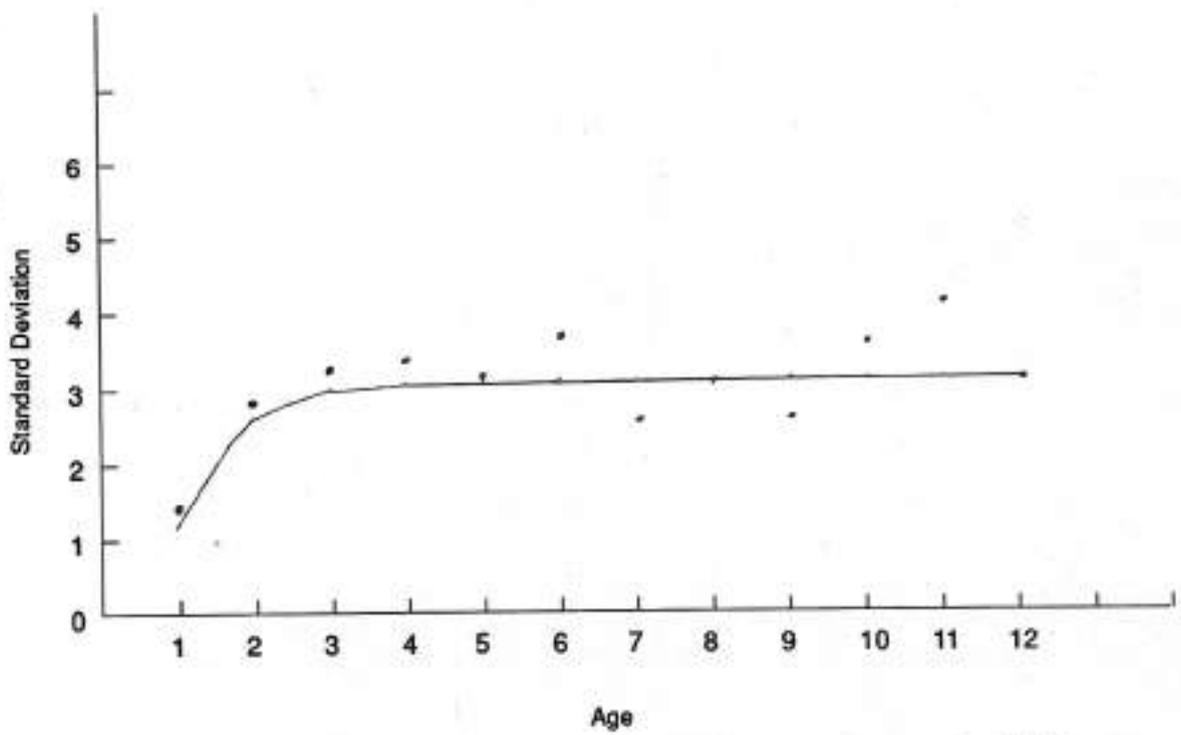
Fig. 2, b) Relationship Between Age and Standard Deviation of Dominant Tree Height
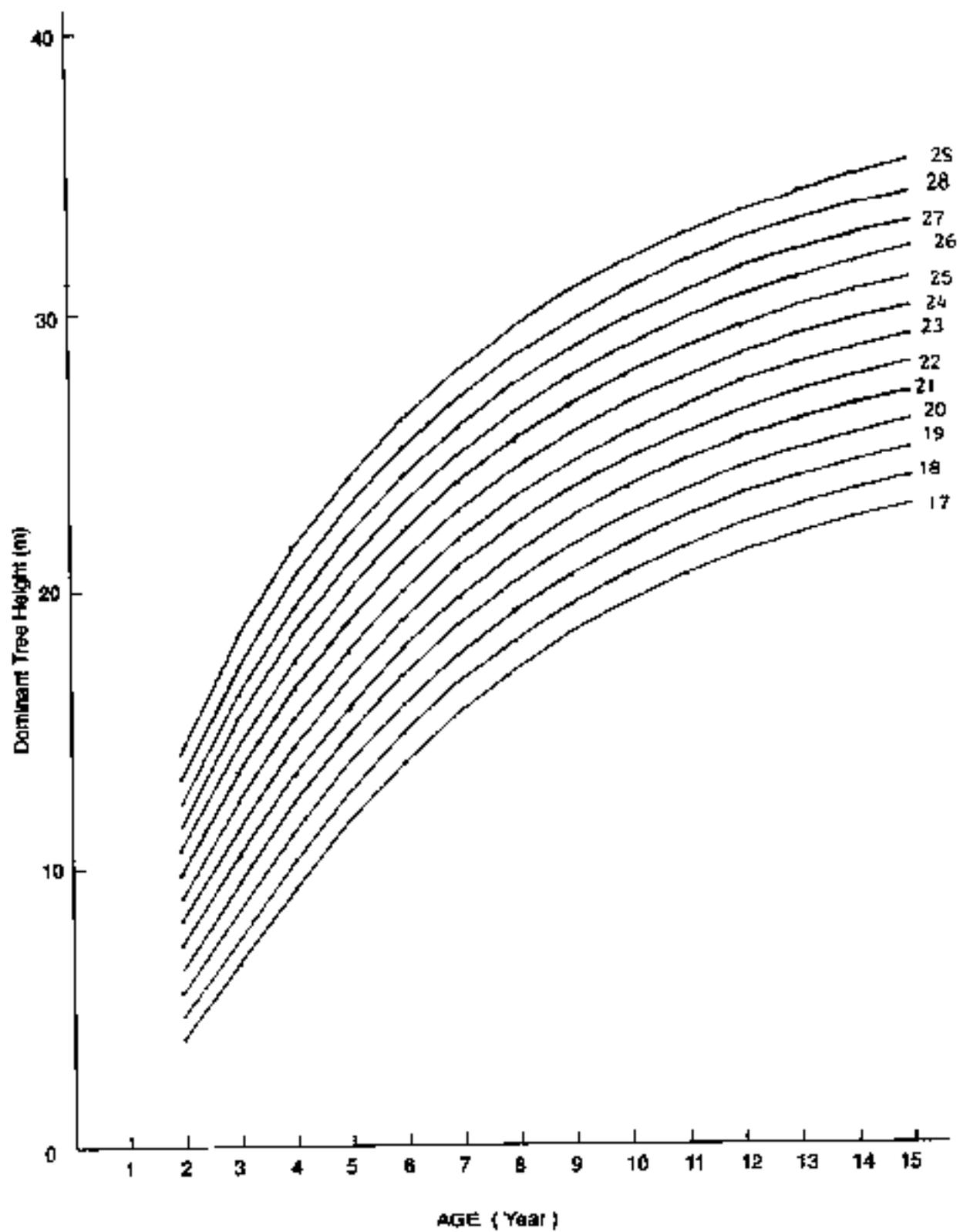
Fig. 3 Site Index Curve By Each Year
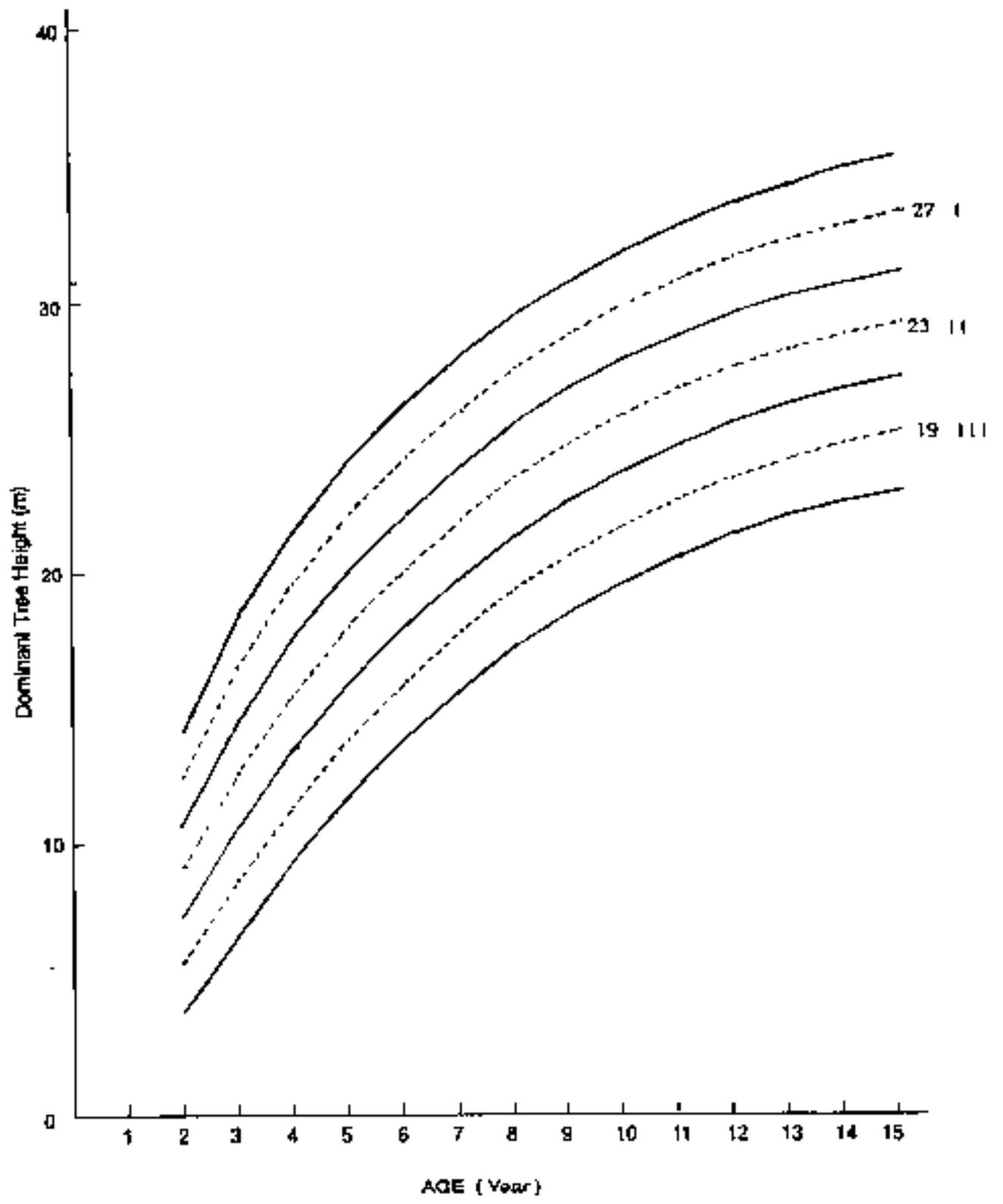
Fig. 4 Site Class and its Center Line
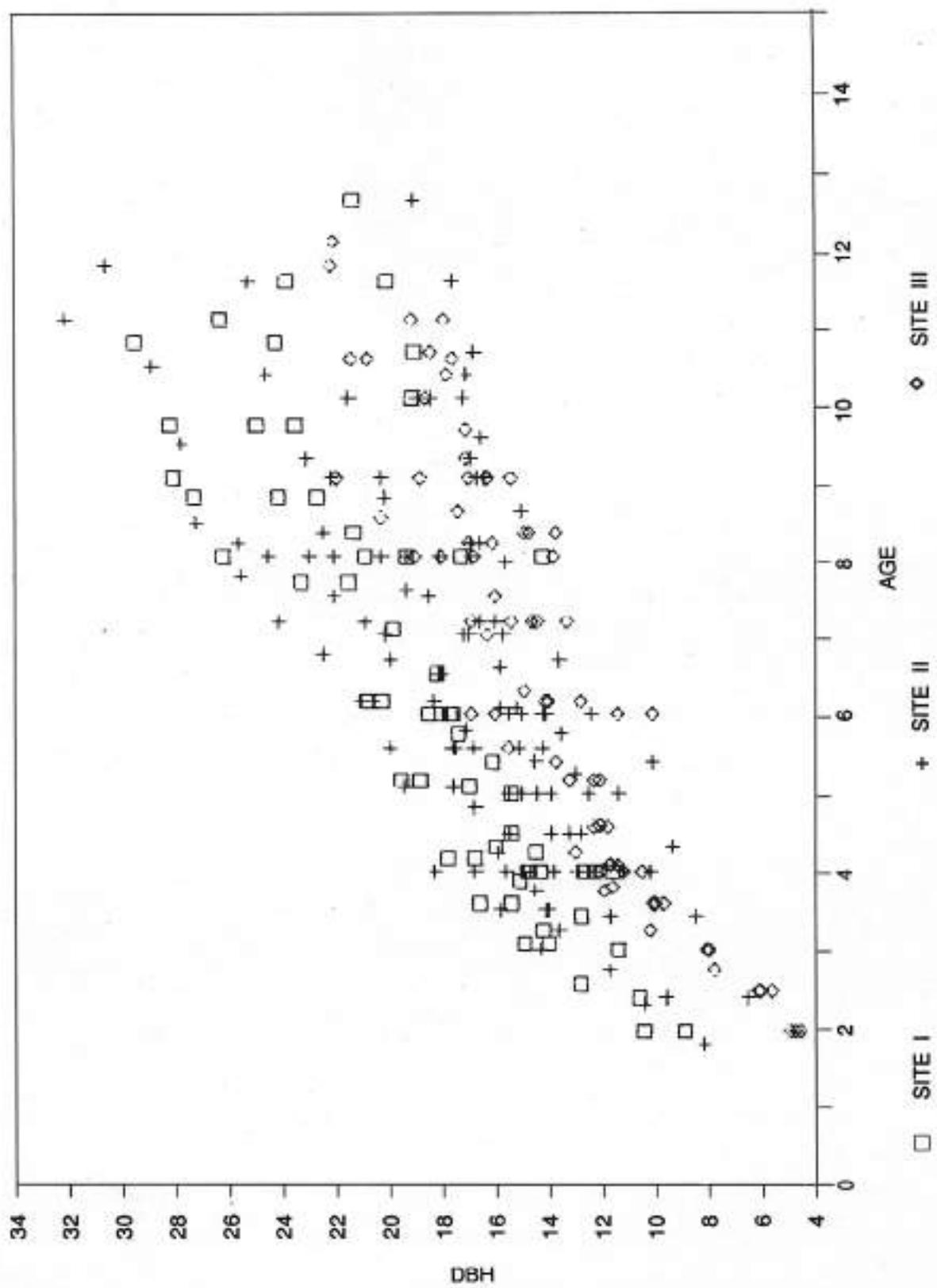
Fig. 5 Relationship Between Age and DBH

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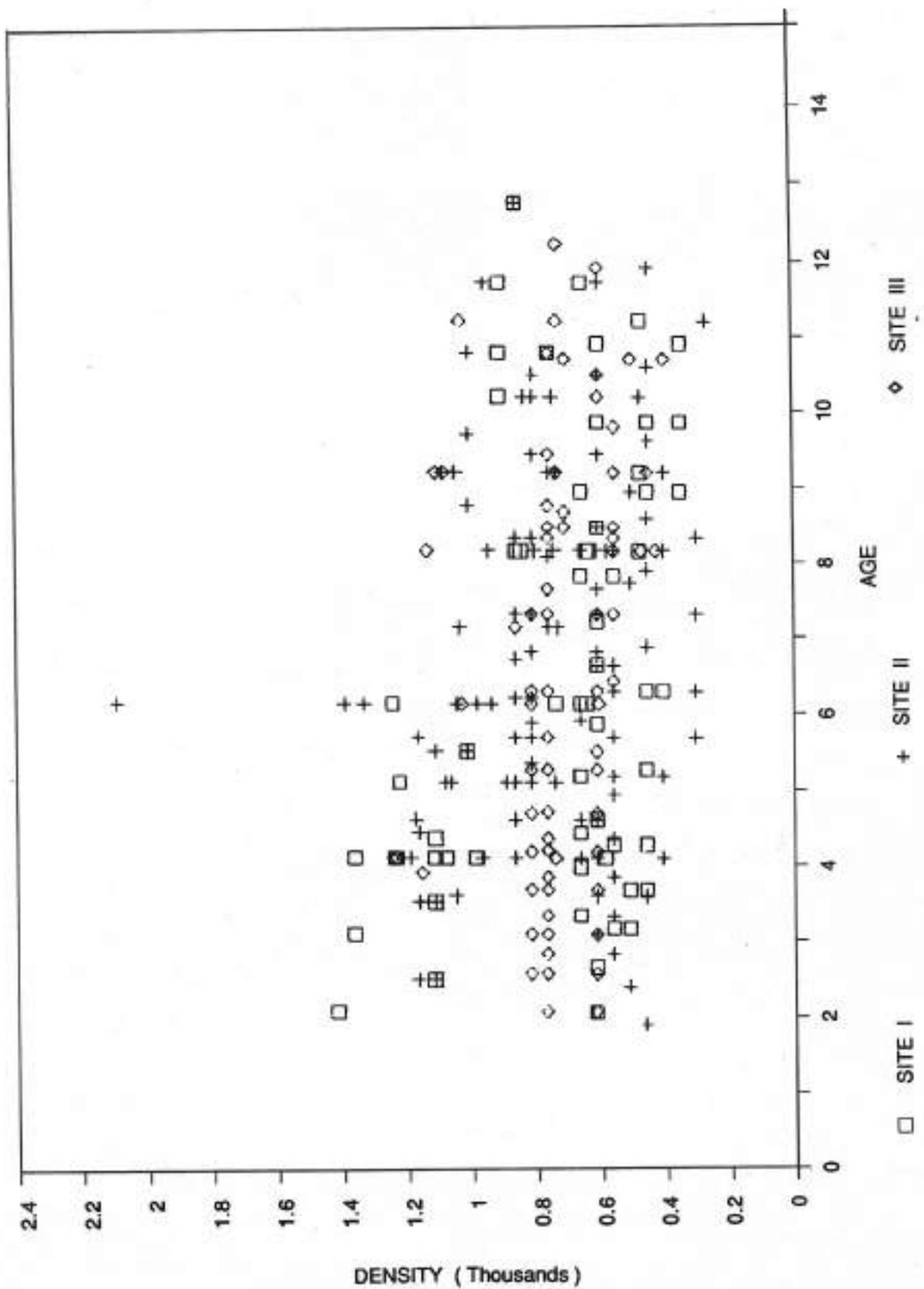
Fig. 6 Relationship Between Age and Stand Density (N)
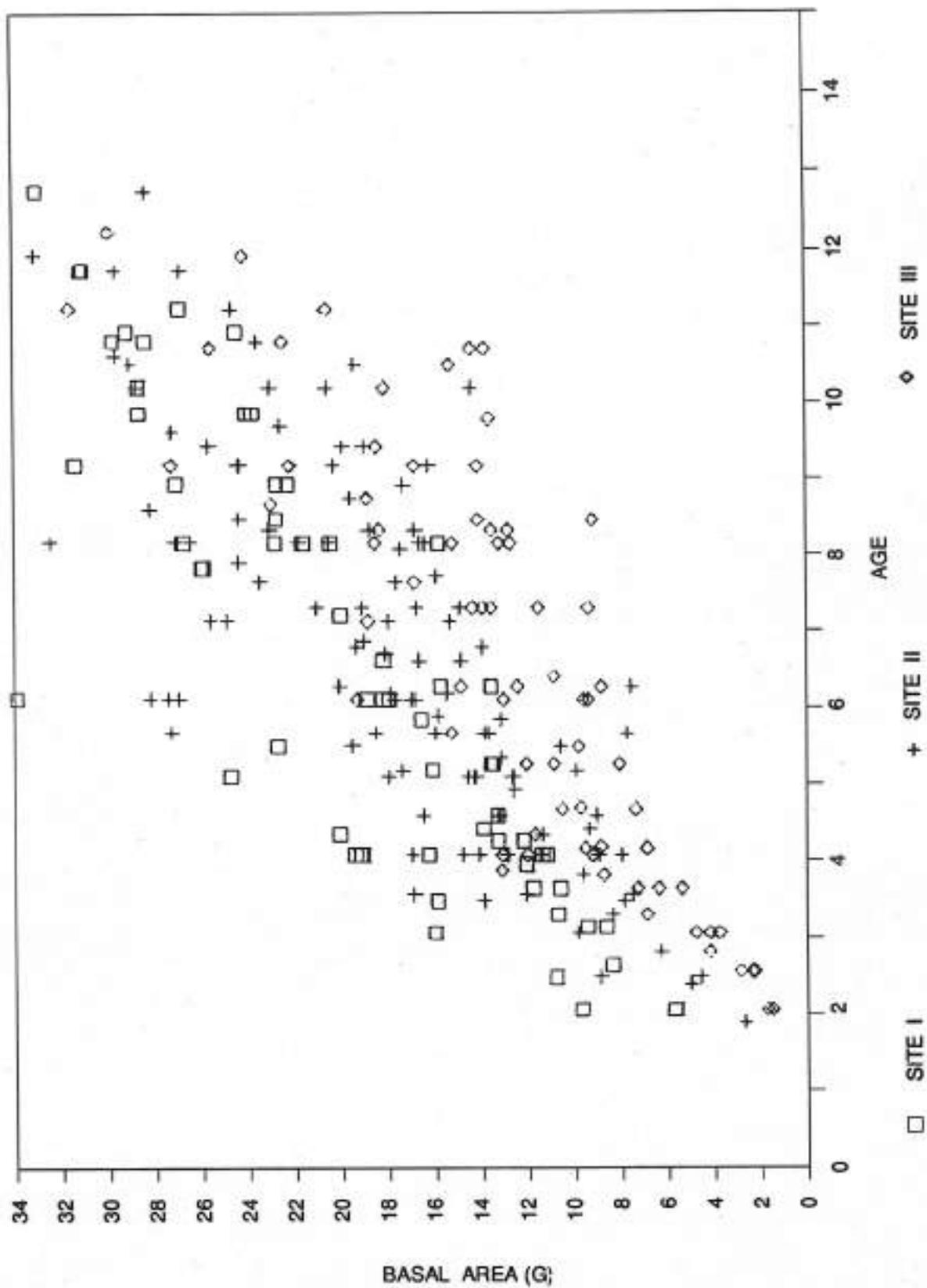
Fig. 7 Relationship Between Age and Basal Area
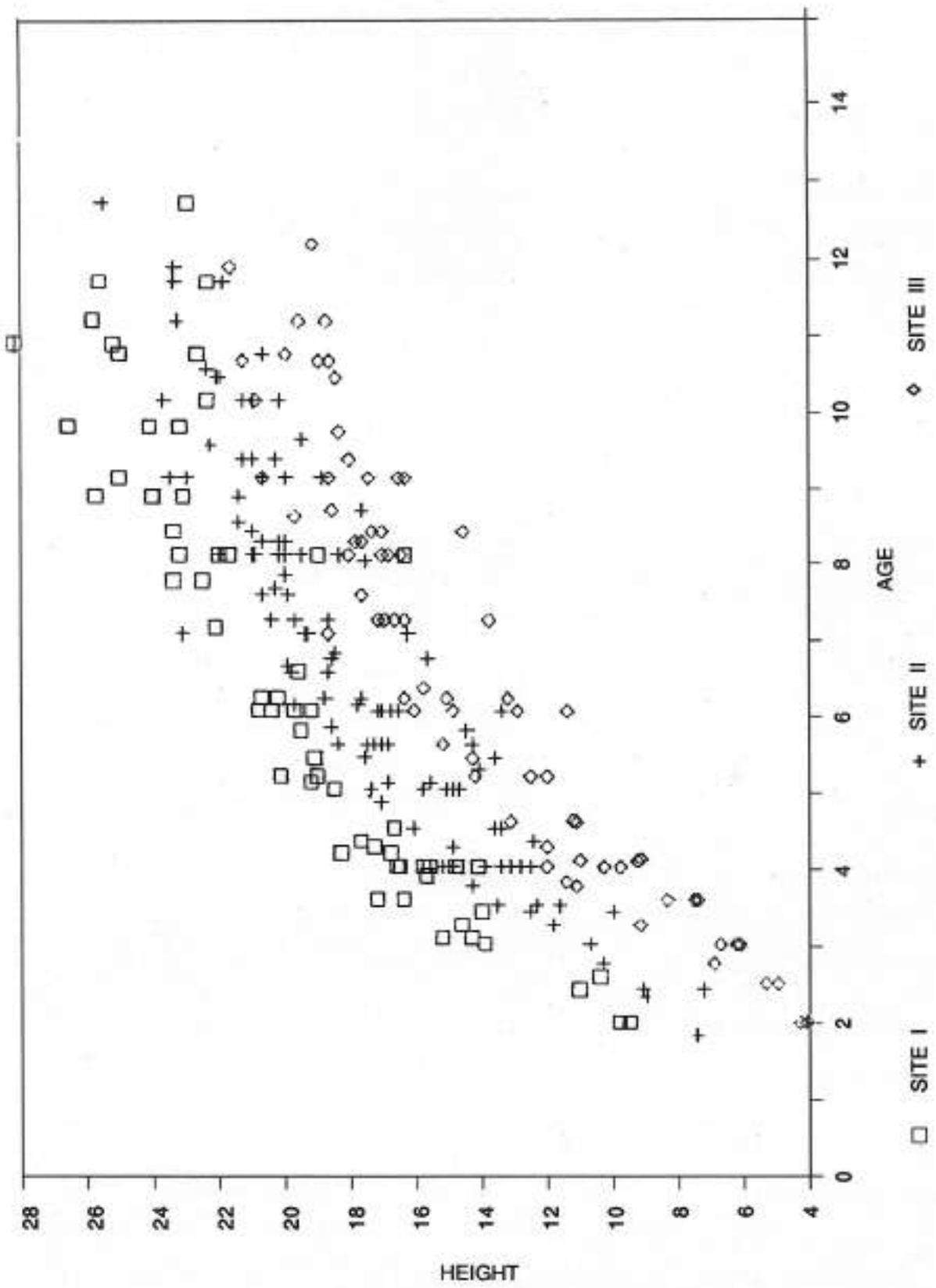
Fig. 8 Relationship Between Age and Height
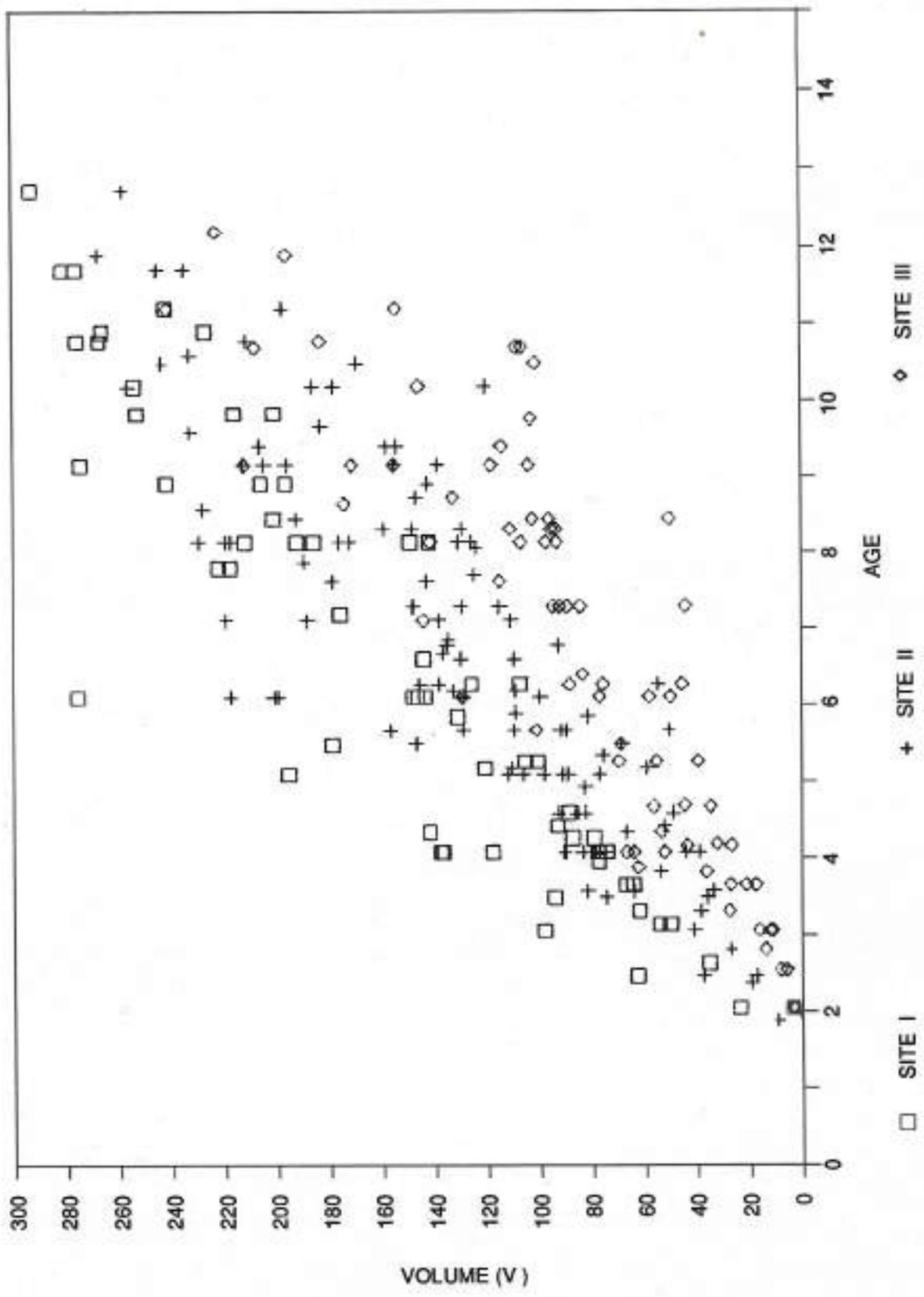
Fig. 9 Relationship Between Age and Volume
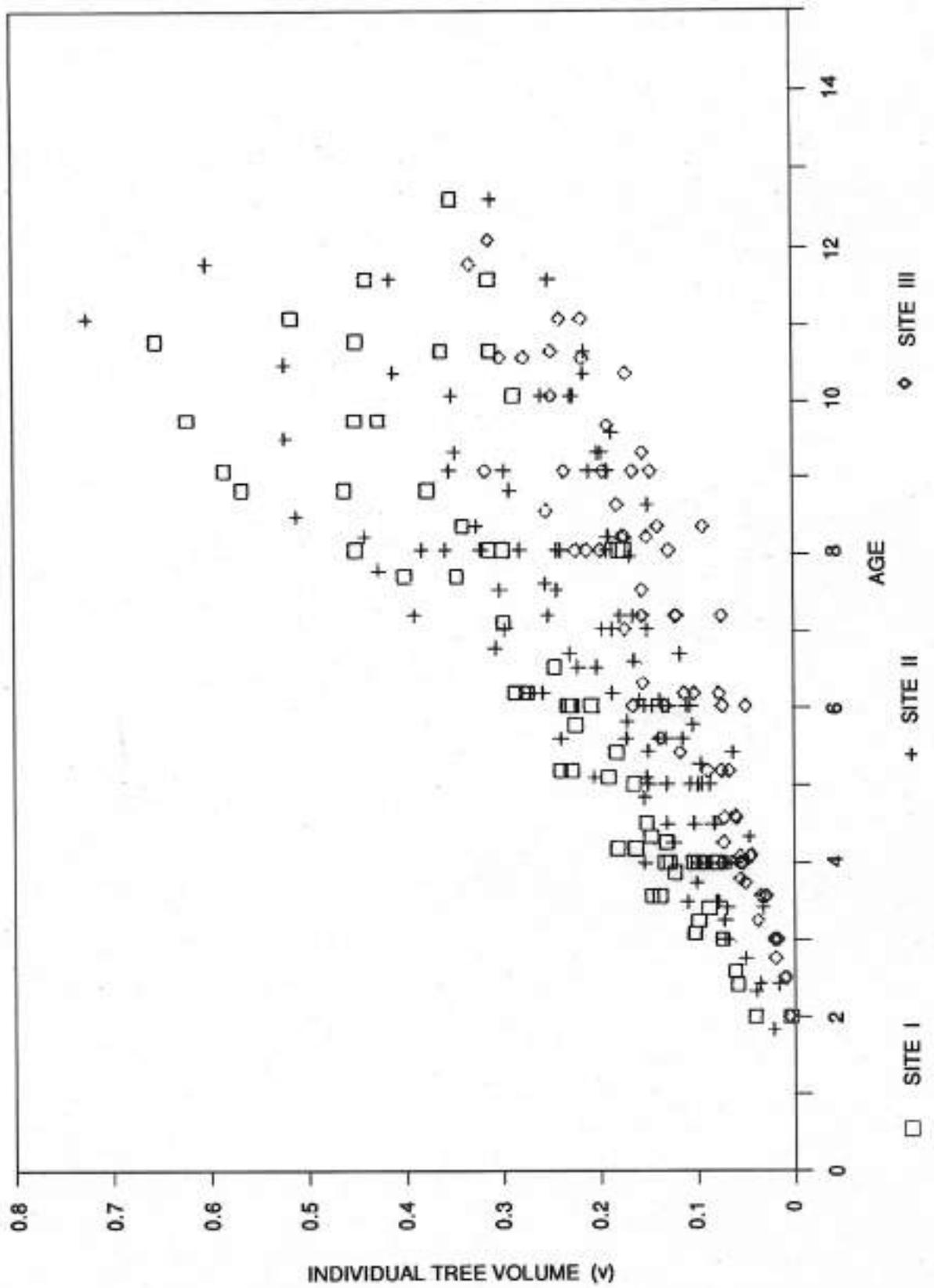
Fig. 10 Relationship Between Age and Individual Tree Volume
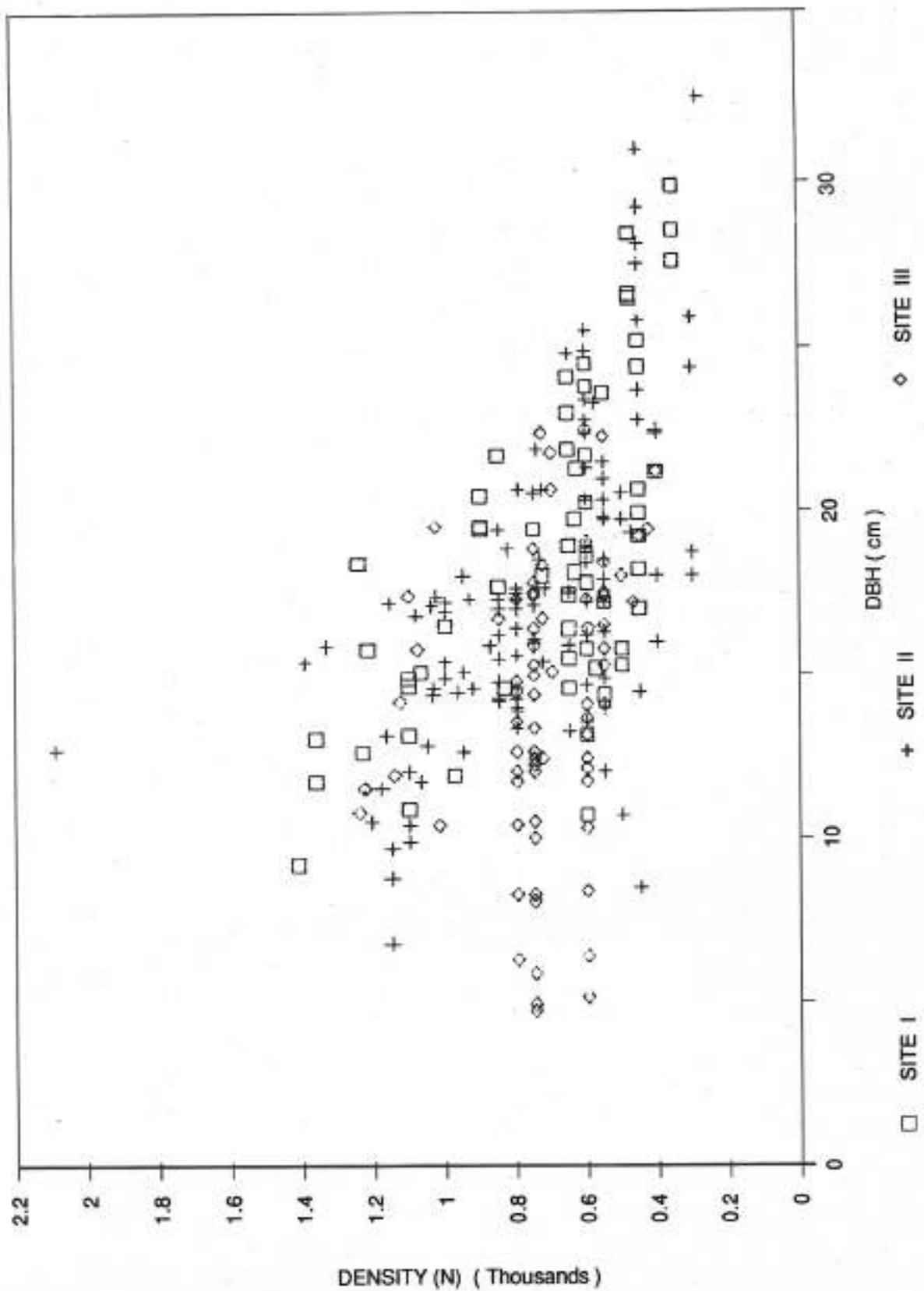
Fig. 11 Relationship Between DBH and Stand Density (N)
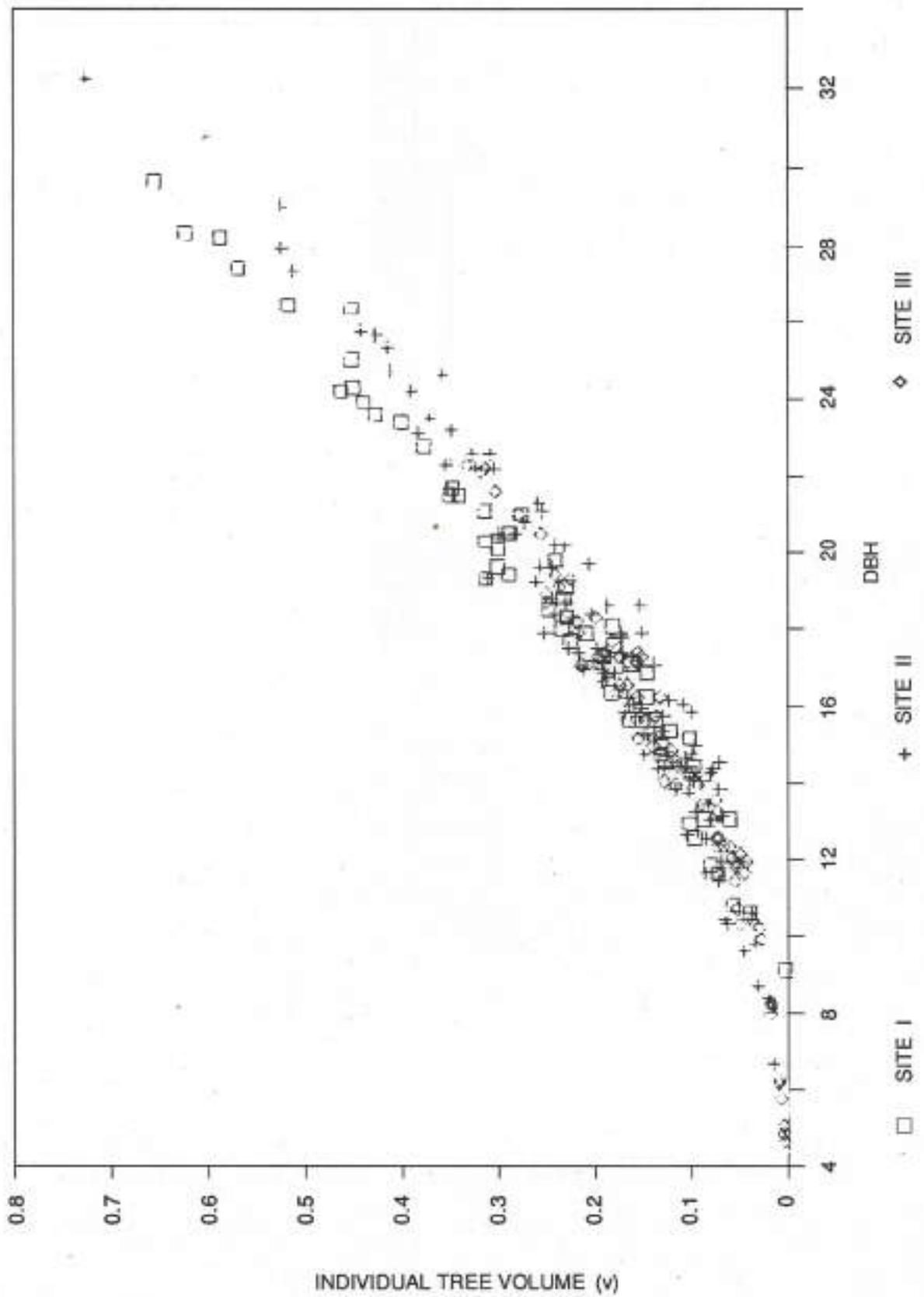
Fig. 12 Relationship Between DBH and Individual Tree Volume
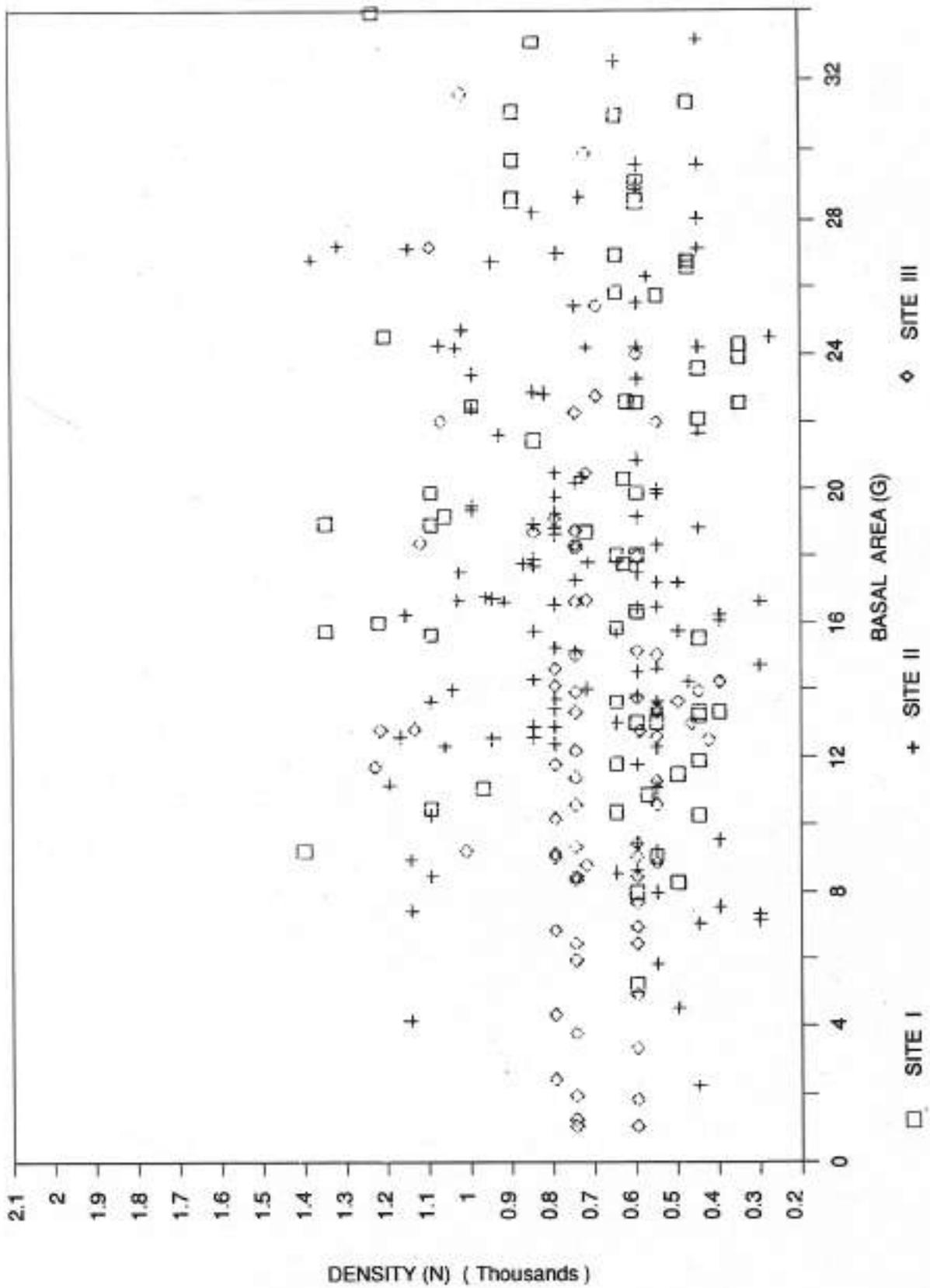
Fig. 13 Relationship Between Basal Area (G) and Stand Density (N)
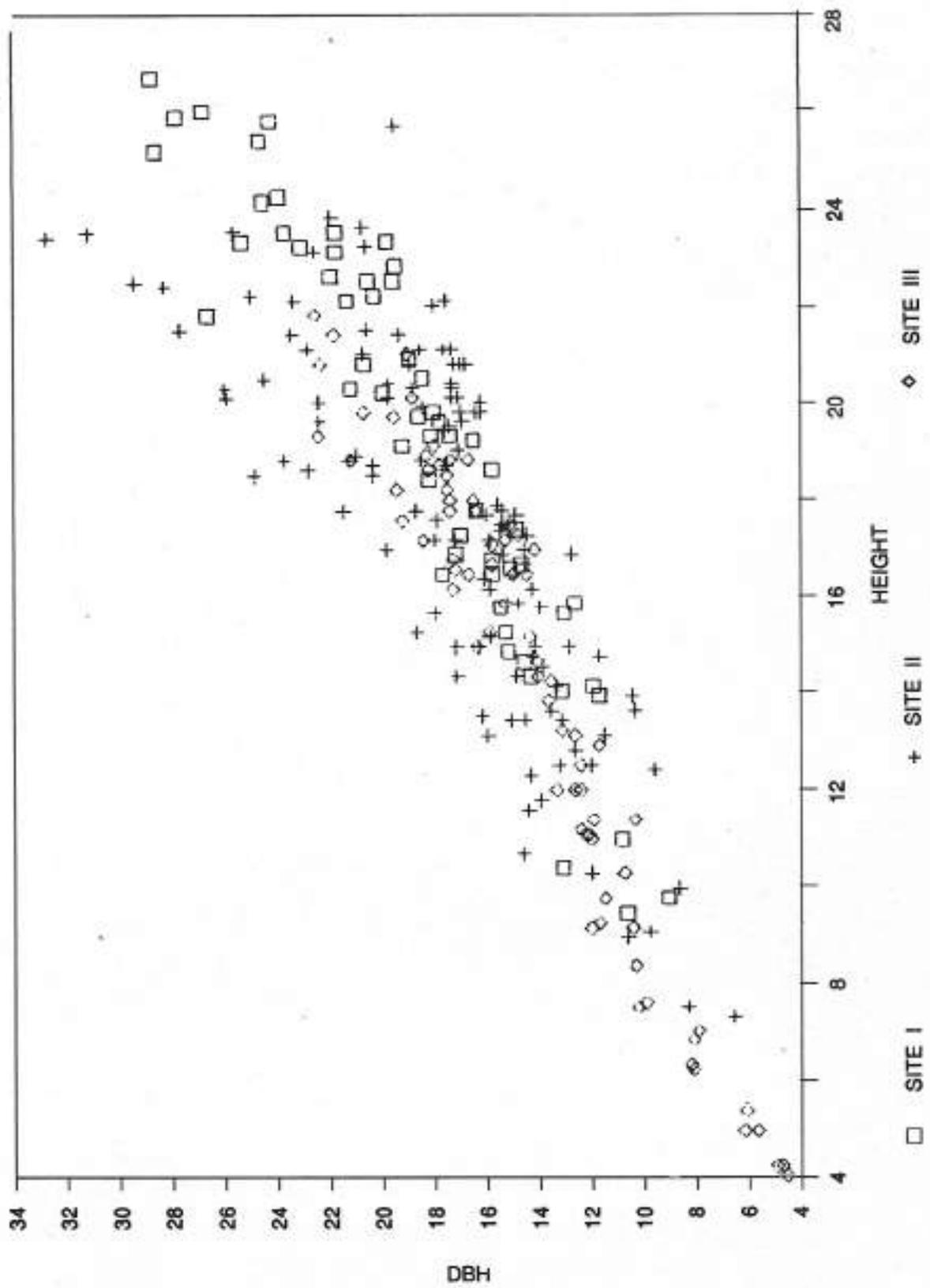
Fig. 14 Relationship Between Height and DBH

Legend: □ SITE I   + SITE II   ◊ SITE III

Axis labels: DBH (vertical), HEIGHT (horizontal)
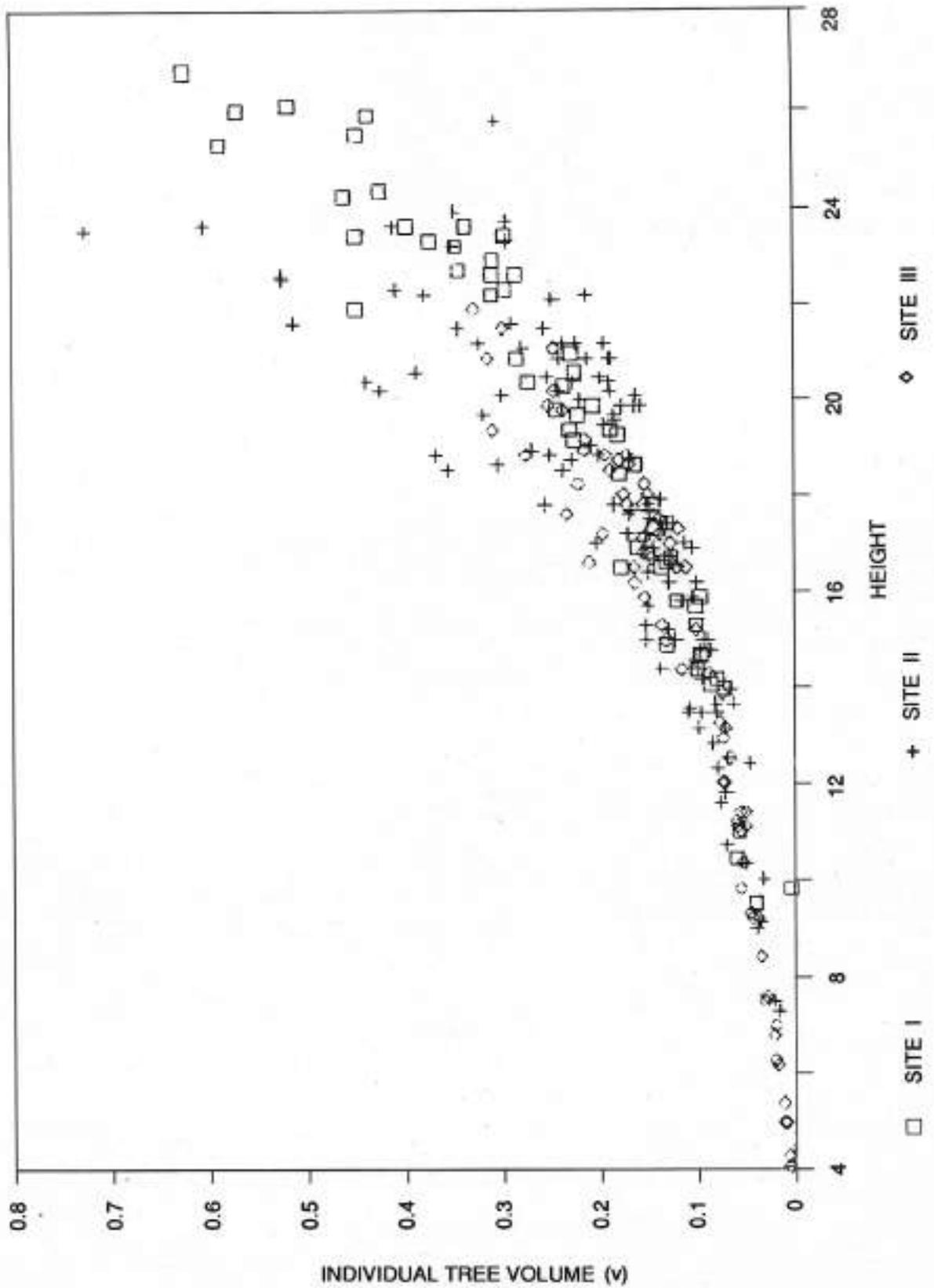
Fig. 15 Relationship Between Height and Individual Tree Volume
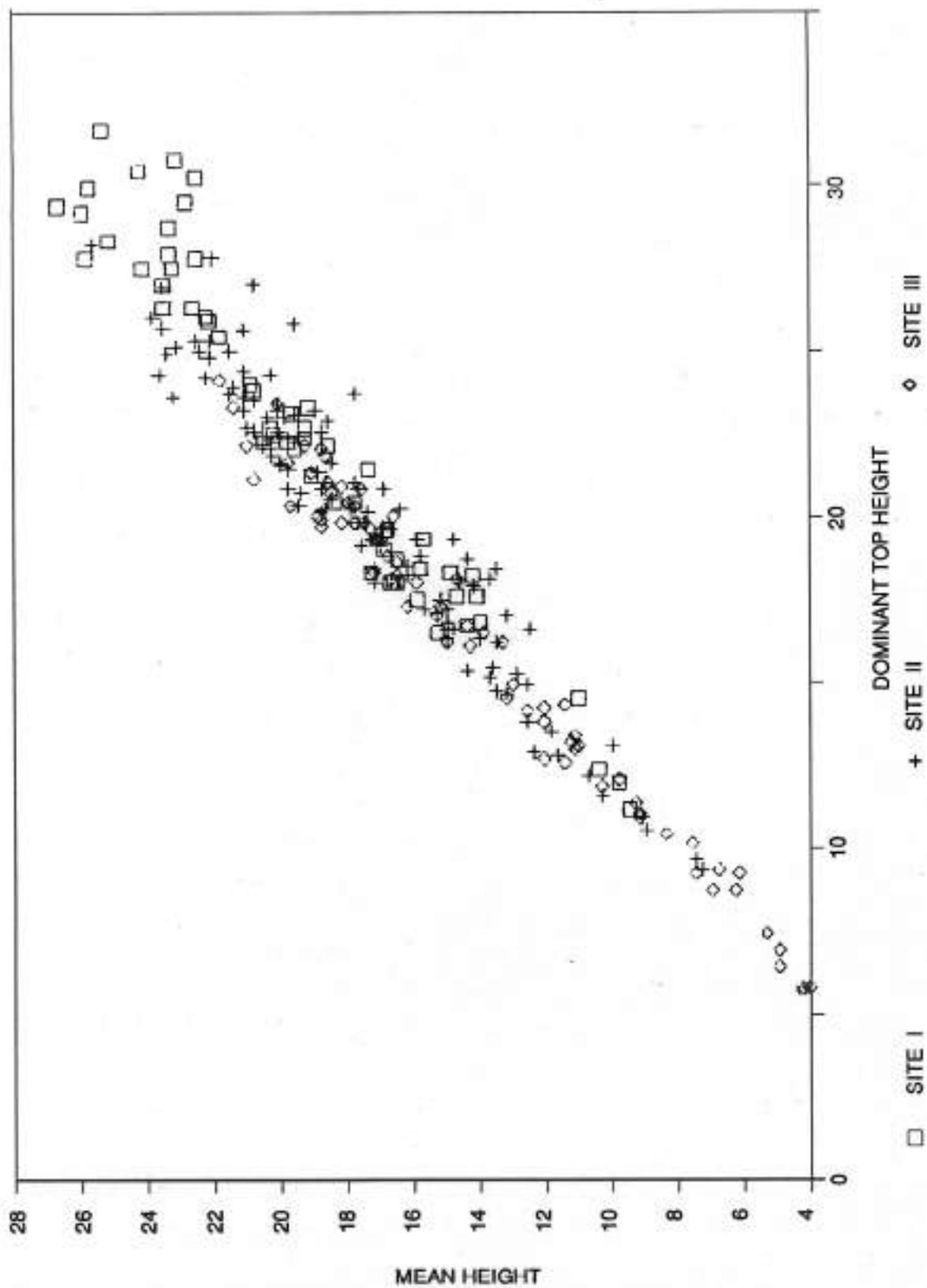
Fig. 16 Relationship Between Dominant Tree Height and Height
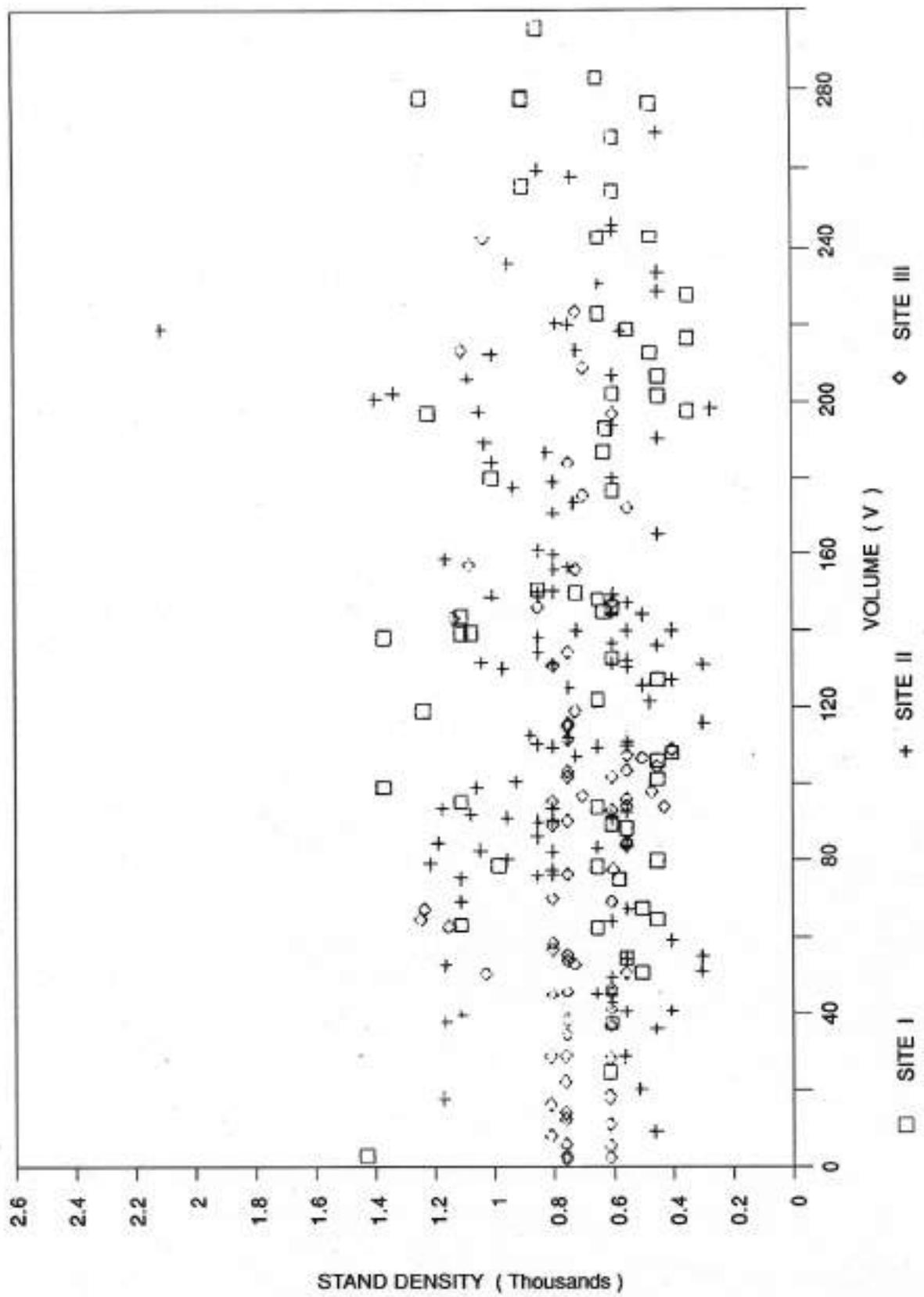
Fig. 17 Relationship Between Stand Volume and Stand Density
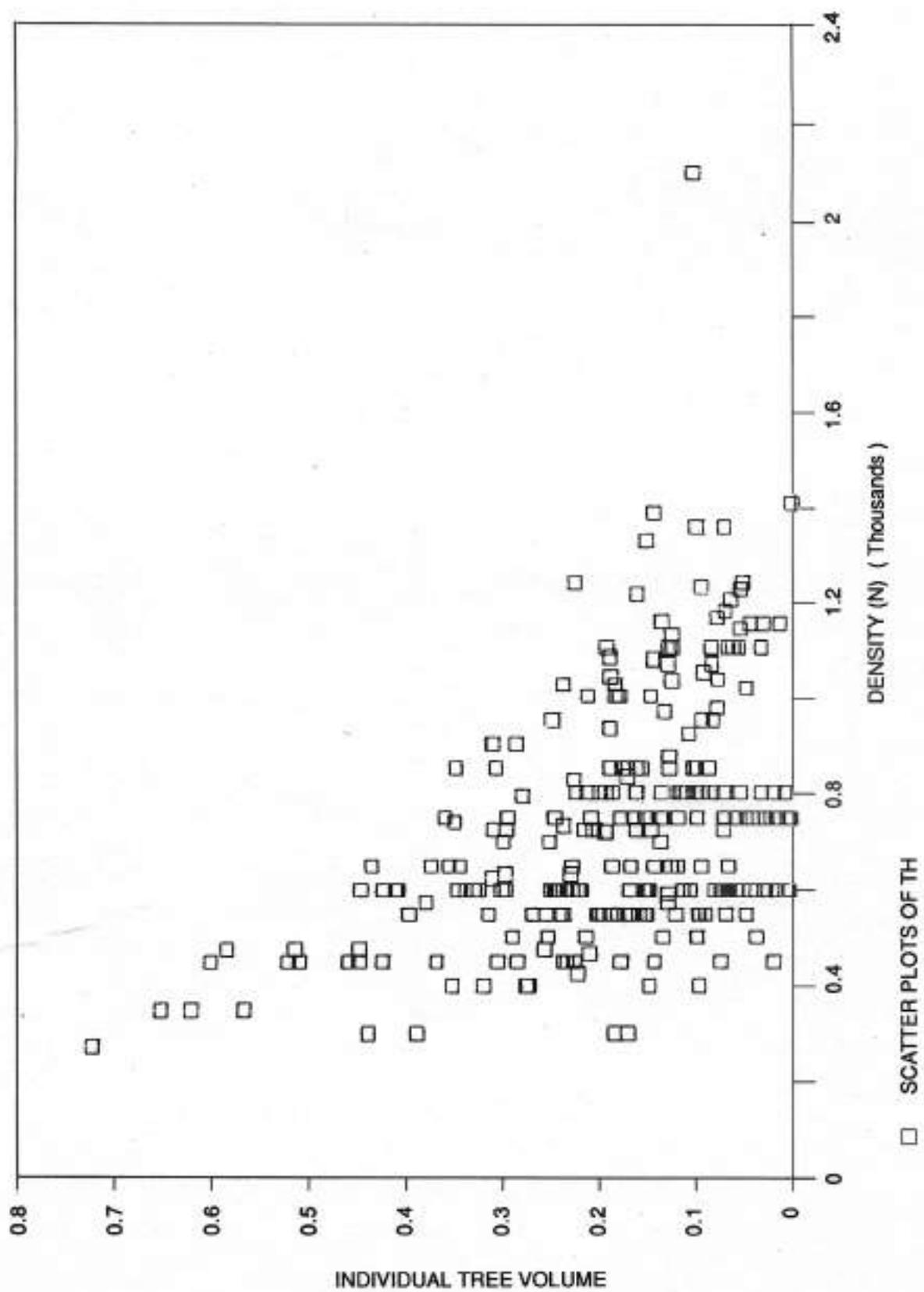
Fig. 18 Relationship Between Stand Density and Individual Tree Volume

DBH WITH MEAN HEIGHT

$$H = 1.3 + D^2/(-1.862227 - 0.138477^*D)^2$$
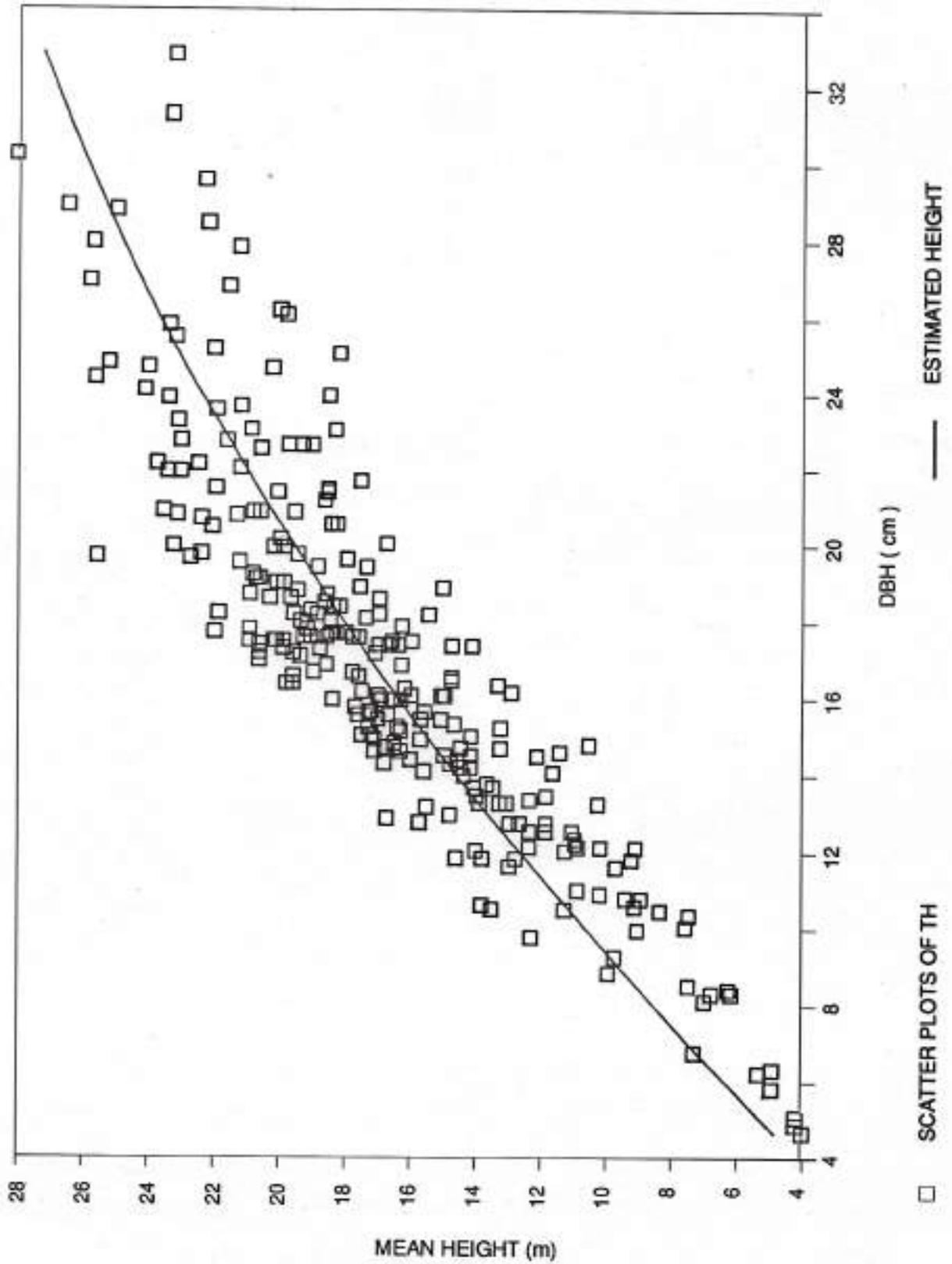
Fig. 19 Relationship Between DBH (D) and Mean Height (H)

ESTIMATED DBH FROM HEIGHT

$$D = 1.862 \sqrt{H - 1.3} / (1 - 0.1385 \sqrt{H - 1.3})$$

HEIGHT (m)

DBH (cm)

Fig. 19, b

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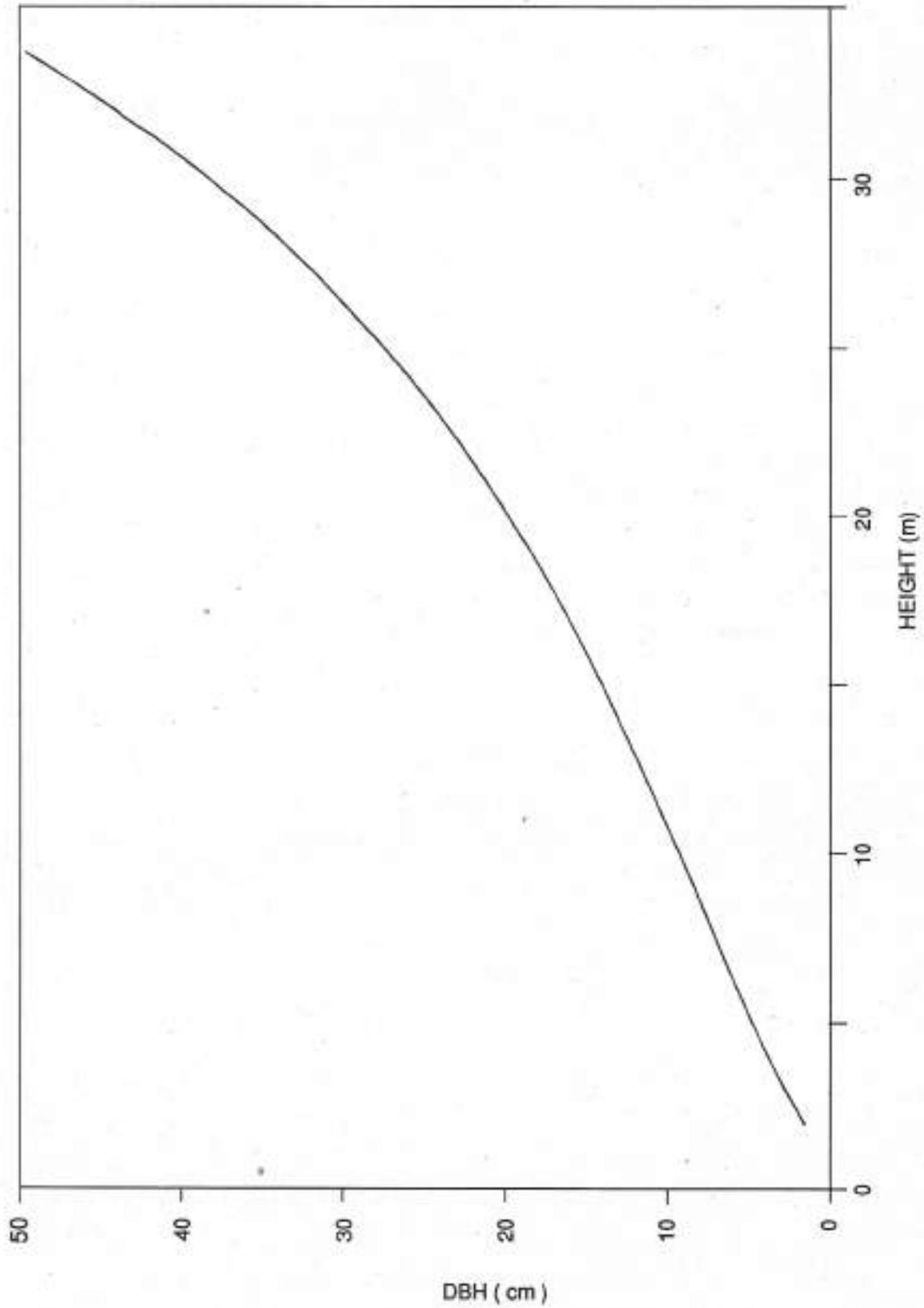
TABLE 1 Materials of PSP and TSP Data.

PL. NO	PLACE	AGE	DBH	TH	v	SPH	BA	V	DTH	SI
1.01	MOMPILIS A	3.3	6.4	6.2	0.012	800	2.9	9.4	8.0	2
1.02	MOMPILIS A	3.8	9.5	8.3	0.028	800	7.0	22.6	10.4	2
1.03	MOMPILIS A	4.2	10.8	10.1	0.053	800	11.0	42.4	12.3	2
1.04	MOMPILIS A	4.7	12.5	11.5	0.070	800	12.4	55.6	14.1	2
1.05	MOMPILIS A	5.3	13.2	14.0	0.094	800	13.2	75.6	17.6	2
1.06	MOMPILIS A	5.8	13.7	14.4	0.102	800	13.2	81.4	17.7	2
1.07	MOMPILIS A	6.7	13.8	15.6	0.115	800	14.0	92.2	18.5	2
1.08	MOMPILIS A	7.0	15.9	16.2	0.147	750	15.4	110.6	19.9	2
1.09	MOMPILIS A	7.9	15.8	17.5	0.165	750	17.5	123.4	20.5	2
1.10	MOMPILIS A	9.0	16.9	18.8	0.206	750	20.3	154.4	22.8	2
1.11	MOMPILIS A	11.0	18.1	19.3	0.231	650	18.9	150.1	22.9	2
2.01	MOMPILIS B	2.8	8.0	6.9	0.018	750	4.1	13.6	8.6	3
2.02	MOMPILIS B	3.3	10.4	9.1	0.037	750	6.8	27.4	10.9	3
2.03	MOMPILIS B	3.8	12.1	11.0	0.049	750	8.7	36.6	12.8	3
2.04	MOMPILIS B	4.3	13.2	11.9	0.071	750	11.7	53.6	13.6	3
2.05	MOMPILIS B	4.8	14.5	14.6	0.101	750	12.8	75.8	16.4	3
2.06	MOMPILIS B	5.3	14.8	14.4	0.107	750	13.4	80.2	17.3	3
2.07	MOMPILIS B	5.8	15.0	16.2	0.121	750	14.4	90.6	18.7	3
2.08	MOMPILIS B	6.6	15.6	17.0	0.143	750	15.4	107.2	20.0	3
2.09	MOMPILIS B	7.5	16.2	17.6	0.153	750	16.9	114.4	20.0	3
2.10	MOMPILIS B	8.6	17.6	18.5	0.177	750	18.9	132.6	21.5	3
2.11	MOMPILIS B	10.6	18.6	19.9	0.242	750	22.4	181.3	23.0	3
3.01	HOBUT A	1.8	8.4	7.4	0.020	450	2.6	9.0	9.5	2
3.02	HOBUT A	2.3	10.6	8.9	0.038	500	4.9	19.0	10.4	2
3.03	HOBUT A	2.8	11.9	10.2	0.049	550	6.2	27.2	11.4	2
3.04	HOBUT A	3.3	13.8	11.7	0.071	550	8.3	38.8	13.3	2
3.05	HOBUT A	3.8	14.7	14.2	0.098	550	9.6	54.0	15.1	2
3.06	HOBUT A	4.3	16.1	14.8	0.121	550	11.4	66.8	16.3	2
3.07	HOBUT A	4.8	17.0	17.0	0.150	550	12.6	82.6	17.7	2
3.08	HOBUT A	5.6	17.7	17.4	0.167	550	13.9	91.6	18.8	2
3.09	HOBUT A	6.5	18.3	18.6	0.198	550	14.9	108.8	20.5	2
3.10	HOBUT A	7.6	19.5	20.2	0.248	500	16.0	124.2	22.0	2
3.11	HOBUT A	8.8	20.3	21.3	0.284	500	17.4	142.2	23.3	2
3.12	HOBUT A	9.6	20.3	21.3	0.282	500	17.3	140.8	22.9	2
4.01	HOBUT B	1.3	5.3	4.8	0.006	700	1.6	4.3	5.9	1
4.02	HOBUT B	1.8	8.4	7.2	0.019	700	3.9	13.4	8.6	1
4.03	HOBUT B	2.3	10.5	8.9	0.035	650	5.8	22.6	10.3	1
4.04	HOBUT B	2.8	12.5	11.0	0.050	650	8.4	32.2	12.8	1
4.05	HOBUT B	3.3	14.4	14.5	0.096	650	10.7	62.2	17.3	1
4.06	HOBUT B	3.9	15.3	15.6	0.119	650	12.1	77.6	18.1	1
4.07	HOBUT B	4.3	16.2	17.6	0.143	650	13.9	92.8	20.1	1
4.08	HOBUT B	5.1	17.2	19.1	0.185	650	16.1	120.4	22.0	1
4.09	HOBUT B	6.0	18.7	20.7	0.225	650	18.2	146.0	23.6	1
4.10	HOBUT B	7.1	20.0	22.0	0.291	600	20.0	174.4	25.6	1
4.11	HOBUT B	8.3	21.4	23.3	0.332	600	22.7	199.0	26.6	1

PL NO	PLACE	AGE	DBH	TH	V	SPH	BA	V	DTH	SI
4.12	HOBUT B	9.1	21.4	23.6	0.330	600	22.9	196.2	26.4	1
5.01	HOBUT C	6.2	16.4	16.8	0.150	800	17.8	120.0	20.9	3
5.02	HOBUT C	6.8	16.6	18.5	0.183	700	18.8	128.3	21.0	3
5.03	HOBUT C	7.3	19.2	19.5	0.213	700	20.1	148.9	20.9	3
5.04	HOBUT C	7.8	19.8	19.5	0.228	700	21.5	159.6	21.3	3
5.05	HOBUT C	8.5	20.4	19.6	0.247	700	22.9	173.0	21.3	3
5.06	HOBUT C	9.4	20.8	20.4	0.264	700	23.7	184.8	22.5	3
5.07	HOBUT C	10.5	21.5	21.2	0.294	700	25.5	205.5	22.9	3
5.08	HOBUT C	11.7	22.2	21.6	0.323	600	24.1	193.8	23.7	3
5.09	HOBUT C	12.5	22.2	21.6	0.322	600	24.0	193.4	22.5	3
6.01	RAMPAYAN	6.7	20.1	18.5	0.225	600	19.3	134.8	19.9	2
6.02	RAMPAYAN	7.2	21.0	18.6	0.246	600	21.0	147.5	19.8	2
6.03	RAMPAYAN	7.5	22.1	19.8	0.296	600	23.4	177.3	21.3	2
6.04	RAMPAYAN	8.3	22.5	20.9	0.318	600	24.3	190.8	22.8	2
6.05	RAMPAYAN	8.3	23.1	21.2	0.340	600	25.6	203.8	23.5	2
6.06	RAMPAYAN	10.3	24.6	22.0	0.402	600	29.0	241.3	23.8	2
6.07	RAMPAYAN	11.5	25.2	23.3	0.404	600	29.6	242.7	25.3	2
6.08	RAMPAYAN	12.5	25.2	23.3	0.404	600	29.3	242.6	23.6	2
7.01	TIMBANG	6.2	21.2	17.6	0.251	550	20.1	138.0	20.7	2
7.02	TIMBANG	6.8	22.5	18.4	0.299	450	19.0	134.5	22.5	2
7.03	TIMBANG	7.3	23.4	18.6	0.363	450	21.8	163.2	22.2	2
7.04	TIMBANG	7.8	25.5	19.8	0.417	450	24.3	187.8	22.8	2
7.05	TIMBANG	8.4	27.2	21.3	0.501	450	28.1	225.3	24.6	2
7.06	TIMBANG	9.4	27.8	22.2	0.512	450	27.2	230.2	24.6	2
7.07	TIMBANG	10.4	28.9	22.3	0.512	450	29.6	230.3	24.9	2
7.08	TIMBANG	11.7	30.6	23.3	0.590	450	33.1	265.5	25.5	2
7.09	TIMBANG	12.5	30.6	23.3	0.588	450	33.1	264.6	24.9	2
8.01	MALIMA A80	4.0	13.6	13.0	0.077	800	11.7	61.2	14.6	3
8.02	MALIMA A80	4.5	14.4	14.7	0.098	800	13.3	78.6	17.0	3
8.03	MALIMA A80	5.0	15.3	15.4	0.120	750	14.5	90.2	17.2	3
8.04	MALIMA A80	5.6	15.7	15.1	0.134	750	15.3	100.6	16.7	3
8.05	MALIMA A80	6.1	16.6	16.8	0.150	750	17.0	112.2	19.1	3
8.06	MALIMA A80	6.6	16.5	17.8	0.157	750	17.0	117.4	19.9	3
8.07	MALIMA A80	7.2	16.9	17.9	0.155	750	18.4	118.6	20.1	3
8.08	MALIMA A80	8.2	17.2	17.8	0.147	750	18.4	110.4	20.1	3
8.09	MALIMA A80	9.3	17.3	18.0	0.151	750	18.5	113.6	20.6	3
8.10	MALIMA A80	10.3	18.0	18.4	0.166	600	15.4	100.6	20.7	3
9.01	MALIMA B80	4.0	13.1	12.4	0.068	650	8.9	44.2	13.6	2
9.02	MALIMA B80	4.5	13.4	13.5	0.082	600	9.0	49.0	14.9	2
9.03	MALIMA B80	5.0	14.1	14.6	0.095	800	12.7	76.8	16.3	2
9.04	MALIMA B80	5.6	14.4	16.8	0.112	800	13.7	89.4	19.3	2
9.05	MALIMA B80	6.1	15.4	17.7	0.136	800	15.5	108.4	19.9	2
9.06	MALIMA B80	6.8	15.8	19.5	0.156	800	16.1	124.8	21.8	2
9.07	MALIMA B80	7.2	16.2	19.6	0.162	800	16.8	129.4	21.1	2
9.08	MALIMA B80	8.2	16.8	20.6	0.185	800	18.8	148.0	22.2	2
9.09	MALIMA B80	9.3	17.1	20.9	0.192	800	19.0	153.6	23.2	2
9.10	MALIMA B80	10.3	17.3	21.9	0.210	800	19.4	168.2	24.4	2

PL NO	PLACE	AGE	DBH	TH	V	SPH	BA	V	DTH	SI
10.01	MALIMA C80	4.0	14.0	14.8	0.088	850	12.9	75.2	16.9	2
10.02	MALIMA C80	4.5	14.1	16.0	0.100	850	13.2	85.2	18.2	2
10.03	MALIMA C80	5.0	14.6	15.7	0.104	850	14.6	88.8	19.0	2
10.04	MALIMA C80	5.6	15.3	17.2	0.128	850	16.0	109.0	19.8	2
10.05	MALIMA C80	6.1	16.0	18.6	0.156	850	17.9	132.4	20.5	2
10.06	MALIMA C80	6.6	16.0	19.8	0.160	850	18.1	136.4	21.2	2
10.07	MALIMA C80	7.2	16.8	19.6	0.174	850	19.1	147.8	22.0	2
10.08	MALIMA C80	8.2	17.1	19.9	0.187	850	23.0	158.6	22.2	2
10.09	MALIMA C80	9.3	17.1	20.2	0.197	800	19.9	157.4	22.6	2
10.10	MALIMA C80	10.3	17.6	20.7	0.208	850	21.4	178.8	23.0	2
11.01	MALIMA A82	2.0	4.9	4.2	0.004	750	1.8	3.0	5.7	3
11.02	MALIMA A82	2.5	6.2	5.3	0.010	800	2.8	7.8	7.3	3
11.03	MALIMA A82	3.0	8.2	6.7	0.020	800	4.7	15.8	9.2	3
11.04	MALIMA A82	3.6	10.3	8.3	0.034	800	7.2	27.2	10.3	3
11.05	MALIMA A82	4.1	11.9	10.9	0.055	800	9.5	43.8	12.9	3
11.06	MALIMA A82	4.6	12.5	13.0	0.071	800	10.5	56.4	14.3	3
11.07	MALIMA A82	5.2	13.4	14.1	0.087	800	12.1	69.6	15.8	3
11.08	MALIMA A82	6.2	14.3	16.3	0.110	800	14.9	88.2	17.9	3
11.09	MALIMA A82	7.2	14.6	17.1	0.118	800	14.4	94.2	19.3	3
11.10	MALIMA A82	8.3	14.9	17.3	0.137	700		95.6	19.5	3
12.01	MALIMA B82	2.0	4.7	4.0	0.003	750	1.4	2.2	5.7	3
12.02	MALIMA B82	2.5	5.8	4.9	0.007	750	2.3	5.6	6.3	3
12.03	MALIMA B82	3.0	8.2	6.1	0.016	750	4.1	12.0	9.1	3
12.04	MALIMA B82	3.6	9.9	7.5	0.028	750	6.3	21.0	10.0	3
12.05	MALIMA B82	4.1	11.9	9.1	0.043	750	8.8	32.4	10.8	3
12.06	MALIMA B82	4.6	12.3	11.1	0.059	750	9.7	44.6	13.0	3
12.07	MALIMA B82	5.2	12.5	11.9	0.074	750	10.9	55.2	14.0	3
12.08	MALIMA B82	6.2	14.2	15.0	0.101	750	12.5	75.8	17.0	3
12.09	MALIMA B82	7.2	14.8	16.3	0.119	750	13.6	89.2	18.3	3
12.10	MALIMA B82	8.3	15.1	17.0	0.136	750	14.2	102.0	19.0	3
13.01	MALIMA C82	2.0	5.1	4.2	0.004	600	1.4	2.6	5.6	3
13.02	MALIMA C82	2.5	6.3	4.9	0.009	600	2.2	5.4	6.8	3
13.03	MALIMA C82	3.0	8.3	6.2	0.018	600	3.7	11.0	8.6	3
13.04	MALIMA C82	3.6	10.2	7.4	0.029	600	5.3	17.4	9.1	3
13.05	MALIMA C82	4.1	11.6	9.2	0.045	600	6.6	26.8	11.2	3
13.06	MALIMA C82	4.6	12.0	11.0	0.058	600	7.3	34.8	13.2	3
13.07	MALIMA C82	5.2	12.3	12.4	0.066	600	8.0	39.6	13.9	3
13.08	MALIMA C82	6.2	13.0	13.1	0.076	600	8.8	45.6	15.9	3
13.09	MALIMA C82	7.2	13.5	13.7	0.074	600	9.4	44.2	16.2	3
13.10	MALIMA C82	8.3	13.9	14.5	0.091	550	9.2	50.2	17.8	3
14.01	DELAYAN A81	3.0	13.2	8.8	0.045	450	7.7	20.4	9.8	2
14.02	DELAYAN A81	3.5	14.3	11.5	0.076	450	7.4	34.0	12.6	2
14.03	DELAYAN A81	4.0	15.8	13.0	0.096	400	7.9	38.2	14.4	2
14.04	DELAYAN A81	4.6	16.6	13.1	0.113	400	8.1	45.0	13.9	2
14.05	DELAYAN A81	5.1	17.8	15.5	0.148	400	9.9	59.0	16.9	2
14.06	DELAYAN A81	5.6	17.8	17.0	0.169	300	7.7	50.6	18.1	2
14.07	DELAYAN A81	6.2	18.5	17.6	0.183	300	7.5	54.8	19.9	2

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PL. NO	PLACE	AGE	DBH	TH	v	SPH	BA	V	DTH	SI
14.08	DELAYAN A81	7.2	20.8	16.8	0.257	200	7.8	51.4	17.9	2
14.09	DELAYAN A81	8.2	22.8	18.0	0.307	150	6.8	46.0	18.5	2
14.10	DELAYAN A81	9.3	25.6	18.7	0.337	150	7.4	50.6	18.6	2
15.01	DELAYAN B81	3.0	12.8	9.5	0.052	550	7.3	28.6	10.5	3
15.02	DELAYAN B81	3.5	13.8	11.6	0.072	550	8.4	39.8	13.4	3
16.03	DELAYAN B81	4.0	14.9	12.8	0.090	650	11.2	58.6	14.5	3
15.04	DELAYAN B81	4.6	15.4	14.3	0.114	600	12.0	68.2	16.5	3
15.05	DELAYAN B81	5.1	15.8	14.9	0.125	600	12.7	75.2	17.4	3
15.06	DELAYAN B81	5.6	16.2	16.3	0.143	600	13.4	85.8	16.1	3
15.07	DELAYAN B81	6.2	16.4	16.4	0.144	600	13.4	66.2	18.1	3
15.08	DELAYAN B81	7.2	17.1	16.6	0.153	600	14.0	91.8	18.5	3
15.09	DELAYAN B81	8.2	17.2	17.6	0.169	550	13.6	93.0	19.5	3
15.10	DELAYAN B81	10.5	20.9	18.6	0.270	400	14.5	107.9	19.8	3
16.01	DELAYAN C81	3.0	14.5	10.8	0.069	800	9.8	41.4	12.0	2
16.02	DELAYAN C81	3.5	16.0	13.4	0.106	800	12.1	63.8	15.2	2
16.03	DELAYAN C81	4.0	18.5	15.1	0.150	600	14.8	90.2	16.8	2
16.04	DELAYAN C81	4.6	18.8	16.6	0.179	600	16.7	107.2	18.9	2
16.05	DELAYAN C81	5.1	19.6	16.8	0.200	550	17.4	110.0	18.8	2
16.06	DELAYAN C81	5.6	20.1	16.3	0.234	550	18.5	126.6	20.2	2
16.07	DELAYAN C81	6.2	20.7	18.7	0.264	550	20.0	145.2	21.0	2
16.08	DELAYAN C81	7.2	24.1	20.3	0.382	300	15.0	114.6	21.8	2
16.09	DELAYAN C81	8.2	25.6	20.1	0.431	300	16.9	129.4	21.5	2
16.10	DELAYAN C81	9.3	26.7	21.1	0.491	200	13.2	98.2	22.2	2
17.01	DELAYAN A83	2.0	10.6	9.4	0.038	600	5.6	23.4	11.0	1
17.02	DELAYAN A83	2.6	13.0	10.3	0.059	600	8.3	35.6	12.2	1
17.03	DELAYAN A83	3.1	14.2	14.2	0.099	550	9.4	54.4	16.4	1
17.04	DELAYAN A83	3.6	15.6	16.3	0.134	500	11.8	67.0	18.4	1
17.05	DELAYAN A83	4.2	17.0	16.7	0.159	550	13.3	87.2	18.7	1
17.06	DELAYAN A83	5.2	19.0	18.9	0.223	450	13.6	100.2	20.9	1
17.07	DELAYAN A83	6.2	20.4	20.6	0.279	450	15.6	125.4	23.4	1
17.08	DELAYAN A83	6.5	22.8	21.8	0.331	500	20.5	165.4	23.3	1
18.01	DELAYAN B83	2.0	10.2	9.1	0.032	500	4.0	16.0	9.8	1
18.02	DELAYAN B83	2.6	13.2	10.3	0.052	500	6.3	26.2	11.5	1
18.03	DELAYAN B83	3.1	15.1	15.1	0.101	500	8.6	50.4	16.2	1
18.04	DELAYAN B83	3.6	16.8	17.1	0.143	450	10.6	64.2	18.0	1
18.05	DELAYAN B83	4.2	18.0	18.2	0.176	450	12.2	79.2	20.1	1
18.06	DELAYAN B83	5.2	19.7	20.0	0.233	450	13.5	105.0	22.1	1
18.07	DELAYAN B83	6.2	20.9	20.1	0.268	400	13.6	107.0	22.3	1
18.08	DELAYAN B83	6.5	23.2	22.3	0.354	450	19.3	159.1	24.7	1
19.01	KARAMATOI A	7.0	23.8	24.4	0.411	550	24.0	226.0	27.6	1
19.02	KARAMATOI A	7.7	23.3	23.3	0.392	550	25.8	215.4	25.9	1
19.03	KARAMATOI A	8.8	24.1	23.9	0.452	450	22.2	203.4	27.1	1
19.04	KARAMATOI A	9.7	24.9	23.1	0.441	450	23.7	198.4	27.5	1
19.05	KARAMATOI A	11.5	24.1	23.8	0.439	450	22.6	197.7	27.8	1
20.01	KARAMATOI B	7.0	25.4	24.1	0.507	350	20.1	177.4	27.1	1
20.02	KARAMATOI B	7.7	26.4	24.9	0.574	350	21.1	201.0	27.5	1
20.03	KARAMATOI B	8.8	27.3	25.8	0.556	350	22.7	194.5	27.4	1

PL.NO	PLACE	AGE	DBH	TH	v	SPH	BA	V	DTH	SI
20.04	KARAMATOI B	9.7	28.2	26.4	0.610	350	24.0	213.4	28.9	1
20.05	KARAMATOI B	10.7	29.5	26.0	0.641	350	24.4	224.4	30.2	1
21.01	KARAMATOI C	7.0	21.4	21.9	0.334	680	26.1	227.2	27.6	1
21.02	KARAMATOI C	7.7	21.6	22.4	0.338	650	25.9	219.6	25.9	1
21.03	KARAMATOI C	8.8	22.7	23.0	0.369	650	27.0	239.6	27.1	1
21.04	KARAMATOI C	9.7	23.5	24.0	0.418	600	28.6	250.6	29.9	1
21.05	KARAMATOI C	10.7	24.2	25.1	0.440	600	29.1	264.0	31.1	1
22.01	BAHMURA A	8.6	19.5	19.8	0.221	750	23.4	166.0	22.5	1
22.02	BAHMURA A	9.5	18.1	23.3	0.295	750	26.5	221.6	26.4	1
22.03	BAHMURA A	10.6	19.2	24.9	0.353	750	26.3	265.0	26.5	1
22.04	BAHMURA A	11.5	23.8	25.5	0.429	650	31.0	278.8	28.4	1
22.05	BAHMURA A	12.5	25.2	26.9	0.491	600	31.4	294.8	31.1	1
23.01	BAHMURA B	8.6	16.8	17.0	0.170	900	21.5	152.6	23.9	1
23.02	BAHMURA B	9.5	18.1	19.1	0.212	900	24.9	190.6	24.3	1
23.03	BAHMURA B	10.6	19.2	22.6	0.304	900	29.7	273.4	29.0	1
23.04	BAHMURA B	11.5	20.2	22.3	0.304	900	31.1	273.8	29.7	1
23.05	BAHMURA B	12.5	21.4	22.9	0.342	850	33.0	290.6	30.2	1
24.01	BAHMURA C	8.6	15.2	17.6	0.147	1000	19.6	146.6	23.3	2
24.02	BAHMURA C	9.5	16.7	19.4	0.181	1000	22.5	181.4	25.4	2
24.03	BAHMURA C	10.6	17.0	20.6	0.208	1000	23.5	208.8	26.6	2
24.04	BAHMURA C	11.5	17.6	21.8	0.245	950	26.6	232.4	27.4	2
24.05	BAHMURA C	12.5	19.2	25.4	0.301	850	28.3	255.8	27.8	2
25.01	BUNANG A	2.4	6.7	7.2	0.015	1150	4.5	17.2	9.2	2
25.02	BUNANG A	3.4	8.7	9.9	0.031	1150	7.8	36.0	12.9	2
25.03	BUNANG A	4.3	9.6	12.3	0.046	1150	9.3	52.4	16.3	2
25.04	BUNANG A	5.4	10.3	13.5	0.062	1100	10.6	66.6	17.8	2
26.01	BUNANG B	2.4	9.6	9.0	0.034	1100	8.8	37.8	10.6	2
26.02	BUNANG B	3.4	11.9	12.4	0.068	1100	13.9	74.6	14.7	2
26.03	BUNANG B	4.3	13.3	15.6	0.102	1100	17.5	112.6	19.0	2
26.04	BUNANG B	5.4	14.7	17.5	0.147	1000	19.5	146.6	19.5	2
27.01	BUNANG C	2.4	10.8	10.9	0.057	1100	10.8	62.6	14.3	1
27.01	BUNANG C	3.4	13.0	13.9	0.085	1100	15.9	94.0	17.3	1
27.01	BUNANG C	4.3	14.7	17.2	0.129	1100	20.0	141.6	21.1	1
27.01	BUNANG C	5.4	16.3	19.0	0.177	1000	22.6	177.4	22.9	1
28.01	PUNTEH A	4.5	15.6	16.6	0.147	600	13.3	88.4	19.3	1
28.02	PUNTEH A	5.8	17.6	19.4	0.218	600	16.5	131.0	21.7	1
28.03	PUNTEH A	6.5	18.4	19.5	0.240	600	18.2	143.8	22.7	1
28.04	PUNTEH A	7.5	18.8	20.0	0.255	600	19.3	152.8	23.7	1
29.01	PUNTEH B	4.5	14.4	16.9	0.114	1150	19.8	130.6	21.8	2
29.02	PUNTEH B	5.8	15.6	17.9	0.145	1150	22.7	167.2	21.3	2
29.03	PUNTEH B	6.5	16.0	18.6	0.173	1050	23.1	181.4	21.3	2
29.04	PUNTEH B	7.5	16.3	19.3	0.188	1000	24.0	187.8	22.0	2
30.01	PUNTEH C	4.5	15.7	16.0	0.127	650	13.3	82.4	17.9	2
30.02	PUNTEH C	5.8	17.3	18.5	0.167	650	15.9	108.4	20.7	2
30.03	PUNTEH C	6.5	18.2	19.7	0.216	600	16.7	129.6	22.6	2
30.04	PUNTEH C	7.5	18.7	20.6	0.237	600	17.7	142.4	23.1	2
31.01	LUMAT	1.1	4.4	3.9		1400	2.0		5.4	1

PL NO	PLACE	AGE	DBH	TH	V	SPH	BA	V	DTH	SI
31.02	LUMAT	2.0	9.1	9.7	0.002	1400	9.6	3.0	11.8	1
31.03	LUMAT	3.0	11.6	13.8	0.072	1350	16.0	97.7	16.5	1
31.04	LUMAT	4.0	12.9	15.5	0.101	1350	19.1	138.4	19.0	1
32.01	LANGKON G	4.0	12.2	11.4	0.072	600	7.6	42.9	13.6	3
32.02	LANGKON G	5.4	13.9	14.2	0.115	600	9.8	68.8	16.4	3
32.03	LANGKON G	6.3	15.1	15.7	0.151	550	10.9	83.2	17.7	3
32.04	LANGKON G	7.2	15.6	16.9	0.153	550	11.6	93.9	19.0	3
32.05	LANGKON G	8.2	16.3	17.8	0.173	550	12.9	94.5	20.1	3
32.06	LANGKON G	9.6	17.3	18.3	0.186	550	13.7	102.4	20.4	3
32.07	LANGKON G	10.5	17.6	18.9	0.211	500	13.8	105.6	21.0	3
33	DELAYAN	6.0	17.8	19.6	0.204	725	18.9	147.7	21.9	1
34	PATAU	6.0	18.2	20.3	0.222	1233	33.9	273.7	21.9	1
35	MALIMA	6.0	14.4	16.5	0.126	1033	17.7	129.7	19.3	2
36	MALIMA	6.0	11.6	12.8	0.073	800	9.4	58.2	14.7	3
37	MALIMA	8.0	17.1	20.1	0.167	933	21.7	174.7	21.7	2
38	KARAMATOI	8.0	18.3	20.9	0.233	733	20.5	171.1	24.0	2
39	KARAMATOI	8.0	14.4	18.9	0.170	833	15.9	141.6	26.7	1
40	KARAMATOI	8.0	17.0	18.4	0.207	467	13.3	96.7	19.7	3
41	KARAMATOI	8.0	19.5	23.1	0.291	633	20.4	184.3	28.3	1
42	TANAKI	4.0	10.7	10.2	0.052	1233	12.0	64.1	11.7	3
43	TANAKI	4.0	11.4	13.0	0.071	1175	12.9	83.4	16.7	2
44	TANAKI	4.0	14.5	16.5	0.125	1100	19.1	137.1	17.7	1
45	PUNTEH	6.0	17.1	16.0	0.161	800	19.3	129.0	17.0	3
46	PUNTEH	6.0	14.3	17.1	0.133	967	17.0	126.2	19.0	2
47	PUNTEH	6.0	17.9	19.1	0.226	633	16.0	143.0	22.3	1
48	PUNTEH	4.0	10.4	13.8	0.065	1200	11.5	78.3	16.0	2
49	PUNTEH	5.0	15.2	17.3	0.146	725	14.3	105.9	19.5	2
50	PUNTEH	5.0	12.7	14.8	0.093	1050	14.3	97.7	16.5	2
51	PUNTEH	6.0	15.2	16.7	0.143	1380	26.9	197.4	19.4	2
52	PUNTEH	6.0	15.7	17.0	0.151	1320	27.3	198.9	19.2	2
54	KINARUT	6.0	12.6	14.9	0.090	1050	13.7	94.1	14.0	3
55	BONGKOL	8.0	18.2	17.0	0.193	550	15.3	106.3	18.0	3
56	ULU KUKUT	8.0	26.2	21.6	0.441	475	26.7	209.5	25.0	1
57	KINARUT	5.0	15.7	15.0	0.128	875	16.0	111.6	17.2	2
58	BONGKOL	7.0	17.2	19.3	0.182	1025	24.8	186.6	20.0	2
59	DELAYAN	7.0	17.4	19.2	0.192	720	18.0	138.1	20.4	2
60	PATAU	5.0	15.8	18.4	0.160	1210	24.6	193.9	21.8	1
61	PATAU	4.0	11.4	9.7	0.055	1220	13.1	66.8	11.9	3
62	MALIMA	5.0	11.6	14.6	0.085	1067	12.6	90.7	19.0	2
63	MALIMA	9.0	16.9	19.9	0.187	1040	24.2	194.1	22.2	2
64	MALIMA	9.0	16.6	20.6	0.188	1080	24.3	202.6	22.2	2
65	BAHMULA	10.0	21.6	23.6	0.344	740	28.7	254.2	25.6	2
66	BAHMULA	10.0	19.3	22.3	0.280	900	28.6	251.9	27.4	1
67	TANAKI	4.0	14.9	16.4	0.129	1067	19.3	137.6	17.7	1
68	KINARUT	4.0	12.3	11.9	0.073	725	9.2	52.7	12.5	3
69	KINARUT	8.0	14.0	16.8	0.125	1125	18.6	141.0	19.0	3
70	KINARUT	8.0	11.2	11.6	0.064	850	10.2	61.2	16.5	3

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PL.NO	PLACE	AGE	DBH	TH	V	SPH	BA	V	DTH	SI
71	LUMAT	8.0	19.2	18.0	0.219	425	12.8	92.9	19.5	3
72	LUMAT	8.0	17.5	16.3	0.175	850	21.6	148.8	17.7	1
73	LUMAT	4.0	12.5	15.7	0.096	1225	16.3	117.5	17.2	1
74	LUMAT ¨	4.0	11.8	14.0	0.060	975	11.4	77.8	17.8	1
75	SARANG	8.0	24.5	18.3	0.350	650	32.4	227.3	21.3	2
76	SARANG	4.0	14.9	13.3	0.095	950	17.0	90.0	14.5	2
77	ULU KUKUT	4.0	17.0	14.8	0.150	600	14.1	89.8	16.0	2
78	LANGKON	4.0	12.5	12.7	0.083	950	12.9	79.3	15.0	2
79	TIMBANG(NR)	8.0	12.6	16.7	0.104	2075	28.1	215.0	20.5	2
80	ULU KUKUT	4.0	15.0	14.7	0.129	575	11.2	74.4	18.0	1
81	TOPOROI	8.0	19.5	19.9	0.237	550	16.7	130.6	23.0	2
82	KINARUT	6.0	10.3	11.3	0.049	1017	9.6	50.1	14.1	3
83	KINARUT	6.0	14.4	13.3	0.108	922	16.9	98.3	18.1	2
85	MANDAHAN	5.6	17.0	14.2	0.136	1153	27.2	156.3	18.4	2
86	TIMBANG	4.5	13.0	13.3	0.079	1181	16.5	92.2	15.8	2
87	LANGKON	6.0	16.2	14.8	0.129	594	13.1	76.9	15.9	3
88	LANGKON	8.0	20.4	20.8	0.274	792	27.1	217.1	22.3	2
89	MANTANAU	3.5	14.2	12.2	0.079	1036	16.9	81.6	12.7	2
90	KARAMATOI	7.8	9.3	13.8	0.049	3913	29.3	190.1	18.7	3
92	BUNANG	3.8	11.8	11.3	0.055	1139	13.1	62.4	12.4	3
93	ULU KUKUT	23.0	33.6	21.5					23.1	3
94	RAMPAYAN	12.0	22.1	19.1	0.303	725	29.9	220.0	21.8	3
95	HOBUT	9.0	16.5	16.3	0.162	725	16.9	117.4	18.3	3
96	HOBUT	9.0	15.8	16.5	0.144	1075	22.1	154.8	17.6	3
97	ULU KUKUT	9.0	28.1	24.9	0.573	475	31.4	272.4	27.9	1
98	KUMBATANG	10.0	17.4	20.9	0.221	800	20.6	176.4	25.2	2
99	KUMBATANG	10.0	19.6	20.1	0.223	825	23.0	184.2	23.9	2
100	LAJONG	9.0	19.0	17.4	0.230	450	14.2	103.4	20.5	3
101	LAJONG	9.0	22.2	22.9	0.346	400	16.3	138.3	24.7	2
102	MOMPILIS	11.0	19.3	19.5	0.233	1025	31.6	239.1	20.0	3
103	MOMPILIS	11.0	18.1	18.7	0.212	725	20.6	153.8	19.7	3
104	TIMUG	10.0	19.1	21.2	0.252	475	14.5	119.8	23.5	2
105	DELAYAN	8.0	23.0	21.9	0.374	575	26.4	215.0	24.9	2
106	BUNANG	7.0	20.3	23.0	0.289	750	25.5	216.9	23.2	2
107	PUNTEH	9.0	22.0	20.6	0.309	550	22.1	169.8	20.8	3
108	MALIMA	9.0	20.4	23.4	0.290	725	24.3	210.0	23.9	2
109	MALIMA	8.0 ·	21.0	21.9	0.305	625	22.7	190.4	25.5	1
110	PATAU	10.0	18.8	20.8	0.242	600	18.2	145.3	21.8	3
111	BAHMULA	13.0	16.6	19.5	0.210	767	20.2	161.2	22.4	
112	KARAMATOI	11.0	26.3	25.7	0.505	475	26.8	239.8	28.7	1
113	PUNTEH	8.0	22.1	19.4	0.313	400	16.5	125.3	22.7	2
114	PUNTEH	9.0	17.2	18.8	0.191	1100	27.2	209.9	21.7	3
115	PUNTEH	7.0	18.2	14.3	0.167	525	14.3	87.6	16.2	3
116	TANAKI	7.0	16.5	18.6	0.169	650	16.9	143.8	19.4	3
117	KARAMATOI	11.0	32.1	23.2	0.710	275	24.6	195.3	24.5	2
118	SDK. GUM GUM	23.0	42.3	30.6					30.6	

TABLE 2 Value Of Dominant Tree Height in Each Site Index and Age

AGE\SI	17	18	19	20	21	22	23	24	25	26	27	28	29
1	2.5	2.9	3.3	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.3	6.7	7.1
2	3.9	4.8	5.8	6.4	7.3	8.1	8.9	9.8	10.6	11.4	12.3	13.1	13.9
3	6.6	7.6	8.5	9.5	10.5	11.4	12.4	13.3	14.3	15.2	16.2	17.1	18.1
4	9.3	10.3	11.3	12.3	13.3	14.3	15.2	16.2	17.2	18.2	19.2	20.2	21.2
5	11.7	12.7	13.7	14.7	15.7	16.7	17.7	18.6	19.7	20.7	21.7	22.7	23.7
6	13.8	14.8	15.8	16.8	17.8	18.7	19.8	20.7	21.8	22.8	23.8	24.7	25.7
7	15.5	16.5	17.5	18.5	19.5	20.5	21.5	22.5	23.5	24.5	25.5	26.5	27.5
8	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
9	18.3	19.3	20.3	21.3	22.3	23.3	24.3	25.3	26.3	27.3	28.3	29.3	30.3
10	19.3	20.3	21.3	22.3	23.3	24.4	25.3	26.3	27.3	28.3	29.4	30.3	31.3
11	20.2	21.2	22.2	23.2	24.2	25.2	26.3	27.2	28.2	29.2	30.2	31.2	32.2
12	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0
13	21.7	22.7	23.7	24.7	25.7	26.7	27.7	28.7	29.7	30.7	31.7	32.7	33.7
14	22.2	23.2	24.2	25.2	26.2	27.2	28.2	29.2	30.3	31.2	32.2	33.2	34.2
15	22.7	23.7	24.7	25.7	26.7	27.7	28.7	29.7	30.7	31.7	32.7	33.7	34.7

TABLE 3 COEFFICIENT TABLE IN EACH EQUATION

EQUATION	SITE CLASS	a	b	R^2
$H = a + b \cdot DTH$	I	1.173	0.805	0.91
	II	- 0.48	0.904	0.92
	III	- 1.67	0.984	0.98
	TOTAL	-0.168	0.882	0.95
$D = -a\sqrt{H-1.3} / (1+b\sqrt{H-1.3})$		-1.862	-0.1385	0.83
	I	9068.8	-0.9042	0.49
$N = aD^b$	II	8709.7	-0.8072	0.34
	III	1023.1	-0.1446	0.05
	TOTAL	2608.4	-0.4787	0.21
	I	0.00003375	2.9989	0.82
$v = aD^b$	II	0.00015470	2.4607	0.94
	III	0.00003680	2.9732	0.98
	TOTAL	0.00005824	2.8047	0.93

TABLE 4

SITE I	MEAN		HA					
AGE	D	H	N	V	G	Vcel	Vmai	PV
1	5.26	5.43	1100	6.98	2.39		6.98	
2	9.87	10.65	1000	38.73	7.66	31.76	19.37	81.99
3	13.21	14.10	879	76.08	12.05	37.35	25.36	49.09
4	16.07	16.76	736	107.55	14.94	31.47	26.89	29.26
5	18.70	18.95	641	138.91	17.64	31.36	27.78	22.57
6	21.14	20.78	574	169.60	20.17	30.69	28.27	18.10
7	23.41	22.33	524	199.16	22.55	29.56	28.45	14.84
8	25.49	23.65	485	227.09	24.76	27.93	26.39	12.30
9	27.40	24.76	454	253.04	26.80	25.95	28.12	10.25
10	29.14	25.71	429	277.15	28.67	24.11	27.71	8.70
11	30.70	26.51	410	298.93	30.36	21.78	27.18	7.29
12	32.09	27.19	393	318.50	31.87	19.56	26.54	6.14
13	33.34	27.78	380	336.15	33.23	17.65	25.86	5.25
14	34.42	28.26	369	351.52	34.41	15.37	25.11	4.37
15	35.38	28.68	360	365.16	35.46	13.64	24.34	3.73

TABLE 5

SITE II	MEAN		HA					
AGE	D	H	N	V	G	Vcel	Vmai	PV
1	4.03	4.07	1100	3.22	1.40		3.22	
2	7.26	7.71	1010	16.27	4.18	13.05	8.14	60.19
3	9.95	10.74	940	37.25	7.32	20.98	12.42	56.31
4	12.37	13.29	880	63.81	10.59	26.56	15.95	41.62
5	14.60	15.43	770	87.25	12.90	23.44	17.45	26.86
6	16.65	17.25	693	110.96	15.09	23.71	18.49	21.37
7	18.53	18.81	635	134.27	17.14	23.30	19.18	17.35
8	20.24	20.12	592	156.53	19.04	22.27	19.57	14.22
9	21.78	21.23	557	177.38	20.79	20.85	19.71	11.75
10	23.18	22.18	530	196.86	22.39	19.48	19.69	9.90
11	24.42	22.99	508	214.54	23.83	17.67	19.50	8.24
12	25.52	23.67	490	230.46	25.12	15.92	19.20	6.91
13	26.50	24.25	476	244.85	26.27	14.40	18.83	5.86
14	27.35	24.73	464	257.41	27.28	12.56	18.39	4.88
15	28.09	25.15	454	268.56	28.16	11.15	17.90	4.15

TABLE 6

SITE III	MEAN		HA						
AGE	D	H	N	V	G	Vcal	Vmai	PV
1	2.65	2.71	1100	1.01	0.60		1.01	
2	4.68	4.77	1050	4.73	1.80	3.72	2.37	78.66
3	6.96	7.37	1010	14.41	3.84	9.67	4.80	67.14
4	9.10	9.79	980	30.13	6.37	15.72	7.53	52.17
5	11.06	11.92	964	51.25	9.26	21.13	10.25	41.22
6	12.85	13.75	854	68.61	11.08	17.36	11.44	25.30
7	14.44	15.28	777	85.47	12.73	16.86	12.21	19.72
8	15.88	16.59	719	101.94	14.27	16.47	12.74	16.15
9	17.18	17.70	675	117.40	15.66	15.47	13.04	13.17
10	18.34	18.66	641	131.88	16.93	14.48	13.19	10.98
11	19.36	19.46	613	145.02	18.07	13.14	13.18	9.06
12	20.26	20.14	591	156.85	19.07	11.83	13.07	7.54
13	21.06	20.72	573	167.54	19.97	10.69	12.89	6.38
14	21.74	21.20	558	176.86	20.75	9.32	12.63	5.27
15	22.34	21.62	546	185.13	21.43	8.27	12.34	4.47

TABLE 7

SUMMARY OF ENVIROMENTAL FACTORS IN SAMPLING PLOTS

PLOT NO.	LOCATION	SI	SOIL (A HOLIZON)				SOIL (B HOLIZON)				SOIL TYPE	TERRAIN	SLOPE	VEG TYPE	CLIMATE TYPE
			DEP	COLOR	TEX	STR	DEP	COLOR	TEX	STR					
1	MOMPILIS	21	10	10YR4/4	SL	GR	<50	2.5Y5/6	SCL	NU	TP	SL. CVX	17	2	1
2	MOMPILIS	21	15	10YR5/3	SCL	GR	<50	10YR6/8	SCL	NU	TLP	SL. CVX	10	2	1
3	HOBUT	23	15	10YR5/1	SL	GR	<50	10YR7/1	S	GR	SBG	FLAT	0	3	1
4	HOBUT	26	10	10YR5/2	S	GR	<50	10YR7/1	SL	GR	SBG	FLAT	0	2	1
5	HOBUT	22	15	10YR5/1	SL	GR	<50	10YR8/1	SL	GR	KPL	FLAT	0	2	1
6	RAMPAYAN	22	20	2.5Y5/4	LiC	GR	<50	10YR7/8	LiC	NU	KMS	FLAT	3	2	1
7	TIMBANG	23	25	10YR3/3	SCL	GR	<50	10YR4/6	SCL	NU	TLP	SL.CCV	5	2	1
8	MALIMA	20	20	10YR5/1	SL	GR	<50	7.5YR8/2	SL	MS	KMT	FLAT	0	3	4
9	MALIMA	22	20	10YR5/1	SL	GR	<50	7.5YR8/2	SL	MS	KMT	FLAT	0	3	4
10	MALIMA	22	20	10YR5/1	SL	GR	<50	7.5YR8/2	SL	MS	KMT	FLAT	0	3	4
11	MALIMA	19	20	10YR5/1	SL	GR	10	7.5YR8/2	SL	MS	KMT	FLAT	0	3	4
12	MALIMA	19	20	10YR5/1	SL	GR	10	7.5YR8/2	SL	MS	KMT	FLAT	0	3	4
13	MALIMA	17	15	10YR6/1	SL	GR	<50	10YR8/1	SL	MS	KMT	FLAT	0	3	4
14	DELAYAN	23	10	10YR5/4	SL	GR	<50	10YR7/6	SL	BL	PIU	FLAT	0	2	4

PLOT NO.	LOCATION	SI	SOIL (A HORIZON)				SOIL (B HORIZON)				SOIL TYPE	TERRAIN	SLOPE	VEG TYPE	CLIMATE TYPE
			DEP	COLOR	TEX	STR	DEP	COLOR	TEX	STR					
15	DELAYAN	19	10	10YR5/4	SL	GR	<50	10YR7/6	SL	BL	PIU	FLAT	5	2	4
16	DELAYAN	21	10	10YR5/4	SL	GR	<50	10YR7/6	SL	BL	PIU	FLAT	0	2	4
17	DELAYAN	23	10	10YR5/4	SCL	GR	<50	10YR7/4	SCL	NU	PIU	SL.CVX	10	2	4
18	DELAYAN	24	15	10YR4/4	SCL	GR	<50	2.5YR7/4	SCL	NU	PIU	SL.CCV	5	1	4
19	KARAMATOI	26	30	10YR5/3	SCL	GR	<50	10YR7/8	SL	NU	PIU	SL.CVX	8	1	4
20	KARAMATOI	26	20	10YR5/4	SL	GR	<50	10YR6/4	SL	GR	TLP	SL.CCV	5	1	4
21	KARAMATOI	26	20	10YR5/4	SL	GR	<50	10YR6/4	SL	GR	TLP	SL.CCV	5	1	4
22	BAHMULA	22	20	10YR5/4	LIC	GR	<50	10YR6/8	LIC	NU	PIU	FLAT	0	1	4
23	BAHMULA	23	15	10YR5/4	LIC	GR	<50	10YR7/4	C	NU	PIU	FLAT	0	1	4
24	BAHMULA	23	15	10YR4/3	CL	GR	<50	7.5YR6/6	CL	NU	PIU	FLAT	0	3	4
29	PUNTEH	24	10	5YR5/6	LIC	GR	<50	7.5YR6/4	LIC	NU	KMS	TOP	20	1	4
30	PUNTEH	24	10	5YR5/6	LIC	GR	<50	7.5YR6/4	LIC	NU	KMS	TOP	20	1	4
32	LANKONG	20	30	7.5YR5/1	SL	GR	<50	10YR6/1	SL	MS	KPL	FLAT	0	2	1
34	PATAU	25	14	10YR6/4	CL	GR	<50	10YR7/6	LIC	NU	TLP	SL.CCV	35	2	4
36	MALIMA	18	15	10YR6/1	SL	BR	25	10YR6/1	SL	MS	KMT	FLAT	0	3	4
37	MALIMA	22	20	10YR5/1	SL	GR	40	7.5YRB/2	SL	MS	KMT	FLAT	0	3	4
38	KARAMATOI	24	8	10YR3/4	SL	GR	<50	10YR6/8	SL	NU	KPL	SL.CVX	19	2	4
39	KARAMATOI	29	20	10YR5/4	SL	GR	<50	10YR6/4	SL	NU	TLP	SL.CCV	5	1	4
40	KARAMATOI	20	15	7.5YR4/4	SL	GR	<50	5YR4/6	SL	NU	TLP	SL.CVX	19	2	4
41	KARAMATOI	28	24	10YR5/8	LIC	GR	<50	7.5YR6/6	LIC	NU	TLP	SL.CVX	5	1	4
42	TANAKI	19	20	10YR4/4	CL	GR	<50	10YR6/8	SCL	BL	TLP	SL.CVX	33	2	4
43	TANAKI	25	20	2.5YR4/2	CL	GR	<50	2.5YR8/4	SCL	BL	TLP	SL.CCV	12	2	4
44	TANAKI	26	26	2.5YR4/2	CL	GR	<50	2.5YR8/4	SCL	BL	TLP	SL.CCV	23	2	4
46	PUNTEH	22	8	7.5YR5/6	SCL	GR	<50	5YR3/6	LIC	NU	KMS	SL.CVX	17	2	4
49	PUNTEH	25	20	10YR5/6	CL	GR	<50	5YR4/8	SCL	NU	KMS	SL.CVX	28	2	4
50	PUNTEH	22	10	10YR5/6	SCL	GR	<50	10YR5/8	SCL	NU	TLP	SL.CVX	18	2	4
51	PUNTEH	23	18	10YR5/4	SCL	GR	<50	10YR6/8	SCL	NU	KMS	SL.CVX	18	2	4
55	BONGKOL	18	15	10YR4/3	CL	BL	<50	10YR5/8	C	NU	LMP	FLAT	0	2	1
58	ULU KUKUT	25	20	2.5YR5/4	LIC	GR	<50	2.5YR7/6	LIC	NU	LAB	VALLEY	10	2	1
59	DELAYAN	22	10	10YR5/4	SL	GR	<50	10YR7/6	SL	BL	PIU	FLAT	0	2	4
61	PATAU	20	20	7.5YR5/3	SC	GR	<50	7.5YR5/6	CL	NU	TLP	SL.CVX	23	2	4
63	MALIMA	21	20	10YR5/1	SL	GR	40	7.5YR6/2	SL	MS	KMT	FLAT	0	3	4
64	MALIMA	21	20	10YR5/1	SL	GR	40	7.5YR6/2	SL	MS	KMT	FLAT	0	3	4
65	BAHMULA	23	15	10YR5/4	LIC	GR	<50	10YR7/4	C	NU	PIU	FLAT	0	1	4
66	BAHMULA	25	15	10YR5/4	LIC	GR	<50	10YR7/4	C	NU	PIU	FLAT	0	1	4
67	TANAKI	28	20	2.5Y4/2	CL	GR	<50	2.5Y6/4	SCL	BL	TLP	SL.CCV	26	2	4
69	KINARUT	20	10	10YR6/4	SL	CR	<50	10YR6/8	SCL	BL	TLP	SL.CCV	30	2	2
71	LUMAT	20	25	10YR5/4	SL	GR	<50	10YR5/8	SL	BL	KPL	SL.CVX	20	2	3
72	LUMAT	18	20	10YR5/3	SL	GR	<50	10YR7/6	SL	BL	KPL	SL.CCV	25	2	3
73	LUMAT	25	20	10YR5/4	SCL	GR	<50	10YR5/6	L	BL	TLP	SL.CCV	18	2	3
74	LUMAT	26	15	10YR4/6	CL	GR	<50	10YR6/6	CL	NU	TLP	SL.CVX	5	2	3
75	SARANG	21	15	10YR5/3	LIC	GR	<50	10YR5/6	LIC	NU	TLP	TOP	18	2	1
76	SARANG	22	20	10YR5/3	LIC	GR	<50	10YR6/6	LIC	NU	TLP	SL.CCV	23	2	1
77	ULU KUKUT	24	15	2.5Y5/3	LIC	GR	<50	2.5Y6/4	LIC	NU	TLP	TOP	10	2	1

PLOT NO.	LOCATION	SI	SOIL (A HORIZON)				SOIL (B HORIZON)				SOIL TYPE	TERRAIN	SLOPE	VEG TYPE	CLIMATE TYPE
			DRP	COLOR	TEX	STR	DEP	COLOR	TEX	STR					
78	LANKONG	23	20	10YR5/6	SL	GR	<50	10YR7/8	SL	MS	KPL	FLAT	0	2	1
79	TIMBANG	24	30	10YR3/4	SC	GR	<50	10YR5/8	CL	NU	TLP	SL.CVX	13	2	1
80	ULU KUKUT	26	10	2.5Y5/3	LiC	GR	<50	2.5Y6/4	LiC	NU	TLP	VALLEY	10	2	1
81	TOPOROI	23	10	10YR5/3	L	GR	<50	10YR7/4	CL	NU	TLP	SL.CCV	18	2	1
82	KINARUT	17	15	2.5Y4/6	SL	GR	<50	2.5Y8/8	CL	BL	TLP	SL.CVX	18	3	2
85	MANDAHAN	22	5	7.5YR3/4	CL	GR	<50	10YR6/6	CL	NU	TLP	SL.CVX	8	2	1
86	TINBANG	22	20	7.5YR3/2	SL	GR	45	7.5YR5/4	SL	BL	TLP	SL.CVX	18	2	1
88	LANKONG	22	20	7.5YR4/2	SiL	GR	<50	10YR6/8	SiL	BL	KPL	FLAT	0	2	1
89	MANTANAU	22	18	7.5YR4/3	L	BL	<50	7.5YR5/4	CL	BL	TLP	SL.CVX	15	2	1
92	BUNANG	21	12	7.5YR4/2	L	GR	30	7.5YR7/1	S	MS	KMT	FLAT	0	2	1
94	RAMPAYAN	18	10	2.5Y4/6	LiC	GR	<50	10YR7/8	LiC	NU	TLP	TOP	10	2	1
95	HOBUT	17	15	10YR6/2	SL	GR	<50	10YR6/4	LS	MS	KPL	SL.CVX	20	3	1
96	HOBUT	17	15	10YR5/4	S	GR	<50	10YR6/6	SL	BL	KPL	TOP	23	3	1
98	KUMBATAN	23	10	2.5Y6/4	LS	GR	<50	10YR7/6	SCL	NU	TLP	SL.CCV	20	1	1
99	KUMBATAN	22	10	2.5Y5/2	SCL	GR	<50	2.5Y7/6	SCL	NU	TLP	TOP	20	1	1
100	LAJONG	19	10	2.5Y4/3	SCL	GR	<50	2.5Y7/6	CL	NU	TLP	SL.CVX	10	2	1
101	LAJONG	23	15	2.5Y5/4	L	GR	<50	10YR7/6	CL	NU	TLP	VALLEY	8	2	1
102	MOMPILIS	17	20	10YR4/4	SL	GR	<50	10YR5/6	SC	NU	TLP	TOP	20	3	1
103	MOMPILIS	16	15	10YR5/3	SL	GR	<50	2.5Y6/8	L	NU	TLP	SL.CVX	25	3	1
104	TIMUG	21	20	10YR5/4	SL	GR	<50	10YR6/8	SL	NU	TLP	SL.CVX	10	2	1
105	DELAYAN	25	25	10YR5/4	SL	GR	<50	10YR7/6	SCL	NU	PIU	SL.CCV	10	1	4
106	BUNANG	25	25	10YR4/3	L	GR	<50	10YR7/2	S	MS	KMT	FLAT	0	2	4
107	PUNTEH	20	20	10YR5/6	SCL	GR	<50	10YR6/8	LiC	NU	KMS	SL.CVX	13	2	4
108	MALIMA	23	20	10YR4/1	SL	GR	<50	2.5Y8/4	SL	MS	PIU	FLAT	0	2	4
109	MALIMA	26	40	2.5Y3/3	SL	GR	<50	2.5Y8/8	SL	BL	PIU	FLAT	0	2	4
110	PATAU	19	20	10YR6/4	SC	GR	<50	10YR7/6	CL	NU	TLP	SL.CCV	30	2	4
112	KARAMATOI	25	20	10YR5/8	LiC	GR	<50	7.5YR6/6	LiC	NU	TLP	SL.CVX	8	1	4
113	PUNTEH	23	20	10YR6/4	SCL	GR	<50	10YR7/8	SCL	NU	TLP	SL.CVX	13	1	4
114	PUNTEH	20	15	10YR6/4	SCL	GR	<50	10YR7/8	CL	BL	TLP	SL.CVX	15	2	4
116	TANAKI	21	15	2.5Y4/2	CL	GR	<50	2.5Y8/4	SCL	BL	TLP	SL.CVX	23	2	4
117	KARAMATOI	21	20	2.5Y4/6	SL	GR	<50	2.5Y6/8	SCL	NU	TLP	SL.CVX	8	1	4

LEGEND: SI SITE INDEX

DEP DEPTH (CM)

TEX TEXTURE — S(SAND) LS(LOAMY SAND) SL(SANDY LOAM) L(LOAM) SiL(SILT LOAM) SCL(SANDY CLAY LOAM) CL(CLAY LOAM) SiCL(SILTY CLAY LOAM) SC(SANDY CLAY) Lic (LIGHT CLAY) SiC(SILTY CLAY) HC(HEAVY CLAY)

STR STRUCTURE — GR(GRANULAR) BL(BLOCKY) NU(NUTTY) MS(MASSIVE)

SOIL TYPE — TLP (Tanjung Lipat) KPL (Kapilit) KMS (Kumansi) SBG (Sibuga) LAB (Laab) KMT (Karamatoi) PIU (Paliu) LMP (Lumpongon)

TERRAIN — SL.CVX (CONVEX SLOPE) SL.CCV (CONCAVE SLOPE)

SLOPE (DEGREE)

VEGETATION TYPE — TYPE 1 (E. odorutum, S. sumatrensis, N. biserrata, bamboo) TYPE 2 (OTHER THAN TYPE 1 AND TYPE 3) TYPE 3 (P/candatum, D. linearis, Dillenia spp., F. acuminata, Rhynocospara spp.)

CLIMATE TYPE — TYPE 1 (COASTAL. NORTH) TYPE 2 (COASTAL MIDDLE) TYPE 3 (COASTAL SOUTH) TYPE 4 (INTERIOR)

TABLE 6

CATEGORY

VARIABLE		CATEGORY

X1 SOIL DEPTH
1   0 -69 cm
2   > 70 cm

X2 HUMUS CONTENT OF A HORIZON
1   ABUNDANT (3/2, 2-3/3)
2   COMMON (4/1-3, 3-4/4)
3   SCANTY (5/1-4, 4-5/6)
4   VERY SCANTY

X3 TEXTURE OF B HORIZON
1   HC   (CLAY 45 - 100%)
2   SC,LIC,SIC   (CLAY 25 - 45%)
3   SCL,CL,SICL   (CLAY 15 - 25%)
4   SL,L,SIL   (CLAY 0 - 15%, LOW SAND CONTENT)
5   LS,S   (CLAY 0 - 15%, HIGH SAND CONTENT)

X4 SOIL TYPE (PARENT MATERIAL)
1   SANDSTONE AND MUDSTONE
2   SANDSTONE
3   MUDSTONE
4   ALLUVIUM

X5 TERRAIN
1   TOP/RIDGE
2   CONVEX SLOPE
3   CONCAVE SLOPE
4   VALLEY
5   FLAT

X6 SLOPE
1   0 - 10 DEGREE
2   11 - 20 DEGREE
3   > 21 DEGREE

X7 VEGETATION TYPE
1   TYPE 1 (*E. odurotum, S. sumatrensis, N. biserrata.* bamboo)
2   TYPE 2 (OTHER THAN TYPE 1 AND TYPE 3)
3   TYPE 3 (*P. candatum, D. linearis, Dillenia spp., F. acuminata, Rhynocospara spp.*)

X8 CLIMATE
1   COASTAL (NORTH)
2   COASTAL (MIDDLE)
3   COASTAL (SOUTH)
4   INTERIOR

TABLE 9 : SUMMARY OF ENVIROMENTAL FACTORS IN SAMPLING PLOTS

PLOT NO.	SITE INDEX Y	SOIL DEPTH X1		HUMUS (A HOL) X2				TEXTURE (B HOL) X3					SOIL TYPE X4				TERRAIN X5					SLOPE X6			VEG TYPE X7			CLIMATE X8			
		1	2	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	2	3	1	2	3	1	2	3	4
1	21	0		0					0				0				0						0		0			0			
2	21	0			0				0				0				0					0				0		0			
3	23	0			0						0			0							0	0					0	0			
4	26	0			0					0			0							0		0			0			0			
5	22	0			0					0			0							0		0			0			0			
6	22	0			0			0						0						0		0			0			0			
7	23	0		0					0				0					0				0			0			0			
8	20	0			0					0						0				0		0				0					0
9	22	0			0					0						0				0		0				0					0
10	22	0			0					0						0				0		0				0					0
11	19	0			0					0						0				0		0				0					0
12	19	0			0					0						0				0		0				0					0
13	17	0				0				0						0				0		0					0				0
14	23	0			0					0						0				0		0			0						0
15	19	0			0					0						0				0		0			0						0
16	21	0			0						0					0				0		0			0						0
17	23	0			0				0							0	0					0			0						0
18	24	0		0					0							0		0				0			0						0
19	26	0			0					0			0					0				0			0						0
20	28	0			0					0			0						0			0			0						0
21	26	0			0					0			0						0			0			0						0
22	22	0			0				0							0					0	0			0						0
23	23	0			0			0								0					0	0			0						0
24	23	0		0					0							0					0	0				0					0
28	24	0			0			0							0		0						0		0						0
30	24	0			0			0							0		0						0		0						0
32	20	0			0					0				0						0		0			0			0			
34	25	0				0		0					0						0				0			0					0
36	18	0				0				0						0					0	0					0				0
37	22	0			0					0						0					0	0					0				0
38	24	0			0					0			0				0						0			0					0
39	29	0			0						0					0		0			0		0		0						0
40	20	0			0						0		0				0						0			0					0
41	28	0				0	0					0				0				0				0						0
42	19	0		0					0				0				0							0		0					0
43	25	0		0					0				0					0					0			0					0
44	26	0		0					0				0					0						0		0					0
48	22	0			0			0							0		0						0			0					0
49	25	0			0				0						0		0							0		0					0
50	22	0			0				0				0				0						0			0					0
51	23	0			0				0						0		0						0			0					0
55	18	0			0		0									0					0	0				0		0			
56	25	0			0			0					0							0		0				0		0			
59	22	0			0						0					0					0	0				0					0
61	20	0			0					0			0				0							0	0						0
63	21	0			0						0					0					0	0					0				0
64	21	0			0						0					0					0	0					0				0

PLOT NO.	SITE INDEX Y	SOIL DEPTH X1		HUMUS (A HOL) X2				TEXTURE (B HOL) X3					SOIL TYPE X4				TERRAIN X5					SLOPE X6			VEG TYPE X7			CLIMATE X8			
		1	2	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	2	3	1	2	3	1	2	3	4
85	23	0			0			0								0					0	0			0						0
86	25	0			0			0								0					0	0			0						0
67	26	0		0					0				0					0						0	0						0
69	20	0			0				0				0					0						0	0			0			
71	20	0			0					0				0			0						0		0					0	
72	18	0			0					0				0				0					0		0					0	
73	25	0			0					0		0						0					0		0					0	
74	26	0			0				0			0				0					0				0					0	
75	21	0			0		0					0				0						0		0			0				
76	22	0			0		0					0					0						0	0			0				
77	24	0			0		0					0				0					0			0			0				
78	23	0			0					0			0							0	0			0			0				
79	24	0		0					0			0				0					0			0			0				
80	26	0			0		0					0						0		0			0			0				
81	23	0			0		0					0					0			0			0			0				
82	17	0			0		0					0				0					0						0	0			
85	22	0		0				0				0				0					0			0				0		0	
86	22	0		0				0				0				0				0			0			0		0			
88	22		0	0				0				0				0				0			0			0		0			
89	22		0	0				0				0				0				0			0			0		0			
92	21	0		0								0				0					0	0			0						0
94	18		0		0			0				0				0					0			0			0			
95	17		0				0				0		0				0				0					0	0			
98	17		0		0						0		0			0							0			0	0			
96	23		0			0			0			0				0					0	0			0		0			
99	22		0		0				0			0				0					0	0		0			0			
100	19		0	0					0			0					0				0			0		0		0			
101	23		0		0				0			0						0		0			0		0		0			
102	17		0	0				0				0				0					0					0	0			
103	16		0		0					0		0				0					0				0	0			
104	21	0			0					0		0				0					0			0	0				
105	25	0			0			0							0	0				0			0					0
106	25	0		0							0				0				0		0			0			0			0
107	20	0			0		0						0	0					0		0					0
108	23	0		0							0				0				0		0			0					0
109	26	0		0							0				0					0	0			0					0
110	19	0					0	0				0					0		0		0	0				0
112	25	0					0	0				0				0			0			0					0
113	23	0					0	0				0				0				0		0				0
114	20	0					0	0				0				0				0			0			0
116	21	0		0				0				0				0			0				0			0
117	21	0			0			0				0				0			0			0				0

TABLE 10

FREQUENCY OF CATEGORIES

VARIABLE	CATEGORY	FREQUENCY (%)
X1		
	1	8 (8.99)
	2	81 (91.01)
X2		
	1	3(3.37)
	2	17 (19.10)
	3	59 (66.29)
	4	10 (11.24)
X3		
	1	4 (4.49)
	2	16 (17.98)
	3	32 (35.96)
	4	33 (37.08)
	5	4 (4.49)
X4		
	1	45 (50.56)
	2	10 (11.24)
	3	8 (8.99)
	4	26 (29.21)
X5		
	1	8 (8.99)
	2	30 (33.71)
	3	16 (17.98)
	4	3 (3.37)
	5	32 (35.96)
X6		
	1	53 (59.55)
	2	24 (26.97)
	3	12 (13.48)
X7		
	1	18 (20.22)
	2	54 (60.67)
	3	17 (19.10)
X8		
	1	30 (3.71)
	2	3 (3.37)
	3	4 (4.49)
	4	52 (58.43)
TOTAL		89 (100)

TABLE 11

CROSS TABLE

ITEM	CATEGORY	SOIL DEPTH X1		HUMUS CONTENT X2				TEXTURE B. HORIZON X3					SOIL TYPE X4				TERRAIN X5					SLOPE X6				VEGETATION TYPE X7				CLIMATE X8			
		1	2	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	3	4

TABLE 12

VALUES GIVEN TO THE CATEGORY IN EACH INDEPENDENT FACTOR (X)

VARIABLE	CATEGORY	VALUE	SINGLE CORRELATION	PARTIAL CORRELATION
X1			0.20655	0.08022
	1	-0.50964		
	2	0.05035		
X2			0.12738	0.37135
	1	2.19073		
	2	0.34795		
	3	0.07634		
	4	-1.69917		
X3			0.06912	0.27199
	1	-1.51774		
	2	0.78670		
	3	0.01889		
	4	-0.29731		
	5	0.66455		
X4			0.05261	0.36260
	1	0.65320		
	2	1.07773		
	3	-0.04745		
	4	-1.53046		
X5			0.34060	0.51921
	1	-1.73269		
	2	-0.97871		
	3	1.38545		
	4	2.31244		
	5	0.44120		
X6			0.17564	0.28215
	1	0.42533		
	2	-0.29700		
	3	-1.29453		
X7			0.56380	0.48794
	1	1.91547		
	2	-0.12318		
	3	-1.63688		
X8			0.28234	0.47234
	1	-1.43971		
	2	-2.91474		
	3	0.70218		
	4	0.94475		

CONSTANT   22.17980

MULTIPLE CORRELATION COEFFICIENT   0.78031 (0.60888)

MEAN STANDARD DEVIATION   1.71736

EQUATION Y (SITE INDEX) IS GIVEN AS.

$Y = 22.18 + X1 + X2 + X3 + X4 + X5 + X6 + X7 + X8$

TABLE 13 CORRELATION COEFFICIENT AMONG ITEMS AFTER QUANTIFIED

ITEM	X1	X2	X3	X4	X5	X6	X7	X8	Y
X1	1.000	-0.067	0.107	0.389	-0.076	-0.177	0.352	-0.164	0.207
X2		1.000	-0.158	-0.076	0.019	0.104	-0.062	-0.152	0.127
X3			1.000	0.286	-0.181	-0.189	-0.025	-0.154	0.069
X4				1.000	-0.227	-0.421	0.118	-0.535	0.053
X5					1.000	0.173	0.015	0.039	0.341
X6						1.000	0.097	0.052	0.176
X7							1.000	0.198	0.564
X8								1.000	0.282
Y									1.000

Table   Relation Between Measured Value and Estimated Value

No	Measured	Estimated	Residual	
1	2.10000D+01	2.04116D+01	5.88420D-01 (	0.343)
2	2.10000D+01	2.08623D+01	1.37698D-01 (	0.080)
3	2.30000D+01	2.18387D+01	1.16130D+00 (	0.676)
4	2.60000D+01	2.23905D+01	3.60946D+00 (	2.102)
5	2.20000D+01	2.23905D+01	-3.90543D- 01 (	-0.227)
6	2.20000D+01	2.23514D+01	-3.51373D- 01 (	-0.205)
7	2.30000D+01	2.53408D+01	-2.34085D+00 (	-1.363)
8	2.00000D+01	2.06531D+01	-6.53105D- 01 (	-0.380)
9	2.20000D+01	2.06531D+01	1.34690D+00 (	0.784)
10	2.20000D+01	2.06531D+01	1.34690D+00 (	0.784)
11	1.90000D+01	2.00929D+01	-1.09291D+00 (	-0.636)
12	1.90000D+01	2.00929D+01	-1.09291D+00 (	-0.636)
13	1.70000D+01	1.88776D+01	-1.87759D+00 (	-1.093)
14	2.30000D+01	2.21668D+01	8.33192D -01 (	0.485)
15	1.90000D+01	2.21668D+01	-3.16681D+00 (	-1.844)
16	2.10000D+01	2.21668D+01	-1.16681D+00 (	-0.679)
17	2.30000D+01	2.10631D+01	1.93690D+00 (	1.128)
18	2.40000D+01	2.57375D+01	-1.73751D+00 (	-1.012)
19	2.60000D+01	2.49692D+01	1.03080D+00 (	0.600)
20	2.80000D+01	2.73334D+01	6.66638D -01 (	0.388)
21	2.60000D+01	2.73334D+01	-1.33336D+00 (	-0.776)
22	2.20000D+01	2.52915D+01	-3.29146D+00 (	-1.917)
23	2.30000D+01	2.29850D+01	1.49775D -02 (	0.009)
24	2.30000D+01	2.12409D+01	1.75909D+00 (	1.024)
25	2.40000D+01	2.38763D+01	1.21750D -01 (	0.071)
26	2.40000D+01	2.38783D+01	1.21750D- 01 (	0.071)
27	2.00000D+01	2.23905D+01	-2.39054D+00 (	-1.392)
28	2.50000D+01	2.28954D+01	2.10464D+00 (	1.226)
29	1.80000D+01	1.83174D+01	-3.17400D -01 (	-0.185)
30	2.20000D+01	2.00929D+01	1.90709D+00 (	1.110)
31	2.40000D+01	2.26328D+01	1.36724D+00 (	0.796)
32	2.90000D+01	2.73334D+01	1.66664D+00 (	0.970)
33	2.00000D+01	2.22062D+01	-2.20823D+00 (	-1.286)
34	2.80000D+01	2.42797D+01	3.72030D+00 (	2.166)
35	1.90000D+01	2.18085D+01	-2.80850D+00 (	(-1.635)
36	2.50000D+01	2.51602D+01	-1.60195D -01 (	-0.093)
37	2.60000D+01	2.41727D+01	1.82734D+00 (	1.064)
38	2.20000D+01	2.25936D+01	-5.93587D- 01 (	-0.346)
39	2.50000D+01	2.08362D+01	4.16376D+00 (	2.425)
40	2.20000D+01	2.25244D+01	-5.24428D- 01 (	-0.305)
41	2.30000D+01	2.18238D+01	1.17622D+00 (	0.685)
42	1.80000D+01	2.00449D+01	-2.04493D+00 (	-1.191)
43	2.50000D+01	2.49233D+01	7.67298D -02 (	0.045)

No	Measured	Estimated	Residual	
44	2.20000D+01	2.21668D+01	-1.66808D-01 (	-0.097)
45	2.00000D+01	2.15369D+01	-1.53690D+00 (	-0.895)
46	2.10000D+01	2.00929D+01	9.07089D-01 (	0.528)
47	2.10000D+01	2.00929D+01	9.07089D-01 (	0.528)
48	2.30000D+01	2.29850D+01	1.49775D-02 (	0.009)
49	2.50000D+01	2.29850D+01	2.01498D+00 (	1.173)
50	2.60000D+01	2.41727D+01	1.82734D+00 (	1.064)
51	2.00000D+01	2.00416D+01	-4.15754D-02 (	-0.024)
52	2.00000D+01	2.23902D+01	-2.39019D+00 (	-1.392)
53	2.50000D+01	2.43298D+01	6.70175D-01 (	0.390)
54	2.60000D+01	2.30042D+01	2.99581D+00 (	1.744)
55	2.10000D+01	2.01558D+01	8.44196D-01 (	0.492)
56	2.20000D+01	2.22864D+01	-2.86417D-01 (	-0.167)
57	2.40000D+01	2.08781D+01	3.12187D+00 (	1.818)
58	2.30000D+01	2.23905D+01	6.09457D-01 (	0.355)
59	2.40000D+01	2.04116D+01	3.58842D+00 (	2.089)
60	2.60000D+01	2.49233D+01	1.07673D+00 (	0.627)
61	2.30000D+01	2.25041D+01	4.95863D-01 (	0.289)
62	1.70000D+01	1.71512D+01	-1.51241D-01 (	-0.088)
63	2.10000D+01	2.08072D+01	1.92816D-01 (	0.112)
64	2.20000D+01	2.32758D+01	-1.27579D+00 (	-0.743)
65	2.20000D+01	2.13780D+01	6.22037D-01 (	0.362)
66	2.20000D+01	2.26621D+01	-6.62147D-01 (	-0.386)
67	2.20000D+01	2.04116D+01	1.58842D+00 (	0.925)
68	2.10000D+01	2.28401D+01	-1.84008D+00 (	-1.071)
69	1.80000D+01	2.08781D+01	-2.87813D+00 (	-1.676)
70	1.70000D+01	1.79209D+01	-9.20949D-01 (	-0.536)
71	1.70000D+01	1.69931D+01	6.91244D-03 (	0.004)
72	2.30000D+01	2.27673D+01	2.32729D-01 (	0.136)
73	2.20000D+01	2.14246D+01	5.75361D-01 (	0.335)
74	1.90000D+01	2.11339D+01	-2.13391D+00 (	-1.243)
75	2.30000D+01	2.41535D+01	-1.15346D+00 (	-0.672)
76	1.70000D+01	1.89137D+01	-1.91371D+00 (	-1.114)
77	1.60000D+01	1.73225D+01	-1.32254D+00 (	-0.770)
78	2.10000D+01	2.05461D+01	4.53897D-01 (	0.264)
79	2.50000D+01	2.54659D+01	-4.65903D-01 (	-0.271)
80	2.50000D+01	2.34003D+01	1.59973D+00 (	0.932)
81	2.00000D+01	2.25936D+01	-2.59359D+00 (	-1.510)
82	2.30000D+01	2.24384D+01	5.61587D-01 (	0.327)
83	2.60000D+01	2.42812D+01	1.71881D+00 (	1.001)
84	1.90000D+01	2.21255D+01	-3.12555D+00 (	-1.820)
85	2.50000D+01	2.42797D+01	7.20300D-01 (	0.419)
86	2.30000D+01	2.27876D+01	2.12438D-01 (	0.124)
87	2.00000D+01	2.07489D+01	-7.48917D-01 (	-0.436)
88	2.10000D+01	2.18085D+01	-8.08501D-01 (	-0.471)
89	2.10000D+01	2.52854D+01	-4.28540D+00 (	-2.495)