高齢メアサスギ林の林分構造について

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Stand-structures of Measa-sugi (*Cryptomeria japonica*) Forests

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要　旨

最近長伐期林業への道が提唱され[3]，鹿児島県では地元スギ品種であるメアサスギの見直しが行われている。メアサスギは材質がすぐれ，成長は晩成型で，壮齢期以降の成長が永く持続する。そこで長伐期生産品種としての価値が極めて高い[1]。したがってこうしたメアサスギ林の調査研究は現下の重要な課題であり，今回現地調査によって、その林分構造を明らかにすることを試みた。

蒲生町を中心に特色ある高齢林分９林分（林齢55年～85年）を選び，主としてその胸高直径の分布を基に林分構造の解析を行った。各林分の胸高直径，樹高，単木材積の平均値，標準偏差，変動係数を明らかにするとともに直径についてはその分布のヒストグラムを描き林分構造を調べた。それによると各林分には，二段林型を示すもの，本数が著しく減少しているもの，超高齢木の混入するものなどがみられ，高齢林の特色ある構造が明らかとなった。ところで直径分布については「同齢単純林における直径分布は，幼齢あるいは若齢の間は一般に正規分布にしたがうが，年齢が進むにつれ，除伐や間伐の影響をうけて，しだいに左傾していき，シャリエＡ型分布からピアソンＩ型分布へと進む傾向がみられる。直径の分布範囲は比較的小さく，変動係数は10～30％である」[4]といわれる。そこで正規分布に近い林分について分布の正規性の検定を行ったが，高齢林分にあってもその直径分布の正規性を否定出来ぬものが見出された。これは除間伐等森林育成作業との関連で今後検討を要する課題を与えるものといえよう。

５林分についてメアサスギ収穫表[2]と比較しその立木度をみると，0.8～1.2の間にあるから，これら林分はほぼ正常に近い林分であるといえる。これら林分の直径の変動係数は10～30％におさまることから，この点は従来の知見を裏づけるものといえる。

Introduction

In Japan, an elongation of the rotation period of Measa-sugi has been advocated earnestly.[3] Measa-sugi is one of the best known varieties of Sugi (*Cryptomeria japonica*) distributed widely in southern Kyushu, especially in Kagoshima Prefecture. It is best in quality and continues to grow for a very long time.[1] So it comes to be quite valuable

for us to be able to treat it with a long rotation-period. It has become a current problem to make further research on the growth and structure of the Measa-sugi stand.

This study aims to make the structure of old Measa-sugi stand clearer.

Materials and Methods

Table 1. Sample Stands

Stand	Location	Age	Sample Area
A	Aira Town	85	0.160 ha
B	Kamou Town	85	0.120
C	Kamou Town	64	0.160
D	Aira Town	70	0.197
E	Aira Town	80	0.155
F	Mizobe Town	55	0.160
G	Yokogawa Town	75	0.160
H	Kirishima Town	78	0.160
I	Kokubu City	65	0.160

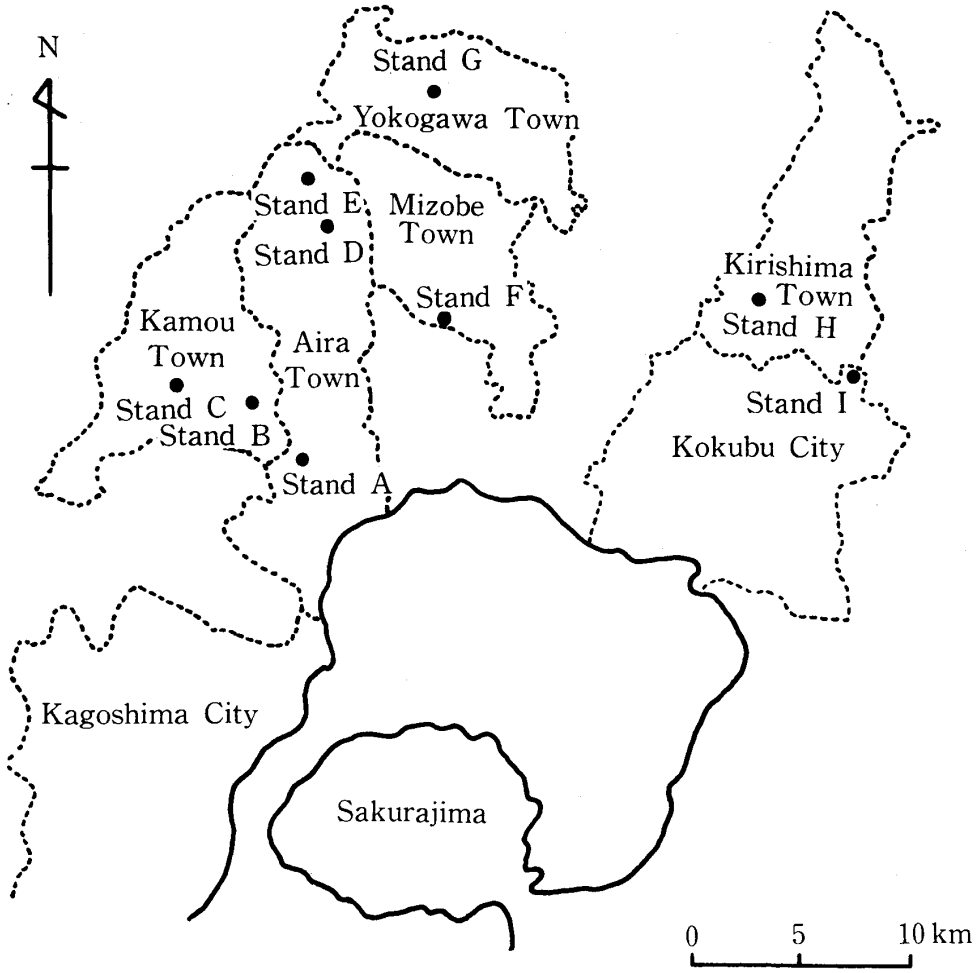

Fig. 1. Location of the stands

In Kagoshima Prefecture, it is in the neighborhood of Kamou Town that Measa-sugi has been distributed wide and dense. As shown in Fig. 1 nine sample-stands were fixed, the basic data of which are shown in Table 1. In the sample plot moulded on 40 m × 40 m square-plot, the ground survey was carried out. The diameter at breast height (DBH) of every tree in its plot was measured by the calliper. Concerning the height, only three sample trees in each diameter-class were measured by the Spiegel-Relascope. The heights corresponding to the diameters of the respective classes were obtained by making use of the height-curve. In this area, the volume of trees was calculated by means of the volume table. Selection of the dominant trees was carried out, using standard B of Terasaki's thinning rule.

Results and Discussion

Table 2. Stand Compositions

Stand	Numbers/ha	Volume/ha	DBH			Height			Volume		
			M.	S.D.	C.V.	M.	S.D.	C.V.	M.	S.D.	C.V.
		m^3	cm	cm	%	m	m	%	m^3	m^3	%
A	294	659.6	49.5	21.69	43.8	24.4	4.03	16.5	2.24	1.71	76.3
B	708	972.8	40.8	7.61	18.7	24.1	1.38	5.7	1.37	0.50	36.5
C	231	403.5	45.0	3.96	8.8	26.7	1.16	4.3	1.74	0.33	19.0
D	569	497.2	34.6	8.45	24.4	20.1	1.78	8.9	0.88	0.45	51.1
E	503	809.9	44.8	8.24	18.4	24.8	1.26	5.1	1.61	0.61	37.9
F	688	740.2	35.0	6.44	18.4	24.4	1.43	5.9	1.08	0.39	36.1
G	200	711.4	63.7	21.54	33.8	26.9	4.97	18.5	3.56	2.21	62.1
H	500	642.7	40.0	6.34	15.9	23.7	1.00	4.2	1.29	0.37	28.7
I	463	662.0	41.1	11.47	27.9	24.4	1.15	4.7	1.43	0.72	50.3

M.: Mean S.D.: Standard Deviation C.V.: Coefficient of Variation

In Table 2 are shown the numbers of trees and the volumes per ha of the respective stand. In each stand, the following items were calculated, respectively; namely, means, standard deviations, coefficients of variations on DBH, height and volume. The age-range in the respective stands varies from 55 to 85 years old. As an index of stand-structure, diameter distribution has been used, generally. Concerning the diameter distribution the following theory has been accepted, namely, in a pure even-aged stand, the diameter distribution-curve shows a type of normal distribution in the younger generation. The older the stand becomes, the clearer becomes the following tendency. Due to the influence of the salvage cutting or the thinning, the type of this curve is apt to change from normal distribution type to Charlier-A type and Person-I type, respectively. The diameter distribution shows an inclination to be shifting to the left. It has also been believed that the values of coefficient of variation range from 10% to 30%.[4] As shown in Table 2, excepting the 3 stands A, C, and G the values are kept within this range.

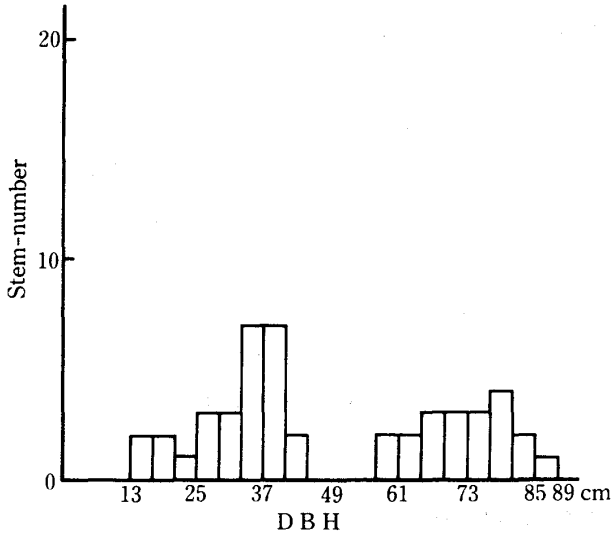

Fig. 2. Diameter Distribution (Stand A)

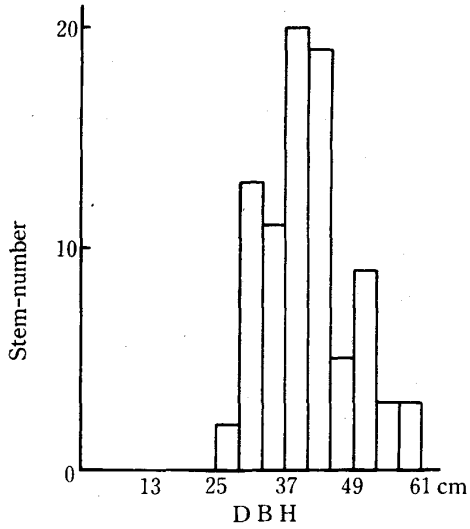

Fig. 3. Diameter Distribution (Stand B)

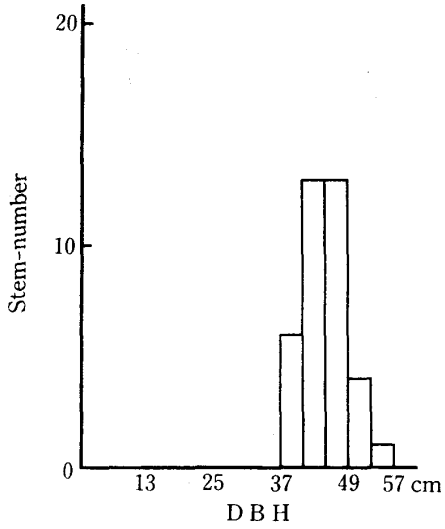

Fig. 4. Diameter Distribution (Stand C)

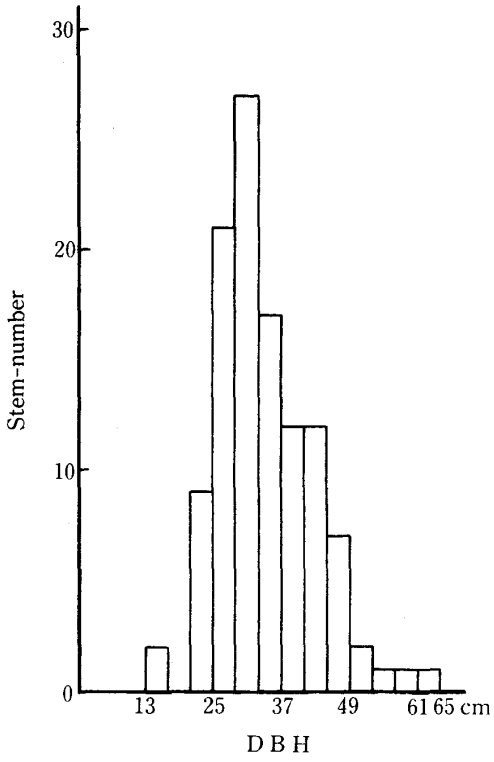

Fig. 5. Diameter Distribution (Stand D)

The diameter distributions in the respective stands are shown in the Figures from 2 to 10. The distribution is divided into 2 groups in Fig. 2. The stand-A is noted to be a two-storied forest. The diameter distribution may be divided into more or less stories. Hence it comes to be necessary to calculate the mean, the standard deviation and the coefficient of variation in the respective groups. In case of the smaller diameter class, the calculated values are 32.4 cm, 8.13 cm and 25.1%, respectively. In case of the larger diameter class, those are 72.7 cm, 8.03cm and 11.0%, respectively. Two coefficients of variation, namely 11.0% and 25.1% are included within the range from 10% to 30%.

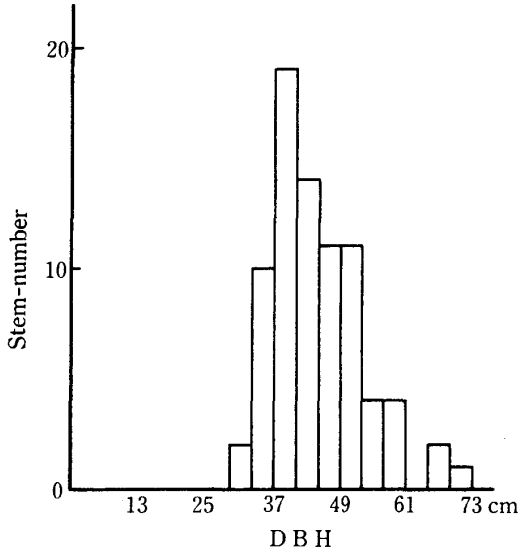

Fig. 6. Diameter Distribution (Stand E)

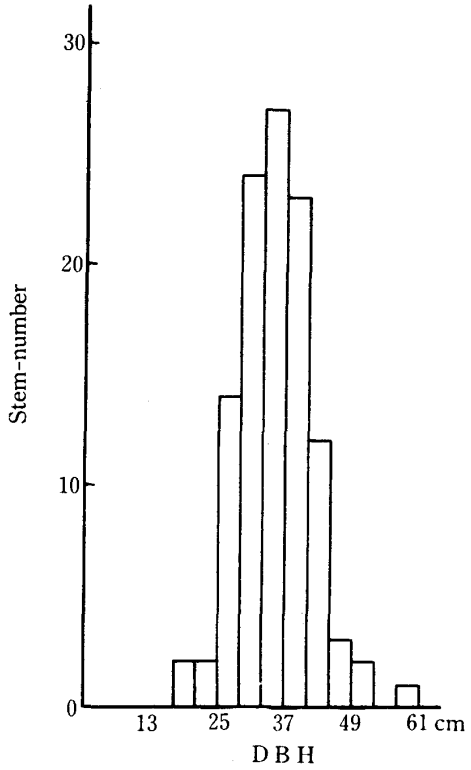

Fig. 7. Diameter Distribution (Stand F)

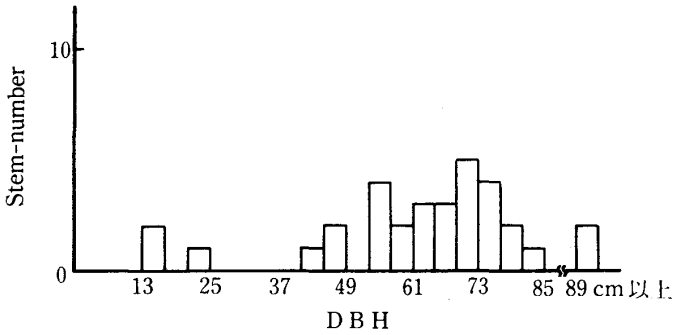

Fig. 8. Diameter Distribution (Stand G)

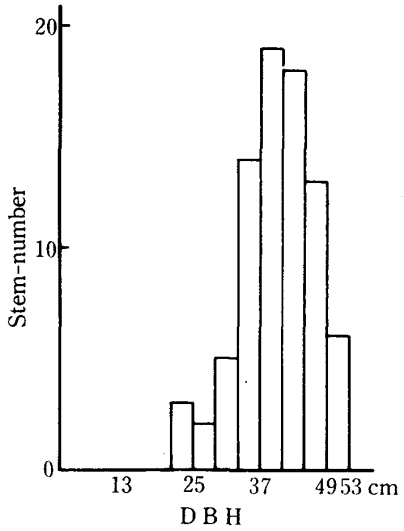

Fig. 9. Diameter Distribution (Stand H)

In Stand C, trees are comparatively a few and the coefficient of variation is smaller than 10%. In Stand G, although the trees are a few, several quite old trees are found and the range of distribution of diameter is wide. In some old Measa-sugi-stand heterogenous group of trees are inevitably mixed, which makes it necessary for us to draw a histogram for the distribution-frequency and to observe the stand-structure, especially if we want to construct a yield-table.

In old Measa-sugi-stand the normalcy of the distribution curve of diameter was put under examination. The results of tests made on normalcy of the frequency-distribution

Table 3. Test of Normality (Stand F)

Class Range	$t=\frac{x-\bar{x}}{s}$	Cumulative Relative Frequency	Relative Frequency	Expected Numbers (F)		Observed Numbers (f)		$\frac{(f-F)^2}{F}$
~19	-2.48	0.0066	0.0066	0.73		1		
19~21	-2.17	0.0150	0.0084	0.92	3.45	1	3	0.059
21~23	-1.86	0.0314	0.0164	1.80		1		
23~25	-1.55	0.0606	0.0292	3.21		1		1.522
25~27	-1.24	0.1075	0.0469	5.16		6		0.137
27~29	-0.93	0.1762	0.0687	7.56		8		0.026
29~31	-0.62	0.2676	0.0914	10.05		13		0.866
31~33	-0.31	0.3783	0.1107	12.18		11		0.114
33~35	-0.01	0.4960	0.1177	12.95		12		0.070
35~37	0.30	0.6179	0.1219	13.41		15		0.189
37~39	0.61	0.7291	0.1112	12.23		15		0.627
39~41	0.92	0.8212	0.0921	10.13		8		0.448
41~43	1.23	0.8906	0.0694	7.63		7		0.052
43~45	1.54	0.9382	0.0476	5.24		5		0.011
45~47	1.85	0.9678	0.0296	3.26		3		0.021
47~		1.0000	0.0322	3.54		3		0.082
Total			1.0000	110.00		110		4.224

$\chi^2=4.224<19.675$ ($\alpha=0.05$ d.f.=14-3=11)

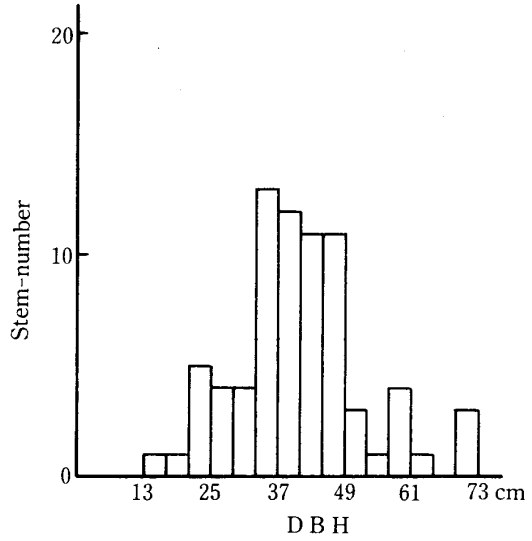

Fig. 10. Diameter Distribution (Stand I)

Table 4. Positions of six stands on yield table

Stand	Site	AN/YN	AV/YV
B	4	1.12	1.19
D	5	0.71	0.64
E	3	0.84	0.92
F	1	1.04	0.90
H	4	0.74	0.86
I	2	0.70	0.80

$\frac{AN}{YN}=\frac{\text{Actual tree numbers/ha}}{\text{Tree numbers in yield table/ha}}$

$\frac{AV}{YV}=\frac{\text{Actual volume/ha}}{\text{Volume in yield table/ha}}$

on Stand F are shown in Table 3. χ^2-value was calculated at 4.224. Comparing with χ^2 value of 19.675 at 5% significant level, it comes to be impossible to deny the normalcy of the curve. In some Measa-sugi-stands it was ascertained that irrespective of the seniority of the tree age, the distribution curve of diameter was normal. By the way, it may be assumed that those might have been some problems in the cultural treatments of these

forests.

The positions of the sample-stands on the yield table are shown in Table 4.[2] These stands were obtained at every site, namely, from the first rank to the fifth rank in the yield table. Excepting only in the case of Stand D, the ratio of AV/YV ranges from 1.2 to 0.8. This is to say that each site is represented quite well by the 5 stands selected as the samples. The coefficients of the variation are included in the range from 10% to 30%.

Summary

Measa-sugi is a well-known variety of Sugi (*Cryptomeria japonica*) and has been widely distributed around Kamou Town in Kagoshima Prefecture. It has quite excellent quality and continues to grow until it reaches old age. In this paper, the stand-structure of Sugi was investigated, with some important views ascertained.

1. In some Measa-sugi-stands, mixing of heterogenous tree-goups with other ordinary ones was noted to be inevitable. So drawing histogram of diameter-distribution was considered to be essential, especially before the realization of an effective construction of yield table.
2. In some of the old Measa-sugi-stands, normal type of distribution is to be shown by the diameter distribution curve.
3. The values of coefficient of variation of DBH in the normal old Measa-sugi-stands are shown within the range from 10% to 30%.

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