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INSTITUTI FORESTALIS FENNIAE

MEDDELANDEN FRÅN SKOGSFORSKNINGSINSTITUTET I FINLAND
MITTEILUNGEN DER FORSTLICHEN FORSCHUNGSANSTALT IN FINNLAND
PUBLICATIONS OF THE FINNISH FOREST RESEARCH INSTITUTE
PUBLICATIONS DE L'INSTITUT DE RECHERCHES FORESTIÉRES DE LA FINLANDE

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LEVEL OF LIVING OF FOREST WORKERS IN FINLAND

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FOREWORD

This report is the last in a series of studies made by the Finnish Forest Research Institute concerning the Finnish forest workers. Earlier publications dealing with earnings of forest workers have been published in the Folia Forestalia-series (no. 1, 1963, and no. 175, 1973). A year ago a book was published in Finnish on the topic of this study: The level of living of forest workers (H e i k i n h e i m o et.al. 1972).

Interest in the level of living of forest workers arose from the idea that an effective forest labour policy is not possible if a complete picture of the labour force in this field is not available. Increasing signs of forest labour shortages gave the last impetus for widening the study from earnings to the level of living as whole.

In collecting and computing the data valuable aid was received from the following institutions: Forest Workers' Pension Fund (Metsäalan Työeläkekassa), the National Board of Forestry (Metsähallitus), the Central Statistical Office (Tilastokeskus) and Postipankki. Without the financial aid of Forest Workers' Pension Fund this study would not have been possible.

Several persons have helped in the execution of this survey. Especially mention should be made of doctors O s m o and P e k k a K a r h u n e n, who assisted in the health study, B r i t a S j ö s t r a n d and K a i j a W e s t i n who have continuously helped in preparing the material, H i l k k a K o n t i o p ä ä who translated the text and A s h l e y S e l b y who carefully checked the whole manuscript. Tens of others have also given valuable help during the six years of completing this study. But particular mention must be made of the several hundreds of forest workers, who kindly gave up a day or two for interviews and health examinations. The authors extend their respectful thanks to all these persons, offices and institutes.

This report contains no detailed suggestions for forest labour policy. This publication gives only an image of a professional group, forest workers, in the late 1960's in Finland, from the viewpoint of the outsider as well as from that of forest workers themselves. It is hoped that this survey gives some useful ideas for the practice of forest labour policy, although the theoretical background of the concept of level of living, and in consequence the structure of this survey, is still in many parts vague.

Helsinki, December 1973

Lauri Heikinheimo *Matti Heikinheimo*

Martti Lehtinen *Aarne Reunala*

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1. INTRODUCTION

Forest workers have, for the whole century, been a major group in the Finnish economy. During the first half of the century the numerous rural population, working in agriculture or without any special profession, took care of forest work. By the 1950s the rural population had decreased, and continued to decrease so markedly that attention was paid to this group of workers. Thus the first studied of the structure of the forest workers body were carried out. During the 1960s these studies were widened from just structure to general conditions especially earnings. During the late 1960s a growing fear of a forest worker shortage resulted in research into the whole concept of forest workers' level of living rather than just into their earnings. The results of this research are here presented.

The problems in this study have been numerous. Foremost was the concept of level of living, which has no generally accepted definition. Definitions vary according to the researchers and problems concerned. In Chapter 2 many definitions of level of living are examined and a choice is made for the purpose of this study being: »the level of living is the degree of true satisfaction of life-needs of a given population, measured by social variables agreed for the purpose» (W a r i s 1964 p. 55). The problem of measurement arises with this definition. How to measure satisfaction and how to define life-needs. The solution was to divide the level of living into nine components, as suggested by the United Nations Expert Committee in 1961, and to modify them for application to the present problem.

The very nature of the concept of level of living meant that cooperation between the authors was close. In particular the role of Dr. Martti Lehtinen and his assistants was vital in planning and executing the health study. In practise, Matti Heikinheimo wrote chapters 2, 3, 6, 8 and 10, Lauri Heikinheimo chapter 5, and Aarne Reunala 26, 6, 7, 9, 11 and 12, but each chapter reflects the opinions of the team.

The material used in this study comes from several sources. The principal data being derived from an interview study made at the end of 1969, when

268 forest workers were interviewed and medically examined. Use has also been made of other studies and available statistics, in order to get as complete a picture of each component of the level of living as possible.

The aim of the study is to draw a rough and many-sided picture of the life of a finnish forest worker using available methods and sources. Because of deficiencies in theory and difficulties in measurement — in many cases when planning the interview and measuring the level of living components »common sense» had to be used — the result obtained can be criticized. It is to be supposed that for forest labour policy this kind of approach is a more useful guide than earlier studies made on forest workers.

2. THEORETICAL EXAMINATION OF THE LEVEL OF LIVING

21. Definitions and concepts

The level of living has become a fashionable word in recent years. Both mass media and private individuals use it. Usually, in a communication process, the listener has to guess what was meant by the »level of living». Semantically, the concept of the level of living is obscure since it has several meanings.

Many scientific publications discussing and studying the level of living, especially during the 1960s, shed light on the concept itself. Those studying the issue by definitions and measurements have perhaps come somewhat closer.

H o y t (1938, pp. 165—184) distinguishes between objetive and subjective level of living. The objective level refers to the quantity of commodities consumed, whereas the subjective level of living is the psychic entity which people find indispensable. The objective and subjective level of living form an entity.

P i p p i n g (1953, pp. 215—216) finds that the level of living is composed of four levels: consumption level, family level, work and leisure time level, and savings level. The level of living can be made to contain many non-measurable components, such as right of ownership, love of freedom, and religious and ethical values.

W a r i s (1964, p. 155) says that »the level of living is the degree of true satisfaction of life-needs of a given population, measured by social variables agreed on for the purpose». S a l a v u o (1968), in his study of the level of living, used this definition by W a r i s.

The term »level of living» has often been used as an equivalent for the welfare of an individual or community: the level of living, in principle, contains everything man finds valuable and desirable (N i e m i n e n 1965, p. 12). R o o s (1968, p. 37) considers that the level of living can be regarded as a partial measure of welfare.

Satisfaction of human needs has been the basis for several international definitions of the level of living. The degree of satisfaction of all human needs is called the level of living (Report . . . 1954 and International . . . 1961). Drewnowski (1966, p. 9) understands with the level of living the level of the satisfaction of a population's needs achieved by means of a flow of commodities and supplies available per time unit. Koskiaho (1969, pp. 24—25) used in her study the Drewnowskian concept of the level of living, however, narrowing the level of living to »comprise that part of the satisfaction of needs the population can obtain with the aid of the flow of services and commodities directed towards it.»

Since it is generally very difficult to measure the satisfaction of needs (Allardt 1971 a, p. 313), many researchers have tended to define the level of living on the basis of empirically measurable variables alone. Such definitions identify the level of living mostly with either the level of income or the level of consumption. Viita (1964, p. 8) understands by the level of living the real possibility of consumption that is or can be financed with the available incomes. Kuusi (1961, p. 22) finds the national income per capita the yardstick that best illustrates the level of living, and according to Wahlbeck (1955, p. 39) income level is a suitable measure of the level of living. Some research workers discard the use of national income per capita as a measure of the level of living for the reason that it fails to express the general factors of life-environment which essentially affects human well-being and health (Dahmén 1970, p. 15).

The Expert Committee appointed by the United Nations General Assembly distinguishes between level of living, standard of living and norm of living. The first refers to the true, prevailing living conditions of a population, the standard of living is a level aspired, and the norm of living refers to target conditions defined for a set purpose. Such a purpose is, for example determination of minimum wages and working hours within the limits of international recommendations and agreements (Report . . . 1954, p. 2).

The overall concept of the standard of living can be expanded by the level of aspiration which refers to a target level. The level of aspiration is usually made slightly higher than the level achieved (Allardt—Littunen 1961, p. 145). With the level of living rising, the level of aspiration rushes ahead. The insatiability of man's mental aspirations, in particular, affects the standard of living requirements and keeps raising them (Walls 1963, p. 119).

The present paper will use the term level of living to the existing conditions.

This review of the definitions of level of living has probably shown that it cannot be simply defined as level of income or level of consumption. Level of living should comprise the satisfaction of both material and immaterial

human needs. The definition should agree to select those concepts and yardsticks which best characterize the existing conditions of life during a certain period (V e p s ä 1966, p. 6).

22. Methods of measuring the level of living

In their 1961 report (International . . . 1961, p. 4) the United Nations Expert Committee agreed on the following nine components for the concept of the level of living:

Health
Nutrition
Education
Working conditions
Housing
Security [1])
Clothing
Recreation
Human rights

The components are not listed in the order of importance since, in principle, they are equally valuable. The list perhaps shows the sequence in which the definition and measurement of the components became precise (W a r i s 1968, p. 69). It should be noted that these nine components of the level of living also define national societal goals (A l l a r d t 1971 a, p. 314). Components are measured by indicators. The components are relatively extensive heterogeneous concepts, while indicators are more homogeneous. Accordingly, the components have several dimensions which are scanned with the aid of indicators (K o s k i a h o 1969, p. 25). The objective measurement of the level of living is difficult largely because the level of living contains a large number of immaterial factors for which no comparable measures can be given by available methods (S a l a v u o 1969, p. 1).

D r e w n o w s k i and S c o t t (1966) have outlined the problem of measuring the level of living and shown a possible solution by developing a level of living index. They divide the level of living into seven components: 1. nutrition, 2. housing, 3. health, 4. education, 5. leisure and recreation, 6. security, and 7. surplus revenue. The first three are associated with satisfying the primary needs, the next three the secondary needs, and the last tertiary needs. D r e w n o w s k i has later improved the level of living index. Its seven components can be divided into three groups. The first

[1]) The definition uses the term »social security» but the present study understands security in a wider sense. It is also taken to cover that part of economic security that cannot be created by social benefits.

group contains four basic components: I nutrition, II protection, III health and IV education. These are human needs satisfied by commodities and services produced through the social and economic activities of the community. The second group contains two components associated with security: V leisure, and VI security. These are needs that population expects the community to satisfy. The third group contains one component factor, VII environment, with needs associated with the human life-environment (D r e w n o w s k i 1970, p. 62). The weakness of any level of living index is that it is difficult to know what the total index measures in reality (A l l a r d t 1971 a, p. 314).

J o h a n s s o n (1971, pp. 31—36) starts from the UN Expert Committee classification of the components of the level of living, but substitutes three with new components. His list is: 1. health, 2. dietary habits, 3. housing, 4. growth conditions and family relations, 5. education, 6. employment and conditions at the place of work, 7. economic resources, 8. political resources, and 9. leisure time and recreation. In his classification, the level of living is determined both on the basis of need satisfaction and utilization of resources. The resource components can also be considered to be goals themselves. For instance, good health is not only a resource but also a tool by which, for example, better employment can be obtained.

The level of living can also be measured by social indicators. Committees appointed by the United States President to consider national goals have worked hard to find social indicators (B a u e r 1969, pp. 22—25). American studies used large number of indicators. For example, a committee appointed by President Hoover in 1933 formulated 37 specific goals; in 1960, under President Eisenhower, the number had climbed to 81 (B i d e r m a n 1969, p. 88). A starting point for the construction of social indicators was that various combined indices are spurious in welfare measurements (A l l a r d t 1971 b, p. 13).

Even the simplest level of living comparison between two individuals presupposes that the individuals have identical values and needs (Report . . . 1954, p. 6). Some primitive physiological needs can be assumed to be approximately similar in all humans, but as soon as personal tastes and preferences are considered, measurement of the level of living, and the degree of need satisfaction, becomes impossible (Report . . . 1954, pp. 6—7). Also, needs change frequently. A l l a r d t finds that modern social policies should be based on people's wishes, even if the ranking of values by people, or all the wishes were not found acceptable, since they may be noxious either to the wishers themselves or other members of society (A l l a r d t 1971 a, p. 312).

The use of multivariate methods offers new possibilities of searching for connections between level of living components on the basis of empirical material (K o s k i a h o 1969, p. 28). Accumulation of various level of living

components in Finland has been studied by Riihinen (1965) and Salavuo (1968, 1969), and in Western Europe by Koskiaho (1969). None of these three authors has found a pure overall component of the level of living but explain that the accumulation of the level of living is mostly incomplete. So far, the use of multivariate methods has not yet disclosed any universally applicable method for the measurement of the level of living.

The level of living of an individual or a population group has usually been measured only by means of earnings or consumption. An exception in Finland is Salavuo, who studied components and indicators suitable for the measurement of small-farmers' level of living, and their accumulation (1968), and the suitability of the economic-level scale for measurement and comparison of wage earners' and small farmers' level of living (1969).

23. Income level as indicator of the level of living

National income and level of living are not identical, but the latter can be meaningfully reviewed in the light of the former, on the basis of underlying reality (Waris 1968, p. 66). The United Nations Expert Committee recommends that earnings and consumption be included in the level of living as a kind of basic information rather than as components of the level of living (International . . . 1961, p. 16). According to Pipping (1953, pp. 147—148), income level cannot be considered part of the level of living, rather it is the condition that must be met before a certain level of living can be reached and maintained. The first condition for an increase in the level of living is the increase in income level (Vepsä 1966, p. 155).

As earnings increase, the consumer, after meeting the indispensable consumption expenses, still has money he can spend on various purposes at any time he chooses. It has been seen that the total of money on consumer durables increases as earnings increase (Saarsalmi 1966, p. 112).

Although national income is used only in international level of living comparisons, it may be useful to point out the weaknesses of the use of national income as basis of comparison, since the same weaknesses are, in principle, inherent in all income comparisons.

— National income is expressed in terms of monetary units, and therefore price changes affect the national income although the level of living may not have changed at all.
— The national income figures do not reveal how easily the income has been earned (hours and conditions of work).
— National income does not show the distribution of income between individuals, or the means of its re-distribution.

— National income indicates nothing concerning the possibilities of using the income: the proportion to be spent on the barest necessities such as food and housing, and the proportion spent by public authorities e.g. on national defence, war, or space programmes.

— The national income figures fail to express how »wisely» the income is spent in each country, how the tastes prevailing in a particular country affect the figures, or how the quality of commodities available varies.

— National income does not cover the factors affecting the living conditions which are disregarded when the national income estimate is made (E k l i n 1965, p. 7).

It has proved difficult, in international comparisons, to find a method by which the national incomes of different countries can be made mutually comparable. It is important to note that a high national income in itself does not guarantee the welfare of individuals (A l l a r d t 1971 b, p. 5). As long as development is reviewed in terms of the monetary values of commodities and services produced, only resources produced are discussed, disregarding the way in which the resources affect human lives (D r e w n o w s k i 1970, pp. 25—26).

The operative yardstick of welfare from the occupational point of view is income, and from the social policy point of view consumption (J o h a n s s o n 1971, p. 6). N o p o n e n (1971 a, pp. 83—84) measures objective welfare by the mean net income of a family per month. He finds that the aspiration level usually exceeds income and achievement level. Of all the variables studied, the aspiration level was effected most by income (N o p o n e n 1971 a, p. 123).

In any measurement of the earnings of a person, a household or a population group the available income probably is of decisive importance for achievement and maintenance of the level of living (S a l a v u o 1969, p. 24). Income at a household's disposal is calculated by adding up takings from productive activity, and income transfers obtained (i.e., pensions and social subsidies), and by subtracting from the total the income transfers the household pays (direct taxes and tax-like fees) (Komiteanmietintö 1966: B 94, pp. 17—21).

The present study compares the annual disposable income of forest worker households' with that of agricultural workers, and the workers of wood processing, metal building, and civil engineering industries.

Table 2.1 shows that in 1966 the annual disposable income of agricultural worker households' was lowest, being about four-fifths of that of forest worker households. The other groups of the table exceeded the annual net incomes of forest worker households by 28—45 %.

Table 2.1. Annual disposable income of forest worker households and some other worker households in 1966. Source: The 1966 Household Survey.

Taulukko 2.1. Metsätyöntekijäruokakuntien ja eräiden toisten työntekijäruokakuntien käytettävissä oleva vuositulo vuonna 1966. Lähde: Vuoden 1966 kotitaloustiedustelun tulolistat.

Household *Ruokakunta*	Annual disposable income *Käytettävissä oleva vuositulo*				Consumption units per household (calorie scale) *Kulutusyksikköjä ruokakunnassa (kaloriasteikko)*	Average size of household, persons *Ruokakunnan keskikoko, henkilöä*
	Fmk per household *mk/ruokakunta*	index *indeksi*	Fmk per consumption unit *mk/kulutusyksikkö*	index *indeksi*		
Forest workers — *Metsätyöntekijät*	8 500	100	2 000	100	4.2	5.0
Wood processing industry workers — *Puuteollisuuden työntekijät*	11 200	132	3 600	180	3.1	3.6
Metal industry workers — *Metalliteollisuuden työntekijät*	12 300	145	4 400	217	2.8	3.5
Building industry workers — *Talonrakennusalan työntekijät*	12 300	145	3 700	184	3.3	4.0
Civil engineering workers — *Maa- ja vesirakennusalan työntekijät*	10 900	128	3 300	163	3.3	3.9
Agricultural workers — *Maatalouden työntekijät*	6 900	81	2 300	114	3.0	3.6

The mean size of forest worker households, and the total consumption units per household exceeded those of the other groups. Per consumption unit, agricultural workers had incomes 14 % higher and metal industry workers had incomes 117 % higher than the forest workers.

In this context it seems unnecessary to discuss in detail the forest workers' and the control groups' income and earning levels, since a detailed comparison has been published (H e i k i n h e i m o et al. 1973). That study examined how the earnings of various groups of workers developed in Finland, Sweden and Norway, as well as the mutual proportions of the forest workers' earnings in these three Scandinavian countries.

24. Consumption level as indicator of the level of living

Consumption level refers to the amount of commodities and services consumed by an individual or group of individuals, or money spent on buying commodities and services within a given period of time (K o r p e l a i n e n 1967, p. 13). The United Nations Expert Committee recommends

that consumption be considered a kind of basic information on the level of living but does not include it among its components (see Chapter 23). The views of the authors who consider the consumption level an empirically suitable measure of the level of living are outlined by Salavuo (1969, p. 12) as follows: »Consumption level is one of the most important parts of the level of living though not identifiable with it. On both individual and group level, consumption is the most conspicuous part of the level of living.» The consumption level makes the tangible measurement of the level of living possible since relevant information is relatively easy to obtain (Sauli 1951, pp. 12—16; Pipping 1953, pp. 143—144; Mod 1962, pp. 19—22; Roos 1968, p. 38; Salavuo 1969, pp. 11—14).

It should not be forgotten, however, that the contents of the level of living cannot be described by material consumption alone, since the level of living covers the satisfaction of all human needs, material and intellectual (Waris 1964, p. 153; Nieminen 1965, p. 8). Consumption level alone does not express the degree of satisfaction very exactly, for prices and need satisfaction are not really the same thing (Salavuo 1969, p. 13). The degree of need satisfaction depends mainly on how commodities and services are used, or how they serve the individual. For example, high cost of living is not necessarily evidence of a high level of living (Drewnowski-Scott 1966, p. 7). Within the limits of the purchasing power available, the consumers tend to obtain commodities that satisfy the highest possible proportion of their varied needs. In order to be able to satisfy the needs to the highest possible degree, the individual consumer must recognize both his needs and his choices. Vepsä (1966, p. 15) says that a kind of standardization of needs is observable within a given social group or income bracket. A family's living habits, and even the consumption level of the social class concerned, can be judged on the basis of the consumption of the individual family (Sauli 1951, p. 13).

In the 19th century, Engel noticed certain regularities between available income and the way in which it is spent. Engel's laws are the following:

1. The poorer the family the larger the proportion of expenditure on food.
2. With other expenses remaining constant, the proportion spent on food is the best measure of the level of living.
3. Households with identical consumption habits and paying the same prices for commodities bought, spend with increasing income a decreasing proportion on indispensable commodities and a growing proportion on commodities of a relatively general nature (Engel 1895, pp. 26—29; Zimmerman 1936, pp. 99—101).

Table 2.2 Consumption expenses of forest worker households and some other groups by main categories in 1966. Source: The 1966 Household Survey.

Taulukko 2.2 Metsätyöntekijäruokakuntien ja eräiden toisten työntekijäruokakuntien kulutusmenot pääryhmittäin vuonna 1966. Lähde: Vuoden 199 kotitaloustiedustelun kulutuslistat.

Consumption expenses by main categories *Kulutusmenot pääryhmittäin*	Household — *Ruokakunta*					
	Forest workers *Metsätyöntekijät*	Wood processing industry workers *Puuteollisuuden työntekijät*	Metal industry workers *Metalliteollisuuden työntekijät*	Building industry workers *Talonrakennusalan työntekijät*	Civil engineering workers *Maa- ja vesirakennusalan työntekijät*	Agricultural workers *Maatalouden työntekijät*
	Per cent — *Prosenttia*					
Food — *Ravinto*	40	33	30	35	32	39
Drink — *Juomat*	6	5	5	6	5	5
Tobacco — *Tupakka*	3	3	3	4	4	4
Clothing and footwear — *Vaatetus ja jalkineet*	9	9	9	9	9	10
Housing — *Asunto*	11	14	16	13	11	14
Light and heating — *Valo ja lämpö*	6	4	3	4	4	6
Household goods etc. — *Taloustavarat ym.*	5	7	5	5	4	5
Health and cleanliness — *Terveys ja puhtaus*	3	4	4	4	3	3
Vehicles, travel etc. — *Ajoneuvot, matkat ym.*	12	13	15	14	19	9
Education, entertainment, recreation — *Kasvatus, huvi, virkistys*	4	6	8	6	5	4
Other expenses — *Muut menot*	1	2	2	2	1	1
Consumption expenses — *Kulutusmenot yhteensä* ..... %	100	100	100	100	100	100
Fmk — *mk*	[1]) 9 292	10 067	11 702	11 556	10 279	[1]) 7 005

E n g e l's laws still hold today. This is shown by the fact that the United Nations Expert Committee recommends that the proportional share of food expenses in the total consumption of a household be considered the general indicator of the level of living (International . . . 1961, p. 14).

The consumption level was lowest among the agricultural worker households (Table 2.2). The consumption expenses of forest worker households

[1]) A comparison of the consumption expenses in table 2.2 with the disposable income in table 2.1 shows that the consumption expenses of forest worker and agricultural worker households exceed income. The reason is that income of people living on farms has been calculated excluding some of the agricultural and livestock products sold. Other human errors may also be included in the figures. These weaknesses do not appreciably reduce the value of the figures in comparison between groups of workers.

[1]) *Verrattaessa taulukossa 2.2 olevia kulutusmenoja taulukon 2.1 käytettävissä oleviin tuloihin näkyy, että metsätyöntekijäruokakuntien ja maataloustyöntekijäruokakuntien kulutusmenot ovat käytettävissä olevia tuloja suuremmat. Tämä johtuu ennen kaikkea siitä, että käytettävissä olevaa tuloa laskettaessa maatiloilla asuvilta on jäänyt ilmoittamatta jonkin verran myytyjä maa- ja karjataloustuotteita. Lukuihin saattaa sisältyä myös muita inhimillisiä virheitä. Mainitut heikkoudet eivät sanottavasti alenna lukujen käyttökelpoisuutta ammattiryhmien välisiin vertailuihin.*

were distinctly higher than those of the agricultural worker households, but 8—26 % lower than those of the other groups compared. Since the number of consumption units in forest worker households was 27—50 % higher than in the groups compared (see Chapter 23), the differences per person are even greater.

Application of E n g e l's first law to the interpretation of Table 2.2 shows that the forest and agricultural worker households are poorer than the others included in the comparison. The commodities of relatively general nature mentioned in E n g e l's third law are represented in Table 2.2 groups by vehicles, travel, education, entertainment and recreation. Money spent by metal industry worker households on vehicles, travel etc. was more than one and a half times that spent by the forest worker households. For education, entertainment and recreation the difference between the said households was more than two-fold.

Interpretation of Table 2.2 using the general indicator recommended by the UN committee, i.e. the relative share of food expenses in the household's total consumption, reveals that the level of living of a forest worker and an agricultural worker household is approximately as high or as low; that of the other households compared also seems to be mutually comparable. In terms of percentages, the difference between the said two levels — occupations of primary and secondary industries — is 6—10 per cent. While a forest worker household spends 40 % of its consumption expenses on food, the percentage for a metal industry worker household is 30 %.

25. Welfare

The contents of welfare goals vary according to the goal-definer's likings, purposes and verbal expression. Definitions given include e.g. the best for the individual, happiness, contentment, welfare, level of living. It is theoretically important that the definition of welfare be based on the need satisfaction of people (A l l a r d t 1971 b, p. 5).

A modern Finnish dictionary defines »welfare» as meaning wealth and affluence, i.e. high degree of material living conditions. The concept »welfare state» usually implies a state with a relatively high material level of living, where public authority has organized a certain amount of social security and comfort for all citizens. It may perhaps be said that the goal of current growth and social policy is the creation of a welfare state (E k l i n 1965, p. 5).

»Three goals of modern social policy have established themselves as criteria of the concept of welfare: reasonable level of living, social security and, the most difficult to measure and determine, comfort» (W a r i s 1961, p. 29). The level of living is usually understood to mean a more limited

entity, especially when it has been used as operational concept in need satisfaction measurement (K o s k i a h o 1969, p. 22). The level of living can be considered a partial measure of welfare (R o o s 1968, p. 37).

Questions of valuation are particularly associated with concepts like minimum level of living, reasonable level of living, aspired level of living, and welfare (E k l i n 1965, p. 7). As time passes, reasonable level of living becomes the minimum level of living: values and needs change both at individual and community level.

Welfare is satisfaction of those needs which produce enjoyment, a feeling of wellbeing, and happiness (H a r v a 1964, p. 24). The more needs are satisfied the more they increase (G a l b r a i t h 1958, p. 121). G a l b r a i t h shows how, in the United States, keeping up employment in automating industrial life requires a continuous growth of production, largely based on artificially accelerated need of consumption. New commodities create new needs, but marketing the additional commodities is possible only with the aid of increasing advertising and expanding hire purchase systems. Increase in the level of living is associated with an ever faster rhythm of life, ever greedier race for money, and increasing difficulty of choice.

If the opinion is that society should maximize the citizens' welfare, it is natural that society should accept only the citizens' valuations as the basis. Since society does not know the individuals' valuations and is unable to follow them, society must confine its goals, adapting them to available means and resources (R o o s 1968, p. 33).

By an individual's welfare R o o s (1968, p. 34) means the state of need satisfaction (state of value realization) which the individual finds adequate and which fits within the framework of the criteria society has laid down for need satisfaction. Welfare depends on both the individual's valuations and on the community's terms concerned with the minimum criteria of need satisfaction, which are binding only for community and not the individual (K o s k i a h o 1969, p. 21). The community, however, makes restrictions on the individual's welfare, and the individual can satisfy his needs only within the standards outlined by the community.

The purpose of social-policy decision-making is to increase people's welfare, i.e. improve the degree of satisfying their needs. It is important to consider how needs and welfare are understood (N o p o n e n 1971 b, p. 266). T o w n s e n d (1969, p. 51) distinguishes between subjective, objective and normative needs. Subjective needs being those which the individual feels he has, although their existence perhaps cannot be shown. Objective needs can be shown as relative absence of possibilities. Normative needs refer to the needs that are generally recognized or the existence of which is acknowledged. Objective welfare means the degree of the true satisfaction of needs, and subjective welfare the degree of need satisfaction experienced by the

individual (S i p i l ä 1970, pp. 16—17; N o p o n e n 1971, p. 15). Normative welfare is explained by N o p o n e n (1971 b, p. 266) so that some issues are accepted as needs and welfare components, while others are not.

In welfare economics man is considered to best known his own needs and their degree of satisfaction. The following definition serves as example: the individual is the best judge of his welfare (M i s h a n 1967, pp. 6—7). It is evident, however, that using subjective welfare and subjective needs to help social decision-making is very questionable, unless the factors contributing towards the development of the needs and their links to the needs to society and its structure are simultaneously considered (N o p o n e n 1971 b, p. 267).

Subjective welfare is the more dependent on objective welfare the larger the amount of the individual's knowledge. If the amount of knowledge is large, man knows his true welfare (S i p i l ä 1970, p. 17). Forest workers, by and large, are not too dissatisfied with their conditions, largely because their knowledge of better conditions is limited and they have no control groups within reach. Since subjective welfare is based on comparisons, knowledge may be considered an indispensable and adequate condition for subjective welfare (N o p o n e n 1971 a, p. 61). For this reason, »the natural objective of social policy is the re-distribution of resources so as to abolish poor conditions. This means in practice the definition of a minimum limit below which no level of living component may sink» (A l l a r d t 1971 a, p. 318).

26. The role of the level of living components

The underlying idea in the measurement of the level of living by means of several components is that one yardstick, say the income level, does not provide a sufficiently detailed and multilateral picture of the level of living. The use of several components, in turn, creates a new problem: how should these components be weighted in order to obtain a balanced and correct picture of the level of living as a whole. Intuitively, it seems evident that the different level of living components are of varying importance in the totality of the level of living.

One way of weighting is to divide the components into basic and other needs. This method, however, is not particularly suitable for a study of the level of living in a country like Finland, where the basic needs e.g. for food and clothing are usually satisfied. In countries with a high standard of living the importance of basic needs as part of the level of living has diminished while that of other needs has increased. It should be noted that the proportional importance of the level of living components varies in different societies, and also between different population groups in one society.

The present study seeks to give a balanced picture of the level of living of the Finnish forest worker by weighting the various components according to their importance for the forest worker himself. The interview study applied two approaches to the weighting problem. Firstly, the forest workers were asked which of the components of the level of living they considered most important, and which in their opinion were most deficient. Secondly, the information obtained was supplemented by a more detailed analysis of the replies by factor analysis.

The question concerning the importance and defects of the components was made at the end of the interview, after the questions concerning each individual component had been gone through. In this phase, the content of the components was somehow familiar to the forest workers. The questions were worded as follows: »Here is a list of the components affecting the level of living. Please choose three, in order of importance, which you consider the most important in life», and »please name the three of the listed components which in your personal life are most deficient». The relative share of the components listed as the most important was multiplied by three, that of the component ranking second by two, and that of the third component by one. The scores were added up, and this gave the following order of the components. The order obtained for the first question is given under the heading »Importance» and that obtained for the second under »Deficiency».

Importance

Component	Score
1. Health	191
2. Housing	95
3. Education	69
4. Working conditions	68
5. Security	65
6. Nutrition	41
7. Human rights	33
8. Recreation	20
9. Clothing	18

Deficiency

Component	Score
1. Housing	114
2. Working conditions	114
3. Education	97
4. Health	68
5. Security	58
6. Recreation	49
7. Clothing	39
8. Nutrition	32
9. Human rights	28

The ranking is seen to be somewat different. A similarity is that the first five components are the same, and so of course are the remaining four. The dissimilarities are explained principally by the fact that »Importance» gives an idea of a kind of general importance of each level of living component to the individual, whereas the »Deficiency» describes the shortcomings experienced personally by the forest workers.

One of the starting points of the present study was to describe the forest worker's level of living from his own point of view, with emphasis on the components subjectively experienced as deficient. For this reason the »order of deficiency» was chosen as the basis for the system of weighting the component factors. This order alone does not, however, give a sufficient idea of the relative importance of the components. It was therefore made more accurate by a study of the individual variables and factor analysis, taking into account simultaneously all the different level of living components.

A detailed review of the components disclosed that the position of health at the head of the »order of importance» was due not only to the general importance of health but also to the risk of a loss of health which is closely associated with forest work. Forest work is higly susceptible to accidents, and occupational ill-health caused especially by the power-saw and the heavy manual work is characteristic of forest work. The ranking fourth of health in the »order of deficiency» reflects only the true state of health and not at all this risk of a loss of health. It is therefore appropriate to give health a higher ranking in the list.

Education ranked third in both lists. In the light of the relevant interview questions it is apparent that education ranked high because the interviewed thought of training and education which, in their younger years, would have given them the opportunity of choosing better occupations. Training for their own occupation as forest workers, by contrast, was not considered defective although few had received any organized training. Training, therefore, was not considered important for a forest worker, and for this reason education in the »order of deficiency» acquired a greater weighting than necessary.

Factor analysis was used to study whether the »order of deficiency» was consistent with the other questions of the questionnaire. The analysis included variables characterizing every level of living component, and also the respondent's opinion of the level of his own living. The variables were factorized and rotated. One factor accumulated parallel with the level of living variable, and this gave loadings to the variables illustrating housing, human rights, working conditions, and security. It can be concluded, therefore, that forest workers' views of the level of living are determined primarily by the housing level, human rights, conditions of work, and security. These com-

ponents, excepting human rights, also ranked highest in the »order of deficiency».

Why did human rights acquire added weight in factor analysis? And why, on the other hand, did components such as health and training, which ranked high in the »order of deficiency», fail to receive a loading in the level of living factor?

Vocational training was not considered to be deficient; this was seen from the study of the variables, and was supported by factor analysis. This stresses the fact that the ranking of education in the »order of deficiency» is higher than it need be. The absence of health in the level of living factor was due to the health variable used: the true state of health. As was seen from the »order of deficiency» the true state of health was not considered very deficient. Factor analysis, therefore, did not negate the finding that the risk of a loss of health is an important factor in the forest worker's life.

The added emphasis on human rights was, therefore, the only new feature obtained by factor analysis in the weighting of components. The most probable explanation for this added emphasis is that in the »order of deficiency» human rights did not assume the ranking consistent with their importance, since it was perhaps the most abstract of the level of living components. When forest workers thought of the »order of deficiency» they were unable to form an idea of the contents of human rights, which often passed without a mention. In factor analysis, however, human rights was based on variables concerned with the appreciation of forest worker's occupation and his treatment by society, and these variables were easy to understand. Consequently, the weighting of human rights in the »order of deficiency» must be increased in order to reach the correct proportions between the component factors.

The result of these considerations was that in the system used for weighting the level of living components the »order of deficiency» must be amended by giving a higher ranking to health and human rights, and a lower ranking to education. Such amendments are highly arbitrary since there are no accurate methods by which to define the mutual importance of the components. Thus the following list of the level of living components represents, above all, a frame of reference and no precise and final order. As mentioned earlier, the list is based on forest worker's subjective views, and can therefore not be expanded to cover other occupational groups. It should also be pointed out that the order of importance obtained can change within a short period of time as the structure of the professional body of forest workers changes and their conditions of life improve.

With these reservations, the level of living components for forest workers are weighted as follows:

1. Health
2. Housing
3. Working conditions
4. Security
5. Human rights
6. Education
7. Recreation
8. Clothing
9. Nutrition

The scores have been omitted since their estimation in relation to the changes made would have been impossible.

In the present study, the order of weighting is taken into consideration in that more space is given to the important components while the less important are described more briefly.

Before studying the individual components of the level of living, a brief glance at its totality may be useful. As was seen earlier, no single unequivocal and applicable measure has been found for the concept of the level of living. However, the term »level of living» specifically refers to one entity comprising all the components, variously weighted. The present study approached the entity of the level of living by asking forest workers for their opinion on their own level of living. The result was subjective but no better measures are available. There were two questions, of which one opened and the other closed the interview. »When you think of your own level of living, do you consider it very high, high, low or very low?» According to the replies, the forest workers' idea of their level of living was very uniform:

Opinion of the level of living	Per cent of respondents
Very high	—
High	5
Cannot say	19
Low	66
Very low	10
	100

Three of every four considered their level of living low or very low. As this question was the first of the opinion poll, the other questions of the interview had not yet affected the forest workers' idea of the concept of the level of living. At the end of the interview, an attempt was made to ascertain whether the forest workers' opinion of their level of living had changed after the detailed questions concerning its components. The following question was put: »Do you find your level of living at the moment much better, better, poorer or much poorer than that of other people?» The distribution of the replies was the following:

Level of living compared with others	Per cent of respondents		
	forest workers	pen-sioners	ex-forest workers
Much better	—	—	—
Better	7	—	17
Cannot say	20	26	15
Poorer	65	58	58
Much poorer	8	16	10
	100	100	100

The distribution of the replies of forest workers was practically the same as for the first question. The interview itself, therefore, did not affect their views. The pensioned forest workers tended to consider their level of living somewhat lower than the active forest workers, whereas those who had entered a new occupation regarded their level of living as slightly better than that of the forest workers. The forest workers' views reinforce the general observations recorded in connection with the survey of the level of earnings and level of consumption (H e i k i n h e i m o et al. 1973, Vuoden 1966 . . .), according to which forest workers had a level of living lower than that of most other groups of workers.

3. MATERIAL AND METHOD

31. Sample from the Rural Labour Force Study

The present study uses three separate samples selected from forest workers, all representing the total body of professional forest workers in Finland. Subsamples taken from Rural Labour Force Study together with a sample selected from the register of the Pension Security Fund are used in all chapters discussing the level of living components, and a sample taken from 1966 Household Survey is mainly used in Chapter 2 for the analysis of earnings and consumption as indicators of the level of living.

The samples of the Rural Labour Force Study were selected from among the men born in 1899—1945, who lived in rural communes in 1961 and had during that year been employed for more than 50 days in paid forest and floating work. A representative sample of these men (the basic sample) was obtained by asking some 28 000 men drawn by lot from the 1961 registers of rural communes concerning their use of time in 1961 (H e i k i n h e i m o—R i s t i m ä k i 1965, p. 6—8). Subsamples were selected by lot from this sample representing the men employed in 1961 for over 50 days in paid forest and floating work. For this purpose, the rural communes of the country were placed into order of magnitude, by labour force districts, according to the number of men who fulfilled the labour input limit required for inclusion in the sample. In this order, the communes were divided into groups of seven, and one commune per group was drawn by lot, with the men included, for each subsample (H e i k i n h e i m o 1963, p. 15). This gave seven parallel subsamples, each of them an independent representative sample of the men living in rural communes in 1961 and born between 1899—1945, who in 1961 according to their own report had been employed for more than 50 days in paid forest and floating work.

The present study used those men of subsamples 3 and 4 of the Rural Labour Force Study who in both 1963 and 1966 had been employed for over 100 days in forest and floating work. These men totalled 170 in 1963 and 86 in 1966. By the time of the level of living interview of 1969, the total was further reduced by six: four had emigrated to Sweden and two had died.

The diminution of the sample from 1963 to 1966 was principally due to the stipulated labour input limit not being reached. The next common causes were old-age pension, change of occupation, and disability. The loss proper was only two per cent.

Subsamples 3 and 4 were good representatives of the basic sample of 28 000 men in the Rural Labour Force Study, both as regards labour input, social-group distribution, occupational distribution and regional distribution (H e i k i n h e i m o 1963, p. 15). The sample was used in the study of forest workers' level of earnings in 1963, when it also represented the basic sample very well as regards age structure. The sample was not supplemented in 1966 when the study of the forest workers' level of earnings was continued. As a result, men aged 18—20 years were missing in 1966, and those under 23 similarly missing from the 1969 study of the level of living. The maturation of the sample also produced other consequences which deserve some attention.

No »fresh blood» was added to the sample for eight years. Forest work recruits its new labour force almost entirely from rural youth. Transfer from some other occupation to forest work is uncommon. Young workers are usually interested in their work but their physical hardiness and occupational skills are not yet at their best. In consequence their earnings are not so high as those of men with a history of 5—15 years of forest work. Disability, and also the change of occupation, show that as the sample ages individuals are eliminated. Disability, however, is a very relative concept, as the necessity of earning a living keeps a large number of medically disabled men in forest work.

32. Sample from the register of the Pension Security Fund

To supplement the sample mentioned above, another random sample was drawn from the register of Pension Security Fund. This register contained data on the age distribution of persons employed in forest work in 1965. This distribution showed how many men had to be selected from each birth year group in order to obtain a sample of 200 men born in 1903—47. The method was as follows:

— The basic year of selection consisted of every second birth-year group (1903, 1905, 1905, . . . 1941, 1943, 1945 and 1947).
— A birthday (1—31) and a spare day were drawn by lot for every birth-year group.
— The basic month of selection was separately drawn by lot for every birth-year group.

— Selection was made from a year book (July 1, 1962—Dec. 31, 1964). Men employed in forest and floating work in 20 or more months were included.

— If the birthday was to be the 8th and the basic month of the birth year group 1903 was December, and if the quota to be selected was not filled by persons born on that day, this was replaced by January 8, 1904, and then by February 8, and so on. If the quota was not filled before next birth year group's basic year of the selection, the spare day was utilized and re-selection started from the basic month.

— After the selection was completed, the men's register extracts were checked to see how long they had been employed in forest work between the beginning of 1965 and the last accounting data of 1967. If during this period they had worked in the forest for more than 20 months, they were included in the sample.

The only drawback with the sample selected from the register of the Pension Security Fund was that the youngest forest workers, aged 18—22, were not included here either.

33. Sample from the 1966 Household Survey

The sample of the 1966 Household Survey comprised about four thousand households. Forest worker households were taken from the sample on the basis of labour input, and any person who had been employed in paid forest and floating work for more than 100 days a year was considered a forest worker. This method yielded 121 households which were checked against the original material, eliminating e.g. machine contractors and men whose labour input in some other sector of economy exceeded that in forestry. This left a material of 95 forest worker households.

The earnings and consumption of forest worker households were compared with those of workers engaged in wood processing industry, metal industry, building industry, civil engineering, and agriculture of the same material. The control groups chosen consisted of occupations as similar as possible to those of the forest worker and contained approximately a hundred households.

34. Interview procedure

The sample of the study of the forest workers' level of living consisted of the 80 men of subsamples 3 and 4 of the Rural Labour Force Study and the 200 men selected from the register of the Pension Security Fund. Although

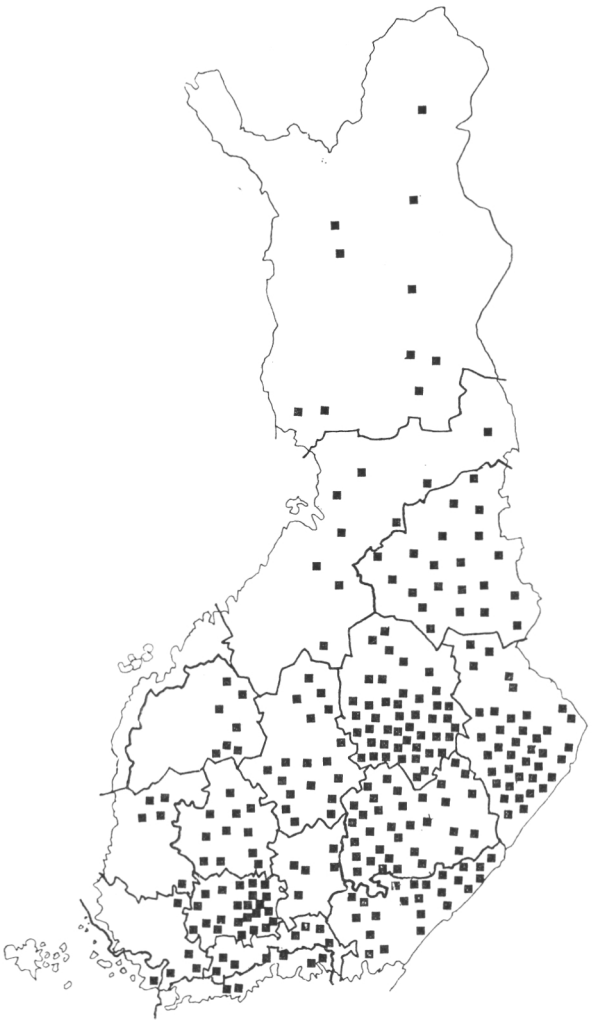


Figure 3.1 The distribution in 1969 of professional forest workers in the sample. One dot represents one forest worker.
Kuva 3.1 Koko maan ammattimaisen metsätyömieskunnan näyte vuonna 1969. Piste tarkoittaa yhtä näytteen miestä.

both samples represented the body of professional forest workers in the whole of Finland, all variables were first calculated from both samples in relation to age. The distributions were seen to be very nearly identical. Almost throughout, the differences between the corresponding lines and columns did not exceed one percent. This observation served to show that a very small sample can give a relatively good idea of all forest workers in Finland. Consequently, for calculation of the final results, the two samples were combined into one of 280 men. Its distribution is shown in Fig. 3.1.

From September to December 1969, 268 forest workers in groups of 2—7 men visited the Forest Workers' Pension Fund in Helsinki for an examination. The examination per person lasted one day and comprised a level of living interview, health interview, laboratory tests, and a medical examination with chest x-ray, audiometry, and detailed examinations of the cardiovascular and respiratory organs. Twelve men of the sample could not be persuaded to come to Helsinki and so the interviewers went to see them.

The level of living interview and health interview were carried out by Matti Heikinheimo and Aarne Reunala, laboratory tests were taken by nurses, and Martti Lehtinen undertook the responsibility for the medical examinations, assisted by several physicians and advanced medical students.

Cardiovascular and audiologic examinations were supervised by relevant specialized physicians, the former by Pekka Karhunen and the latter by Osmo Karhunen.

The sample of forest workers had undergone some change in the interval between the selection of the sample and the date of examination. Of the 280 men of the sample, 42 had changed occupation and 19 had retired on pension. The bulk of the data presented is concerned with the total sample. Where the views of those who had changed occupation or retired on pension differed greatly from those of the forest workers, they are presented separately. It should be borne in mind, however, that the change of occupation was, in many cases, by no means definitive. Often it was a result of an excessive labour force supply in primary production, with accompanying long-term unemployment, or of temporary employment in some other sector. The results concerning health give the number of men as 268, which refers to the men who visited Helsinki.

The majority of the present results are given in the form of tables or graphs. The most common classification variables used are age, marital status, social group, occupational group, and region. The presentation of the results also pays attention to the opinions verbally expressed by the forest workers.

4. HEALTH

41. Introduction

Before embarking on a study of the Finnish forest worker's health, it must be pointed out that the subject of the study, the F i n n i s h man, leads in international mortality statistics, especially that of cardiovascular diseases. The forest worker has a unique social status in Finland. His life is darkened by concern about daily living, concern about employment and, above all, concern about health. Furthermore, this man works in the forest, and his site of work is therefore air-conditioned to correspond exactly to the northerly climate of this country. The distances he has to cover to and from the site of work, and the movements required for the work, each involve difficult cross-country conditions. The work is physically heavy and requires uncomfortable and strenuous working positions and movements.

The methods of forest work underwent almost revolutionary changes in the 1960s. Machines arrived in the forest, bringing with them the efficiency of industrial work together with the accompanying evils. The state of health of the men studied was greatly affected by the factors bearing upon national health in general, as well as by factors arising from their social standing and their work. In many pathological states, it is difficult to distinguish between these components.

The study comprised an extensive interview concerned with the subject's health. The questions involved e.g. his medical history, accidents, war-time injuries, and particularly the symptoms of cardiovascular and respiratory diseases, orthopaedic complaints, and finger symptoms associated with the use of the power saw. Medical examination consisted of a clinical examination including percussion, auscultation, blood pressure measurement, etc. The customary blood and urine tests were also made. ECG was taken at rest from all the subjects and — if their condition permitted — after bicycle ergometric exertion. Vitalograph and peak flow was used to measure pulmonary capacity function. A chest x-ray was taken of all the subjects, and they also underwent an audiometric hearing test. If necessary, they were examined by an otologist.

42. General state of health

»Do you feel healthy» was one of the questions asked in the interview. 42 % answered in the affirmative and 58 % in the negative. The answers by age groups are given in Fig. 4.1, which clearly shows that only in the age group under-30 the majority of men considered themselves healthy.

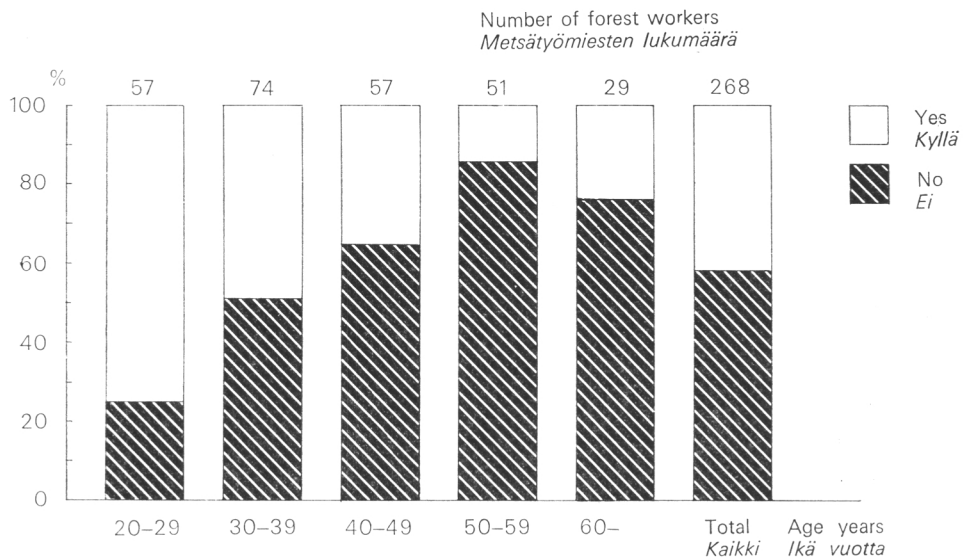


Figure 4.1 Forest workers' replies to the question: »Do you feel healthy?»
Kuva 4.1 Metsätyömiesten vastaukset kysymykseen: »Tunnetteko itsenne terveeksi?»

Answers to the question »Do you consider that you are, at present, capable of work?» are similarly given in Fig. 4.2. Negative answers became more frequent after the age of 50, but even in the oldest age group those considering themselves capable of work are in the majority. The conclusion may, perhaps, be drawn that forest workers suffer from various complaints at quite an early age, which by the age of 50 begin to affect working capacity.

Treatment prescribed by a hospital or a doctor was being received by 38 men at the time of the examination and had been received earlier by 163 men, giving a total of 201 men (75 %). Daily benefits under the Health Insurance Act had been paid to 33 men in the last two years, and 20 of the examined men had received invalidity pension. 87 men had undergone surgery and 17 had received radiotherapy. The most common operations were:

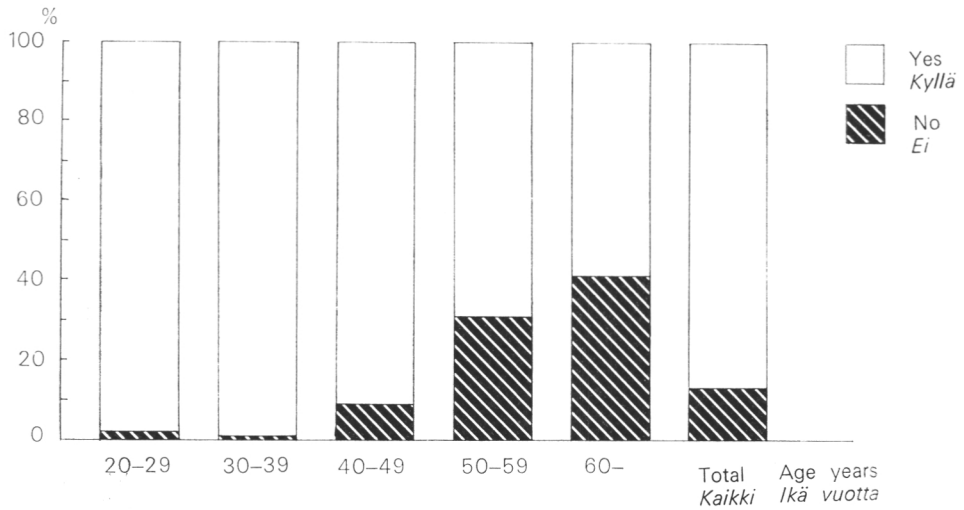


Figure 4.2 Forest workers' replies to the question: »Do you consider that you are capable of work at this moment?»

Kuva 4.2 Metsätyömiesten vastaukset kysymykseen: »Pidättekö tällä hetkellä itseänne työkykyisenä?»

Operation	Number
Appendectomy	18
Herniotomy	12
Abscess incision	12
Operation made for an accident	8
Tonsillectomy	7
Removal of a splinter or bullet	7
Gastric ulcer	6
Benign tumour	5
Goitre	4

71 % of the men had been victims of a forest work accident and 30 % of some other accident.

95 per cent of the interviewees had accomplished their national military service. 93 had served in front-line troops in the 1939—44 wars, and approximately every third (32 men) had been wounded. With a single exception, the war veterans were over 45 years old. Among the factors adversely affecting the state of health of the men of this age group, the war, and especially front-line service, should not be forgotten.

The interview also dealt with the loss of working days due to illness and accidents. Results obtained are compiled in Tables 4.1 and 4.2. It can be seen that the number of diseases and accidents is correlated with age. The difference in sick-absence between the oldest and the youngest age group was almost ten-fold: the average number of lost work days was 6 days per man in the age group 20—29 and over 56 days in the group 60 or over. The same trend is noticeable in the number of days lost for accident.

Table 4.1 Disability days of forest workers affected with illness in 1969.
Taulukko 4.1 Sairaana olleiden metsätyömiesten sairauspäivät vuonna 1969.

Age group *Ikäryhmä*	Disability days *Sairauspäiviä*	Men *Miehiä*	Disability days/man *Sairauspäiviä/mies*
20—29	99	17	6
30—39	145	12	12
40—49	282	16	18
50—59	265	11	24
60—	225	4	56
Total — *Yhteensä*	1 016	60	17

Table 4.2 Disability days of forest workers suffering accidents in 1 969.
Taulukko 4.2 Tapaturmiin joutuneiden metsätyömiesten tapaturmapäivät ikäryhmittäin vuonna 1969.

Age group *Ikäryhmä*	Disability days *Tapaturmapäiviä*	Men *Miehiä*	Disability days/man *Tapaturmapäiviä/mies*
20—29	85	9	9
30—39	139	9	15
40—49	38	3	13
50—59	88	4	22
60—	121	4	30
Total — *Yhteensä*	471	29	16

In the medical examination, the physical condition of 13 % of the sample was considered to have deteriorated, and for the remainder it was normal The height and weight distributions of the forest workers were as follows:

Height, cm	%	Weight, kg	%
—159	4	—59	13
160—169	36	60—69	44
170—179	48	70—79	30
180—	12	80—	13

On the basis of the present study, the mean measures of the Finnish forest worker were a height of 171 cm and a weight of 69 kg. On the basis of these measures, the forest workers' nutritional condition can be considered normal. Obesity was infrequent. The sample contained no man with a weight exceeding 100 kg. According to the relative weight index

$$\frac{\text{weight (kg)}}{\text{height (cm)} - 100}$$

only 3 % exceeded the index value 1.2 and were definitely obese. Physical condition or performance was measured in connection with the heart examination. The results will be reported in the chapter on cardiovascular diseases.

43. Laboratory tests

The erythrocyte sedimentation rate (ESR) exceeded 20 mm/h in 32 men. In four of them it was 40 mm/h or more. Haemoglobin levels lower than the normal limit of 14 mg/100 ml were found as follows:

Haemoglobin, g/100 ml	Number of men
— 9.9	1
10.0—11.9	2
12.0—13.9	41

Slight anaemia seemed to be relatively common in forest workers. Thyroid was examined by determining from blood samples the iodine extracted into butanol (the so-called BEI determination). If the range of normal values is taken to be 3—8 μg/100 ml, three men showed readings suggesting hypo- and ten hyperfunction of thyroid gland. Blood sugar was determined by paper indicator. One man was found to have a pathologically high blood sugar concentration. The cholesterol levels are presented in connection with the risk factors of heart diseases. Of the serological determinations, Latex test gave a positive reaction in five men indicating the presence of the so-called rheumatoid factor. Positive cold agglutination reactions were found in 11 men and cryoprecipitation reactions in 12 men. It may be mentioned that those reactions seemed to have no connection with the finger symptoms characteristic of the so-called vibration disease. Urine tests were made with paper indicators. A positive glucose response was seen in two and haematuria in one. Positive albumin reactions were checked with further tests.

44. Cardiovascular diseases

Interview data

Dyspnoea or chest pain in connection with exertion are among the principal symptoms of heart diseases. The degree of severity of the disease is often reflected by the amount of exertion that is required to trigger off the symptom. It is true that some other diseases, a poor physical condition e.g. owing to obesity can give similar symptoms. For this reason, the diagnosis of a probable heart disease can only be made on the basis of replies to a certain series of questions.

Fig. 4.3 shows the incidence of dyspnoea and chest pain noted on exertion among the forest workers studied. It shows clearly that tolerance of exertion owered with advancing age.

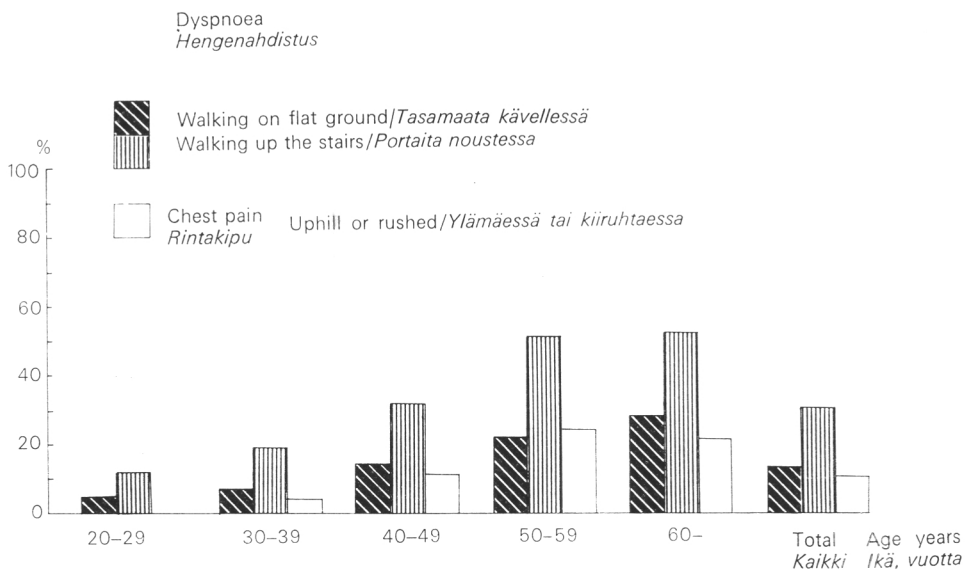


Figure 4.3 Frequency of symptoms of cardiac diseases manifested in connection with exertion among forest workers.

Kuva 4.3 Rasituksen yhteydessä ilmenevien sydänsairauksien oireiden esiintyminen metsätyömiehillä.

Performance

Performance was measured with bicycle ergometer at the same time as exertion ECG was taken. In this measurement, exertion is increased by steps, all the time observing the pulse rate, which rises with increasing exertion. On the basis of the degree of change, the maximum performance of the test subject can be determined. It depends on the oxygen intake capacity and hence also on the functional capacity of the circulatory organs, especially the heart. Exertion ECG can disclose heart diseases not diagnosed from the ordinary resting ECG. The weakness of the method is that a person in poor conditions, such as a cardiac patient, cannot be subjected to exertion without risk, and an affected limb, for example, can prevent cycling. The results of performance measurement are presented in Fig. 4.4. It is seen that performance usually remained good up to the age of 50, after which a distinct change is noticeable. Less than half of those aged 60 or more were fit enough for the exertion test.

The forest workers' own views concerning their physical condition are shown in Fig. 4.5. It is interesting to note that both the measured perfomance and the subjective estimate of the general condition deteriorate after the age of 50.

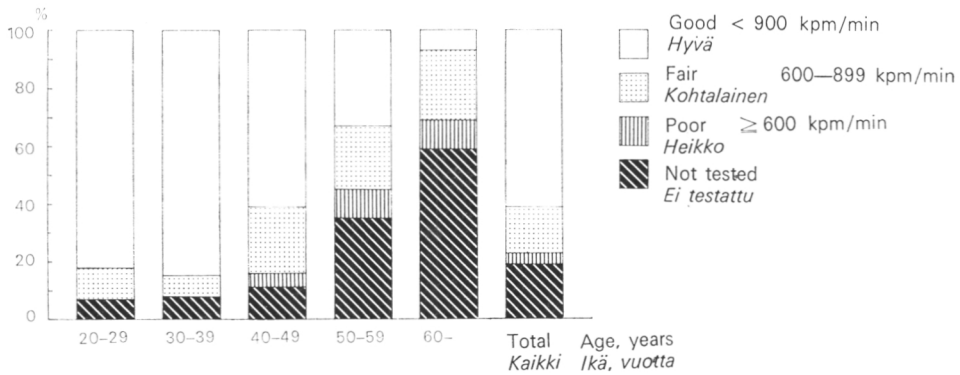


Figure 4.4 Forest workers' performance.
Kuva 4.4 Metsätyömiesten suorituskyky.

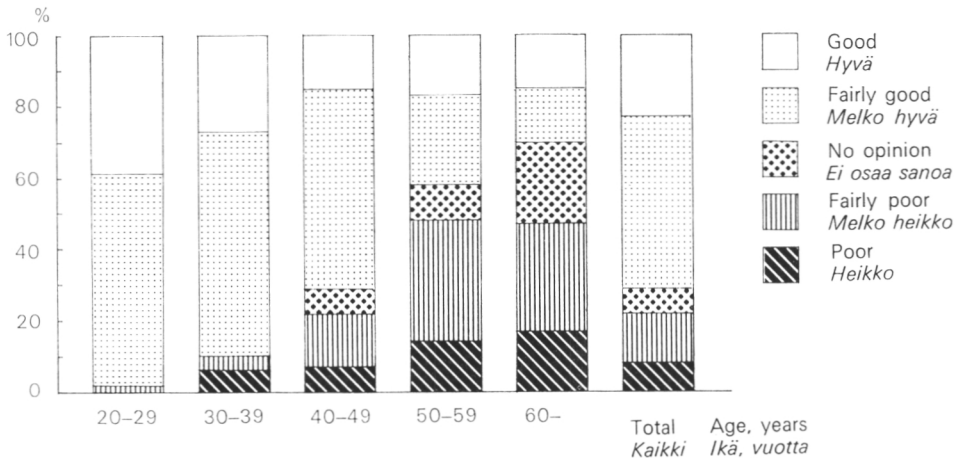


Figure 4.5 Forest workers' opinion of their own physical condition.
Kuva 4.5 Metsätyömiesten mielipide omasta yleiskunnostaan.

Blood pressure

If hypertension was recorded, the subject rested for 10 minutes, and after that a re-measurement was made. The lower readings were entered as the subject's blood pressure levels. The blood pressure is known to vary over quite wide limits. The excitement due to examination may raise the pressure in many cases. For obese and muscular subjects, the measurement may yield technically excessive values. The diagnosis of hypertension should not be made unless measurements are checked on several days. For this reason it is impossible to say how many of the forest workers examined require drug therapy for hypertension. The level often considered as the pathological limit is 160 mm Hg in the arteries during the systolic, or contracting, phase of the heart, and 100 mm Hg during the diastolic, or resting, phase of the heart. The forest workers whose blood pressures exceeded either of these

limits were requested to consult the medical officer in their domicile for repeated measurements. The level of the diastolic blood pressure is considered significant, and for the prognosis of hypertension, for instance, decisive.

The abnormally high values of systolic and diastolic blood pressures are given in Figs. 4.6 and 4.7. It is seen that 22 % showed a high systolic and 16 % a high diastolic pressure.

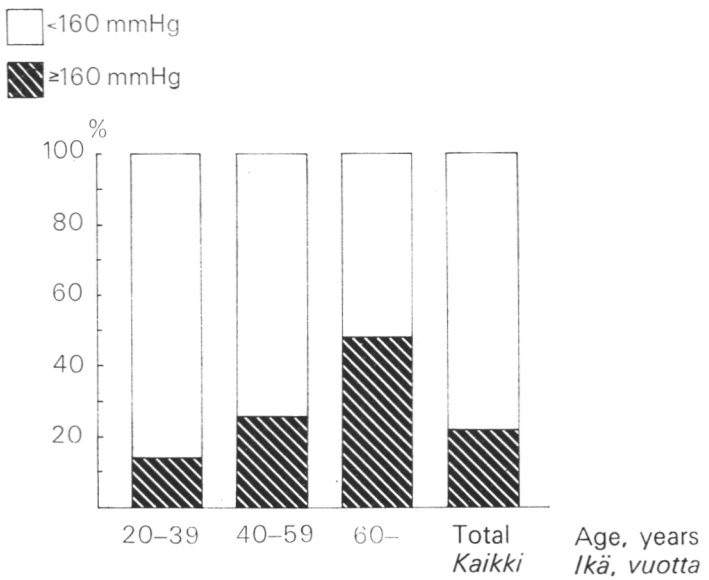


Figure 4.6 Forest workers' systolic blood pressure.
Kuva 4.6 Metsätyömiesten systolinen verenpaine.

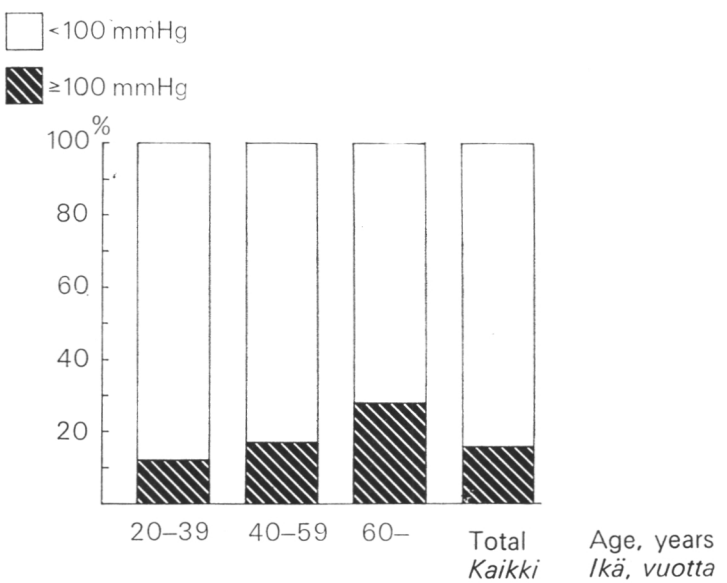


Figure 4.7 Forest workers' diastolic blood pressure.
Kuva 4.7 Metsätyömiesten diastolinen verenpaine.

Ischaemic heart disease

Ischaemic heart disease implies a locally deficient supply of blood to the heart, regardless of whether the subject has symptoms or not. Ischaemic heart disease is usually divided into two categories: the coronary occlusion or heart infarction, and a probable coronary heart disease (CHD). In cardiac infarction a part of the myocardium is damaged, and this is usually visible in the resting ECG.

A coronary disease is probable if exertion of a certain degree releases a paroxysmal chest pain, an attack of so-called angina pectoris, or if changes indicative of coronary disease are seen in resting or exertion ECG. However, a normal exertion ECG does not always entirely exclude the coronary heart disease. On the other hand, it may sometimes give false positive results.

Fig. 4.8 shows the prevalence of coronary heart disease diagnosed in the present sample according to the above indications. Even with due allowance for the difficult diagnosis of this disease, especially in its early stages, and also the potential errors that may arise on the above basis, the result must be considered alarming. Ischaemic heart disease was found in a total of 26 % of the examined subjects. In the 40—59 age group the percentage exceeded 40, and among those aged 60 or over it exceeded 60 %. In about 70 % of the cases of ischaemic heart diseases the diagnosis was based on ECG changes.

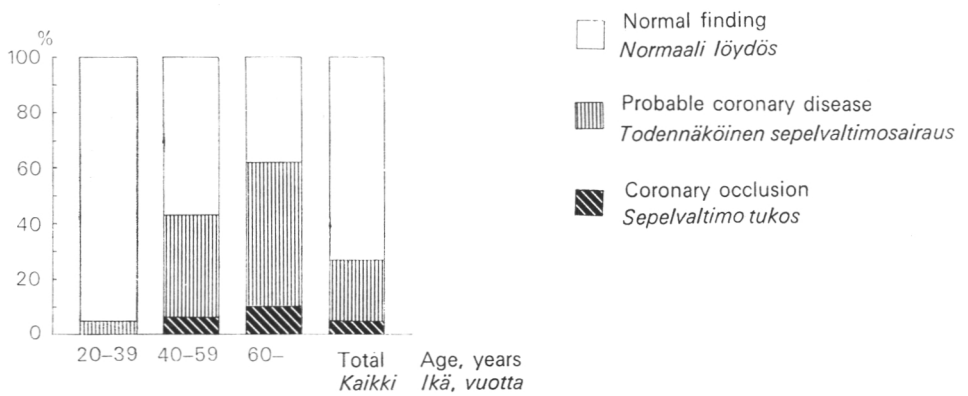


Figure 4.8 Incidence of ischaemic heart diseases in forest workers.
Kuva 4.8 Metsätyömiehillä esiintyvä iskeeminen sydänsairaus.

Other heart diseases

Certain characteristic changes of the ECG help to recognize left ventricular hypertrophy of the heart. In mild cases it is indicated by high ECG waves; whereas in severe cases the changes produced resemble those caused by the ischaemic heart disease. Thus, the differential diagnosis may be difficult.

In young people engaged in hard manual work a slight degree of left ventricular hypertrophy (LVH) is a relatively common finding without major importance. If hypertrophy is pronounced, it is a sign of a disease causing stress on the left ventricle, such as hypertension, valve defect, or other heart disease. LVH was found in about 7 % of the forest workers examined; just over a half of them belonged to the under -40 age group. More than half the number of men with LVH had hypertension. Every fourth, in radiography, showed a distinctly enlarged heart (volume over 550 ml/sq.m). Attacks of paroxysmal cardiac pain characteristic of ischaemic heart disease occurred in half of the men of 40 or over, who had left ventricular hypertrophy. A congenital heart disease was suspected in five men on the basis of medical examination or radiographic finding. In four of them, the finding suggested a so-called shunt flow through an interatrial or interventricular septal defect. Valve defects classified as probably significant were detected in four. Another seven men showed changes of minor importance in the cardiac contour. All these subjects were requested to consult a medical officer.

Certain risk factors of ischaemic heart disease

Extensive international mass examinations have led to the conclusion that the ischaemic heart disease develops as a result of the combined long-term effect of several factors. Various risk factors promoting arteriosclerosis i.e. fat deposits on the arterial intima, have been shown; they also increase the probability of an onset of coronary heart disease. Among the most important risk factors, according to general opinion, are hypertension, high blood cholesterol level, and smoking. Further risk factors consist of diabetes, obesity, high blood triglyceride level, lack of exercise, psychic and social stress, etc. In connection with the present study, attention was given to the first three factors. The results of the blood pressure measurements were given above. When 100 mmHg was considered the limit level of normal diastolic pressure, approx. 16 % of men showed values necessitating observation and possibly treatment.

Cholesterol

Finns are known to have high blood cholesterol levels. Table 4.3 presents the cholesterol levels of the examined forest workers. If concentrations exceeding 300 mg/100 ml are considered pathological and therefore definitive risk factors, 28 % of the total sample showed values exceeding this limit. But if according to general international practice, the upper limit for a normal cholesterol level, is placed at 250 mg/100 ml, it is found that 68 % of the forest workers exceeded the risk limit.

Table 4.3 Forest workers' blood cholesterol level.
Taulukko 4.3 Metsätyömiesten veren kolesterolipitoisuus.

Cholesterol level — *Kolesterolipitoisuus* mg/100 ml	Men *Miehiä*	%
—200	9	3
200—249	75	29
250—299	108	40
300—349	51	19
350—399	18	7
400—	6	2
Total — *Yhteensä*	267	100

Smoking

Forest workers' smoking habits are illustrated in Figs. 4.9—4.11. In all the groups the proportion of active smokers was more or less constant: two out of every three men smoked. The desire for smoking was satisfied by cigarettes. Few smoked a pipe or cigars. In the graph illustrating the quantities of tobacco consumed the consumption per day is converted into grams (one American-type cigarette = 1 gram). The young consumed slightly more tobacco than the old. Approximately half the subjects examined were relatively heavy smokers, their 24-hour consumption exceeding the limit of 15 American-type cigarettes.

It is alarming to note that in the age group of 20—29 half the number of smokers had smoked for over 10 years and one man for over 20 years. In the 30—39 age group almost all had a long history of smoking. The figure shows clearly that men of a young age are often old smokers; the toxic effects of tobacco have had time to become well established in them.

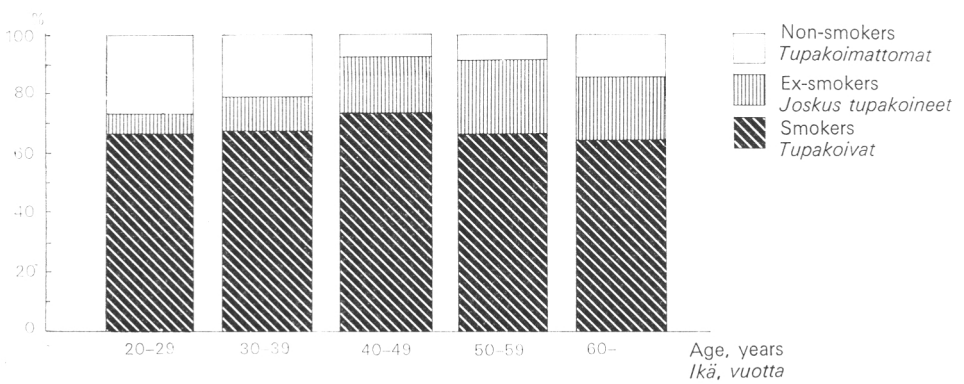


Figure 4.9 Forest workers' smoking habits.
Kuva 4.9 Metsätyömiesten tupakointi

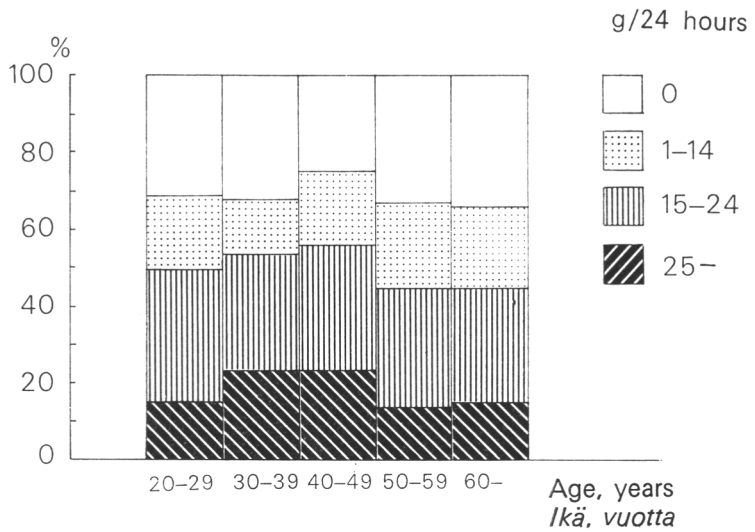


Figure 4.10 Forest workers' tobacco consumption per day (one American-type cigarette = 1 g).
Kuva 4.10 Metsätyömiesten tupakankulutus vuorokaudessa (yksi »pölli» on yksi gramma).

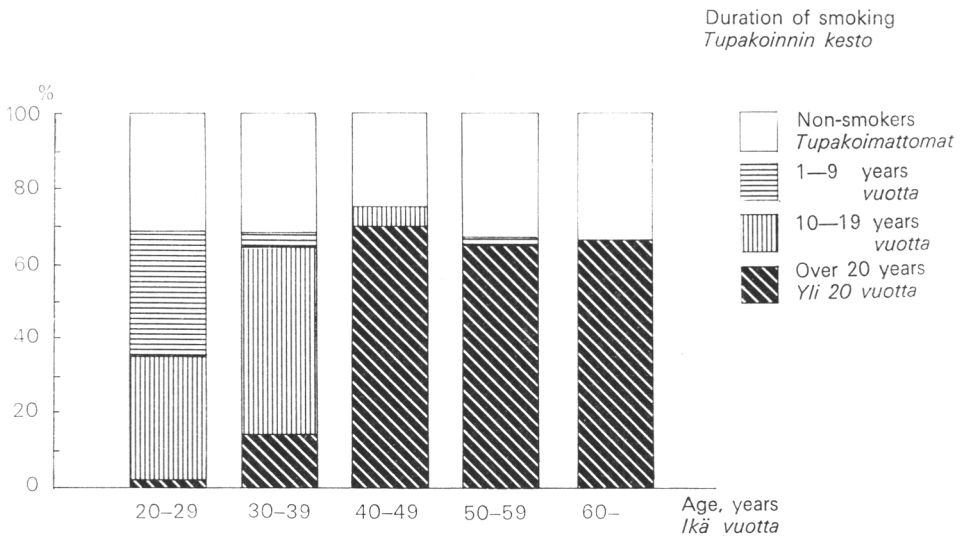


Figure 4.11 Duration of forest workers' smoking.
Kuva 4.11 Metsätyömiesten tupakoinnin kesto.

Vasculature

In medical examination the great arteries were examined by auscultation and palpation. A murmur suggesting arterial stenosis was noted in the

auscultation of the jugular arteries, unilaterally or bilaterally, in about 7 %, and in the auscultation of the femoral arteries in about 17 % of the subjects examined. No pulse of the metatarsal arteries was felt on the right in some 5 % and on the left in some 7 % of the subjects examined. In two men the pulse of the posterior tibial arteries was not felt.

Varicose veins were seen in the right lower limb of 14 and left lower limb of 18 men. Eczema due to varicose veins was observed in one. The general impression is, however, that the state of the venous circulation in the forest workers' lower limbs was good. Examination of the great arteries showed signs of arteriosclerosis or hardening of the arteries, but their significance cannot be reliably estimated without follow-up studies.

45. Respiratory system

Prevalence of respiratory system complaints in forest workers has been studied in detail in 1964 on the forest work sites of Kainuu and North Karelia. A comparison of the present results with the former reveals a gratifying trend of development for tuberculosis. In 1964, radiological changes suggesting active lung tuberculosis were found in 13 out of the 1 441 men examined, i.e. nearly 1 %. In the present study, the chest x-ray of 268 men disclosed no case of tuberculosis. 13 % showed scars in the lungs or pleura, and another 13 % showed radiological signs of emphysema. Lung function tests revealed slight respiratory disturbances in about 10 % and a pronounced pulmonary disfunction in about 1 % of the examined subjects.

The diagnosis of pulmonary diseases is not based on radiography and the examination of pulmonary function alone. Characteristic symptoms of respiratory tract diseases are cough, sputum, and a predisposition to acute respiratory infections. Prolonged bronchitis, for example, develops slowly with these symptoms, and not until a late stage does it lead to radiographic changes and distinct pulmonary disfunction. The cough and sputum symptoms in forest workers have been classified on the basis of a questionnaire used in international epidemiologic studies and also in the 1964 forest worker study. Chronic bronchitis was diagnosed in men who had both symptoms, cough and sputum, and who in the last three years at least once had had a respiratory tract infection accompanied by at least a week's disability for work. Fig. 4.12 shows the symptoms of the respiratory tract in age group 20—39 years.

With equal distribution on young and old, 20 % had cough and 40 % sputum. Chronic bronchitis, classifiable as a definitely pathological condition, was noted in about 4 %.

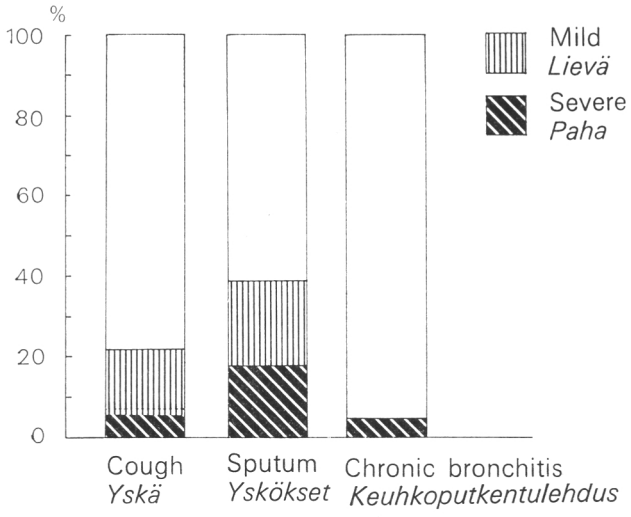


Figure 4.12 Symptoms of forest workers' respiratory tract diseases in age group 20—39 years.

Kuva 4.12 Metsätyömiesten hengityselinten sairauksien oireet ikäryhmässä 20—39 vuotta.

It is seen that forest workers showed a high prevalence of symptoms of respiratory tract diseases, and consequently the risk of chronic bronchitis is obvious. Smoking has a definite causal connection with the development of these symptoms.

46. Diseases of the gastrointestinal tract

The diagnosis of gastrointestinal tract diseases usually presupposes complicated roentgen and other examinations which could not be included in study programme. Attention was given at medical examination to the poor state of the forest workers' dentition. Dental caries, loss of teeth and artificial dentures were common. According to the physician's estimate, only about 7 % of the examined forest workers had a more or less normal dentition. Examination of the abdominal organs disclosed an untreated hernia in 12 men. The men were asked in the interview for symptoms of gastrointestinal tract diseases. Pain or ache in the upper abdomen was reported by 59 men. The onset of pain occurred immediately after a meal in 29, 1—2 hours after a meal in 9, during work in 8, and on empty stomach or during the night in 31. The pain was persisting and daily in 19 men. On the basis of this information it may be estimated that about 6—7 % of the examined men had upper abdominal pain arising from a gastric ulcer. The frequency of other symptoms of the gastrointestinal tract can be seen from the following list:

Symptom	% of the examined men
Swelling and »fullness» of stomach	25
Heartburn	24
Borborygmi and flatulense	20
Regurgitation	19
Eructations	14
Haemorrhoids	8
Anorexia	6
Nausea	6
Vomiting	4
Diarrhoea	4
Blood in the faeces	3
Constipation	3

The symptoms at the top of the list are characteristic of functional disorders of the stomach and large intestine. Various symptoms attributable to the gastrointestinal tract were common in the forest workers. The majority of symptoms can be interpreted as functional, caused by »gastric catarrh» or irritation of the large intestine. The study did not consider the role of the dietary regime and dietary habits in these complaints.

47. Orthopaedic diseases

The precondition for good working ability of heavy manual workers is the perfect functioning of their back and limbs. It has been found that heavy manual workers, such as construction workers and stevedores, are frequently affected by various kinds of back and limb pain. The same is also true, according to the interview data, for forest workers. Of the 268 men examined, 75 % said that in the last years they had suffered from back and limb symptoms. The location and prevalence of these symptoms was as follows:

	% of the interviewed
Lumbosacral spine	47
Lower limbs	37
Upper limbs	32
Cervical spine	23
Thoracic spine	9

Accordingly, forest work affects most the lumbosacral spine and least the thoracic spine area. Back and limb symptoms are usually chronic: 14 % of

the examined subjects had been treated by a doctor and 3 men in a hospital for this pain in 1968—69. Sick leave had been required for this pain by 7 %, and 53 % of the examined men found that pain had interferred with their work.

The usual description of the lumbosacral pain was dull ache, or pain felt on movement. The pain was usually felt during or after work.

The sample was divided into three groups according to the length of time during which the men had used the power saw. A control group consisted of the men who had never used or possessed a power saw. In recent years, as the methods of forest work have changed, the annual use of power saw may have increased manyfold compared with the corresponding use 5 or 10 years ago. For this reason, giving the duration of power saw use in terms of years is a highly approximate index of the true length of the time of power saw use.

Figs. 4.13—4.14 review the distribution of the most common back and limb symptoms in the groups of power saw users. In the young age group of 20—39 it is clearly seen that the men without a power saw were practically symptom-free, while various complaints turn up in the course of the years of power saw use. In the older group, aged 40—59, the differences between men using or not using a power saw remain small, apart from upper limb symptoms. It would seem that the orthopaedic symptoms are associated with age and heavy manual work, and the impression is obtained that the power saw accelerates the onset of these symptoms and prematurely ages its user.

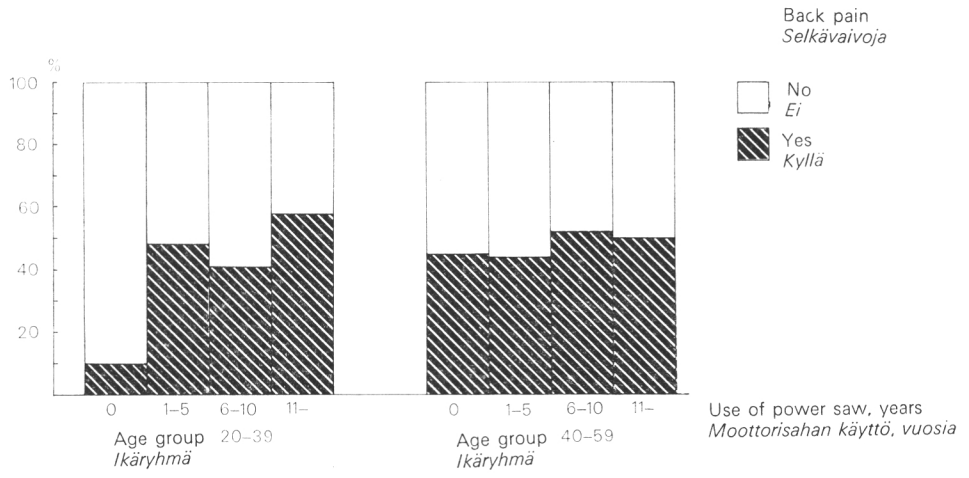


Figure 4.13 Forest workers' lumbar and sacroiliac pain related to their use of the power saw.
Kuva 4.13 Metsätyömiesten lanneristiselkävaivat ja moottorisahan käyttöaika.

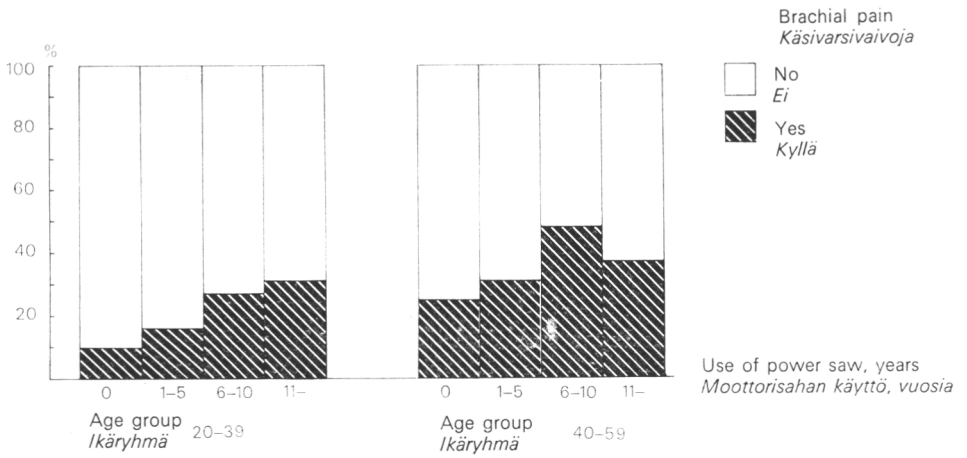


Figure 4.14 Forest workers' brachial pain related to their use of the power saw.
Kuva 4.14 Metsätyömiesten käsivarsivaivat ja moottorisahan käyttöaika.

48. Vibration disease

Vibration affecting the body may produce various health hazards. Vibration affecting the upper limbs damages in the first place the mechanism regulating the small arteries of the hands and may gradually lead to changes in nervous and connective tissue. The visible signs of such changes are bone and joint injuries and muscular atrophy.

Symptoms of the so-called vibration disease may consist of upper limb aches, numbness of hands, poor cold tolerance and reversible colour changes in fingers. A special characteristic is episodes of the fingers going white and »deadened». Similar symptoms may also occur in persons who never have used vibrating tools.

The prevalence of various finger symptoms among the forest worker sample, based on the interview data, is presented by age groups in Fig. 4.15.

The most characteristic symptom of the vibration disease is generally considered to be the white fingers. The prevalence of this symptom by age and the number of years of power saw usage is shown in Fig. 4.16. It can be seen that every second worker under 40, who had used the power saw for more than 5 years, suffered from white fingers; for the older age group the figure was 60 %. The figures concur with those reported from studies in Sweden. The Institute of Occupational Health (Työterveyslaitos), in a study carried out in the Ilomantsi region, has reported similar figures. The interview revealed that cold weather was definitely the factor triggering off the finger symptoms. The fingers of the left hand were somewhat more affected than those of the right hand. A total of 200 men (70 %) of the sample had

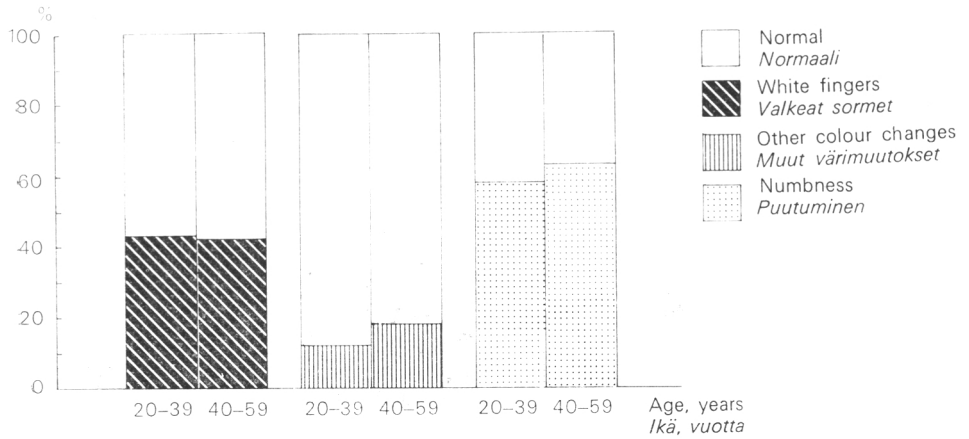


Figure 4.15 Forest workers' finger symptoms.
Kuva 4.15 Metsätyömiesten sormioireet.

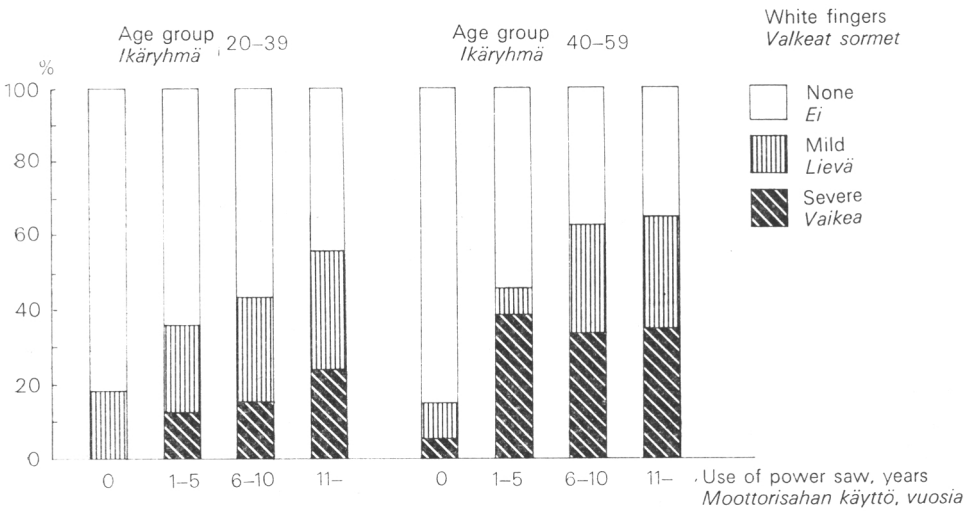


Figure 4.16 Forest workers' white finger syndrome related to their use of the power saw.
Kuva 4.16 Metsätyömiesten valkosormisuus ja moottorisahan käyttöaika.

finger symptoms of some kind. 79 of them considered their finger trouble as severe and 121 as mild or insignificant. Finger symptoms had caused disability for 19 men. In a comparison of the finger symptoms and other examination findings, no correlation could be shown between the finger symptoms, and the cardiovascular condition, blood pressure, blood cholesterol level or smoking habits.

The vibration disease is classified as occupational disease and is covered by the Occupational Diseases Act. The estimated number of power saws in 1970 was over 160 000, and the number of men engaged in forest work for

more than 150 days per year was estimated at 40 000. The total number of cases of vibration disease for which compensation was paid as occupational disease in 1969 was only 10. The disproportion between the prevalence of vibration disease and the number of cases for which compensation was paid under the Occupational Diseases Act is striking.

49. Changes in hearing

The impairment of hearing produced by noise develops gradually. A worker exposed to noise during work at first notices nothing particular in his hearing ability, but later on he finds that, after a noisy day of work, it is difficult to understand ordinary speech, although he can hear it. At the same time, indefinite tinnitus may also occur. After a night's sleep the hearing is normal again, and the tinnitus is gone. Gradually the situation worsens and the hearing is not restored after rest. This means that a hearing defect has developed, first in the area of high sounds. Later the person loses the ability to hear ordinary speech well.

Changes produced by noise in the inner ear, the cochlea, are among those that cannot be repaired. Noise tolerance is different in different people. The risk limit affecting the hearing is 85 dB (decibels). This means that a worker should not be allowed, without due protection, go on working for lengthy periods in environments with a noise level exceeding 85 dB. Protection is obtained through various protective devices. Dry cottonwool provides no protection against noise, wet cottonwool some. Ear plugs give a relatively good protection, but hearing protectors and helmet are the best. It may be pointed out that the noise level of a power saw averages 115 dB, thus considerably exceeding the risk limit of 85 dB.

The examined forest workers included 224 men who had used the power saw more than a year, whereas none had used it for over 20 years. The average duration of use was nine years. Changes typical of noise were found in the audiograms of 63 % of the power saw users, i.e. nearly two of every three men. Some other ear disease was diagnosed in 15 men.

Fig. 4.17 reveals that changes of the audiogram increased with the number of years during which power saw had been used.

Fig. 4.18 shows that definite changes in the audiogram peculiar to a noise injury were found in less than 10 % of the 20—29 age group studied, whereas in age group 50—59 changes of this type were noted in 30 %. Hearing obviously is impaired with age. Normally, however, 70-year olds do not show the audiographic changes found in the 50—59 age group of the present sample. Also, it was found that over 20 % of the examined subjects with a normal audiographic finding showed a transient impairment of hearing, which is known to be the first symptom of an incipient noise injury.

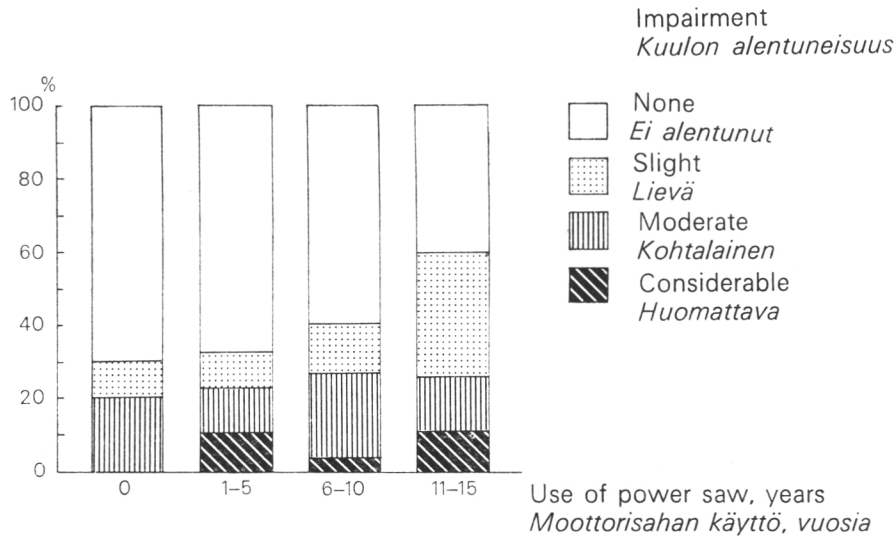


Figure 4.17 Forest workers' hearing impairment in age group 20—39 related to their use of the power saw.
Kuva 4.17 20—39-vuotiaiden metsätyömiesten kuulomuutokset ja moottorisahan käyttö.

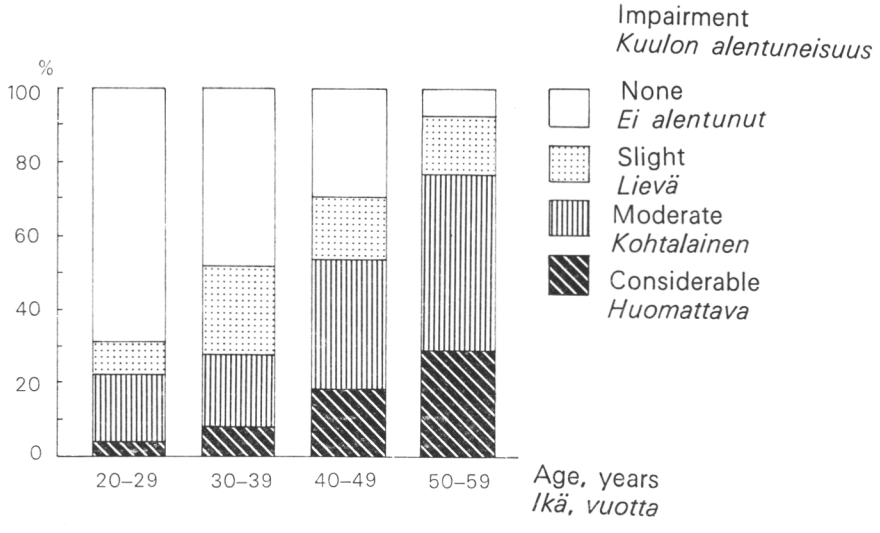


Figure 4.18 Forest workers' hearing impairment characterictic of noise injury.
Kuva 4.18 Metsätyömiesten meluvammalle ominaiset kuulomuutokset.

Impairment of hearing due to noise is classified as occupational disease. In 1962—69, according to information received by the occupational diseases centre of the Institute of Occupational Diseases, compensation was paid for a total of 42 cases.

410. Forest work accidents

According to the interview data, over 70 % of all subjects studied had sustained accidents in forest work. On the basis of memorized information on the events and the way in which in which the injury occurred, the accidents have been classified in Table 4.4 according to their nature and the duration of disability. The axe proved to be by far the most dangerous tool. The high rate of accidents produced by a falling tree is also remarkable.

Table 4.4 Accidents in forest work and duration of resulting disability, during total period of work.

Taulukko 4.4 Metsätyössä sattuneet tapaturmat ja niistä aiheutuneen työkyvyttömyyden kesto koko työssäoloaikana.

Accidents caused by *Tapaturman luonne*	Duration of disability *Työkyvyttömyyden kesto*		Total — *Yhteensä*	
	Less than a month *Alle kuukausi*	One month or more *Kuukausi tai enemmän*	Number of men *Lukumäärä miehiä*	%
Axe — *Kirveen aiheuttamat tapaturmat*	141	14	155	46
Power saw — *Moottorisahan aiheuttamat tapaturmat*	17	1	18	5
Other tools — *Muiden työkalujen aiheuttamat tapaturmat*	31	3	34	10
Tractor and other work machines — *Traktorin ja muiden työkoneiden aiheuttamat tapaturmat*	1	2	3	1
Traffic — *Liikennetapaturmat*	1	1	2	1
Falling tree — *Kaatuvan puun aiheuttamat tapaturmat*	33	5	38	11
Fall and slip of foot — *Kaatumisen ja liukastumisen aiheuttamat tapaturmat*	9	3	12	4
Other accidents, of which — *Muut tapaturmat, joista*	63	10	73	22
— affecting an eye — *silmätapaturmat*	(13)	(1)	(14)	
— affecting the back — *selkätapaturmat*	(18)	(2)	(20)	
Total — *Yhteensä*	296	39	335	100

411. Ex-forest workers

In the interval from inclusion in the sample to the time of the examination, 40 forest workers of the total series had changed occupation. The state of health of these ex-forest workers is shown in Table 4.5, which divides the group into two parts of 20 men each: men under 40 and those of 40 or over. In the older group, almost every other man had an ischaemic heart disease, practically all had finger symptoms, and two of every three lumbosacral pain. It seems that the ex-forest workers did not essentially differ in their state of health from the forest workers continuing their former occupation. The high rate of finger symptoms among them is worth noting. Table 4.6 shows that they are comparable with the rest of the series as regards the use of power saw.

Table 4.5 Certain symptoms and findings in ex-forest workers.
Taulukko 4.5 Eräät oireet ja löydökset ammattia vaihtaneilla metsätyömiehillä.

Age group *Ikäryhmä*	Number of men *Lukumäärä miehiä*	Ischaemic heart disease *Iskeeminen sydäntauti*	Finger symptoms *Sormioireet*	Limb and back symptoms *Raaja- ja selkäoireet*	Respiratory tract symptoms *Hengitys-elinten oireet*
		%			
—40	20	20	55	25	30
40—	20	45	90	70	30
Total — *Yhteensä*	40	33	73	48	30

Table 4.6 Use of power saw by ex-forest workers.
Taulukko 4.6 Ammattia vaihtaneiden metsätyömiesten moottorisahan käyttö.

Age group *Ikäryhmä*	Use of power saw, years *Moottorisahan käyttöaika vuosissa*				Total — *Yhteensä*	
	0	1—5	6—10	11—		
	%				%	Men *Miehiä*
—40	5	20	70	5	100	20
40—	15	10	40	35	100	20
Total — *Yhteensä*	10	15	55	20	100	40

412. Measures taken after the examination

The examined subjects were informed of the findings and where necessary, requested to consult a doctor or a hospital for further examination or treatment. On the basis of the post-examination measures and the overall picture obtained of each subject on medical basis, the sample was divided into three groups:

1. The healthy individuals and those with a disease that required no further examination or treatment and did not affect the working capacity.
2. Those in whom a disease was diagnosed that required further examination or treatment, and in whom the effect of disease on working capacity could only be evaluated definitely after a detailed examination to follow.
3. Those in whom the examination revealed a disease for which continued work in the former occupation no longer could be considered suitable in view of their state of health.

Fig. 4.19 shows the distribution of the post-examination measures by age. It is seen that even in the young age groups approximately one in every four required some kind of medical attention. After the age of 50 the number of men whose state of health makes them unsuitable for forest work already was remarkably high.

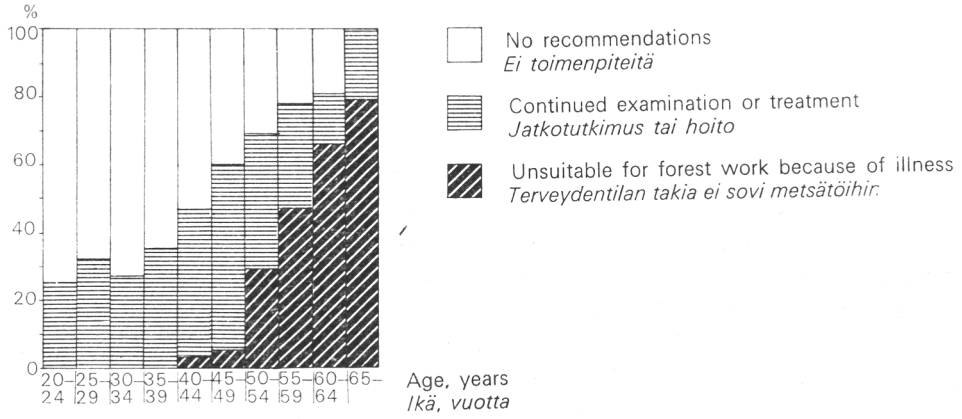


Figure 4.19 Recommendations given to forest workers' on the basis of examinations.
Kuva 4.19 Metsätyömiehille tutkimusten perusteella suositellut toimenpiteet.

5. HOUSING

51. Importance of housing

Good housing conditions are more important for people's wellbeing in a cold country like Finland than in the countries with temperate or warm climates. A proof thereof is the persisting difficulty in Finland to produce enough housing to meet the demand. The unusually high number of summer cottages also indicates the weight of housing in the Finnish level of living.

The problem of a forest worker's housing is bipartite, in the same way as is a building worker's: the family home and the work site housing. It is typical of Finnisch social thinking that, until recently, a forest worker's place of living has been taken to mean his work site lodgings, the »camps» these men originally used to build for themselves in the wintery forest. This building activity was later legislatively transferred to become the responsibility of employers.

The forest worker's home and family were far from the work site lodgings. The work sites were seasonal, and there were few workers who thought that employer should share the responsibility for the living conditions of these seasonal workers' families. The work site lodgings, with associated services, canteens, laundry etc. were improved with legislative reforms so that the man in the best lodgings often perhaps had better housing facilities and service than his wife and children at home.

The Karvonen Committee drafted a law, in the early 1950s, concerning the family dwellings of permanent forest workers, it recommended that dwellings be built jointly by the employer and the state. The idea was never legislatively implemented but employers have put these ideas partly into practice.

The following will discuss the homes of forest worker families and of unmarried men.

52. Size of family

That forest workers have many children is a known fact, and this essentially affects the level of housing. A large number of young children increases consumption and the need for living space, it also reduces income compared

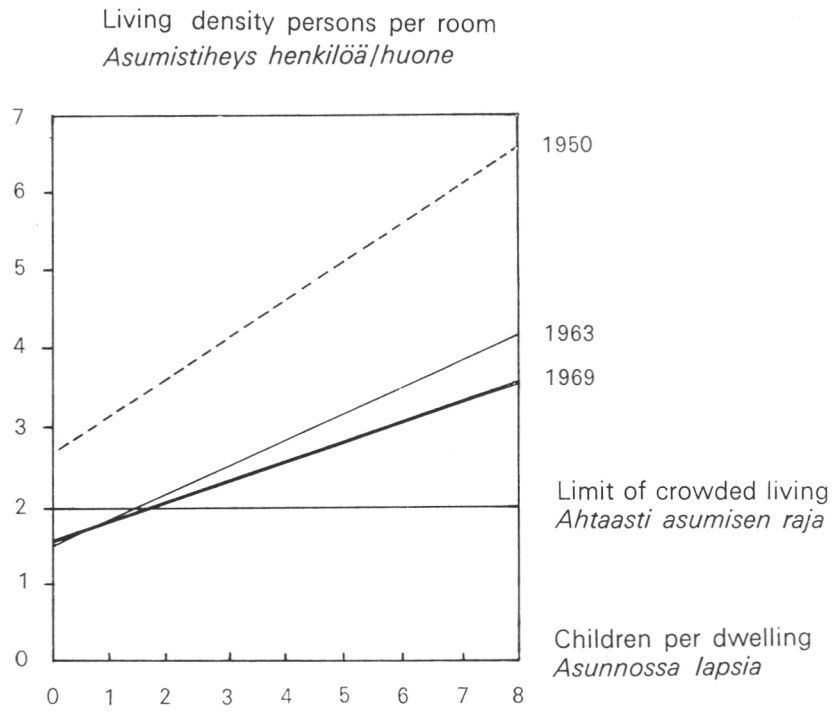


Figure 5.1 Forest workers' living density and number of children in 1950, 1963 and 1969.

Kuva 5.1 Ammattimaisten metsätyömiesten asumistiheys ja lasten lukumäärä vuosina 1950, 1963 ja 1969.

with consumption needs. In the 1950 Housing study of professional forest workers it was found, as an average for the whole country that the housing of families became crowded, i.e. more than 3 persons per room, as soon as there were more than one child per family (Fig. 5.1).

In 1963 the housing situation had already eased in the rural districts, primarily as a result of emigration from the countryside, and it was the second child which made the housing crowded according to the then definition, 2 persons per room. In these calculations the kitchen with a floor area exceeding 7 sq.m. is also counted as room. Fig. 5.1 also presents the corresponding comparable result for 1969. Progress has taken place both in that the general standard of housing has improved (the line describing the living density has declined) and in that the relative housing misery of families with many children has eased (the ascending angle of the line is less sharp).

One of the explanations is that the number of children per forest worker family has fallen. It is very clearly visible from Table 5.1.

Table 5.1 Distribution of professional forest workers according to the number of children per household (1950) and per living quarters (1963, 1966 and 1969).

Taulukko 5.1 Ammattimaisten metsätyömiesten jakautuminen ruokakuntaan kuuluvien lasten lukumäärän mukaan vuonna 1950 ja asunnossa asuvien lastenl ukumäärän mukaan vuosina 1963, 1966 ja 1969.

Year *Vuosi*	Children — *Lapsia*					Total, per cent *Yhteensä prosenttia*
	0	1—2	3—4	5—6	7—	
	per cent of forest workers — % *metsätyöntekijöistä*					
1950	35	38	20	5	2	100
1963	41	32	18	6	3	100
1966	47	33	15	3	2	100
1969	54	31	12	2	1	100

53. Living density and dwelling size

There is no wholely satisfactory means of comparing the housing standards of families of widely different composition. The living density figure quoted above, i.e. the quontient of number of persons and number of rooms per dwelling, is a much used index of the housing standard of large numbers of people. Here, however, it is used for the following reason, slightly different from the usual.

The living density of a certain part of population is obtained in the Finnish population census by dividing the total of the relevant part of population by the total number of rooms in their dwellings. This gives a figure showing the number of persons per room, provided these persons were to be evenly divided into these rooms.

Living density usually diminishes when the dwelling size grows. Consequently, in the calculation described the mean produced is a weighted average of the living densities of the individual dwellings, weighted with the number of rooms in the same dwelling. This places more weight on the small than the large living densities. Such a mean suggests a standard of housing better than that really exists. People occupying the small crowded dwellings have no chances of spreading over the large spacious dwellings.

An exaggerated example may illustrate the point.

A feudal village has a prince sleeping the night alone in a palace with 100 rooms. The population of the village, including the prince's servants, totals 499 persons living in 100 dwellings of one room each. In the palace the living density is 1 : 100 persons per room, and in the village 499 : 100, or 5 persons per room. The mean calculated in the usual way is 500 : 200 for the whole village, 2.5 persons per room, a figure that in reality expresses very

little. A better parameter is obtained by calculating separately the living density of all dwellings and the unweighted mean of the living density figures. Assuming that all villages families have the same living density, 5 persons/room, we obtain $\frac{(100 \times 5 + 0.01)}{101}$, i.e. 5 persons per room. In other words, one exceptionally spacious dwelling in a large number hardly affects the general index at all. The present study has used the latter method of calculation, apart from a few exceptions which are separately mentioned and give the two means side by side.

Table 5.2 shows the development of professional forest worker's living density, calculated in this way, in the whole country in 1950—69 and regionally in 1963—69. The reduction in crowded living is obvious and relatively fast. The mean for the whole country has fallen by one-half, and that for South Finland can be considered satisfactory. Nevertheless, even for this occupational group the goal in today's conditions should be 1 person per room, excluding the kitchen, according to international recommendations.

Table 5.2 Forest workers' living density by regions in 1963, 1966 and 1969 and in the whole country from 1950 to 1969.

Taulukko 5.2 Ammattimaisten metsätyömiesten asumistiheys alueittain vuosina 1963, 1966 ja 1969 ja koko maassa 1950—69.

Region *Alue*	Forest workers' living density, persons/room *Metsätyömiesten asumistiheys, henkilöä/huone*			
	1950	1963	1966	1969
Southern Finland — *Etelä-Suomi*	—	1.8	1.5	1.5
Central and Eastern Finland — *Keski- ja Itä-Suomi*	—	2.0	2.2	1.7
Northern Finland — *Pohjois-Suomi* ..	—	2.4	2.0	1.8
Whole country — *Koko maa*	3.4	2.0	2.0	1.7

As the living density has fallen in all regions the differences between regions have distinctly diminished, which is shown by Table 5.2. However, the south of the country still holds a better position than the central, eastern and northern regions.

According to Table 5.3, the distribution of forest workers according to the living density of their dwelling has changed relatively even more than the means indicate.

The proportion of the men with a living density under 2 has increased from 1950 from a quarter to over 60 %. However, there were in 1969 12 % of professional forest workers whose families still had living densities exceeding 3. In 1960 they been about 50 %.

Table 5.3 Relative distribution of professional forest workers according to living density, 1950—1969.
Taulukko 5.3 Ammattimaisten metsätyömiesten suhteellinen jakautuminen asumistiheyheyden mukaan vuosina 1950—1969.

Living density, persons/room *Asumistiheys henkilöä/huone*	Year — *Vuosi*			
	1950	1963	1966	1969
	per cent of men — % *miehistä*			
—1.9	24	50	52	62
2—2.9	30	27	25	26
3—3.9	19	13	14	8
4—5.9	18	9	7	3
6—	9	1	2	1
Total — *Yhteensä*	100	100	100	100

The background of these abrupt changes is understood from a study of living density by social groups. Fig. 5.2 shows the living density figures for the farming population and the landless. A definite reduction in living density is noticeable for all social groups, but most for those who in 1950 had

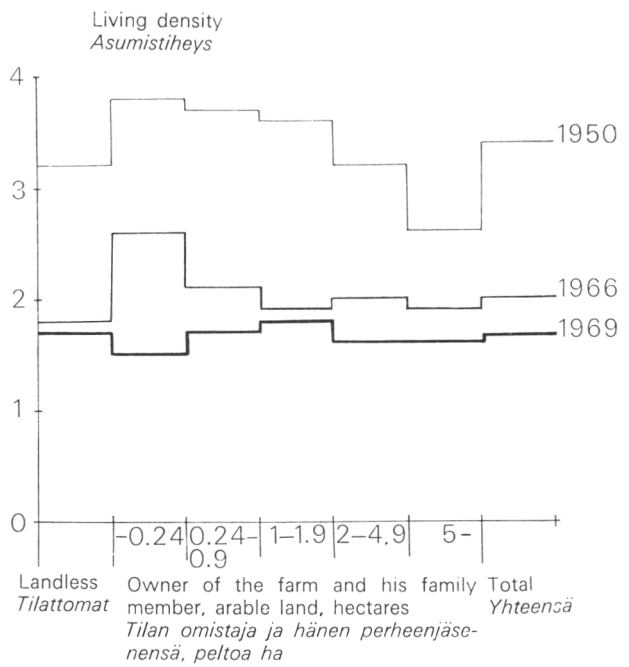


Figure 5.2 Forest workers living density by social groups in 1950, 1966 ja 1969.
Kuva 5.2 Ammattimaisten metsätyömiesten asumistiheys yhteiskuntaryhmittäin vuosina 1950, 1966 ja 1969.

the poorest conditions: the men of the very small farms (less than 2 ha arable land) and their families. The result is the approximately equal housing level in 1969 of all the groups.

Had the living density still been diminishing with the increase of the arable land, as was the case in 1950, some of the improvements of the housing standard could have been explained by the fact that forest workers had replaced small farms with bigger farms. After the living density differences between social groups have been adjusted, this increase in original possessions of the forest workers apparently is not an important component of the housing standard. The most important seems to have been the reduced number of children in these families, the increase in space per person as a result of migration from countryside, and — to some extent — the improved rural housing following repairs and new constructions.

In conclusions, let us return to the difference in the living density of small and large dwellings discussed earlier. The living density diminishes very clearly as the number of rooms per dwelling increases (Table 5.4). If the mean 1969 living density of the whole forest worker material, 1.7 persons/room, is recalculated in the way used in the population census, the result obtained is 1.5. The difference between these means reflects the social disparity in the distribution of the dwellings.

This living density (1.5) of the forest workers may be compared with that of the total Finnish population obtained from the 1970 census, which is 1.0. The figure for the rural districts is 1.1, for all cities and towns including Helsinki 0.98.

The forest workers' dwellings have been and are small as regards the number of rooms, but their floor area is also small. Half of the men in the 1969 sample had a dwelling smaller than 50 sq.m., nearly 20 % one smaller than 30 sq.m., and only 25 % had a dwelling larger than 70 sq.m.

Table 5.4 Forest workers' living density by the number of rooms in 1963 and 1969.

Taulukko 5.4 Ammattimaisten metsätyömiesten asumistiheys huoneiden lukumäärän mukaan vuosina 1963 ja 1969.

Number of rooms per dwelling *Asunnon huoneiden lukumäärä*	Living density, persons/room *Asumistiheys henkilöä/huone*	
	1963	1969
1	2.6	2.6
2	2.4	1.8
3	1.7	1.6
4	1.4	1.2
5	1.2	0.9
6	1.0	1.0

The differences between social groups in this respect were large. Over half of those who had more than 5 ha of arable land had dwellings larger than 70 sq.m., whereas the figure for those with 2.0—4.9 ha was 25 % and for those with less than 2 ha less than 10 %. Only a quarter of the landless had a »large» dwelling of over 70 sq.m.

The regional variation in the floor area distribution of dwellings was relatively small.

An interesting observation was that 40 % the forest workers who in 1969 were asked about the distance of their dwelling from the nearest densely populated centre found the distance too long, and 60 % considered the distance acceptable. This opinion seemed to lack correlation with the floor area of the dwelling. Apparently there is no definite interdependence between the floor area and distance of the dwelling.

54. Ownership of dwelling

It is characteristic of the Finnish countryside that houses are usually owned by the occupant. In 1950 about 70 % of the professional forest workers owned their dwelling, in the 1960s about 80 % (Figure 5.3). In South Finland the proportion of owned dwellings seems to be on the decline, while

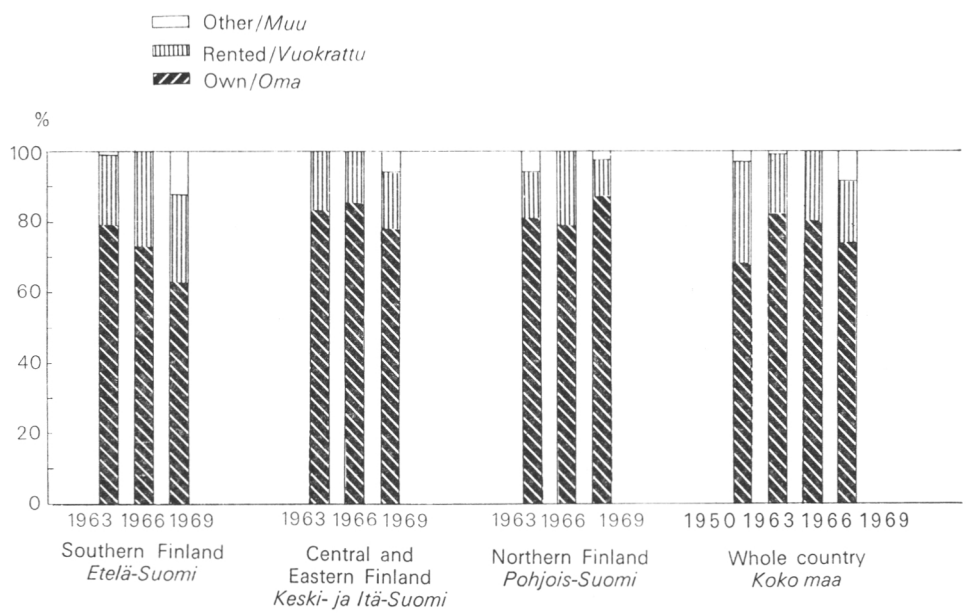


Figure 5.3 Ownership of forest workers' dwellings in 1950—1969.
Kuva 5.3 Ammattimaisten metsätyömiesten asunnon hallinta 1950—1969.

that of privately rented dwellings increases accordingly. Other regions show no distinct main trends, and the proportion of owned dwellings has almost unchangingly remained at the 80 % level.

It is natural that farmholders with family members live almost exlusively in houses they own. No essential change seems to have taken place on this point. But it is noted that the landless decreasingly live in dwellings of their own. From the 52 % in 1963 the percentage has fallen to 40 % in 1969. The percentage of privately rented dwellings has not changed from the 45—50 % level, whereas the share of others, owned by employers and the like, had climbed from practically nil to 17 % by 1969.

Young forest workers with families rented their dwellings relatively more often than others in 1969. The employer-owned houses, or work-site dwellings, mostly housed unmarried middle-aged men.

55. Domestic effects

Effects available to the occupants are having an increasingly important position as measure of the level of living and above all of the standard of housing. Their spread since 1950, when only a quarter of all forest workers had electricity, and piped water was practically monexistent, describes very aptly the changes in the housing of this population group.

Table 5.5 and Fig. 5.4 show the spread of some of the most common effects in the accommodations of professional forest workers from 1950 to 1969.

Table 5.5 Some domestic effects in the dwellings of professional forest workers, 1950—1969.

Taulukko 5.5 Ammattimaisten metsätyömiesten asunnon varusteet vuosina 1950—1969.

Fittings *Varuste*	1950	1963	1969
	Per cent of professional forest workers % *ammattimaisista metsätyömiehistä*		
Electricity — *Sähkö*	25	50	63
Main drainage — *Viemäri*	1	19	31
Running water — *Vesijohto*	1	14	29
Television — *Televisio*	—	11	51
Telephone — *Puhelin*	—	6	11
WC	—	3	12
Central heating — *Keskuslämmitys*	—	4	11
Bathroom — *Kylpyhuone*	—	1	4

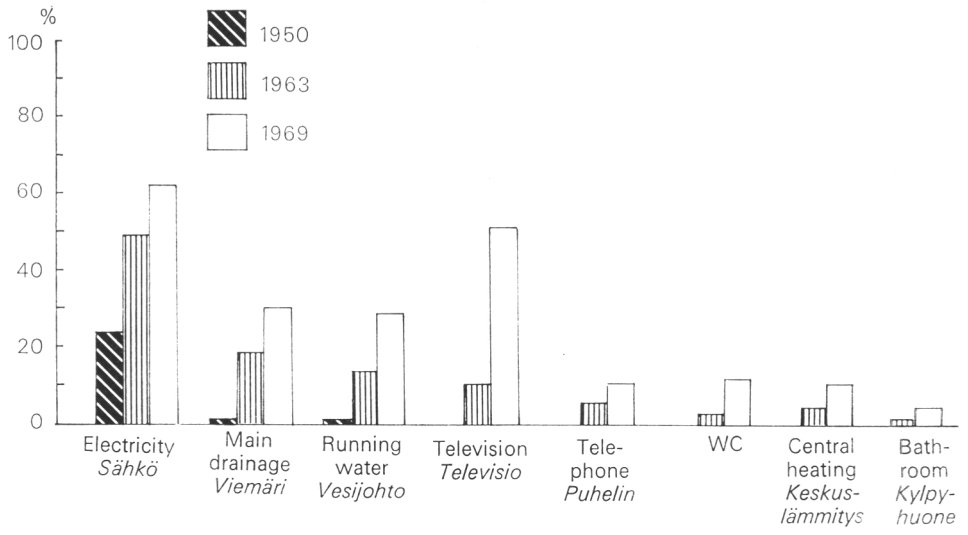


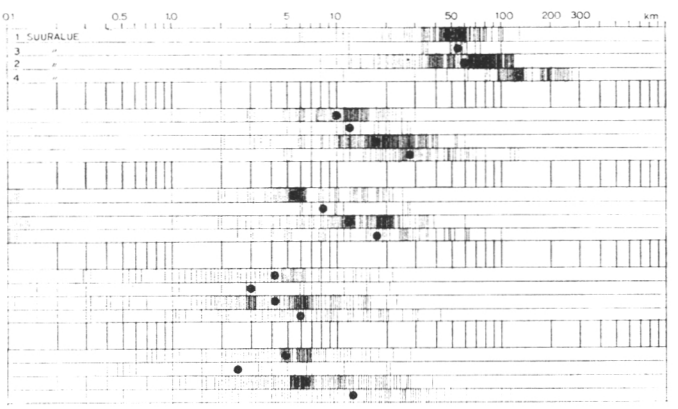
Figure 5.4 Domestic effects in forest workers' dwellings.
Kuva 5.4 Ammattimaisten metsätyömiesten asunnon varusteet.

A review of the extent of effects by regions shows that the rate of development in South Finland has been much slower than elsewhere in Finland, and the availability of electricity in the south has even fallen since 1950. The explanation is, probably, that slightly different groups of population were involved in different years, and in South Finland forest work apparently has moved increasingly to remote districts. The result is that North Finland represents the most advanced region in the frequency of most of the fittings. Central and East Finland are not far from the South Finnish level. The same trend towards equalizing the differences is therefore visible in living density and in the extent of effects.

The same cannot be said about differences between the social groups. The improvements on the dwellings of the landless has been much faster than in those of the farmer families, although differences between farms of different sizes have been smoothed. While in 1963 the extent of effects in the dwellings of farmers and the landless was much the same, by 1969 the landless forest workers lived in dwellings which in most respects were better equipped than those of the farmer families. Even in the largest farm size class (over 5 ha of arable land) only the incidence of television sets and telephones slightly exceeded that among the landless. As far as all other effects are concerned, the dwellings of the landless on the average were better than those of the farmers with more than 5 ha of arable land.

56. Location of dwelling

The 1963 forest worker sample was studied for the effect of the location of the forest workers' family dwelling to the contacts he and his family had with the surroundings. Fig. 5.5 gives an idea of the distances a forest worker family had to cross in the early 1960s to participate in the social services an urban dweller expects to find in the immediate neighbourhood of his place of living (V ä ä n ä n e n 1973). The mean distance to the nearest city, depending on the region was 50—120 km, to the central village 10—30 km, a densely populated place 5—20 km, post office 3—6 km, and house for social gatherings 2—10 km. This may provide some food for thought especially bearing in mind that, in 1969, only 11 % of these dwellings had a telephone.



Distance
Etäisyys

Nearest town
Lähin kaupunki

Village
Kirkonkylä

Nearest population centre
Lähin taajama

Post office
Postitoimisto

Clubs house
Seuratalo

1 Southern Finland/*Etelä-Suomi*
2 Central and Eastern Finland/*Keski- ja Itä-Suomi*
3 Ostrobothnia/*Pohjanmaa*
4 Northern Finland/*Pohjois-Suomi*

Figure 5.5 The distance of forest workers' dwellings from the nearest service centres in 1963. Black dot indicates the average distance (Eero Väänänen).
Kuva 5.5 Metsätyömiesten asuntojen etäisyys lähimmistä palvelupisteistä vuonna 1966. Musta ympyrä tarkoittaa keskiarvoetäisyyttä (Eero Väänänen).

The distances are emphasized, naturally, by the scattered settlement typical of Finland. Houses are not generally grouped to make villages but scattered over extensive areas along the roadside.

The effects of this isolated living were measured for example by how often the children played. It is known that a child is bound to a small area

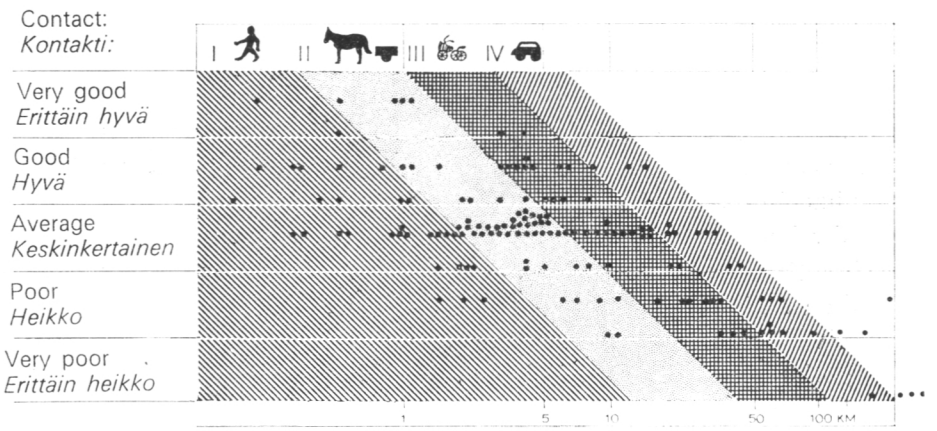


Figure 5.6 The influence of means of transportation on the forest worker's contact with his home in 1963. Black dot represents one man in the sample (Eero Väänänen).

Kuva 5.6 Kulkuvälineen vaikutus metsätyömiehen kodin ja työpaikan väliseen kontaktiin vuonna 1963. Musta piste tarkoittaa yhtä metsätyömiestä näyteessä (Eero Väänänen).

surrounding its home. Isolation therefore, dictates that the child plays only inside the family, which naturally may decisively reduce the child's chances of successful human relations outside its own family.

The same applies to distances between the family dwelling and the father's place of work. Fig. 5.6 presents the relevant findings.

When distance exceeded 10 km, hardly anybody visited home 7 times a week or more. Only 40 % made 3—6 weekly visits home. When the distance between home and place of work was 1—10 km, 20 % of the men went home every day, and 80 % 3—6 times a week.

These results apply to the year 1963 when forest workers had few motor vehicles. They no longer hold good today. However, isolated living and long distances to and from work still are a problem. It should be possible for the forest worker to be able to live in a densely populated community with its communal technology, piped water, sewage, electricity and traffic facilities. But forests cannot be moved into a village, and therefore the distance between working site and home remains long, and may become even longer when all these demands are met. The prospects are increased by the continuous reduction of the forest workers required. North Finland is shown to be totally unable to reconcile the forest workers' place of work and a permanent home in a population centre. Temporary housing will therefore remain topical.

57. Opinions concerning housing

In the 1969 health study the forest workers were asked, amongst other things their opinion about their housing conditions. Apart from a very small group (8 %), those of the interviewed forest workers who had a dwelling of their own were satisfied, as were those who had dwellings provided for them by the employers. But of those living in privately rented houses, 30 % were dissatisfied, despite the fact, emphasized above, that the rented dwellings were definitely better equipped than owner-occupied dwellings.

In this connection it may be useful to review the demands the forest workers made of their dwellings in 1969. Those dissatisfied with privately rented dwellings missed, in the first place, the greater freedom a house of their own would give them. Other drawbacks were small size of the dwelling, its poor condition, and that it was old-fashioned.

The opinions were classified as »too large», »of suitable size», »too small» and »no opinion», and each forest worker's statement was related to his own living density. It was found that 75—80 % of the forest workers with a living density of less than 2 persons per room considered their dwelling »of suitable size». Not until the living density rose to 2—3 persons per room did dissatisfaction become generally motived. But even after the living density had risen to 3—4 persons per room, 20 % were of the opinion that the dwelling was of suitable size. In other respects also, a general feature in forest workers' attitudes was the modesty of their aspirations.

6. WORKING CONDITIONS

61. Working conditions and their measurement

Work is a natural expression of life for a healthy individual. If the amount of work to be done equals the demands of the natural human desire of action, work creates pleasure in the worker, some kind of joy of creation. The magnitude of human needs or the small compensation paid for the work makes most men work much harder than the natural desire of action requires. This converts work into a stress which produces an unpleasant feeling which is the stronger the more work the subject has to do. The usual incentive to work is in fact, not a joy of creation but the wages, salary or entrepreneur's profit (L e n t o 1964, p. 830).

Working conditions are of fundamental importance as components of human wellbeing and satisfaction. The adverse effect of disturbed working conditions can never, at least not entirely, be compensated by values of other kind, such as economic rewards, shortened working hours, etc. (Talousneuvosto 1972, p. 147).

Working conditions ranked third, after health and housing in the order of the level of living components. Working conditions were followed in this list by security and human rights. They are, in fact, closely connected with health, security and human rights.

A part of the shortcomings in working conditions consists of health hazards: exposure to all weathers, the heaviness of work and the risk of accidents are all health hazards. Security in relation to working conditions is largely explained by the fact that forest work is accident-prone, and by the high rate of unemployment, both producing economic insecurity. Among human rights, the lack of appreciation of forest workers and the unjust treatment by society, are also closely connected with working conditions.

In this context, working conditions refer to a series of physical, mental and social events which take place between the forest worker's leaving home in the morning and returning from work in the evening.

Forest workers were asked about the greatest shortcomings in their working conditions. The list of shortcomings compiled from their replies

gave the sequence in which matters are discussed in this chapter. The main emphasis is on the forest workers' own opinions, and information obtained in this way is valuable in the efforts to improve the working conditions and make them more attractive.

62. Greatest shortcomings in working conditions

»Which do you find as the greatest shortcomings in your working conditions? Please list the most important three of the following:

— work is irregular
— working hours are different from day to day
— work is heavy
— work takes place in the open air
— work is dirty
— work is badly paid
— work is not appreciated
— work is detrimental to health.»

When the opinions listed as the worst shortcoming of the working conditions were multiplied by three, the second worst by two and the third worst by one, a weighted list of the shortcomings was obtained:

Opinion	%
Work is badly paid	29
Work is heavy	27
Work is determinental to health	20
Work is irregular	10
Work is dirty	5
Work takes place in the open air	3
Working hours are different from day to day	3
Work is not appreciated	2
Total	100

Forest workers considered their low wages as the greatest shortcoming in their working conditions. On payday many forest worker's earnings seem very low, considering that he has a large family to keep and that he has worked at piece rate. The heaviness of the work was second greatest, and its hazards to health the third greatest shortcoming. These shortcomings are closely interconnected: the heavy work and many awkward working postures tend to accelerate the onset of diseases.

Irregularity of work means, in the first place, that there is not always work to do. Poor wages were shown to cause three times more concern than irregularity of work. One explanation may be that the permanently employed and those with short unemployment periods do not consider unemployment a very serious drawback. The other is, perhaps, that some small farmers doing forest work appreciate the additional earnings from the forest, and unemployment does not concern them in the same way than the men living on forest work alone. Nor did all the interviewed men combing unemployment with the irregularity of work, especially as they could choose an alternative reply with a more distinct wording. However, an often repeated question was »What does irregularity of work mean?» or »Does this cover unemployment?». This shows that men who considered unemployment a really serious shortcoming understand that it should be classified under the irregularity of work.

Lack of appreciation of forest work was not such a shortcoming that it frequently ranked among the first three. It is possible that appreciation is often combined with wages, and it is believed that when wages increase the appreciation will also improve.

63. Methods of calculating wages in forest work

It is not necessary to discuss in this connection the forest workers' annual income, since a separate study has been made on the subject (H e i k i n h e i m o et al. 1973). The following will give a survey of how the forest workers would like to have their wages paid.

Almost all the interviewed men had at some time in their lives worked on logging. Three-quarters of all forest workers had even been engaged in horsedrawn haulage. The percentages are given below:

Type of work	%
— logging of timber	97
— horse-drawn haulage of timber	74
— other forest work	93

»Which do you find is the most suitable way of paying the wages for forest work?» The question was made separately for all types of work (Table 6.1).

The method of wage payment for felling and haulage today is almost exclusively at piece-work rates, whereas other types of forest work are equally divided between time and piece-work rates. The forest workers seemed to be relatively happy with the prevailing methods since their opinions did not differ very much from the current practice as can be seen

Table 6.1 The method regarded in 1969 by the men in sample as most suitable for the payment of wages for various kinds of work.

Taulukko 6.1 Näytteen miesten v. 1969 sopivimpana pitämä palkkaustapa eri työlajeissa.

Kind of work *Työlaji*	The method most suitable for the payment of wages *Sopivin palkkaustapa*						
	Hourly *Tunti-palkka*	Daily *Päivä-palkka*	Monthly *Kuukausi-palkka*	Piece-rate *Urakka-palkka*	No opinion *Ei osaa sanoa*	Total *Yhteensä*	
	%					%	Men *Miehiä*
Felling — *Hakkuu*	1	3	11	84	1	100	[1]) 231
Haulage — *Ajo*	1	2	14	82	1	100	[1]) 175
Other forest work — *Muu metsätyö*	15	13	17	53	2	100	[1]) 224
Total — *Yhteensä*	6	7	14	72	2	100	

[1]) The total of respondents is not 238, because only those who had been working in the kind of work concerned were asked.

[1]) *Vastausten summa ei ole 238, koska kysymys esitettiin vain niille metsätyömiehille, jotka olivat tehneet ao. työlajin töitä.*

from Table 6.1. So far, only about one-seventh of those who expressed their opinions desired monthly wages.

Sweden has been short of forest workers for over five years. Manpower shortage has led to heavy increases in earnings but at the same time attitudes towards forest workers have become more favourable. It has been realized that the forest workers' takings begin to fall as early as from the 35th year of age. This is just the opposite to the wages of other occupational groups, which usually increase with age. Over 70 % of the Swedish forest workers are of the opinion that they should be receiving monthly wages.

Although only 14 % of the Finnish forest workers think that monthly wages are the best suited method of payment for forest work, it would be useful if the employers and trade unions, separately or in cooperation, started planning new machinery for the handling of forest workers' wage problems in a more objective way.

64. Heaviness of forest work

»Do you consider forest work very light, light, heavy or very heavy?» The test interview preceding the principal interview suggested that the distribution of the replies would be heavily skewed. This notwithstanding, the form of the question was not changed, since it was interesting to see whether some men would call forest work light work. In the total series,

Table 6.2 Forest workers' ex-forest workers' and pensioners' opinions regarding the heaviness of forest work.

Taulukko 6.2 Metsätyömiesten, ammattia vaihtaneiden ja eläkeläisten mielipiteet metsätyön raskaudesta.

Group *Ammattiryhmä*	Opinion regarding the heaviness of forest work *Mielipide metsätyön raskaudesta*			Total — *Yhteensä*	
	No opinion *Ei osaa sanoa*	Heavy *Raskasta*	Very heavy *Erittäin raskasta*	%	Men *Miehiä*
	%				
Forest workers — *Metsätyömiehet*	3	44	52	100	[1]) 236
Ex-forest workers — *Ammattia vaihtaneet*	2	29	69	100	42
Pensioners — *Eläkeläiset*	16	42	42	100	19

[1]) Two forest workers found that forest work is light or very light.

[1]) *Kaksi metsätyömiestä oli sitä mieltä, että metsätyö on kevyttä tai erittäin kevyttä työtä.*

there were two men, i.e. less than 1 %, who found forest work light. Both were about 50 years old, healthy small-farmers with families. One was engaged in timber measuring alone, the other in floating. Both replies were apparently based on the men's recent experience, and it is therefore no wonder they found their work light.

Table 6.2 shows that 96 % of forest workers considered forest work heavy or very heavy. Studies of the consumption of energy required for work have shown that forest work is almost the only occupation in which energy consumption exceeds 4 800 kcal/24 h (K a r v o n e n 1970, pp. 189—192). Against this background, one would say that forest workers do not overestimate the heaviness of their work.

Pensioners considered forest work least heavy, probably because the majority were old men during whose life-time the working hours had been shortened. One pensioner said that forest work is somehow medium heavy work.

The ex-forest workers were emphatically of the opinion that forest work is very heavy. Some had had to change occupation because their health no longer permitted work in the forest. Others who, for reasons other than health, had moved to other permanent occupations found their new work much lighter.

65. Unemployment

Unemployment is a serious misfortune which frequently occurs among forest workers. In the first ten months of 1969, more than half of the inter-

viewed men had had periods of unemployment, averaging over 60 days of work.

Forest workers were seemingly reconciled with the fact that their occupation contained relatively long periods of unemployment as an essential component. This is evident from the fact that not until the annual amount of unemployment exceeded 75 working days, i.e. 3 months, did they think that there had been relatively much or much unemployment (Table 6.3). The mean period of unemployment of all forest workers in the first ten months of 1969 was about six weeks. Unemployment, and fear of unemployment, produces a continuous feeling of insecurity in the life of the forest worker and his family.

Table 6.3 Forest workers' unemployment and their opinion regarding the amount of unemployme nt in January—October 1969.

Taulukko 6.3 Metsätyömiesten työttömyyspäivät ja mielipide työttömyyden määrästä tammi—lokakuussa vuonna 1969.

Opinion regarding the amount of unemployment *Mielipide työttömyyden määrästä*	Men *Miehiä*	%	Average number of days of unemployment per man *Työttömyyspäiviä keskimäärin miestä kohden*
Small or rather small — *Vähän tai melko vähän*	30	13	25
No opinion — *Ei osaa sanoa*	5	2	67
Rather great or great — *Melko paljon tai paljon*	90	38	75
Unemployed — *Työttömänä olleita*	125	53	63
No unemployment — *Ei työttömänä*	113	47	0
Total — *Yhteensä*	238	100	33

Annual unemployment of only a few days was very unusual. A reason may have been that some men considered a short period of unemployment so negligible that they overlooked it in their reply. Unemployment covered by work on their own farm, so-called concealed unemployment, apparently had a parallel effect. If no forest work is available, minor jobs are done at home.

66. Working hours and time spent on travelling to and from work

In January—February 1967 the forest workers' working day had a mean length of 7.2 hours. The length varied according to the types of work as follows (H e i k i n h e i m o et al. 1973):

	Hours
Timber logging with power saw	7.0
» » without power saw	6.2
Horse-drawn haulage of timber	7.1
Other forest and floating work	7.6

The short daylight hours and severe frost of the early winter also shorten the length of the working day. For this reason, calculated for the whole year, the working day probably is somewhat longer.

Forest workers under 30 years of age worked about half-an-hour per day longer, and those over 60 about half-an-hour per day shorter than the average.

Forest workers accept the need to travel considerable distances between their home and their place of work. This is shown, for example, by the fact that if daily consumption of time for covering the distance between home and work is about an hour, it is considered relatively short (Table 6.4). Not until the time expenditure is an hour and 40 minutes is it considered long.

Table 6.4 Forest workers' average daily time of travelling to and from work in 1969 and their opinion regarding the time spent on travelling.

Taulukko 6.4 Metsätyömiesten päivittäinen työmatka-aika vuonna 1969 ja mielipide työmatkoihin kuluneen ajan määrästä.

Opinion about the time of travelling *Mielipide työmatka-ajasta*	Men *Miehiä*	%	The average time of travelling to and from work, minutes per man *Työmatka-aika keskimäärin minuutteina miestä kohden*
Short — *Vähän*	28	13	47
Rather short — *Melko vähän*	45	21	61
No opinion — *Ei osaa sanoa*	24	11	81
Rather long — *Melko paljon*	81	38	82
Long — *Paljon*	38	18	99
Total — *Yhteensä*	[1]) 216	100	76

[1]) The number of men is not 238 because pensioners were not asked.

[1]) *Miesten lukumäärä ei ole 238, koska kysymystä ei esitetty eläkeläisille.*

Time spent on going to and from the place of work depends very much on the means by which the distance is covered. Motor vehicle ownership by forest workers in Sweden 1966 and in Finland 1967 is shown by the following percentages (Bendz--Yttermyr 1966; Heikinheimo et al. 1972).

	Sweden %	Finland %
Private car	58	23
Motorcycle	27	12
Moped		50
No motor vehicle	15	15
Total	100	100

The relative ownership of motor vehicles is practically the same in Finland and Sweden. However, the private car is nearly as common among the Swedish forest workers as the motor cycle and moped in Finland.

The majority of the Finnish forest workers have bought their vehicle to spend less time on going to and from work and to be able to compete for sites of work at relatively long distances from their homes. Their purchase has been almost compulsory. The alternative might sometimes be work-site lodgings.

Those over 60 spent most time on going to and from work, as can be seen from Table 6.5. This is largely because they least often owned motor vehicles and therefore, more often than the other age groups, had to take a bus, ride a bicycle, ski, walk, drive by horse or row.

Table 6.5 Forest workers' travelling time as a function of age in 1969.
Taulukko 6.5 Metsätyömiesten työmatka-aika iän funktiona v. 1969.

Age, years *Ikä, vuotta*	Travelling time, hours *Työmatka-aika, tunteina*			Total — *Yhteensä*	
	—1	1—2	2—		
	%			%	Men *Miehiä*
20—29	18	68	14	100	44
30—39	17	63	20	100	64
40—49	11	58	21	100	53
50—59	28	56	17	100	36
60—	5	42	53	100	19
Total — *Yhteensä*	17	62	21	100	[1]) 216

[1]) See footnote of table 6.4 — *Katso taulukon 6.4 alaviitettä.*

67. Independence of forest work, job satisfaction

Forest work offers at least one advantage to its worker: independent nature of the work. Nearly 95 % were of the opinion that their work was sufficiently independent. The forest worker can usually decide for himself what time he goes to work, how long hours he wishes to work, when he takes a day off, when he wishes to visit population centres and see people, and so on. All these are important freedoms for many a forest worker, and perhaps just because of them, many men withstand the stresses of their work from one year to another.

Modern people tend to criticize their own occupation: they are dissatisfied with education, pay and conditions of work. It is unusual to meet satisfied people.

Satisfaction with forest worker's occupation is relatively frequent. Over two-thirds of each group were satisfied or very satisfied. Satisfaction with forest worker's occupation seems to increase proportionately: forest workers — ex-forest workers — pensioners (Table 6.6, Fig. 6.1).

Table 6.6 Forest workers' ex-forest workers' and pensioners' satisfaction with forest work.

Taulukko 6.6 Metsätyömiesten, ammattia vaihtaneiden ja eläkkeellä olevien tyytyväisyys metsätyömiehen ammattiin.

Satisfaction with forest work *Tyytyväisyys metsätyömiehen ammattiin*	Group — *Ammatitryhmä*		
	Forest workers *Metsätyömiehet*	Ex-forest workers *Ammattia vaihtaneet*	Pensioners *Eläkeläiset*
	%		
Very satisfied — *Hyvin tyytyväinen*	7	12	26
Satisfied — *Tyytyväinen*	62	59	47
No opinion — *Ei osaa sanoa*	2	5	5
Dissatisfied — *Tyytymätön*	25	24	16
Very dissatisfied — *Hyvin tyytymätön*	4	—	5
Total — *Yhteensä*	100	100	100

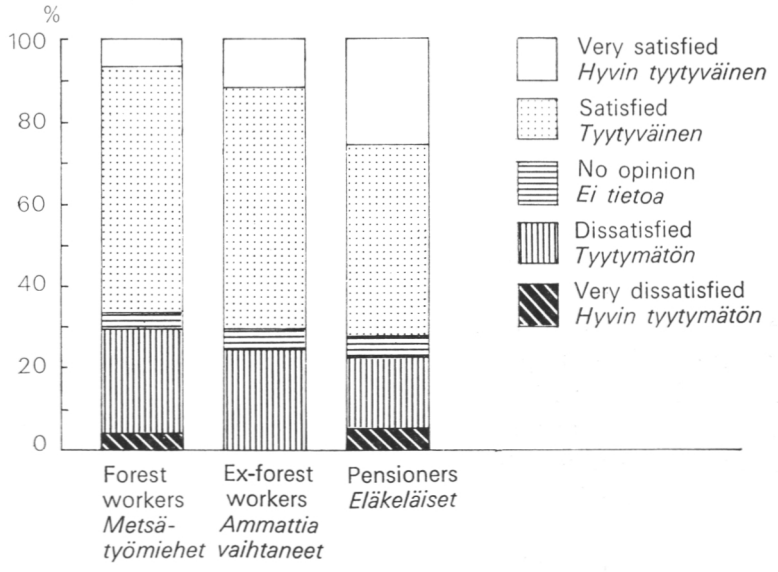


Figure 6.1 Forest workers', ex-forest workers' and pensioners' satisfaction with forest work.

Kuva 6.1 Metsätyömiesten, ammattia vaihtaneiden ja eläkkeellä olevien tyytyväisyys metsätyömiehen ammattiin.

The percentages of forest workers satisfied with their occupation, by age groups, were:

Age, years	Satisfied, %
20—39	63
40—59	68
60—	85
Total	67

Satisfaction with the forest worker's occupation increases with age. This is perhaps because the older men have long worked in the forest and seen the progress of the occupation. They have as if grown together with their job. The satisfaction of the elderly men may also have a compulsory or submissive touch, since they know that they no longer can change occupation and had better be satisfied.

Apparently the question »How satisfied are you with the forest worker's occupation» did not measure the true degree of satisfaction for all men. An indication is that many men said: »what else can one do?». The satisfaction of these men refers more to the fact that they are employed and can support themselves and their families with their earnings than to the occupation itself.

68. Readiness to change occupation

»If it were possible for you, which occupation would you rather choose?» The question was hypothetical and tried to measure the subjet's readiness to change occupation and his preferences among occupations. For pensioners and elderly men the question was put in the past tense, and it was therefore equally applicable to old and young. It was found that 140 men, i.e. 59 % of all the interviewed forest workers, would have liked to change occupation had it been possible.

Is there a contradiction between the forest worker's satisfaction with his job and his willingness to change occupation, since two-thirds were satisfied and yet three-fifths would have liked to change occupation had there been a chance? A contradiction apparently exists but a large proportion is easy to explain, considering that for a number of the forest workers there was no choice. The readiness to change occupation, therefore, probably also measures the forest workers' true satisfaction with their job.

Since the forest workers were free to name the job they would have preferred had they had the chance, the classification of occupations was difficult. Following kinds of replies were listed: »Physician, because the world runs after money», »Some kind of self-employment or master builder», »Driver of a bakery lorry», »Any factory work as long as one is sheltered by

a roof», »Any job with better pay», »Some interesting job, not factory or building», »A nice job in a factory».

Sectors that the forest workers, ready to consider a change of occupation, would have accepted had they had a chance were:

Sector of work	%
— well-paid light work, indoors	29
— factory work	36
— building work	10
— machine operator, fitter	9
— janitor	4
— farmer	2
— other work	11
Total	100

The vast majority of forest workers favourably inclined to change of occupation considered as ideal job a work done indoors, light and better paid than forest work, which many specified as factory work. Approximately one-fifth of those wishing to change the job named outdoor work as their ideal. Just over 10 % chose their ideal jobs among the occupations requiring a higher level of education.

The reasons why the forest workers would have liked to change occupation were the following:

	%
Working conditions	64
Wages	15
Health	18
Other reasons	3
Total	100

Roughly four-fifths of the forest workers ready to change job considered factors associated with their working conditions as the most important reasons for their willingness to change job. 15 % first thought of the low wages.

It is interesting to compare the greatest shortcomings in forest workers' working conditions and the reasons for which three-fifths of the forest workers would have changed to another occupation, had it been possible.

	Shortcomings in working conditions, %	Reasons for willingness to change job, %
Health factors	20	18
Low wages	29	15
Other shortcomings in working conditions	48	64
Other factors	2	3
Total	100	100

The percentage distributions are seen to be fairly similar: only the low wages gain emphasis when the working conditions are split into components, as was done in discussing their shortcomings.

If it is desired that forest workers should have job satisfaction, the shortcomings in their working conditions must be abolished. Among the most important steps would be improving the wage structure, easing of the heaviest phases of work, the greatest possible elimination of health hazards, and establishing job security.

7. SECURITY

71. Concept and measurement of security

Security as a level of living component is closely associated with the other components, so much so that it is sometimes difficult to draw a line. On the other hand, security can be considered one of the basic human needs without which balanced human life is not possible.

The family earlier used to be the main source of security against social risks. Today society increasingly attempts to make sure that individuals enjoy certain security throughout their lives (P u l k k i n e n 1969, pp. 3—9). Society has placed particular emphasis on developing economic security, by creating pension security systems, health insurance systems and the like, to provide economic support for those in need of it. These social security systems tend to guarantee a certain minimum security for every human being.

However, it depends decisively on the individuals and circumstances whether they are able to obtain a security superior to this minimum. Property and earnings are the basis of an individual's economic security. With forest workers, however, safety at work is a particularly important component of security. The risk of work accidents and occupational diseases entails a continuous risk of a loss of income. The seasonal character of forest work also adds to the risk of a loss of income and thus to insecurity.

Among the level of living components, security ranked fourth in importance, after health, housing, and working conditions. This shows that the role of security in forest workers' lives is considerable. Furthermore, both health and working conditions are closely connected with security. Loss of health either through accident, occupational disease or otherwise, results in disability for work, economic difficulties, and insecurity. The high ranking of working conditions is probably due to the accident-proneness of forest work and the frequent unemployment. Both can cause economic insecurity. Health and a possibility to work are therefore important conditions for security. Their high ranking in importance indirectly also emphasizes the role of security.

There are two reasons why it is difficult to measure security: security avoids a precise definition, and is also an emotion which in itself cannot be

measured. Security will be approached in this paper by reviewing several factors connected with the feeling of security. Attention is first given to earnings and income, and the factor that most essentially reduces them, viz. unemployment. An idea of the property owned by forest workers is created on the basis of interview data. Of the statutory social security systems, those to be discussed in this context are the unemployment insurance and work pension insurance systems. Work safety and associated factors are also shortly discussed.

72. Forest workers' earnings and incomes

Perhaps the most prominent part of economic security is composed of earnings and incomes, and this during a lengthy period, say one year. No official statistics are available on annual earnings and incomes, but a study has been made of Finnish forest workers' level of earnings (H e i k i n h e i m o et al. 1973). According to it, the annual earnings and incomes of forest workers and certain control groups in 1966 were:

Employment category	Fmk	Ratio
Metal industry workers, annual earnings ...	8 724	147
Wood processing industry workers, annual earnings	8 118	137
Permanent forest workers, National Board of Forestry, annual earnings	6 935	117
Professional forest workers, annual income ..	5 924	100

The term professional forest workers refers to men employed in forest and floating work for more than 100 days per year. The forest workers' annual income was distinctly lower than the annual earnings of the industrial workers. However, it should be noted in comparing the figures that industrial workers usually live in population centres where the cost of living is higher than in the rural districts. Hence the difference between the groups in terms of consumption is slightly smaller. The forest workers' annual income contained 695 mk (12 %) of enterprise income from their own farming and forestry. This shows that income obtained from small farms still was of considerable importance for the economic security of forest workers.

The 1966 Household Survey (Vuoden 1966 . . .) also studied the size of the households, which was:

for forest workers	5.0	persons/household
for metal industry workers	3.5	» »
for wood processing industry workers	3.6	» »

The forest worker families contained, on the average, 1.5 persons more than the other households. Their incomes, therefore, were divided on a larger group, and as a result, the economic security given by the incomes was more markedly inferior to that of the other groups than a comparison of the totals alone would suggest.

The forest workers' low incomes were largely due to unemployment. 53 % of the interviewed professional forest workers had been unemployed in 1969 for varying periods. The mean period of unemployment was 63 days. The men who had been unemployed were asked whether the unemployment had aroused insecurity in them. The question was »do you consider that you have been unemployed for a short, fairly short, fairly long or long period?» 38 % replied »long» or »fairly long», 13 % »short» or »farly short», while 2 % were unable to express any opinion. Three-quarters of those who had been unemployed, and thus 38 % of the forest workers of the total material, considered that their period of unemployment had been long and that it had weakened their economic security.

However, the seasonal variations in forest work are being smoothed as the proportion of permanently employed forest workers increases. In the future this will reduce the forest workers' unemployment and the economic insecurity it produces. Also, since 1966 the forest workers' earnings have come considerably closer to those of the industrial workers. In 1971, the annual earnings of the permanent forest workers of the National Board of Forestry exceeded those of the industrial workers (H e i k i n h e i m o et al. 1973). If the wage developments in forest work continue on the same lines, the professional forest workers, also, will catch up with the industrial workers' annual earnings in a few years' time.

73. Property, savings and insurances as part of economic security

A cornerstone of economic security is property. A house of one's own, savings and other possible assets create security in that the owner is not absolutely dependent on regular income. The importance of property as guarantee of economic security is particularly noteworthy for forest workers, since continued income from work, due to unemployment and also to the health hazards of the work, is always uncertain.

The present study tried to ascertain the amount of property by interviewing the forest workers in the autumn of 1969. The questions made were mainly concerned with the dwelling and its equipment; concerning other property they were not so detailed. No attempt was made to convert the amount of property into terms of money, and priority was given to the forest workers' opinions of the amount and sufficiency of their property.

Most forest workers lived in dwellings of their own. In 1969, the forest workers lived as follows:

In a dwelling of their own (or the family's)	74 %
In a rented dwelling	18 %
Other dwellings	8 %
	100 %

The houses were usually in the countryside, on small farms, as is shown by the following distribution of forest workers. In 1969, of the professional forest workers

40 %	were farm-holders
18 %	were farm-holders' family member and
42 %	others
100 %	

The farms were usually small (77 % had less than 5 ha of arable land), and so were the dwellings. Hence the economic security they offer is probably limited. This is also indicated by the deficiency of effects in the dwellings. Only one-third, for example, had piped water and drainage. The forest workers' housing level has been discussed in greater detail in Chapter 5.

Although the forest workers' own houses are small their importance as source of economic security is emphasized by the fact that forest workers seldom have any other property. The forest workers were simply asked »Have you got any property?», to which 75 % answered in the affirmative and 25 % said they had no property. The property of those replying in the affirmative mainly consisted of their small farm. This is shown by Table 7.1, according to which 85 % of farm-holders or their family members said they owned some property. Only 61 % of the others had property, which consisted of a dwelling of their own, or a motor car. 23 % of the forest workers had a car. 81 % of the married and 65 % of the unmarried men said they had property.

A second question tried to find out whether the respondents considered they had enough property: »Do you consider you have enough property?» Many expressed the infinitiness of human needs by saying »One never has enough property», but others took it more personally, trying to estimate the amount of property reasonable for their own needs. These two attitudes to the question could not be separated. The final result, presented in Table 7.2, was that 69 % answered »too little» and 31 % were satisfied with the amount of their property. It was intriguing to note that the »too little» group contained 72 % of those with property but only 63 % of those with no property.

Table 7.1 Forest workers' opinion regarding their property, as a function of social group and marital status.

Taulukko 7.1 Metsätyömiesten mielipide omaisuudestaan yhteiskuntaryhmän ja siviilisäädyn funktiona.

Social group *Yhteiskuntaryhmä*	Forest workers who think they *Metsätyömiesten mielestä heillä*				Total — *Yhteensä*	
	have property *on omaisuutta*		have no property *ei ole omaisuutta*			
	men *miehiä*	%	men *miehiä*	%	men *miehiä*	%
Owner of farm or his family member — *Tilanomistaja tai hänen perheenjäsenensä*	117	85	20	15	137	100
Landless — *Tilaton*	62	61	39	39	101	100
Total — *Yhteensä*	179	75	59	25	238	100
Marital status *Siviilisääty*	men *miehiä*	%	men *miehiä*	%	men *miehiä*	%
Single — *Naimaton*	52	65	28	35	80	100
Married — *Naimisissa*	119	81	28	19	147	100
Widow or divorced — *Leski tai eronnut*	8	73	3	27	11	100
Total — *Yhteensä*	179	75	59	25	238	100

Table 7.2 The adequacy of forest workers' property.

Taulukko 7.2 Metsätyömiesten omaisuuden riittävyys.

Forest workers who think they *Metsätyömiesten mielestä heillä*	Forest workers who think they *Metsätyömiesten mielestä heillä*				Total — *Yhteensä*	
	have adequate property *on riittävästi omaisuutta*		do not have adequate property *ei ole riittävästi omaisuutta*			
	men *miehiä*	%	men *miehiä*	%	men *miehiä*	%
have property — *on omaisuutta*	51	28	128	72	179	100
have no property — *ei ole omaisuutta*	22	37	37	63	59	100
Total — *Yhteensä*	73	31	165	69	238	100

Table 7.3 shows the opinions of the sufficiency of property distributed by age. The age group 30—40 in particular considered they had too little property. The explanation is, probably, that in this age group the economic burden of children and the need of space for the family are at their maximum. This viewpoint was corroborated by the study of the number of the interviewee's own children under 15 living at home (Table 7.4).

Table 7.3 The adequacy of forest workers' property as a function of age.
Taulukko 7.3 Metsätyömiesten omaisuuden riittävyys iän funktiona.

Age group, years *Ikäryhmä, vuotta*	Forest workers who think they *Metsätyömiesten mielestä heillä*				Total — *Yhteensä*	
	have adequate property *on riittävästi omaisuutta*		do not have adequate property *ei ole riittävästi omaisuutta*			
	men *miehiä*	%	men *miehiä*	%	men *miehiä*	%
20—29	18	39	28	61	46	100
30—39	16	24	51	76	67	100
40—49	15	27	40	73	55	100
50—59	14	32	30	68	44	100
60—	10	38	16	62	26	100
Total — *Yhteensä*	73	31	165	69	238	100

Table 7.4 The adequacy of forest workers' property as a function of the number of own children (under 15 years) living at home.
Taulukko 7.4 Metsätyömiesten omaisuuden riittävyys kotona asuvien omien lasten (alle 15-v.) lukumäärän funktiona.

Children living at home *Kotona asuvia lapsia*	Forest workers who think they *Metsätyömiesten mielestä heillä*				Total — *Yhteensä*	
	have adequate property *on riittävästi omaisuutta*		do not have adequate property *ei ole riittävästi omaisuutta*			
	men *miehiä*	%	men *miehiä*	%	men *miehiä*	%
1—2	10	17	49	83	59	100
3—	8	24	26	76	34	100
Total, men with children — *Yhteensä miehet joilla lapsia* ...	18	19	75	81	93	100
No children — *Ei lapsia*	55	38	90	62	145	100
Total — *Yhteensä*	73	31	165	69	238	100

Of the interviewee's 38 % with no children found that they had enough property, against 19 % of those who had children.

Real estate as source of economic security has the weakness that it is difficult to convert into money should a sudden need arise. Forest workers' unemployment annually causes a need of cash funds which must be met somehow. Savings would therefore be of utmost importance to forest workers. However, they have little, as can be seen from Table 7.5. Only 23 % replied in the affirmative to the question »Have you got savings?» The exact amount of the savings, in terms of money, was not inquired in order to

Table 7.5 The amount and adequacy of forest workers' savings.
Taulukko 7.5 Metsätyömiesten säästöjen määrä ja riittävyys.

Forest workers who think they *Metsätyömiesten mielestä heillä*	Forest workers who think they *Metsätyömiehen mielestä hänellä*		Total — *Yhteensä*		
	have adequate savings *on riittävästi säästöjä*	do not have savings adequate *ei ole riittävästi säästöjä*			
	%		%	men *miehiä*	%
have savings — *on säästöjä*	20	80	100	55	23
do not have savings — *ei ole säästöjä*	12	88	100	181	77
Total — *Yhteensä*	14	86	100	236	100

avoid a negative attitude to the interview by demanding details. In spite of this, many volunteered information regarding the amount, which usually ranged from a few hundreds to a few thousand Finnmarks. Of the savers 20 % considered their savings sufficient, and even of those with no savings, 12 % considered they had enough. On the average, 14 % of all the men interviewed were of the opinion that their savings were sufficient. A vast majority, 86 %, considered their savings insufficient.

In addition to property and savings, there is a third means of increasing one's security against unexpected misfortunes, viz. insurances. The interview made an approximate division of insurances into two categories: property insurances and personal insurances. In the same way as for property and savings, the forest workers were asked whether they had insurances, and secondly, whether they considered them sufficient for themselves and their families.

Table 7.6 shows the opinions on the amount and sufficiency of the personal insurances, including life insurance, accident insurance, health insurance, etc. 30 % of the respondents had such insurances. About half the number of the interviewed considered the amount of their personal insurances sufficient. It is interesting to note that the insufficiency of personal insurances was felt relatively more by the group that had these insurances than among those who had no insurances.

Property insurances were much more common than personal insurances. 68 % had property insurances, as can be seen from Table 7.7. Usually the insured object was the house the policy-holder owned. Satisfaction with the sufficiency of property insurances was greater than that of personal insurances; 79 % found their property insurance sufficient.

Table 7.6 The amount and adequacy of forest workers' personal insurances.
Taulukko 7.6 Metsätyömiesten henkilövakuutusten määrä ja riittävyys.

Forest workers *Metsätyömiehillä*	Forest workers who think they *Metsätyömiesten mielestä heillä*		Total — *Yhteensä*		
	have adequate personal insurances *on riittävästi henkilövakuutuksia*	do not have adequate personal insurances *ei ole riittävästi henkilövakuutuksia*			
	%		%	men *miehiä*	%
have personal insurances — *on henkilövakuutuksia* ...	43	57	100	72	30
do not have personal insurances — *ei ole henkilövakuutuksia*	52	48	100	166	70
Total — *Yhteensä*	49	51	100	236	100

Table 7.7 The amount and adequacy of forest workers' property insurances.
Taulukko 7.7 Metsätyömiesten omaisuusvakuutusten määrä ja riittävyys.

Forest workers *Metsätyömiehillä*	Forest workers who think they *Metsätyömiesten mielestä heillä*		Total — *Yhteensä*		
	have adequate property insurances *on riittävästi omaisuusvakuutuksia*	do not have adequate property insurances *ei ole riittävästi omaisuus vakuutuksia*			
	%		%	men *miehiä*	%
have property insurances — *on omaisuusvakuutuksia* .	81	19	100	162	68
do not have property insurances — *ei ole omaisuusvakuutuksia*	75	25	100	75	32
Total — *Yhteensä*	79	21	100	237	100

Summarizing, it may be concluded that forest workers' economic security is not particularly low as far as property insurances are concerned, whereas 50 % of the interviewed found their personal insurances insufficient. Property and savings were felt as insufficient (Fig. 7.1).

Since the forest workers' property and savings do not provide sufficient economic security in the event of unemployment or disability, legislative systems have been created which give forest workers and other wage earners

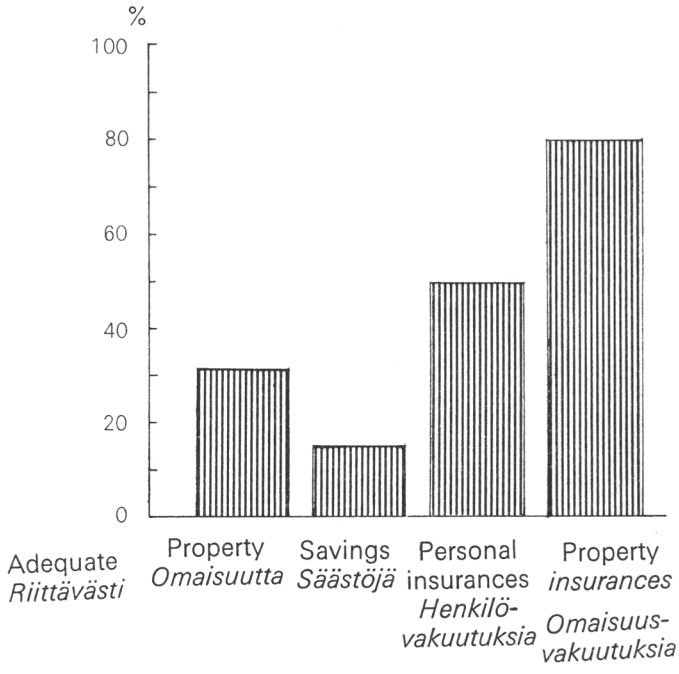


Figure 7.1 Forest workers' opinion concerning the adequacy of their property, savings and insurances.

Kuva 7.1 Metsätyömiesten mielipide omaisuuden, säästöjen ja vakuutusten riittävyydestä.

economic support if required. Unemployment insurance and work pension insurance are the most important among these social security insurance systems.

74. Unemployment insurance

The unemployment insurance system is based on unemployment funds operated by trades unions. The Rural Workers' Unemployment Fund, which the forest workers can join, works in conjunction with the Union of Rural Workers. The sole purpose of an unemployment fund is to support its members while they are without employment. Membership is voluntary and open to all paid workers under 60 years of age in branches belonging to a sector of the Fund.

The Rural Workers' Unemployment Fund grants daily and special daily benefits to its members. A member is entitled to benefits as soon as he has held the membership for the six immediately preceding months, and while holding the membership also been at work for a minimum of six months. Subsidy becomes payable as soon as unemployment has lasted six days. In

order to obtain the subsidy, the applicant must present a certificate issued by a labour exchange official to the effect that no work suitable for him has been available. The amount of the subsidy in 1971 was maximum 30 mk day for a forest worker with family members to support, and maximum 23 mk per day for others. Subsidy can be paid for up to 100 days for members who have paid their membership fees for six months, and for up to 150 days for those who have paid membership fees for 3 years. In special cases the government can grant permission to pay subsidies for an even longer period.

The unemployment fund system is jointly financed by the state, employers and workers. The state is responsible for 50 %, employers for 43 % and fund members for 7 % of the subsidies paid. The membership fee of the Rural Workers' Unemployment Fund has risen continuously. Since 1969 it has been 1,50 mk per week (78 mk per year). It should be noted that employers pay an unemployment insurance contribution for all workers, including those who are not members of the unemployment fund. In this way the contributions paid by employers for all workers benefit only those workers who are members of the unemployment fund (Maaseututyöväen työttömyyskassan . . .).

The extent of the Rural Workers' Unemployment Fund can be seen from Table 7.8. The Fund started its activity in 1958 but did not gain importance until the 1960s. The table shows that, in recent years, over a half of the Fund members have annually received unemployment benefits. Approximately 70—80 % of the members are forest workers and the unemployment benefits received by forest workers in 1971 was about 15 million Fmks.

The role of unemployment funds as an economic security factor for forest workers is reduced by the fact that perhaps less than one-fourth of the

Table 7.8 Benefits under the Rural Workers' Unemployment Fund 1967—1971. Source: Annual reports of the Rural Workers' Unemployment Fund.
Taulukko 7.8 Maaseututyöväen työttömyyskassan toiminta v. 1967—1971. Lähde: Maaseututyöväen Työttömyyskassan toimintakertomukset.

Year *Vuosi*	Members in the Fund *Kassassa jäseniä*	Unemployment benefits received by *Työttömyysavustusta sai*		Average benefits *Avustusta keskimäärin*		Total benefits, millions Fmk *Avustusta maksettu kaikkiaan milj. mk*
		persons *henkilöä*	per cent of members *% jäsenistä*	per day *päivässä*	per person *henkilöä kohti*	
				Fmk — *mk*		
1967	15 200	9 497	62	—	874	8.3
1968	19 438	11 013	57	14.20	1 302	14.3
1969	19 978	12 726	64	15.20	1 425	18.1
1970	18 589	10 693	58	16.60	1 450	15.6
1971	20 896	12 321	59	19.20	1 660	20.4

professional forest workers are members. The total number of professional forest workers in 1966 was about 75 000 (H e i k i n h e i m o et al. 1973), and by 1971 their total probably had fallen to about 65 000. An estimated 15—16 000 forest workers were members of unemployment fund. The low membership figures are due, above all, to the regional and structural disunity of the forest worker body. Forest workers who own a farm or work for part of the year in other occupations have not considered their position as forest workers permanent enough to prompt them to join the Union of Rural Workers.

Forest workers can obtain also unemployment benefits under the Employment Act (1971). Any person admitted to the Unemployment Register is paid benefit from state funds unless employment can be found for him. No information is available on the subsidies paid to forest workers on the basis of the Employment Act and the preceding Unemployment Subsidy Act. Many forest workers considered the unemployment benefits system less convenient than the unemployment fund system. Furthermore, a considerable number of forest workers holding a farm remain completely outside the Employment Act.

75. Work pension insurance

Work pension systems were established in Finland in the early 1960s to supplement the National pension system. They are based on the Workers' Pension Act (TEL) and the Act on Pensions for Workers under a Short-term Work Contract (LEL); the two Acts entered into force on July 1, 1962. The forest workers fall under the LEL system, together with farm workers, building workers and longshoremen. The pension is determined on the basis of aggregate wages. The annual pension equals 1 % of the total of the wages the workers has earned since the age of 23 and for which insurance premium accordance with LEL has been paid. The pension of workers born before 1 July 1919, however, accrues faster. Any earning under 1 200 mk a year are disregarded in the determination of the LEL pension.

The employer alone is responsible for the cost of the work pension system. The premium for LEL pensions amounts to 6 % of the gross wages (1971). In forest work, for the power saw costs are deducted when the earnings serving as a basis for pension are calculated. This method of calculation has been much criticized since, as a result, the pensions remain very small. The deduction for the power saw costs is 30 % of the gross earnings although their share, in reality, is less than 20 % (V e h v i l ä i n e n 1971, p. 22). 10—15 % of the true earnings therfore is not counted for pension.

The LEL Pension Funds grant old age pensions, disability pensions, family pensions and, since 1971, unemployment pensions. Table 7.9 shows

Table 7.9 The number of pensioners in the Forest Workers' Pension Fund and average pension, 1963—1971. Source: LEL Tilastovuosikirja.

Taulukko 7.9 Metsäalan Työeläkekassan eläkkeensaajien lukumäärä ja keskimääräinen eläke vuosina 1963—1971. Lähde: LEL Tilastovuosikirja.

Year *Vuosi*	Old-age pension *Vanhuuseläke*		Disability pension *Työkyvyttömyyseläke*		Family pension *Perhe-eläke*		Unemployment pension *Työttömyyseläke*		Total *Yhteensä*		Total pension, millions Fmk *Eläkesumma milj. mk*
	pensioners *eläkkeen saajia*	Fmk/month *mk/kk*	pensioners *eläkkeen saajia*	Fmk/month *mk/kk*	pensioners *eläkkeen saajia*	Fmk/month *mk/kk*	pensioners *eläkkeen saajia*	Fmk/month *mk/kk*	pensioners *eläkkeen saajia*	Fmk/month *mk/kk*	
1963	12	13	207	53	—	—	—	—	219	50	0.1
1964	98	15	669	51	—	—	—	—	767	47	0.5
1965	409	37	1 241	62	—	—	—	—	1 650	56	1.3
1966	892	42	2 558	63	—	—	—	—	3 450	57	2.9
1967	1 537	45	3 114	65	187	51	—	—	4 838	58	3.8
1968	2 123	49	4 565	68	496	55	—	—	7 184	61	6.5
1969	2 938	58	5 718	77	878	60	—	—	9 534	70	8.8
1970	3 427	66	6 828	83	1 252	66	—	—	11 507	76	11.9
1971	3 995	73	7 268	105	1 577	71	14	71	12 854	91	14.4

the number of pensioners of the Forest Workers' Pension Fund, and the mean pensions in 1963—71.

The number of pensioners has continued to rise, and exceeded the 10 000 limit in 1970. The mean monthly pension in 1971 was 91 mk. The total of pensions paid has increased continuously and in 1971 amounted to 14.4 million Fmk. The work pensions system, therefore, is approaching the unemployment insurance system as regards the totals paid. It is apparent that the work pensions total in the next few years will surpass the unemployment insurance total and that work pensions, together with national pensions, will constitute the most important factor promoting forest workers' economic security. This is also shown by the fact that the Forest Workers' Pension Fund between 1 July 1962 and 31 December 1970 collected a total of 154.4 million Fmk, from which 35.7 million Fmk, i.e. 23 %, were paid out as pensions. 105.3 million Fmk (68 %) was transferred to the Insurance Premium Fund, and will in due course be redistributed to pensioners. The remaining 9 % of the funds accrued was spent on administration.

What is the forest workers' own opinion on the work pension system and the security it creates? The interview asked: »Do you consider that the forest workers' work pension security is very well, well, badly or very badly organized?» The replies are given in Table 7.10. The work pension system was unfamiliar to many of the interviewed, 23 % could not say their opinion,

Table 7.10 Forest workers' opinion concerning work pension security, as a function of their property.

Taulukko 7.10 Metsätyömiesten mielipide työeläketurvan järjestelystä omaisuuden funktiona.

Forest workers who think they *Metsätyömiesten mielestä heillä*	Forest workers think the work pension security has been arranged *Metsätyömiesten mielestä työeläketurva on järjestetty*			Total *Yhteensä*	
	well or very well *erittäin hyvin tai hyvin*	no opinion *ei osaa sanoa*	badly or very badly *huonosti tai erittäin huonosti*		
	%			%	men *miehiä*
have property — *on omaisuutta*	22	23	55	100	179
have no property — *ei ole omaisuutta*	34	22	44	100	59
Total — *Yhteensä*	25	23	52	100	238

and some of the respondents even seemed to confuse the work pension and national pension systems.

25 % were satisfied with the work pension system, 52 % considered the work pension system bad or very bad. The table also shows that forest workers with property were, on the average, less satisfied with the work pension security than those with no property. The explanation is, perhaps, that the work pensions are relatively smaller for the better-off than the poor, and this breeds dissatisfaction.

Those who found that the work pension system was bad or very bad were asked what kind of improvements they would like to see. An approximate classification of these was:

— higher pension	46
— lower pension age	39
— pension to include power saw costs	13
— better position for the elderly	6
— various improvements	7
— work pension system misunderstood or not known	23
Total	134

Some proposed two improvements, and therefore the number of proposals exceeds the number of the dissatisfied of Table 7.10. Most of the wishes were associated with the amount of pension and the pension age. Those wishing a higher pension are supported by statistics; in 1970 the mean LEL pensions paid by the Building Workers' Pension Fund (131 mk/month) and the Longshoremen's Pension Fund (145 mk/month) were almost twice those of the

forestry sector. The desired pension age was 53 years, i.e. 12 years lower than the present pension age of 65 years. It is also remarkable that a considerable proportion of the dissatisfied knew nothing of the work pension system. This was directly seen in 23 replies, but additionally quite a number of those wishing to increase the pension or lower the pension age hardly distinguished between the work pension and national pension systems. It is obvious that information on work pensions should be distributed more efficiently. But it may be said that both increasing the pensions and lowering the pension age would be extremely necessary improvements towards the economic security of forest workers.

76. Work safety

761. Accident prevention and health protection

Forest work is heavy manual work in exceptionally severe conditions. It exposes the worker both to accidents and occupational diseases. The extent to which these risk factors can be reduced by accident prevention and by health protection is important for the forest worker.

The high accident rate places forest work among the most dangerous occupations. Only in house construction has the accident rate in recent years been higher than in forest work. In 1967, there were on the average 184 accidents per 1 000 man-years, against 67 for all trades (K l é n 1971). About 70 % of all professional forest workers have some time been involved in accident leading to absence from work.

Estimated on the basis of the days of absence, forest work accidents often are relatively minor. In 1967 forest work accidents caused a loss of 34 working days per accident, on the average, against 46 days in all trades (K l é n 1971). 4 % of the forest workers receiving disability pension in 1970 had been pensioned owing to an accident (LEL Tilastovuosikirja 1971, p. 30), another indication of the relatively mild degree of the accidents.

Timber logging is the most important type of forest work. In 1969, 64 % of forest work accidents occurred in logging (Sosiaali- ja terveys . . . 1971). With the increased limbing by power saw, the power saw is rapidly replacing the axe as the most dangerous tool in forest work.

Education is among the traditional and most important methods of accident prevention. Learning the correct methods of work not only increases the productivity of work and the worker's earnings but also reduces the risk of accidents. The current training capacity, however, suffices to give basic and supplementary training in the 1970s to only about one-quarter of professional forest workers. The others learn their working methods on their own, and they are not always the safest.

Other measures can also be taken to promote accident prevention. Safer tools can be designed to comply with the change in the methods of work. The power saw is a tool with poor safety characteristics particularly. Kick guard, safety chain and vibration-damping device are necessary improvements. The first-mentioned, since the beginning of 1972, is compulsory for the new power saws. Personal protective devices are also of importance in accidents prevention.

Finally, the pace of forest work, like all piece-rate work, is very fast and this may contribute to many accidents. Introduction of time-based wages might have an accident-reducing effect.

Control of occupational diseases is an essential part of occupational health protection. Occupational diseases accompanying forest work are vibration disease or white fingers, hearing defects, and lumbar pain. Prevention of these occupational diseases is an extensive field of work where a lot remains to be done. Medical examinations of permanent forest workers are now being introduced, the first step in occupational health protection. It is an absolute necessity that the state of health of professional forest workers be examined at one- or two-years intervals.

Occupational diseases can be prevented by the same methods as accidents: safer working methods should be taught, tools and protective devices improved, and the rate of work kept within reasonable limits.

762. Protective devices

Increasing attention has been given in the last few years to the forest worker's personal protective devices and clothing at work. Several models of working clothes and many devices promoting safety at work have been introduced in the market.

A committee on safety in forest and agricultural work (Metsä- ja maatalouden . . . 1971) made in 1970 an inquiry into the use of protective devices among professional forest workers. The results revealed that forest workers used them as follows:

Hearing protectors	25 %
Protective goggles	7 %
Helmets	7 %

However, no less than 86 % of the respondents reported that they were prepared to wear hearing protectors. Three-quarters considered the helmet combination (helmet+hood+goggles+hearing protectors) as a good solution against accidents to the head and against noise. Two-thirds considered protective gloves necessary for power-saw men. There seems to be a contradiction

between the indicated willingness to wear protective devices and their actual use. The lack of use is probably partly due to the clumsiness involved in their use, partly to the forest workers' evasive attitude to safety problems, and finally to the view that the employer should pay a part of the purchase price of all protective equipment.

About four-fifths of the forest work school pupils wore the helmet combination daily in their work. It therefore seems probable that the use of protective equipment will spread quite quickly amongst forest workers as a whole. The safety of forest work can naturally be rapidly improved if the protective equipment is statutorily made compulsory, as was suggested by some respondents to the inquiry. The problem to be solved in that case is who pays. Many considered the protective equipment very expensive.

8. HUMAN RIGHTS

81. Concept

The Universal Declaration of Human Rights adopted by the United Nations in 1948 enumerates the following rights: personal freedom, freedom of thought, conscience and religion, political rights, right to own property of which the individual shall not be arbitrarily deprived, right to education, right to social security, and right to equal protection of the law (S u o n t a u s t a 1963, p. 158). Practically the same basic rights are guaranteed in the Constitution of Finland (1919) and the supplementary laws and statutes, apart from social rights and other dues citizens are entitled to expect from society. The citizens are only given a certain degree of freedom, which supposedly is not to be violated (K a s t a r i 1963, p. 487). However, economic and social rights which also are aims in themselves, cannot be reached without improving the basic rights and freedoms of man (The I.L.O. . . . 1968, p. 6).

The social rights mentioned in the Declaration of Human Rights contain e.g. the following:

— Everyone is entitled to realization of the economic, social and cultural rights indispensable for his dignity and the free development of his personality,

— Everyone has the right to work, to free choice of employment and to just conditions of work,

— Everyone who works has the right to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity,

— Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family

— . . . and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyong his control (Kansainväliset . . . 1968, p. 7).

This expansive interpretation is given to human rights in this context. The forest workers' human rights are approached by an study of the fairness of treatment by society, suffering of injustices, and appreciation of forest workers.

82. Fairness of treatment

»Does society treat you justly?» was a question not very easy to reply. This is shown by the fact that relatively few of the interviewed gave a directly affirmative or negative answer. However, after some concentration the majority was able to give their opinions in conclusive terms. But the large »no opinion» group indicates that expressing an absolute opinion was difficult.

The distribution of forest workers' opinions on their treatment by society was as follows:

Treatment by society	%
Fair	56
No opinion	12
Unfair	32
Total	100

More than half of the number of forest workers were of the opinion that society treated them fairly. The opinion, however, appeared forced in many cases. The wording »I cannot complain very much» was relatively frequent. Statements of this kind prompt the question why the alternative replies were not made more numerous, which would have enabled a more detailed determination of treatment by society. This was because the pilot interview preceding the study revealed a too pronounced accumulation of opinion to the intermediate alternatives, which would have further reduced the information obtainable on the question.

Table 8.1 and Fig. 8.1 show that the youngest forest workers were satisfied with the treatment by society. They included the highest proportion of those convinced of the just treatment by society, and the smallest proportion of those who had noticed unjust treatment. The middle-aged forest workers were the most dissatisfied, and those aged 50—59 found it difficult to define their opinion.

As the amount of property increased, dissatisfaction with treatment by society grew (Table 8.2). It is possible that a person living on a farm larger than 5 ha of arable land views things more from a farmer's than a forest worker's angle. He may perhaps identify himself with a farmer and think that e.g. the subsidies paid by society to farming are too small. It may also be assumed that with increased wealth the level of knowledge is often higher, and this arouses dissatisfaction.

Table 8.1 Forest workers' opinion regarding their treatment by society, as a function of age.

Taulukko 8.1 Metsätyömiesten mielipide yhteiskunnan kohtelusta, iän funktiona.

Age — *Ikä*	Treatment by society — *Yhteiskunnan kohtelu*				
	Fair *Oikeuden-mukainen*	No opinion *Ei osaa sanoa*	Unfair *Epäoikeuden-mukainen*	Total *Yhteensä*	
	%			%	Men *Miehiä*
20—29	61	13	26	100	46
30—39	60	8	33	100	67
40—49	51	13	36	100	55
50—59	50	18	32	100	44
60—	58	12	31	100	26
Total — *Yhteensä*	56	12	32	100	238

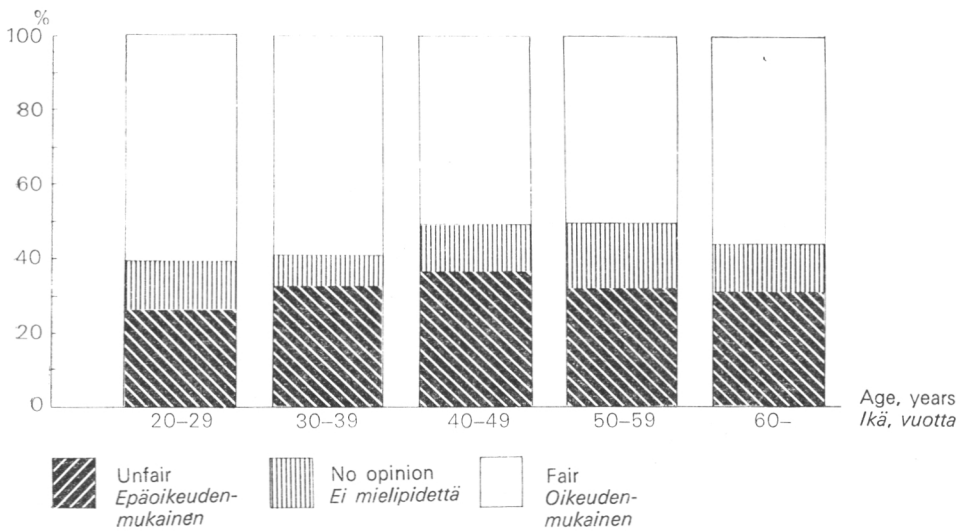


Figure 8.1 Forest workers' opinion regarding their treatment by society.
Kuva 8.1 Metsätyömiesten mielipide yhteiskunnan kohtelusta.

The categorical opinions of the landless are worth noting. They expressed their opinion regarding their treatment by society more definitely than other social classes. It is possible that worries about the inadequacy of property do not arouse in the landless dissatisfaction with the existing conditions but that they feel happy that »a worker is worth his earnings», an amount of money with which they, with modest expectations, support themselves and their families from one day to the next. Their starting point may be that

Table 8.2 Forest workers' opinion regarding their treatment by society, as a function of social group.

Taulukko 8.2 Metsätyömiesten mielipide yhteiskunnan kohtelusta yhteiskuntaryhmän funktiona.

Social group *Yhteiskuntaryhmä*		Treatment by society — *Yhteiskunnan kohtelu*				
		Fair *Oikeuden-mukainen*	No opinion *Ei osaa sanoa*	Unfair *Epäoikeuden-mukainen*	Total *Yhteensä*	
		%			%	Men *Miehiä*
Owner of farm or his family member, arable land, hectares *Tilanomistaja tai hänen perheenjäsenensä, peltoa ha*	5—	44	16	41	100	32
	2—5	51	18	31	100	45
	—2	56	13	20	100	60
Landless — *Tilattomat*		61	8	31	100	101
Total — *Yhteensä*		56	12	32	100	238

»there have been worse days», and they find that developments are now leading towards a better, more just society.

Sixty per cent of the ex-forest workers considered that society treated them justly, while 30 % found the treatment unjust. 58 % of the pensioners found that society had treated them justly, and 37 % found the treatment unjust.

The ex-forest workers have partly retained the forest worker's attitude, and partly acquired that of their new occupation. They did not seem to be bitter that »they had had to change occupation since earnings from forest work were insufficient», or happy because »they had gained access to indoor working places away from the cold and the low wages». Their attitudes to society had remained almost unchanged or perhaps become slightly more favourable. The men who in the middle of their best working years had had to accept a disability pension considered that society had treated them unjustly. Their dissatisfaction, however, was not very pronounced.

83. Suffering of injustice

»In which way do you consider that you have suffered injustice?» People who felt that society had treated them unjustly were also able to state the injustices they had suffered. Only one forest worker said: »Well, in all kinds of things — I cannot give any details». The others had one or more things in mind which were not in order for them, personally. Suffering injustices, therefore, seemed to be well organized in forest workers' minds.

Those 76 forest workers who found that society was treating them unjustly, listed a total of 93 causes of the injustices which are grouped as follows:

Causes of injustice	Number of opinions
Taxation	22
Pay	21
Unemployment	12
Treatment by authorities	7
Pensions	5
Appreciation	5
Others	21
Total	93

Taxation and pay were the worst two causes of injustice. »Taxes are the same as in business centres although benefits are smaller». »Wages could be higher.» Often the type of work is linked up with earnings: »Heavy work at low pay».

The blame for unemployment was mostly laid on society, sometimes also on the employer. An indication is given in the following plain statements: »Work has been promised but not given» and »There is no work».

Bad or partial treatment by authorities was the complaint of many forest workers. Some were of the opinion that »authorities are partial and put pressure on the poor». »I saw how a policeman shot a bird on the road, but if I report it I will run into difficulties myself.»

»I cannot see a doctor to get a pension without money, and the pension, it is too small to live on». The small pensions were considered such a bad thing that seeing a doctor or going to hospital is postponed as long as possible.

The lack of appreciation was for some forest workers a burden difficult to carry. The reply given could be unexpectedly spiteful: »Anywhere you go they say that's just another forest worker, and not worth being called a man». The same middle-aged forest worker said that appreciation had recently improved.

84. Appreciation

A study of the appreciation of occupations was carried out in Finland in the early 1960s (R a u h a l a 1966). Communal council members from six communes were asked to give their scores for 1 400 occupations in the order of appreciation. The scorers were 150 council members representing political parties proportionately to the votes the parties had assembled at the 1960 communal elections. The score of the most appreciated occupation was about

75 and that of the least appreciated about 30. The appreciation of forest workers, compared with that of certain other groups of workers, had the following appearance (R a u h a l a 1966, pp. 250—256):

Occupation	Score
Forest worker	41.7
Wood processing industry worker	41.9
Metal industry worker	47.4
Building woker	42.7
Agricultural worker	37.1

In the interview we asked: »Do people in general value forest workers very highly, highly, lowly or very lowly?» Only 1 % of the forest workers was of the opinion that the appreciation of forest workers is very high, while 6 % considered that it is very low. These extreme alternatives can therefore overlooked, and they are combined with the midmost opinion groups (Table 8.3, Fig. 8.2).

Two-thirds were of the opinion that people in general have a low appreciation of forest workers. About one-sixth of the men found no suitable reply among the four alternatives. Their replies were »cannot say» or »it is something in between» or »the right alternative is missing».

Young men were much more uncompromising than the old. Nearly four-fifths of the forest workers under 40 were of the opinion that forest workers' appreciation was low, while 10 % found that it was high. With advancing age, it seems to become more difficult to determine the appreciation level. This is probably because the central alternatives differed very much, or because the elderly men found it difficult to admit that their work had a

Table 8.3 Forest workers' opinion as to how people in general appreciate forest workers, as a function of age.

Taulukko 8.3 Metsätyömiesten mielipide siitä, miten ihmiset yleensä arvostavat metsätyömiehiä, iän funktiona.

Age, years *Ikä, vuotta*	Appreciation of forest workers — *Metsätyömiesten arvostus*				
	High *Korkea*	No opinion *Ei osaa sanoa*	Low *Matala*	Total *Yhteensä*	
	%			%	Men *Miehiä*
20—29	11	13	76	100	46
30—39	12	9	79	100	67
40—49	13	15	73	100	55
50—59	30	23	48	100	44
60—	19	35	46	100	26
Total — *Yhteensä*	16	16	68	100	238

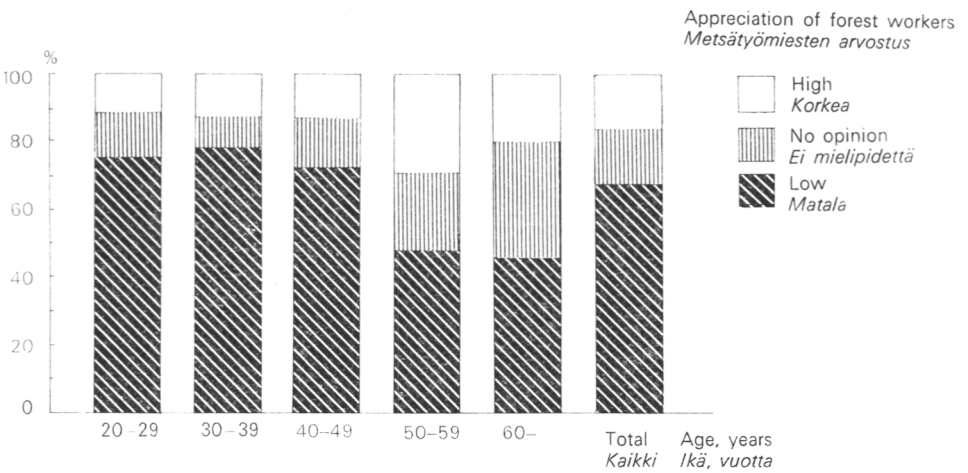


Figure 8.2 Forest workers' opinion as to how people in general appreciate forest workers.
Kuva 8.2 Metsätyömiesten mielipide siitä, miten ihmiset yleensä arvostavat metsätyömiehiä.

low appreciation, considering that throughout their lives they had been busy in an occupation not appreciated.

Farm holders and assisting family members with more than 5 ha of arable land were practically unanimous that people in general have a low appreciation to forest workers (Table 8.4). The members of this social group apparently identify themselves rather to the farm holder than the forest worker. They have some property, and can therefore manage during the worst periods of unemployment without the additional earnings they usually fetch from forest work. For an idea of the general appreciation of forest workers,

Table 8.4 Forest workers' opinion as to how people in general appreciate forest workers, as a function of social group.
Taulukko 8.4 Metsätyömiesten mielipide siitä, miten ihmiset yleensä arvostavat metsätyömiehiä yhteiskuntaryh män funktiona.

Social group *Yhteiskuntaryhmä*		Appreciation of forest workers — *Metsätyömiesten arvostus*				
		High *Korkea*	No opinion *Ei osaa sanoa*	Low *Matala*	Total *Yhteensä*	
		%			%	Men *Miehiä*
Owner of farm or his family member, arable land, hectares *Tilan omistaja tai hänen perheenjäsenensä, peltoa ha*	5—	3	6	91	100	32
	2—5	27	24	49	100	45
	—2	25	23	52	100	60
Landless — *Tilattomat*		10	12	78	100	101
Total — *Yhteensä*		16	16	68	100	238

the members of this social group may view it against their own background and think of a forest worker who is landless or has a very small farm: the appreciation of such forest workers must be low.

About 50 % of the interviewed men living on farms of less than 5 ha of arable land were of the opinion that the appreciation of forest workers was low, 25 % considered that the appreciation was high, and the remaining 25 % had no opinion. These small farmer—forest workers probably consider a forest worker a permanent worker who works throughout the year for the same employer and who perhaps is housed by the employer but has no links with land or cattle.

The work input by the landless in forest work definitely exceeds that of other social groups. They consider themselves direct forest workers. Their views of the general appreciation of forest workers are closest to the mean value of the views of all forest workers. Nearly four-fifths of the landless found that the appreciation of forest workers was low.

The ex-forest workers and pensioners held more favourable views on appreciation of forest workers' than the forest workers themselves. The ex-forest workers perhaps recalled the free working hours which they appreciated in forest work. This may have contributed to their idea of the appreciation of forest workers. The majority of the pensioners, on the other hand, were old men, and this explains their favourable attitude.

The chapter on education supplies information on forest workers' vocational training. It may be pointed out that applicants to forest work schools in 1969, 1970 and 1971 were too few to fill the training capacity. The falling numbers of trainees correlate with the forest workers' human rights, primarily appreciation or rather the lack of appreciation.

On the other hand, applicants for forest machine schools have been numerous enough. Perhaps the word »machine» has raised the appreciation so much that there is no shortage of applicants any longer.

It will be difficult in the future to find skilled manpower for forest work, unless the appreciation of forest workers is raised by better wages, better housing conditions and more effective training. In other words, forest work as occupational alternative must be made attractive enough to secure a supply of sufficient labour force of good standards.

9. EDUCATION

91. Education as a level of living component

As the national economy advances from primary production to secondary, and further to tertiary production, education becomes increasingly important in establishing social change. Education is today considered a basic factor of economic growth. In this sense, it covers all means of increasing the population's knowledge and skills, both vocational training, higher level education and scientific research. In the period 1926—1957, one-third of the economic growth in the USA was based on increase of work and capital, and two-thirds on creative intelligence and raised level of knowledge. In Sweden, three-quarters of the economic growth of the 1950s was based on a raised level of knowledge. In Finland the corresponding proportion at that time was about one-half (N i i t a m o 1962).

Education, therefore, is of decisive importance for a better level of living. The level of living and education of a given occupational or social group also are interconnected, in that those with a higher education hold better positions, both economically and socially, than the less educated. If the income level is used to measure the level of living, the difference between the educational groups is manifest. Table 9.1 gives the median incomes of certain occupational groups in Finland in 1966. The less education a person had received the lower was his income and his level of living in general. A comparable figure for forest workers' income was not available for the table. It may be estimated to lie somewhere between industrial and agricultural workers. Education gives, therefore, possibilities towards a higher level of living.

Education has a different weight as level of living component within a particular occupational group. Forest workers have the same basic education as others, having passed through the compulsory primary school. There is, additionally, organized vocational training for forest work, by which vocational skills can be increased and improved. Improved vocational skill increases future earnings, and these additional earnings can be used to repair defects in other level of living components, and thus to raise the level of living.

Table 9.1 Incomes of private individuals according to profession or occupation in 1966. Source: Tilastollinen vuosikirja 1969, table 270.

Taulukko 9.1 Yksityisten henkilöiden tulot ammatin mukaan vuonna 1966. Lähde: Tilastollinen vuosikirja 1969, taul. 270.

Profession or occupation *Ammattiryhmä*	Median income in 1966 *Mediaanitulo v. 1966*	
	Fmk *mk*	ratio *suhdeluku*
Doctors — *Lääkärit*	31 680	100
Lawyers — *Asianajajat*	24 600	78
Technical staff in industry — *Teollisuuden tekninen henkilökunta*	15 430	49
Industrial foremen — *Teollisuuden työnjohtajat*	11 290	36
Industrial workers — *Teollisuuden työntekijät*	6 170	19
Workers in agriculture and related occupations — *Maatalous sivuelinkeinoineen, työntekijät*	2 050	6

In the ranking of level of living factors according to their importance and defectiviness, forest workers placed education third. This shows that education is considered as one of the important level of living components. An analysis of the high ranking of education revealed that forest workers, when they estimated the value of education, thought of it primarily as a means of social progress towards the better paid and more appreciated occupations. The vocational training of a forest worker, however, was not considered particularly important as a level of living component. The present study, therefore, supports the view that education plays a role as level of living component from an individual's point of view expressly because education offers an access to better paid and more appreciated occupations. As level of living component for a vocational group, such as forest workers, education is so far of little importance. The reason is that a forest worker who has obtained his vocational skills in practical work reaches approximately the same level of earnings as one who has had vocational training. So far, only relatively few forest workers have had forest work instruction.

The conclusion to be drawn is, therefore, that education as level of living component is not so important for a forest worker as for the whole society and the development of its level of living. For this reason, in the ranking of the level of living factors, education was lowered from the third to the sixth place. This diminution of the value of education was based on appraisal, but probably gives an approximately correct picture of the relationship between education and the other level of living components.

The educational level is relatively easier to measure than many other level of living components. The measurement was based on the interview of forest workers, the 1966 Household Survey, and the statistics and files of the National Board of Forestry concerned with forest work and forest nachine schools and vocational training courses.

92. Forest workers' basic education

Basic education refers to the standard education imparted by primary and secondary schools, people's colleges and open universities. The purpose of this education is to furnish the subject with adequate general knowledge to enable him to obtain and use the particular skills required by his profession.

Forest workers' basic training is illustrated by Table 9.2, based on interview data autumn 1969. Forest workers are a group with homogeneous basic education. Only something like 2 % have continued school after the primary school. Some of the elderly forest workers had not been to primary school at all, or had only done a few weeks or months of an peripathetic school, mainly owing to the unorganized school conditions in the remote districts in the beginning of this century.

The interview contained no separate question on literacy but it was found that 3 men (about 1 %) were unable to read.

Table 9.2 Basic education of forest workers in 1969.
Taulukko 9.2 Metsätyömiesten peruskoulutus v. 1969.

School — *Koulu*	Forest workers — *Metsätyömiehiä*	
	men *miehiä*	%
Less thar primary school — *Vähemmän kuin kansakoulu*	40	17
Primary school — *Kansakoulu*	193	81
More than primary school — *Enemmän kuin kansakoulu*	5	2
Total — *Yhteensä*	238	100

The 1966 Household Survey supplied information on the funds used on studies and culture. The results are given in Table 9.3, which separately quotes the sums spent by forest workers and control groups on books, and on school and course fees. It should be recalled that the figures of the table apply to the whole household, which means that at least a part of the school and course fees arise from the education of other family members, e.g.

Table 9.3 Money spent on books, and on school and course fees by forest worker households and control groups in 1966. Source: The 1966 Household Survey.

Taulukko 9.3 Metsätyömiesten ja vertailuryhmien ruokakuntien kirjoihin ja koulu- ja kurssimaksuihin käyttämät varat vuonna 1966. Lähde: Vuoden 1966 kotitaloustiedustelu.

	Forest workers *Metsätyömiehet*	Wood processing industry workers *Puuteollisuuden työntekijät*	Paper industry workers *Paperiteollisuuden työntekijät*	Metal industry workers *Metalliteollisuuden työntekijät*	Building industry workers *Talonrakennusalan työntekijät*	Civil engineering workers *Maa- ja vesirakennusalan työntekijät*
	Fmk — *mk*					
Money spent on books — *Kirjoihin käytetyt varat*	22	32	66	53	20	18
School and course fees — *Koulu- ja kurssimaksut*	19	42	92	140	56	33
Total — *Yhteensä*	41	74	158	193	76	51

children. The amount of money spent by forest worker households on education and culture was distinctly smaller than that of the other groups. Industrial workers spent 2—4 times as much money on education per household as forest workers. Calculated per consumption unit, the difference was no less than 2.5 to 7-fold. This considerable difference is perhaps partly explained by the fact that rural districts failed to offer so good possibilities of participating in courses or going to school as the industrialized districts. Secondly, the forest worker households' incomes were definitely lower than those of other groups. As far as basic education and cultural awareness go, forest workers do not seem to hold so good a position as industrial workers.

93. Forest workers' vocational training

Organized vocational training of forest workers began in Finland in the 1960s. At the moment there are six forest work schools imparting instruction in the form of courses of different duration, maximum 10 months. In addition, a forest machine school operates at Hirvas, and two forest work schools provide separate forest tractor and forest improvement machine lines which train forest machine drivers. Training runs along two lines. Young workers intending to take up the occupation go through the longer courses for vocational training, while short duration courses are arranged to provide supplementary training for those already engaged in forest work. Table 9.4 presents the applicants for forest work schools in 1963—1971, and Table 9.5 the applicants for forest machine lines in 1966—1971.

Table 9.4 Applications and admissions to forest work schools, 1963—1971. Source: Forest training department of the National Board of Forestry.

Taulukko 9.4 Metsätyökouluihin hakeneet ja otetut oppilaat v. 1963—1971. Lähde: Metsähallituksen metsäopetusosasto.

Year *Vuosi*	Applications *Hakenut oppilaaksi, henkilöä*	Admissions *Otettu oppilaaksi, henkilöä*	Admissions as a percentage of applications *Otettujen %-osuus hakijoista*	Training capacity, persons *Koulutuskapasiteetti, henkilöä*
1963	114	40	35	40
1964	167	80	48	80
1965	204	80	39	80
1966	189	130	69	130
1967	238	130	55	130
1968	196	130	66	130
1969	151	110	73	135
1970	157	119	76	135
1971	184	127	69	135

Table 9.5 Applications and admissions to forest machine lines, 1966—1971. Source: Forest training department of the National Board of Forestry.

Taulukko 9.5 Metsäkonelinjoille hakeneet ja otetut oppilaat v. 1966—1971. Lähde: Metsähallituksen metsäopetusosasto.

Year *Vuosi*	Applications *Hakenut oppilaaksi, henkilöä*	Admissions *Otettu oppilaaksi, henkilöä*	Admissions as a percentage of applications *Otettujen %-osuus hakijoista*
1966	36	20	56
1967	238	71	30
1968	331	60	18
1969	331	60	18
1970	203	74	38
1971	230	67	29

Training capacity of forest work schools has slowly increased and now amounts to 135 pupils a year. Since 1969 the capacity has not been fully utilized, which is due to a reduced number of applicants. When forest work schools first started activities, only a third could be admitted, against three-quarters of the applicants in 1971. It seems that the interest of young people in forest work training is diminishing.

On the other hand, the number of applicants for the Hirvas forest machine school and for forest tractor and forest improvement machine lines has been sufficient. The capacity of the forest machine lines is fully exploited, and only one-third to one-sixth of the applicants could be admitted. This

suggests that machines and technology interest the young people more than the instruction in manual work-intensive methods given in forest work schools.

The mean age of the pupils admitted to forest work and forest machine schools could be calculated from the files of the National Board of Forestry: in 1963 it was 23 and ever since it has been 21 years annually. Hence the forest work school pupils usually have work experience of a few years' duration.

The purpose of forest work training is to impart formal instruction in forest work, to an extent enabling the pupils after school to carry out skilled work in various sectors of forestry. The aim is to train the forest worker to become a permanent year-round worker. In 1968 the National Board of Forestry tried to find out how this aim had been reached, by sending an inquiry about the placement of the men who had passed through a forest work and/or a forest machine school. The inquiry comprised 363 persons, and 317 (87 %) of them replied. The distribution of the repondents on the various sectors of work is shown in Table 9.6.

Table 9.6 Placement in 1968 of trainees from forest work and forest machine schools. Source: Forest training department of the National Board of Forestry.

Taulukko 9.6 Metsätyö- ja metsäkonekoulun käyneiden sijoittuminen vuonna 1968. Lähde: Metsähallituksen metsäopetusosasto.

Sector *Ammattiala*	Trainees from forest work schools *Metsäkoulun käyneet*	Trainees from forest machine schools *Metsäkonekoulun käyneet*	Total *Yhteensä*
	%		
Forestry — *Metsäala*	64	61	63
Other sector — *Muu ala*	16	12	16
Military Service — *Sotaväessä*	14	9	14
Unemployed — *Työttömänä*	6	18	7
Total % — *Yhteensä* %	100	100	100
persons — *henkilöitä*	284	33	317

Of the respondents 63 % worked in the forest, 16 % had changed occupation, and 7 % of the forest workers with completed vocational training were unemployed. The remainder were doing their national military service. The majority of the trained men, therefore, worked in the sector for which they had been trained. A slight movement to other occupations is probably a

characteristic feature in the changing society. But unemployment of vocationally trained forest workers does not give a very good picture of the chances provided by forest work, and this may be one of reasons why interest in forest work training has diminished.

Two-thirds of those who had passed through a forest work or forest machine school and worked in the forest were employed in work supervision and other jobs matching their training. One-third continued their studies in forest machine schools, work supervision schools and forest ranger schools. The forest work school, therefore, is a ladder to higher vocational training in forestry and to a higher level of living to a considerable number of the trainees.

The continued and supplementary instruction provided for forest workers by the National Board of Forestry has expanded greatly. This is seen from Table 9.7. At present, there are more than 100 courses arranged annually, with over 2 000 attendants. Assuming that the courses are attended only by professional forest workers (more than 100 days of forest work per year), whose total number is about 65 000, 3—5 % of the professional forest workers may be estimated to have supplementary training annually. In addition, 2 000 men receive work site instruction during a day or a day and a half. The course attendants have a mean age of 30, i.e. they are 10 years older than the pupils of the forest work schools. The emphasis of the courses is on

Table 9.7 Continued and supplementary education of forest worker and work site instruction, 1962—1971. Source: Forest training department of the National Board of Forestry.

Taulukko 9.7 Metsätyömiesten jatko- ja täydennyskoulutus ja työmaaneuvonta v. 1962—1971. Lähde: Metsähallituksen metsäopetusosasto.

Year *Vuosi*	Number of courses *Kurssien lukumäärä*	Number of pupils *Oppilasmäärä*	Days of teaching *Opetuspäiviä*	Days per pupil *Oppilaspäiviä*	Mean age of pupils, years *Oppilaiden keski-ikä, vuotta*	Work site instruction, number of pupils *Työmaaneuvonta, oppilasmäärä*
1962	2	18	44	396	—	—
1963	3	40	74	1 072	20	2 000
1964	5	127	33	768	31	2 500
1965	19	332	193	3 389	27	2 491
1966	66	1 151	770	13 285	31	2 137
1967	79	1 500	783	14 437	32	2 276
1968	74	1 459	717	13 406	34	2 194
1969	109	1 858	957	17 253	32	1 762
1970	120	2 061	1 148	19 302	..	534
1971	156	2 655	1 524	23 268	..	948

logging and forest cultivation as can be seen from the attendances of the courses arranged in 1971:

Course	Attendance
Power saw logging techniques	1 528
Forest cultivation	240
Seedling stand management	257
General course	143
Logging methods	51
Forest machine courses	295
Business economics	131
Forest machine repair courses	10
Total	2 655

The forest workers of the sample of this report were asked whether they had had vocational training and what they thought of it. The results are presented in Table 9.8 and Fig. 9.1. Of the interviewed, 74 (31 %) had attended one or more vocational courses. Irrespective of whether or not the respondent had taken part in vocational training, he was asked »Are you satisfied with your vocational training?» The purpose of the question was to find out the opinion on the training received, and also the attitude to vocational training among those who had gained then vocational skills by work alone. The interview revealed that the question was difficult to many who had had no organized vocational training. This is also visible from the table in which the pro-

Table 9.8 Forest workers' satisfaction with vocational training, as a function of participation in vocational training courses in 1969.

Taulukko 9.8 Metsätyömiesten tyytyväisyys ammattikoulutukseen käytyjen ammattikurssien määrän funktiona vuonna 1969.

Vocational training, weeks *Ammattikurssien määrä, viikkoja*	Satisfaction with vocational training *Tyytyväisyys ammattikoulutukseen*			Total *Yhteensä*	
	Satisfied *Tyytyväinen*	No opinion *Ei osaa sanoa*	Dissatisfied *Tyytymätön*		
	%			%	men *miehiä*
0	56	21	23	100	164
1—2	60	13	27	100	30
3—4	71	12	17	100	24
5—9	73	—	27	100	11
10—	56	11	33	100	9
Persons attended vocational training, total — *Ammattikursseja käyneet yhteensä*	65	11	24	100	74
Total — *Yhteensä*	59	18	23	100	238

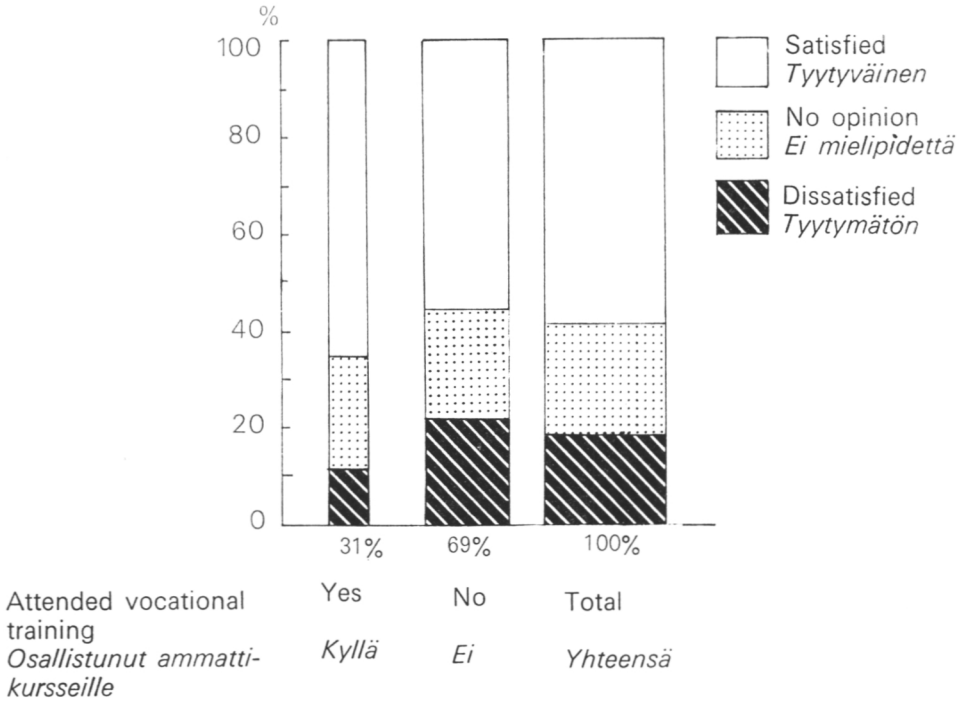


Figure 9.1 Forest workers' satisfaction with their vocational training.
Kuva 9.1 Metsätyömiesten tyytyväisyys ammattikoulutukseensa.

portion of the »no opinion» replies in this group is twice that of the group that had passed through vocational training courses. The interviewer often had to explain the question to the untrained: »Are you satisfied with the vocational skills obtained without vocational training?», which made reply easier. 56 % of those who had not attended courses answered in the affirmative, whereas 23 % found organized vocational training necessary. Also the majority (65 %) of those who had had vocational training were satisfied with it, while 25 % considered it inadequate. On the whole, the table suggests that forest workers did not consider vocational training particularly important: vocational skills are considered adequate even without training. On the other hand, training might be useful but it is often difficult to attend courses.

Table 9.9 shows the distribution of the opinions by age groups. The basis of this distribution is suggested by the last column which gives the proportion of the vocationally trained per age group. One half of the youngest age group has received vocational training. The proportion of the vocationally trained decreases towards the older age groups, and in the over-60 group only 4 % had had vocational training. The youngest age groups, however, are most dissatisfied with their training. Almost 30 % finds it unsufficient. The over-

Table 9.9 Forest workers' satisfaction with vocational training and the number of trained workers, by age groups, in 1969.

Taulukko 9.9 Metsätyömiesten tyytyväisyys ammattikoulutukseen ja koulutusta saaneiden määrä ikäryhmittäin vuonna 1969.

Age, years *Ikä, vuotta*	Satisfication with vocational training *Tyytyväisyys ammattikoulutukseen*			Total *Yhteensä*		Participation in vocational courses *Ammattikursseilla ollut*	
	Satisfied *Tyytyväinen*	No opinion *Ei osaa sanoa*	Dissatisfied *Tyytymätön*				
	%			%	men *miehiä*	men *miehiä*	%
20—29	57	15	28	100	49	23	50
30—39	57	13	30	100	67	24	36
40—49	62	13	25	100	55	16	29
50—59	68	18	14	100	44	10	23
60—	46	46	8	100	26	1	4
Total — *Yhteensä*	59	18	23	100	238	74	31

50 group thinks they have learnt all they could, and only 11 % considered their vocational training insufficient. Vocational training in fact should be given above all to forest workers under 40. They are both willing to attend courses and capable of making use of the training obtained.

94. Sufficiency of vocational training

Forest workers themselves do not as a rule consider the vocational training particularly important. This notwithstanding, there is reason to review the training also from another angle. Shortage of forest workers is already felt in some districts, and without efficient measures it is predicted that the manpower shortage will be a serious fact in the latter half of the 1970s. In order to ensure manpower supply, forest work must be debeloped into a competitive occupation. This can be done by improving the forest workers' status in various level of living factors. Education is one of the most essential factors in improving the picture of forest work as an occupation. Vocational training is presupposed by permanent work contracts of forest workers. The amount of education and appreciation of the occupation are directly proportional. An occupation needing no training is not appreciated.

According to a rough projection, the need of forest workers in Finland in 1980 will be as follows:

Labour input in forest work, days	No. of men needed
11—100	31 000
101—150	7 000
151—	26 000
Total	64 000

Vocational training is required above all by the men permanently doing over 150 days of forest work per year; their share of the total labour input is about two-thirds. In order that the age distribution of this group were smooth, a total of 8 000—10 000 new young men should enter the forest worker corps in 1967—1980. The present vocational training capacity, however, can train only about a quarter of this number, about 2 000 men. P u o s k a r i (1971) arrived at approximately the same result in his estimate.

Training by supplementary courses plays its own part in increasing the occupational skills. With the present capacity, supplementary training can be given to some 2 500 men per year. If the supplementary training goal is made realtively low, i.e. each forest worker attending training course once every five years, about 8 000 men should have been trained in 1970, and still in 1980 the need of training would amount to some 5 000 men.

Summarizing, with the present training capacity it is possible to train only a quarter of the new young workers entering the occupation, and similarly supplementary training can only be given to a quarter of those now employed in forest work. Even this can be done only provided all forest workers working less than 150 days per year in the forest, i.e. seasonal and temporary workers, are excluded from all vocational training.

Another problem is the obvious unwillingness of young people to undertake forest work. It is impossible to increase vocational training if there are no applicants for the schools. An important prerequisite for expansion of vocational training is to make the forest worker's occupation attractive and competitive among all the other occupations open for a young person who is on the point of deciding which occupation to choose.

10. RECREATION

101. Recreation and its measurement

The leisure time of forest workers can be considered to consist of the time left over after the daily working hours (including time spent on going to and from work). Leisure time might be said to begin at the end of the working hours. Leisure and recreation are closely related. Both are necessary for the maintenance of mental and physical health and working capacity. The United Nations Expert Committee recommends that leisure time and recreation be measured by obtaining descriptive material on the items of this component (International . . . 1961, p. 15). The present study has tried to observe this recommendation, and recreation has been measured by the sufficiency of leisure time, willingness to recreation, the most popular form of recreation, willingness to take part in club, organizational or association work, the most popular form of participation, and the amount of funds spent on recreation.

102. Sufficiency of leisure time

The study of the forest workers' level of earnings (H e i k i n h e i m o et al. 1973) shows that forest workers' daily working hours in January—February 1967 totalled 7.2 hours. In 1969 the forest workers spent, on the average, an additional hour and a quarter on going to and from work. The remaining hours of the day and night were leisure time. One or two days at the weekend were also free, and a number of the permanent forest workers had a paid annual holiday.

Table 10.1 shows that three-quarters of the forest workers considered the leisure time sufficient. The oldest group backed this opinion most emphatically.

The marital status clearly affected the forest workers' opinions concerning the sufficiency of their leisure time:

Table 10.1 Sufficiency of forest workers' leisure time as a function of age.
Taulukko 10.1 Metsätyömiesten vapaa-ajan riittävyys iän funktiona.

Age, years *Ikä, vuotta*	Leisure time — *Vapaa-aikaa*			Total *Yhteensä*	
	Sufficient *On riittävästi*	No opinion *Ei osaa sanoa*	Insufficient *Ei ole riittävästi*		
	%			%	Men *Miehiä*
20—29	72	—	28	100	46
30—39	81	—	19	100	67
40—49	69	—	31	100	55
50—59	80	2	18	100	44
60—.	85	4	12	100	26
Total — *Yhteensä*	76	1	23	100	238

Marital status	Not enough leisure, %
Unmarried	6
Married	33
Widowed or divorced	9
Mean	23

A third of the married forest workers found that they had too little leisure. The fact can perhaps be explained by the married men being expected, and themselves expecting, to achieve a greater labour input both in forest work and at home than the unmarried. Social pressure on the married men is stronger. Partly, this pressure may make the married men to feel that their leisure time is insufficient.

103. Desire for recreation

Forest workers' free-time interests have been studied in Sweden. The result was that about one-third had no interests, for their off duty hours had to be spent solely on rest and sleep to enable them to recover from the stress of the heavy work (B l o m q u i s t—O l o f s s o n 1960). Two-thirds of the forest workers had energy to spare in their leisure time on things other than resting. Their means of recreation consisted of various hobbies.

The question »Would you like more frequent occasions for recreation?» proved to be too vague before the interview. The hypothetic nature of the question was not clear. The question was reworded: »Would you like more frequent occasions of recreation provided you had time, money and facilities?»

Four-fifths of the forest workers would willingly accept more frequent occasions for recreation (Table 10.2, Fig. 10.1). Of those with insufficient leisure over 90 % wished more frequent occasions for recreation. The figure for those who found that they had sufficient leisure was 75 %. Insufficiency of leisure, therefore, seemed increase the desire for recreation.

Table 10.2 Forest workers' enthusiasm for recreation, as a function of the sufficiency of leisure time.

Taulukko 10.2 Metsätyömiesten virkistäytymishalukkuus vapaa-ajan riittävyyden funktiona.

Leisure time *Vapaa-aikaa*	Desired more frequent recreation *Haluaa käydä useammin virkistäytymässä*		Total *Yhteensä*	
	Yes *Kyllä*	No *Ei*		
	%		%	Men *Miehiä*
Sufficient — *Riittävästi*	75	25	100	182
Insufficient — *Ei ole riittävästi*	91	9	100	54
Total — *Yhteensä*	79	21	100	236

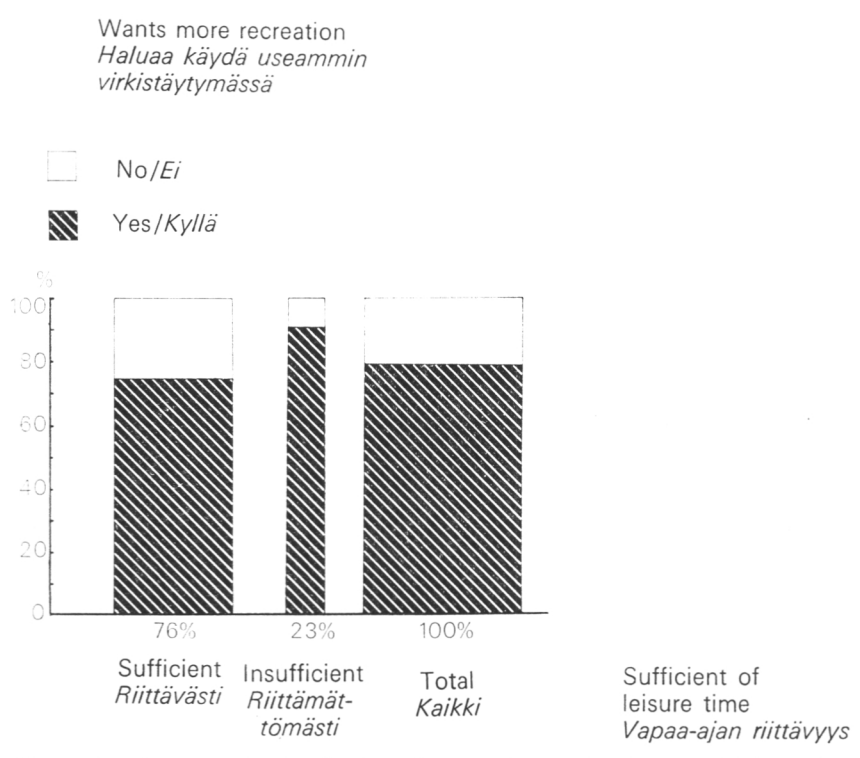


Figure 10.1 Forest workers' enthusiasm for recreation and sufficiency of leisure time.

Kuva 10.1 Metsätyömiesten virkistäytymishalukkuus ja vapaa-ajan riittävyys.

The material aspect of recreation can be approached from the basis of the consumption expenses of the 1966 Household Survey. The sums spent annually by households on education, amusements and recreation were:

	Fmk
forest workers	403
wood processing industry workers	564
metal industry workers	910

The wood processing industry workers' and metal industry workers' households spent 40—126 % more money on education, amusements and recreation than the forest worker households. Calculated per consumer unit the expenses of these control groups were 2—3 times those of the forest workers. There are two reasons: the forest workers' incomes are smaller, and in the countryside the recreational facilities are not so readily available as in centres of population.

After this review of the material facilities for recreation, we may survey the correlations of the willingness to recreation with marital status, general physical condition, location of the dwelling, and the region of the country.

The relationship between desire for recreation and marital status was:

Marital status	Wishes more frequent recreation, %
Unmarried	74
Married	82
Widow or divorced	64
Total	79

As stated previously, the married forest workers found that they were short of leisure time. It was also noted that shortage of leisure increases the desire for recreation. Even now the married men, more than those of any other marital status, wished extended possibilities of recreation.

The forest workers' opinions of their own general physical condition were divided by the question into five categories: good, fairly good, cannot say, fairly poor, and poor. A review of the correlations between desire for recreation and physical consition reveals distinct differences between the extreme alternatives. About 90 % of the men who considered their physical condition good wished to have more occasions for recreation, against 64 % among the men who found their physical condition poor.

The location of the dwelling affected the desire for recreation. The forest workers who found that they lived too far from a centre of population wished to have occasion for recreation 5 % more often than the average, whereas those who found that they lived at a suitable distance from a centre of

population, wished to have occasion for recreation 5 % less often than the average.

The distribution of desire for recreation between the regions of the country was the following:

Region	Wishes more frequent recreation, %
South Finland	63
Central and East Finland	88
South and Central Ostrobothnia	100
North Finland	74
Total	79

In South Finland the desire for recreation was definitely lowest, probably because the distances to service centres are smaller and the need for recreation to a higher degree satisfied than elsewhere in the country.

Those who wished more frequent occasions for recreation were asked what kind of recreation they desired. The score gained by the most popular form of recreation was multiplied by two and that of the second most popular by one, and by adding those a weighted ranking was obtained.

Form of recreation	% of opinions
Fishing	34
Hunting	19
Restaurant	12
Cinema	10
Sports championships	9
Dance and soirées	8
Theatre	4
Other	3
Total	100

As already mentioned, 76 % of the forest workers considered the amount of their leisure time sufficient and 80 % would have liked more frequent opportunities for recreation. Why do they not go hunting and fishing more often, when more than half report that that is what they want? The explanation is the heavy work. Many of the interviewed said: »After a day's work I only want to eat and sleep. Work takes all my energy».

Theatre visits as the most or second most desired form of recreation fetched only 4 % of the forest workers' opinions. This is largely because many a forest workers had never been to a place where there would have been a theatre. When the forest workers examined in Helsinki were offered a choice, during their visit, of going to theatre or accepting 10 mk money, about 20 % chose the theatre. »Let's go and see something we've never seen» was the motivation many of them gave.

The alternative other forms of recreation fetched 3 % of the men's opinions. Six of these would have liked to travel or to hike, one to view the TV, one to swim and one to go to concerts.

104. Desire to take part in club, organizational or association work

»Would you like to take more part in club, organizational or association activities?» These activities did not attract the forest workers so much as those of their leisure time hobbies that were associated with nature.

Table 10.3 shows that two-fifths of the forest workers would have liked to take more part in association work. The low rate might be due to their lack of interest. A few men said: »I belong to the hunting club and that's enough». Some individual forest workers took active part in trades union work, and one was communal council member for the second 4-year period.

Table 10.3 Forest workers' willingness to participate more in clubs, and organized social activities, as a function of age.
Taulukko 10.3 Metsätyömiesten halukkuus osallistua enemmän kerho-, järjestö- tai yhdistystoimintaan iänfunktiona.

Age, years *Ikä vuotta*	Wishes to participate more in clubs, and organized social activities *Haluaa osallistua enemmän kerho-, järjestö- tai yhdistystoimintaan*			Total *Yhteensä*	
	Yes *Kyllä*	No opinion *Ei osaa sanoa*	No *Ei*		
	%			%	Men *Miehiä*
20—29	37	—	63	100	46
30—39	58	3	39	100	67
40—49	31	5	64	100	55
50—59	27	5	68	100	44
60—	39	4	58	100	26
Total — *Yhteensä*	40	3	57	100	238

It seems that 30—39 year old forest workers are the most active. In addition to the greatest willingness to more recreation, their interest in taking more part in club, organizational or association work was keener than among the other age groups.

The forest workers who had reported willingness to take more part in club, organizational and association work were asked to specify the activity they desired. When the score for the most popular activity were multiplied by two and those of the second most popular by one, a weighted ranking was obtained.

Club, organizational or association work	% of opinions
Trades union	30
Hunting club	28
Sports club	24
Youth club	7
Political party	6
Congregational work	3
Other activity	2
Total	100

Forest workers were most interested in trades unions and hunting clubs. It is intriguing to note the interest in trades union work, since only about a quarter of the forest workers are organized to date. Raising the degree of organization would strengthen the forest workers' position in the labour market. Political and congregational work rarely ranked first. In the »other activity» group, one of the men would have liked to take part in chess club and philatelist club work, another to join a fishing club and yet another just club activity that he could not define.

Among ex-forest workers the desire to take more part in club, organizational or association work was slightly less pronounced than among the forest workers, but the role of trades unions also emerged emphatically from the ex-forest workers' opinions.

105. Recreation compared with other level of living components

Recreation ranked seventh among the level of living components. Only clothing and nutrition were considered less important. However, four-fifths of the forest workers would like to have more frequent occasions for recreation, and two-fifths would like to take more part in club, organizational or association activities. This shows that forest workers' recreation has shortcomings which, however, are less important than those affecting health, housing, and working conditions.

Recreation has no particularly close ties with other level of living components, but is more or less connected with almost all of them. Monetary compensation for work is somehow involved in almost all recreation, for recreation is largely consumption. Recreation needs health, for a healthy person is better capable of recreation than a sick one. The location of the dwelling affects decisively the use of many recreational services. Recreation often makes demands on clothing. A hungry person usually satisfies his physical hunger first and puts his mental or spiritual recreation second.

Leisure time and recreation are compensations for work. Their purpose is to keep the individual mentally and physically capable of work. Some

forest workers find their work so heavy that their leisure time is almost exclusively spent on recovering from the stress of work, on rest and sleep.

Every attempt at repairing the shortcomings in forest workers' leisure time and recreation should pay attention to factors that indirectly increase the facilities of recreation. Best results will probably be obtained by facilitating forest work with the result that less rest is required for recovery from the stress of work, by improving the pay which leaves more money to be spent on recreation, and by building dwellings in centres of population which brings modern cultural services within an easy reach for forest workers.

11. CLOTHING

111. Clothing as level of living component

Forest workers' clothing has recently begun to interest employers, authorities and clothes producers. The result was a report by Forest Work Clothing Committee (Komiteanmietintö 1969: B 6), an inquiry into forest work clothing by the committee for Work Safety in Agriculture and Forestry (Metsä- ja maatalouden . . . 1971), and model clothes produced by several manufacturers. It is difficult to estimate the source of this relatively sudden interest. Apparently the transformation of forest work into a vocation for permanent workers and the employers' efforts to emphasize this vocational character of the work have contributed to the increased interest. The manufacturer who was the first to start had, by the spring of 1971, sold more than 10 000 sets of forest work clothing to employers and individual forest workers. Four of five other manufacturers were also ready to enter the market.

To date most forest workers have worn as working clothes rough woollen clothing or old clothes that earlier had been worm for other purposes, such as terylene trousers, pullovers, etc. There is no detailed information of the type of clothing worn earlier and worn now. In any case, the selection is most varied and justifies the assumption that many garments are unhealthy and impractical for the worker.

Against the background of the overall level of living, however, the role of clothing is relatively small. Clothing ranked last but one among the level of living components. Only nutrition was considered even less important. The forest workers' life problems are mainly elsewhere. The interview, however, brought forth deficiencies of clothing which deserve attention. They are worth especially because they are relatively easy to put right, perhaps easier than many deficiences related to the other level of living components.

In the interview, clothing was measured by requesting the forest workers' opinions concerning their clothing and the improvements they desired. In addition to the interview data, the 1966 Household Survey provides information on forest workers' clothing, especially the money spent on it. Information is also available from the committee reports mentioned above.

112. Forest workers' working clothes

The forest workers were simply asked at the interview: »Have you got enough suitable clothes?» The question was not limited to working clothes alone. The distribution of the replies is shown in Table 11.1. Of the respondents 35 % considered that they did not have enough suitable clothes. Two-thirds were satisfied with the amount and quality of their clothing. The rate of dissatisfaction was higher in age groups 40—49 and 50—59 than in the others. This is perhaps because illnesses begin to affect forest workers of this age, and the importance of warm and practical clothing acquires added emphasis.

Table 11.1 Forest workers' opinion regarding their clothing, as a function of age.
Taulukko 11.1 Metsätyömiesten mielipide vaatetuksesta iän funktiona.

Age, years *Ikä, vuotta*	Opinion regarding clothing — *Mielipide vaatetuksesta*				
	Clothing is sufficient *On riittävästi*	No opinion *Ei osaa sanoa*	Clothing is insufficient *Ei ole riittävästi*	Total *Yhteensä*	
	%			%	persons *henkilöä*
20—29	65	2	33	100	46
30—39	69	1	30	100	67
40—49	58	2	40	100	55
50—59	59	—	41	100	44
60—	69	4	27	100	26
Total — *Yhteensä*	64	1	35	100	238

Those who according to their reply did not have enough good clothing were requested to specify those clothes which they considered lacking. Table 11.2 gives a rough classification of these shortages. Some of the 83 who wished improvements of clothing made several suggestions, and therefore the table carries a total of 109 items.

A considerable number of the complaints were concerned with working clothes, especially winter clothing. Several wishes were expressed: the clothes should be warm, light-weight, water-tight, durable and permeable to sweat. A frequent statement was, »suitable working clothes do not exist at all.» This apparently is true, at least partly, since some workers who had test-worn the current forest work clothes considered them relatively clumsy and

Table 11.2 Clothing deficiencies of forest workers.
Taulukko 11.2 Vaatteita, joita metsätyömiehiltä puuttui.

	Deficiencies *Puutteita, kpl*	%
Working clothes — *työvaatteita*	32	29
Warm winter clothes — *Lämpimiä talvivaatteita*	20	18
Rain clothes — *Sadevaatteita*	19	17
Better clothes for leisure — *Vapaa-ajan parempia vaatteita*	21	19
Clothes for formal occasions — *Juhlavaatteita*	17	16
Total — *Yhteensä*	109	100

rather poor in quality. The ordinary set of forest work clothes, with the necessary additional equipment (helmet, hearing, gloves, boots, etc.) costs mk 250—300, and the intermediate set that has been found extremely useful, another mk 100—150. Viewed against the forest worker's earnings these sums are considerable, an opinion expressed by many in the interview: »The employer should pay for the working clothes». As labour force becomes more permanent and the manpower supply is reduced, working clothes may make a benefit with which the employers can try to increase the competitive position of forest work compared with other occupations.

The Forest Work Clothing Committee also states that it is difficult to design any clothing suited to the varying conditions of forest work (Komiteanmietintö 1969: B 6, p. 21). In the winter especially, the alternation of muscular work and rest, always in the open air, produces thermal adjustment problems. The worker should not be too hot while working, nor should he be cold while resting. The principles recommended by the Committee to solve this problem are conduction of heat, air currents within the clothes, and regulation of the number of clothing layers. According to the Committee close cooperation of specialists in these problems is required, for a durable solution of clothing problems.

The Committee for Work Safety in Forestry and Agriculture carried out an inquiry in 1970 to find out the forest workers' wishes regarding working clothes. The inquiry covered forest workers and pupils of forest work schools. Detailed considerations were obtained, as a result of the inquiry, concerning the quality of the material, location of pockets, boots and gloves, and personal protective devices. Concerning the general properties of the clothes, the wishes were much the same as in the present interview. Many men also said that a good set of clothing is so expensive that the employer should share the purchase costs.

113. Other clothes

The information available on forest workers' clothes other than the working clothes is not very detailed. Table 11.2 shows that 38 forest workers (16 %) considered they did not have suitable clothes for leisure time or festival occasions. They had in mind either a dark suit or blazer and trousers, and shoes. Someone pointed out that forest work wages did not permit keeping up with fashions. On the whole, however, forest workers' other clothes were not so defective as their working clothes.

The material of the 1966 Household Survey also contained information on the money spent by households on clothing, quoted in Table 11.3.

Table 11.3 Money spent on clothing and shoes by forest worker households and households of workers in the wood processing and metal industries in 1966. Source: The 1966 Household Survey.

Taulukko 11.3 Metsätyöntekijäruokakuntien ja puu- ja metallityöntekijäruokakuntien vaatetukseen ja jalkineisiin käyttämät varat vuonna 1966. Lähde: Vuoden 1966 kotitaloustiedustelu.

Type of clothing *Vaatteen laatu*	Forest workers *Metsätyöntekijät*			Wood processing industry workers *Puuteollisuuden työntekijät*			Metal industry workers *Metalliteollisuuden työntekijät*		
	Fmk per household *Ruokakuntaa kohti, mk*	Per consumption unit *Kulutusyksikköä kohti*		Fmk per household *Ruokakuntaa kohti, mk*	Per consumption unit *Kulutusyksikköä kohti*		Fmk per household *Ruokakuntaa kohti, mk*	Per consumption unit *Kulutusyksikköä kohti*	
		Fmk *mk*	ratio *suhdeluku*		Fmk *mk*	ratio *suhdeluku*		Fmk *mk*	ratio *suhdeluku*
Men's overclothes — *Miesten päällysvaatteet*	210	50	100	209	67	134	206	74	148
Women's overclothes — *Naisten päällysvaatteet*	123	29	100	181	58	200	271	97	334
Children's clothes — *Pikkulasten puvut*	3	1	100	3	1	(100)	12	4	(400)
Men's underwear — *Miesten alusvaatteet*	62	15	100	97	31	207	102	36	240
Women's underwear — *Naisten alusvaatteet*	69	16	100	88	28	175	118	42	262
Children's underwear — *Pikkulasten alusvaatteet*	9	2	100	4	1	(50)	9	3	(150)
Other clothing articles — *Sekalaiset asusteet*	67	16	100	77	25	156	70	25	156
Fabrics, yarns — *Kankaat, langat*	96	23	100	98	28	139	86	31	135
Repair of clothes — *Vaatteiden korjaus*	—	—	—	—	—	—	3	1	—
Clothing, total — *Vaatetus yhteensä*	641	153	100	757	244	159	877	313	204
Footwear, total — *Jalkineet yhteensä*	215	51	100	155	50	98	184	66	129
Clothes and shoes, total — *Vaatetus ja jalkineet yhteensä*	856	204	100	913	294	144	1 063	380	186

The households of wood processing and metal workers spent 7—24 % more money, per household, on clothing and footwear than forest worker households. The latter comprised an average of 4.2 consumption units and the former 3.1 and 2.8, respectively. Per consumption unit, therefore, the industrial workers' clothing expenses exceeded those of forest workers by no less than 44—86 %. Industrial workers spent more money especially on women's outer garments and on men's and women's underwear. Forest worker households spent more money than industrial workers on footwear. These differences probably emphasize the urban-rural difference. In population centres fashions must be observed, whereas natural conditions in the countryside at large and in forest work particularly require sturdy and more practical footwear.

In the light of consumption figures, forest worker households lag behind the industrial workers in clothing standards. On the other hand, expectations are not so high concerning clothing in the rural areas as in the urban areas. This was evident from the forest workers' interview, since relatively few recorded deficiencies in other than working clothes.

All attempts to improve the forest workers' position must pay attention to the working clothes. It seems that since several manufactures have now presented their model clothes for forest work, a serviceable set of working clothes will probably soon be compiled. But the question of who is going to pay the cost of these clothes, which in forest workers' opinion are relatively expensive, will have to wait for a solution. Some employers have experimentally obtained such sets of clothes for their permanently employed forest workers. The employer's participation in the cost of purchasing the working clothes would doubtless contribute towards a rapid spread of the clothes among forest workers.

12. NUTRITION

121. Nutrition as level of living component

Nutrition has traditionally been one of the important areas studied by level of living researchers. Consumption level has been used to measure the level of living, and nutrition is responsible for a large proportion of consumption. Engel observed that the poorer a family the larger the proportion of its expenses spent on food. On this basis, he found the proportion of food of total consumption the best index of the level of living. The United Nations Expert Committee (International . . . 1961) also recommends that the proportional share of food expenses in total consumption be used as a general indicator of the level of living. Nutrition therefore has a special role, different from the other components, in the level of living entity.

In the ranking of the level of living components, however, nutrition took the last place. This shows that forest workers do not find nutrition a particular problem in their lives. It is a satisfied need, or at least one satisfied to a higher degree than the other level of living components.

Some factors emphasizing the importance of nutrition should, however, be noted. Firstly, health and nutrition are interconnected: varied and adequate food is a basic condition of good health. Secondly, forest work is considerably heavier than most industrial occupations. Energy consumption in industrial work varies within a range of 4—9 kcal/min (K a r v o n e n 1970); in rather light logging it amounts to some 9 kcal/min, and in the heaviest phases of work, i.e. carrying or skidding a log, it may rise to 12—20 kcal/min (L e v a n t o 1970, R ö n n h o l m et al. 1963). High energy consumption of course requires a large amount of food. The role of nutrition in forest workers' life should therefore not be underrated, although they themselves do not consider it very important.

Nutrition was measured in the present study by interviewing forest workers. No effort was made to find out what the men ate daily. The main purpose was to find out the men's opinions on their nutrition and whether they considered their daily diets deficient in any respects.

The 1966 Households Survey was also available. It provided detailed information on the money spent on food by the forest worker households and those of the control groups.

122. Forest workers' nutrition

Forest worker households spent 40 % of their consumption expenses on food, against only 30 % for the metal industry worker households. As a result, forest workers had less money in hand than the metal industry workers with which to satisfy other needs. The forest workers' level of living was definitely lower than that of the metal industry workers.

The food expenses of forest worker and control group households, according to the 1966 Household Survey, were:

	Per household, Fmk	Per consumption unit, Fmk
Forest workers	3 750	890
Wood processing industry workers	3 310	1 070
Metal industry workers	3 530	1 260

The forest worker households as a whole spent more money on food than the control groups, but calculated per consumption unit the forest workers' food expenses were smaller. If forest workers' food expenses per consumption unit are indexed as 100, those of wood processing industry workers were 120 and metal workers 141.

The Household Survey recorded the sum of money spent on food, which is not necessarily proportional to the amount and standard of the food. These figures, therefore, are not the best possible indicators of the nutritional level. Bearing in mind the physical strain of forest work, it may be said with a fair degree of certainty that the forest workers' nutritional level is not so good as that of industrial workers. The same is suggested by the observation in Chapter 4, according to which only about 3 % of the forest workers studied, on the basis of the relative weight index, were definitely obese.

Almost 85 % of the interviewed considered their food tasty and almost 90 % found it nourishing, as can be seen from the following:

Opinion on food	% of the interviewed
Tasty	84
No opinion	8
Tasteless	8
Total	100
Nourishing	89
No opinion	3
Poorly nourishing	8
Total	100

Thirteen % of the interviewed considered their food deficient either in taste or nutritional value. The next question was, briefly, »Would you wish for improvements in your food?» The distribution of the replies was:

	% of the interviewed
Yes	37
No opinion	2
No	61
Total	100

Although only about 13 % found the food tasteless or poorly nourishing, more than one-third of the interviewed wished improvements. In most cases, the food could be more varied, and as a result, more tasty and nourishing. It seems as if the respondents had not been fully logical in their replies. However, it is more probable that the difference arose from differing forms of the questions. The first questions were intended to find out whether the respondents were satisfied or dissatisfied with their food. The next question was made to find out whether the respondent wished improvements in his food. It is evident that the dissatisfied wished improvements, but the satisfied may just as well have had some desirable improvements in mind. The opinion »food is tasty» does not exclude the possibility that it could be tastier still.

The desired improvements, approximately classified, were the following:

	Number of desires
Better, more varied food	33
More fruit and vegetables	21
More meat	19
Hot meals in the forest, or cooks at the camps	10
Cheaper prices	6
Total	89

The majority of the replies were generally held. It was, however, difficult for the respondents to say immediately how their diet could be improved. A few wishes were shared by many of the interviewed, the most important improvements being more meat and more fruit and vegetables. The desire for »cheaper prices» was particularly aimed at meat. Furthermore, the desire for »hot meals in the forest» is worth noting. In the winter especially, meals on the working site are often deficient owing to the severe conditions; just drinking coffee and eating frozen sandwiches. »In the summer food goes bad and in the winter it freezes», was one of the comments.

The National Board of Forestry and forest companies have made efforts to facilitate meals by introducing transportable »mess-rooms» in which men

during working hours can warm themselves and eat the food they have brought with them. This does not abolish the need of warm, freshly cooked meals. There are on sale various thermos containers in which to keep soups etc. warm, but their popularity is reduced by their unsuitable sizes and perhaps their high prices. In addition, the taste of food suffers during several hours of storage. The problem of a hot meal awaits a solution.

The 1966 Household Survey provided detailed information on money spent on food items by forest worker and control group households. As can be seen from Table 12.1 and Fig. 12.1, forest workers spent more money only on butter and sugar and less money on all other foods than the industrial worker households. The difference was particularly great in money spent on vegetables and greens, fats other than butter, and on eggs. This comparison

Table 12.1 Money spent on food by forest worker households and households of workers in the wood processing and metal industries in 1966. Source: The 1966 Household Survey.

Taulukko 12.1 Metsätyöntekijäruokakuntien ja puu- ja metallityöntekijäruokakuntien ravintoon käyttämät varat vuonna 1966. Lähde: Vuoden 1966 kotitaloustiedustelu.

Article of food *Ravintoaine*	Household — *Ruokakunta*								
	Forest workers *Metsätyöntekijät*			Wood processing industry workers *Puuteollisuuden työntekijät*			Metal industry workers *Metalliteollisuuden työntekijät*		
	Fmk per household *Ruokakuntaa kohti, mk*	Per consumption unit *Kulutusyksikköä kohti*		Fmk per household *Ruokakuntaa kohti, mk*	Per consumption unit *Kulutusyksikköä kohti*		Fmk per household *Ruokakuntaa kohti, mk*	Per consumption unit *Kulutusyksikköä kohti*	
		Fmk *mk*	ratio *suhdeluku*		Fmk *mk*	ratio *suhdeluku*		Fmk *mk*	ratio *suhdeluku*
Cereals — *Viljatuotteet*	590	140	100	620	200	143	570	204	146
Meat products — *Lihatuotteet*	695	165	100	700	226	137	750	268	162
Fish — *Kala*	100	24	100	80	26	108	85	30	125
Milk, cheese — *Maito, juusto*	745	177	100	625	202	114	590	211	119
Eggs — *Munat*	75	18	100	95	31	172	95	34	189
Butter — *Voi*	535	127	100	340	110	87	310	111	87
Other fats — *Muut rasvat*	35	8	100	90	29	362	45	16	200
Fruit, berries — *Hedelmät, marjat*	200	48	100	160	52	108	265	95	198
Potato products — *Perunatuotteet*	90	21	100	75	24	114	60	21	100
Roots, vegetables — *Juurikasvit, vihannekset*	60	14	100	90	29	207	140	50	357
Sugar — Sokeri	230	55	100	155	50	91	110	39	71
Sugar products — *Sokerivalmisteet*	130	31	100	110	35	113	120	43	139
Other foods — *Muut ruoka-aineet*	35	8	100	35	11	138	35	12	150
Restaurants, free meals — *Ravintolakäynnit, vapaat ateriat*	230	55	100	125	40	73	355	127	231
Total — *Yhteensä*	3 750	893	100	3 310	1 068	120	3 530	1 261	141

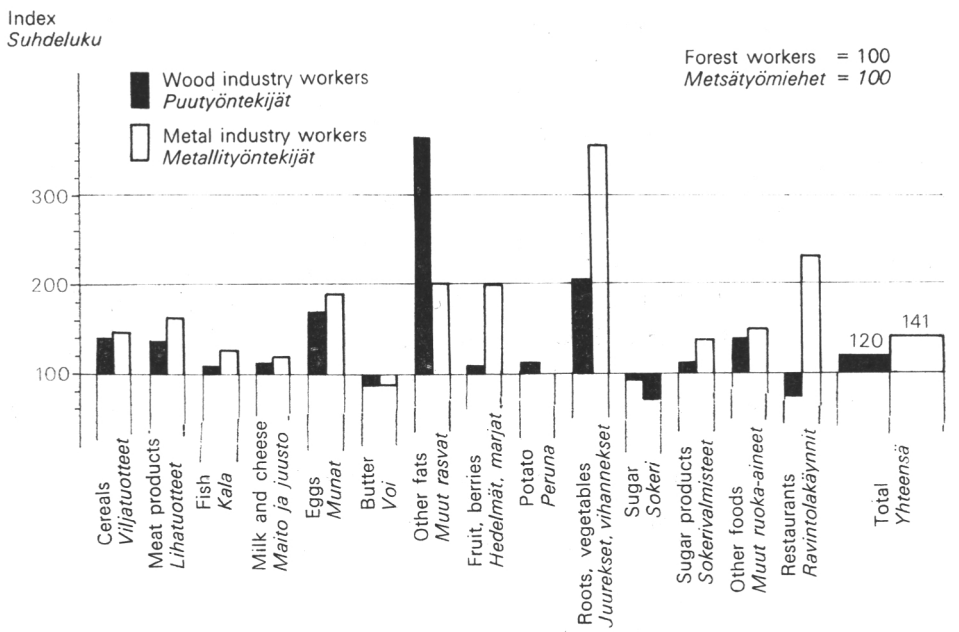


Figure 12.1 Money spent on food per consumption unit in 1966. A comparison of forest worker households with control groups.

Kuva 12.1 Ravintoon kulutusyksikköä kohti käytetyt varat vuonna 1966. Metsätyöntekijäruokakuntien vertailu eräisiin toisiin ryhmiin.

may give a too unfavourable impression of the forest worker's nutrition, since two-thirds lived on farms, and some of the farm products used as food for the family may have remained unrecorded in the bookkeeping. Such an amount is impossible to estimate.

DISCUSSION

The main contents of this study were published in Finnish in autumn 1972 in a book titled »Suomalainen metsätyömies» (H e i k i n h e i m o et. al. 1972). Since its publication we have received some criticisms, particularly concerning the health of forest workers. The basis for this criticism has been other health examinations carried out by the National Board of Forestry and some forest companies. According to those studies the health of forest workers is remarkably better than the health of our sample. The conclusion has been made that our study gives a poor picture of reality.

We do not agree with this conclusion. Our critics have not realized that these studies represent different populations. The National Board of Forestry has examined its permanent forest workers and companies have examined only their employees, many of whom have permanent work contracts or are short time seasonal workers. Permanent workers represent the best quality of workers, whereas our sample was drawn to represent the whole population of professional forest workers in Finland. So far about one tenth or, perhaps, one fifth at most of the professional forest workers have permanent contracts with their employers. So it is erroneous to claim that permanent forest workers represent the »correct» picture of the state of health of this professional group. It may be correct when we are talking about permanent forest workers, but immediately, when we begin to talk about the whole professional group, we have to take into consideration also other than permanent workers. In this study we especially deal with all persons whose main livelihood is by working in the forests. The data do not contain seasonal forest workers or even professional forest workers, who had worked in the forests for less than four years during the 1960s. It is probable that most of the men examined in our health study had been doing paid forest work for at least 100 days every year between 1961 and 1969.

Such a choice of data resulted from the principle, adopted earlier that when studying the effects of forest work on the workers and then earnings, the data have to be restricted to those workers who have been influenced most by the special character of forest work. This means that when measuring the level of earnings, the measurements have to be confined to those workers who have been professional forest workers so long that they have achieved

good professional skill and routin of work. Similarly, when studying the effects of forest work on workers' health, it is important to choose the data in such a way that it is possible to check, over a period of years, the slowly developing effects of work on health. This is necessary in order to be able to prevent in advance the harmful effects of work which is the main aim of Finland's national health policy.

If a comparison is made between the results of this study and other studies made by state and forest companies — taking into account only those men who have been engaged in forest work for several years — it can be seen that the frequencies of the vibration disease and changes in hearing are similar. In other words, most men who have used a power-saw for several years suffer from these symptoms.

Data for this study were gathered in 1969. The structure of the body of forest workers has been changing continuously. The development of the power saw and new logging methods altered the structure of the professional body of forest workers during the 1960s, with a marked reduction in seasonal forest workers. It may be that these developments reached their peak between 1970 and 1972, after the data for this present study were gathered. During these years the number of loggers decreased by about 15 000, or about 20—25 % of the total number of the whole profession. Consequently it may not be very long before current developments reduce the relevance of the results of this study for the purpose of planning forest labour policy in Finland.

We consider, however, that the value of this study does not only lie on the actual quantitative material collected. As far as we know, this is one of the first attempts at describing the whole life situation of a professional group. This study has strengthened our view that succesful forest labour policy can no longer be based on wages alone, but that all aspects of the level of living have to be taken into consideration. We believe that this must be the basis of the future forest labour policy both in Finland and, perhaps, elsewhere.

SUMMARY

The concept of level of living has been studied by a great number of scientists. From the vast number of definitions for the level of living that of the United Nations Expert Committee was chosen. This divided level of living into components (Chapter 2).

A random sample of 268 forest workers was interviewed and examined in Helsinki in autumn 1969 (Chapter 3).

The health study revealed that cardiovascular diseases, the most dangerous national diseases in Finland, were common among forest workers. One in every four was affected by coronary heart disease. Forest workers smoke a lot and many had high blood cholesterol levels. All study results clearly indicate the influence of advancing age, which increased the disease rate and marred the capacity to work. Chronic bronchitis was common. Gastrointestinal tract symptoms indicated functional disorders of the stomach and the large intestine. Aches of the lumbar and sacroliac spine were common. Over two-thirds had finger symptoms relating to »vibration disease». Two out of every three users of the power saw showed impairment of hearing due to noise. Forest work is extremely prone to accidents. It is evident that these men, in addition to their tiring work, are more exposed to psychic and social stresses due to their working and living conditions than many other groups in Finnish society (Chapter 4).

Forest workers' housing has improved remarkably since the 1950s. Living density has fallen, the amount of domestic effects has increased, and with the increased amount of motor vehicles it is possible for forest workers' to spend their free time at home. About 80 % of forest workers owned their residences (Chapter 5).

Working conditions are fundamental components of welfare. Low pay, heaviness and unhealthiness of work were considered as the worst shortcomings of forest work. More than half of the forest workers interviewed had been unemployed for an average of over sixty working days during the first ten months of 1969. The average time for travelling to and from work was an hour and a quarter. Independence was considered as the most positive feature of forest work. About two thirds of the interviewed were satisfied

with their occupation. Sixty per cent however, would have wanted to change occupation if a suitable opportunity had existed (Chapter 6).

Earnings and income are a basic factor of economic security. Because of unemployment annual income of forest workers remained smaller than that of industrial workers during the 1960s. Property, savings and insurances had only a minor role in forest workers economic security. Rural workers' Unemployment Fund and Forest Workers' Pension Fund, subsidized by the employers and the State, gave important, although still insufficient, increases to economic security. Forest work is an accident prone occupation. There is much to be done to develop safer and healthier working methods (Chapter 7).

More than 50 per cent of forest workers considered that society treated them justly. Taxation and wages were meant as the main reasons for unjust treatment. Two thirds of forest workers considered that people in general appreciated them poorly or very poorly (Chapter 8).

Forest workers considered education as quite unimportant for them. They had all gone to primary school, one third of them had attended vocational training. The changing methods of forest work increase demand for vocational training (Chapter 9).

Three quarters of forest workers considered their leisure time sufficient. The same amount wanted to have more possibilities for recreation. Organisational activities did not, in general, arise forest workers' interest (Chapter 10).

So far, forest workers have used whatever clothes they have found practical. One third of the interviewed thought that their clothes were unsuitable. Many special work clothes have been developed, but their relatively high price has been the reason for their slow adoption by forest workers (Chapter 11).

Food is one of the basic elements of health, especially when work is heavy. Forest workers did not consider they had any major deficiencies in their nutrition. Two improvements were desired: their diet might be more varied, and in-the-forest facilities for warm lunches should be developed (Chapter 12).

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METSÄTYÖMIESTEN ELINTASO

Tiivistelmä

Tämä on viimeinen osa niistä metsätyövoimaan kohdistuneista tutkimuksista, jotka aloitettiin Eduskunnan aloitteesta Metsäntutkimuslaitoksessa kymmenisen vuotta sitten. Tähän mennessä on julkaistu seuraavat raportit: Metsätyömiesten ansiotaso (Lauri Heikinheimo 1963, Folia Forestalia 1), Earnings of forest workers in Scandinavia, especially in Finland (Lauri Heikinheimo, Matti Heikinheimo, Aarne Reunala, 1973, Folia Forestalia 175) ja Suomalainen metsätyömies (Lauri Heikinheimo, Matti Heikinheimo, Martti Lehtinen ja Aarne Reunala, 1972, WSOY), Lisäksi on julkaistu joukko artikkeleita ja pidetty lukuisia näihin tutkimuksiin pohjautuvia suullisia esityksiä. Tämä julkaisu on rakenteeltaan samantapainen kuin »Suomalainen metsätyömies»-kirja. Oleellisin ero on siinä, että tämä englanninkielinen esitys on tarkoitettu koti- ja ulkomaisille työvoimaongelmista kiinnostuneille tutkijoille. Niinpä elintaso-käsitteen teoreettinen tarkastelu on perusteellinen ja ehkä raskas, ja taulukkoaineisto on yksityiskohtaisempi kuin suomenkielisessä julkaisussa. Muita ennen julkaisemattomia tuloksia tässä ei esitetä. Tällaisen julkaisun tarve tuli korostetusti esille ILO:n metsätyötä käsitelleessä kokouksessa keväällä 1973 Genevessä, jossa osoitettiin suurta kiinnostusta tämän tapaiseen tutkimukseen. Valitettavasti näitä tuloksia ei siinä vaiheessa ollut käytettävissä kuin suomenkielisinä.

»Suomalainen metsätyömies»-kirjan ilmestymisen jälkeen on esitetty kritiikkiä etenkin sen metsätyömiesten terveydentilaa koskevasta luvusta. Sekä metsähallituksessa että eräissä yhtiöissä on suoritettu terveystarkastuksia ja todettu, että tutkittujen metsureiden terveydentila on ollut parempi kuin tässä tutkittujen miesten terveys. Tästä on vedetty se johtopäätös, että tämän tutkimuksen tulokset antavat todellista synkemmän kuvan metsätyön terveydelle aiheuttamista haitoista. Tällainen johtopäätös on mielestämme virheellinen ja johtuu siitä, että kysymyksessä ovat eri perusjoukot, jotka vain osittain peittävät toisensa. Metsähallitus ja yhtiöt ottanevat vakinaiseen työsuhteeseen ammattimaisia metsätyöntekijöitä parhaasta päästä, joten heillä on palveluksessaan ammattitaitoisin, työkykyisin ja siten myös tervein osa ammattiryhmästä. Ansiotasovertailumme (FF 175) osoitti selvästi että metsähallituksen vakinaiset metsätyömiehet ovat ammattimaisten metsätyömiestemme eliittiryhmä. Vakinaiset työntekijät muodostavat kuitenkin vastø ehkä kymmenennen osan ammatikseen metsätöitä tekevistä, joten ei ole perusteltua esittää heidän edustavan »oikeata» kuvaa ammattiryhmän terveydentilasta. Kun siirrytään käsittelemään koko metsurikuntaa on otettava huomioon ammattiryhmän enemmistö, tilapäisissä työsuhteissa työskentelevät. Tämän tutkimuksen näytteisiin poimitut miehet olivat tehneet metsätöitä ammatikseen useimpina 1960-luvun vuosista, mutta harvaa poik-

keusta lukuunottamatta vain tilapäisissä työsuhteissa. Aineistossa ei siis ole lyhytaikaisesti metsätöitä tehneitä kausityöntekijöitä eikä myöskään ammatikseen metsätöissä olleita, jotka olivat näissä töissä 1960-luvulla vähemmän kuin neljänä vuotena. On todennäköistä joskaan sitä ei voida varmuudella osoittaa ilman suuria kustannuksia, että Helsingissä v. 1969 terveystutkimuksemme läpikäyneistä metsureista (268) valtaosa oli tehnyt palkattuja metsätöitä vähintään 100 pv. vuodessa joka vuosi 1961—69.

Näin pitkälle viety aineiston karsinta johtui siitä 1960-luvun alussa ansiotasoa tutkittaessa omaksutusta periaatteesta, että jos halutaan tutkia metsätyön vaikutusta tuloihin tai elintasoon, on aineisto rajattava siihen väestöryhmään, johon metsätyön erikoisluonne on vaikuttanut selvästi ja jatkuvasti. Tämä merkitsee, että tulotasoa mitattaessa mittauksen tulisi kohdistua sellaisiin työntekijöihin, jotka ovat tehneet metsätöitä ammatikseen niin kauan, että ovat saavuttaneet hyvän ammattitaidon ja työrutiinin. Vastaavasti ja varmaan vieläkin tärkeämpää lienee metsätyön ja terveydentilan vuorovaikutusta tutkittaessa rajata aineisto niin, että on mahdollista todeta myös metsätyön hitaasti, vuosien kuluessa mahdollisesti aikaansaamat vaikutukset terveydentilaan, jotta haitalliset vaikutukset voitaisiin ennakolta ehkäistä. Sehän on kansanterveyspolitiikan päätavoite.

Jos viimeaikaisten metsureiden työmaatutkimusten niukkoja julkisuuteen annettuja tuloksia vertaa tämän tutkimuksen vastaaviin tuloksiin niin, että molemmista aineistoista otetaan huomioon vain pitkäaikaisesti metsätyötä tehneet miehet, näyttävät esim. tärinäoireitten ja kuulovaurioitten esiintymistiheydet varsin yhtäpitäviltä molemmissa aineistoissa, ts. valtaosa moottorisahaa kauan käyttäneistä miehistä kärsii näistä oireista.

Huomattakoon vielä, että metsätyömieskuntamme on erittäin nopeasti vaihtumassa ja myös vähenemässä. Metsätyön kausimaisuus on ennenkin aiheuttanut, että jonain vuonna tähän työhön osallistuneista erittäin suuri osa ei enää seuraavana vuonna palannut metsätöihin. Tätä vaihtumista lienee maaseutuväestön suurentuneen liikkumisalttiuden vuoksi entistä enemmän.

Toisaalta koko metsätalouden työvoima supistuu nopeasti. Metsätalouden ja uiton koko työpanos oli v. 1969, jossa on tämän tutkimuksen pääpaino, 70 tuhatta työvuotta. Kaikki tämä merkinnee, että v. 1969 suoritettu läpileikkausanalyysi metsätyövoimasta voi varsin nopeasti vanhentua. Korostettakoon kuitenkin, että nimenomaan tässä käytetyllä näytteellä on pitkäaikaisempi ennustearvo kuin rutiininomaisilla työmaatarkastuksilla.

Elintason teoreettinen tarkastelu

Sanasta elintaso on viime vuosina tullut muotisana. Ilmaisullisessa mielessä elintasokäsite on verraten hämärä, koska sillä on monta merkitystä. Inhimillisten tarpeiden tyydyttäminen on ollut lähtökohtana useissa kansainvälisissä elintasomääritelmissä. Koska kuitenkin tarpeiden tyydytyksen mittaaminen on yleensä hyvin vaikeaa, monet tutkijat ovat pyrkineet määrittämään elintason siten, että se käsittäisi vain empiirisesti mitattavia muuttujia. Tällaisissa määritelmissä elintaso tavallisimmin samaistetaan joko tulotasoon tai kulutustasoon. Kuitenkaan Yhdistyneien Kansakuntien asettama elintaso-käsitettä tutkinut asiantuntijatoimikunta ei katso tulojen ja kulutuksen olevan varsinaisia elintason osatekijöitä.

Vuoden 1961 raportissaan YK:n asiantuntijatoimikunta päätyi seuraavien yhdeksän osatekijän mukaanottamiseen elintasokäsitteen piiriin:

1. Terveys
2. Ravitsemus
3. Koulutus
4. Työolot
5. Asuminen
6. Turvallisuus
7. Vaatetus
8. Virkistys
9. Inhimilliset oikeudet

Tässä tutkimuksessa käytetään tätä osatekijäluokitusta sekä sellaisia osoittimia, joiden on katsottu parhaiten soveltuvan metsätyömiesten elintason mittaamiseen.

Elintason osatekijöiden merkitys vaihtelee eri yhteiskunnissa ja eri aikoina. Tässä tutkimuksessa pyritään antamaan tasapuolinen kuva suomalaisen metsätyömiehen elintasosta painottamalla elintason osatekijöitä sen mukaan, miten tärkeitä ne ovat metsätyömiehen kannalta. Osatekijöiden painotus ratkaistiin haastattelun perusteella. Metsätyömiehiltä kysyttiin, mitä osatekijöitä he pitivät tärkeimpinä ja toisaalta, missä he kokivat eniten puutteita. Näitä vastauksia täydennettiin faktorianalyysilla, jossa oli mukana yksityiskohtaisempia kysymyksiä elintason osatekijöistä, ja näin saatiin tässä kirjassa käytettävä painotusjärjestys.

Eräänlaisen painotetun kuvan elintasosta antoivat metsätyömiesten mielipiteet elintasonsa korkeudesta. Kolme neljästä metsätyömiehestä piti elintasoaan matalana tai erittäin matalana.

Tutkimuksessa käytetään kolmea metsätyömiehistä poimittua näytettä: Maaseudun työvoiman tutkimuksen alaotoksia, Eläketurvakeskuksen työsuhderekisterin näytettä ja vuoden 1966 kotitaloustiedustelun näytettä.

Terveys

Tutkimus antoi synkän kuvan metsätyömiesten terveydestä. Vaarallisimmat kansantautimme, sydän- ja verisuonitaudit olivat metsätyömiehillä yleisiä. Joka neljäs heistä sairasti sepelvaltimosairautta. Tämän taudin riskitekijät, etenkin veren korkea kolesterolipitoisuus ja tupakanpoltto olivat metsätyömiehillä tavallisia. Suorituskyky laski selvästi etenkin 50 vuotta täyttäneiden metsätyömiesten ryhmässä. Kaikissa tutkimustuloksissa kuvastuu selvänä iän sairauksia lisäävä ja työkykyä jäytävä vaikutus. Metsätyömiehillä 50 vuoden ikä näyttää muodostavan tässä suhteessa merkittävän käännekohdan. Hengityselinten oireiden yleisyys kertoo metsätyömiesten taipumuksesta sairastua pitkälliseen keuhkoputkentulehdukseen ja sen myötä keuhkojenlaajentumaan. Metsätyömiehillä usein esiintyvät ruoansulatuskanavan oireet viittaavat lähinnä mahan ja paksunsuolen toiminnallisiin häiriöihin ja ne selittyvät heidän ravintonsa yksipuolisesta koostumuksesta ja ruokailutapojen poikkeuksellisuudesta.

Metsätyömiehet kärsivät yleisesti erilaisista selkä- ja raajaoireista, ennenkaikkea lanneristiselän seudun säryistä. Tärinäsairaudelle ominaisia sormioireita oli yli kahdella kolmasosalla metsätyöntekijöistä. Nämä vaivat näyttävät lisääntyvän moottori-

sahan käyttöajan ja iän mukana. Moottorisahan käyttäjistä oli meluhuonokuuloisuutta kahdella miehellä kolmesta. Metsätyö osoittautui erittäin tapaturma-alttiiksi.

Metsätyömiesten tärinäsairaus ja kuulomuutokset liittyvät läheisesti moottorisahan käyttöön. Myös ammatin tapaturma-alttius on varmasti helposti ymmärrettävissä. Muilta osin ei heidän huonoa terveydentilaansa voitane selittää tavanomaisella riskitekijäajattelulla. On ilmeistä, että nämä miehet joutuvat raskaita ruumiillisia ponnistuksia vaativan, kuluttavan työn lisäksi kestämään työ- ja elämänolosuhteista johtuvia psyykkisiä ja sosiaalisia rasituksia suuremmassa määrin kuin yhteiskuntamme muut ryhmät yleensä. Tämän vuoksi tuntuisi siltä, että metsätyömiesten terveydentilaa ei pystytä kohentamaan pelkästään työterveydenhuoltoa ja lääkintäpalveluja kehittämällä, vaan huomiota on kiinnitettävä kokonaisuudessaan heidän elämänpiirinsä epäkohtiin.

Asuminen

Metsätyöntekijöillä on Suomessa yleensä omistusasunto, tämä on luonnollinen seuraus siitä, että valtaosa heistä kuuluu edelleenkin maatilojen haltijoihin tai näiden perheenjäseniin. Myös tilattomista lähes puolet omistaa asuntonsa, joskin tämä osuus näyttää olevan laskemassa.

Metsätyöntekijöiden asumistiheys oli 1970-luvun alkaessa keskimäärin hieman alle 2 henkilöä huonetta kohden, kun keittiökin laskettiin huoneeksi. Näinollen tämän väestönosan asuminen on edelleen luokiteltava ahtaaksi. Se ei enää sanottavasti vaihtele hallintatavan mukaan eikä alueittain tai yhteiskuntaryhmittäin. Vuodesta 1950 jolloin asumistiheys oli keskimäärin yli 3 henkilöä/huone, on tilanne kuitenkin hyvin paljon parantunut. Kuitenkin ahtaus edelleen selvästi lisääntyy perheen lapsiluvun suuretessa. Asuntotilanteen parantuminen johtuu suurelta osalta lapsiluvun selvästä pienentymisestä.

Vuoden 1950 jälkeen, jolloin ammattimaisista metsätyöntekijöistä vain 1/4:lla oli sähkö ja muita mukavuuksia ei juuri ollenkaan, on asuntojen varustus lisääntynyt paljon: vuonna 1969 oli sähkö 60 %:lla, vesijohto ja viemäri 30 %:lla, televisio 50 %:lla sekä puhelin, WC tai keskuslämmitys 10 %:lla. Kylpyhuone sen sijaan oli harvinainen.

Vuodesta 1963 on tietoja metsätyömiesten asuntojen sijainnista. Silloin oli niiden etäisyys lähimmästä kaupungista keskimäärin Etelä-Suomessa 50 km, Pohjois-Suomessa 150 km. Työpaikan etäisyys kodista oli useimmiten yli 5 km ja yli 10 km oli vielä hyvin tavallinen työmatka, joka usein pakotti yöpymään työpaikalla.

Työolot

Metsätyömiesten työoloissa on paljon parantamisen varaa. Pahimpina epäkohtina koettiin palkkauksen pienuus, työn raskaus, työn haitallisuus terveydelle ja työttömyys. Valtaosaltaan urakkatöillä leipänsä hankkivien metsätyömiesten ansiot pienenevät iän lisääntyessä, kun muiden työntekijöiden ansiot yleensä kasvavat työvuosien myötä. Metsätyömiesten ansioiden aleneminen aiheutuu ruumiillisen suorituskyvyn heikkenemisestä jo 35 ikävuoden jälkeen.

Lähes kaikki haastatellut pitivät työtään raskaana tai erittäin raskaana työnä. Miesten käsitys työnsä raskaudesta vastaa hyvin energiankulutustutkimuksia, joissa on todettu, että metsätyö on lähes ainoa ammatti, jossa energian kulutus on yli 4 800 kilokaloria vuorokaudessa. Työn raskaus on myös lisäämässä työstä aiheutuvia terveydellisiä vaurioita. Metsätyömiesten keskimääräinen työttömyysaika vuoden 1969 kymmenen ensimmäisen kuukauden aikana oli noin kuusi viikkoa: työttömyys ja sen pelko aiheuttaa metsätyömiehen ja hänen perheensä elämään jatkuvan turvattomuuden tunteen.

Metsätyössä on sitä tekevän henkilön kannalta ainakin yksi hyvä puoli, työn itsenäisyys. Lähes 95 prosenttia metsätyömiehistä oli sitä mieltä, että heidän työnsä on riittävän itsenäistä.

Lähes 60 prosenttia metsätyömiehistä olisi halunnut sopivan tilaisuuden tullen vaihtaa ammattia. Valtaosa näistä miehistä piti ihanneammattinaan sisällä suoritettavaa, kevyttä ja metsätyötä paremmin palkattua työtä, jonka useat vielä nimesivät tehdastyöksi.

Turvallisuus

Turvallisuus on vaikeasti määriteltävä ja vaikeasti mitattava elintason osatekijä. Tutkimuksen turvallisuutta käsittelevässä osassa rajoitutaan selvittelemään metsätyömiesten tuloja ja omaisuutta, työttömyysvakuutus- ja työeläkejärjestelmiä sekä työturvallisuutta. Tulojen suhteen metsätyömiehet ja heidän perheensä elävät paljon turvattomammassa asemassa kuin teollisuustyöntekijät. Tulojen pienuus johtuu suurelta osalta työttömyydestä. Kolme neljäsosaa metsätyömiehistä ilmoitti omistavansa omaisuutta, mutta omaisuuden määrä oli niin vähäinen, että se ei juuri lisännyt taloudellista turvallisuutta. Niinpä lakisääteiset sosiaaliturvajärjestelmät ovat metsätyömiehille erittäin tärkeitä. Työttömyyskassasta metsätyömiehet voivat saada avustusta työttömyysaikana, mutta heikkoutena järjestelmässä on se, että sen piirissä on vain noin neljäsosa ammattimaisista metsätyöntekijöistä. Työeläkejärjestelmän avulla pyritään lisäämään turvallisuutta etenkin työkyvyttömyyden ja vanhuuden aikana. Eläkkeiden antamaa turvaa pidetään kuitenkin vielä vähäisenä lähinnä pienen eläkkeen ja korkean eläkeikärajan takia.

Tapaturmatiheys on metsätöissä korkein talonrakennustoiminnan jälkeen. Tapaturmien ehkäisy kohtaa vaikeuksia: koulutuskapasiteetti ei riitä, työvälineiden kehitys ei etene riittävän nopeasti ja metsätöiden urakkapalkka on omiaan pitämään työtahdin turvallisuuden kannalta liian kiivaana. Työterveyssuojelun ensimmäisenä edellytyksenä ovat säännölliset terveystarkastukset. Metsätyötä varten on kehitetty turvallisuutta lisääviä työpukuja ja suojaimia. Niitä on kuitenkin otettu varsin hitaasti käyttöön.

Inhimilliset oikeudet

Metsätyömiesten inhimillisiä oikeuksia lähestytään tarkastelemalla yhteiskunnan kohtelun oikeudenmukaisuutta, vääryyden kärsimistä ja metsätyömiesten arvostusta. — Yli puolet metsätyömiehistä oli sitä mieltä, että yhteiskunta kohtelee heitä oikeudenmukaisesti. Tähän mielipiteeseen kätkeytyi kuitenkin usein väkinäisyyttä; ei löytynyt mitään kovin pahaa valittamisen aihetta. Kolmasosa miehistä koki kärsineensä

vääryyttä. Syyt tähän olivat: liian ankara tai epäoikeudenmukaieen verotus, palkkauksen pienuus, runsas työttömyys sekä viranomaisten huono tai puolueellinen kohtelu.

Metsätyömiesten arvostus on matalampi kuin rakennustyömiesten ja metallityöntekijäin arvostus. Kaksi kolmannesta metsätyömiehistä oli sitä mieltä, että ihmiset yleensä arvostavat metsätyömiehet matalalle, kuusitoista prosenttia oli sitä mieltä, että heidän arvostuksensa on korkea.

Koulutus

Koulutuksella on kolmenlainen merkitys elintason osatekijänä: Koulutus on eräs taloudellisen kasvun perustekijä ja siten väline yhteiskunnan elintason nousuun; koulutus on yksilötasolla väylä kohti paremmin palkattuja ammatteja ja kolmanneksi ammattikoulutuksella on mahdollista päästä parempiin ansioihin jonkin ammatin puitteissa. Metsätyömiesten peruskoulutus rajoittuu yleensä kansakouluun. Ammattikoulutusta metsätöihin annetaan sekä 10 kk kestävällä peruskoulutuksella että 1—2 viikon mittaisilla kursseilla. Nykyisellä koulutuskapasiteetilla pystytään kuitenkin antamaan opetusta vain osalle metsätyömieskunnasta. Vuonna 1969 haastatelluista metsätyömiehistä kolmasosa oli saanut jonkinlaista ammattikoulutusta, muiden ammattitaito perustui pelkästään omaan kokemukseen. Huolimatta metsätyövoiman määrän supistumisesta voidaan nykyisillä voimavaroilla antaa opetusta 1970-luvulla vain noin neljäsosalle ammattimaisista metsätyömiehistä. Kokonaan oma ongelmansa on se, että metsätyön ammattikuva on nuorison silmissä muuttunut niin vähän houkuttelevaksi, että metsätyökouluihin halukkaiden määrä on jatkuvasti laskenut. Vuosina 1969—1971 jäi osa oppilaspaikoista täyttämättä.

Virkistys

Vapaa-aika ja virkistys ovat välttämättömiä edellytyksiä ihmisen henkisen ja fyysisen terveyden sekä työkyvyn säilymiselle. Kolme neljäsosaa metsätyömiehistä piti vapaa-aikansa määrää riittävänä. Metsätyön raskauden tähden noin kolmasosalla metsätyömiehistä ei ole kuitenkaan lainkaan harrastuksia, sillä heidän vapaa-aikansa kului toipumiseen työn rasituksista: lepäämiseen ja nukkumiseen. Tästä syystä onkin helppo ymmärtää, että noin 80 % metsätyömiehistä haluaisi käydä useammin virkistäytymässä. Toivottuja virkistyksen lähteitä olivat metsätyömiesten mielestä kalastaminen, metsästys ja ravintolassa käyminen. Kerho-, järjestö- ja yhdistystoiminnasta metsätyömiehiä kiinnostivat lähinnä ammattiyhdistys ja metsästysseura.

Metsätyömiesten vapaa-ajanvietto- ja virkistysmahdollisuuksia voidaan parhaiten edistää työtä keventämällä, palkkausta parantamalla ja sijoittamalla asunnot elinkelpoisiin asutuskeskuksiin, jolloin nykyajan kulttuuripalvelukset saadaan metsätyömiesten ulottuville.

Vaatetus

Metsätyömiesten vaateongelmat ovat työvaatteissa. Sopimattomat työvaatteet ovat vaaraksi terveydelle. On kuitenkin vaikea löytää sellaista vaateratkaisua, joka tyydyttäisi kaikki metsätyön asettamat vaatimukset. Tästä huolimatta useat valmis-

tajat ovat kehittäneet työpukumalleja, jotka hiljalleen ovat pääsemässä yleisempään käyttöön metsätyömiesten keskuudessa. Niiden laajemman leviämisen esteenä on toistaiseksi ollut hinta: monien metsätyömiesten mielestä työpuvut ovat niin kalliita, että työnantajan olisi osallistuttava niiden hankkimiskustannuksiin.

Ravitsemus

Monipuolinen ja riittävä ravinto on yksi terveyden perusedellytyksiä. Metsätyömiehillä ravinnon merkitystä korostaa vielä työn vaatima suuri energiamäärä. Työn raskaus huomioon ottaen metsätyömiesten ravitsemustaso ei ole yhtä korkea kuin teollisuustyöntekijöillä. Ravitsemustasossa ei kuitenkaan metsätyömiesten mielestä ole kovin pahoja puutteita. Parantamisen varaa on lähinnä kahdessa seikassa: ruuan tulisi olla nykyistä monipuolisempaa, jolla tarkoitetaan lähinnä lihan, vihannesten ja hedelmien osuuden lisäämistä. Toiseksi ruokailu työpäivän aikana jää tavallisesti puutteelliseksi, koska ei ole riittävästi mahdollisuuksia kuljettaa tai valmistaa lämmintä päiväateriaa.

TUTKIMUKSIA PUIDEN VUOTUISEN PITUUSKASVUN AJOITTUMISESTA

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ALKUSANAT

Käsillä oleva julkaisu perustuu Raulon laatimaan käsikirjoitukseen, jonka molemmat tekijät ovat muokanneet ja viimeistelleet painokuntoon. Tutkielman kenttätöissä Punkaharjulla on avustanut metsänhoitaja S u l o R o i h a, joka on myös valvonut aineiston laskentaa. Käytetyt lämpötilahavainnot on ystävällisesti antanut käyttöön tutkimuksen kulkua kiinteästi seurannut professori R i s t o S a r v a s. Englanninkielisen lyhennelmän on tarkastanut Mr J o h n D e r o m e, M.Sc.

Käsikirjoituksen ovat lukeneet professorit R i s t o S a r v a s ja M a x. H a g m a n sekä fil.tri, dos. V e i k k o K o s k i. Suomen Metsätieteellinen Seura on avustanut työn suoritusta apurahalla.

Tekijät esittävät parhaat kiitoksensa edellä mainituille.

Helsingissä, marraskuussa 1973

Jyrki Raulo *Matti Leikola*

SISÄLLYSLUETTELO

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1. JOHDANTO

Puiden pituuskasvun ajoittumista ja riippuvuutta eri ympäristötekijöistä, erityisesti ilman lämpötilasta ja kasvukauden pituudesta on tutkittu Pohjoismaissa hyvin runsaasti (esim. Hesselman 1904, Romell 1925, Hertz 1929, Mork 1941, Godske 1961, Huikari ym. 1967, Hari ym. 1970 ja Odin 1972). Tähän mennessä suoritetut selvitykset on luonnollisesti keskitetty ennen kaikkea paikallisiin havupuulajeihin, mäntyyn ja kuuseen, ja vain vähäisemmässä määrin lehtipuihin ja ulkomaisiin puulajeihin. Eri provenienssien pituuskasvun ajoittuminen ja sen merkitys kasvupaikan ilmasto-oloihin sopeutumisen osoittajana on niinikään ollut mielenkiinnon kohteena (Langlet 1936, 1943, Robak 1957, Dormling ym. 1968, Magnesen 1969, 1971, 1972, Hagner 1970 a, b, Dietrichson 1968, 1969, 1971 ym.). Vertailevia havaintoja usean eri puulajin pituuskasvusta on sen sijaan julkaistu vähän. Toisaalta esim. Keski-Euroopasta on saatavissa runsaasti tietoa eri puulajien ja provenienssien pituuskasvusta (esim. Burger 1926, Anic 1956, Wilhelmi 1957, Lyr ym. 1965, Schober 1967, Hoffmann ym. 1973).

Tämän tutkielman tarkoituksena on esitellä viiden havupuu- ja seitsemän lehtipuulajin pituuskasvun ajoittumista ja riippuvuutta lämpösummasta luonnossa. Seitsemän puulajin osalta kysymystä on tarkasteltu metsikkötasolla ja viiden osalta useihin yksilöihin kohdistuneiden mittausten perusteella.

2. TUTKIMUSAINEISTO JA -MENETELMÄ

Pituuskasvumittaukset suoritettiin vuosina 1964 ja 1965 metsäntutkimuslaitoksen Punkaharjun kokeilualueeseen kuuluvassa Laukansaaressa (61°47'P., 29°19'I, korkeus 80 m.p.y.).

Mitattavat koepuut valittiin eri kohteista: uudistusaloilta, tienvarsilta ja peltojen reunoilta. Viljavuudeltaan em. kasvupaikat vastasivat lähinnä käenkaali-mustikkatyyppiä. Koepuiksi valitut männyt kasvoivat kuitenkin miltei kaikki puolukkatyyppiä vastaavilla kasvupaikoilla.

Tutkitut puulajit, koepuiden lukumäärät ja keskimääräiset pituudet on esitetty taulukossa 1. Iältään puut olivat 5—15 vuotiaita. Syntytavaltaan kaikki havupuut olivat siementaimia, lukuunottamatta pihtoja, joiden joukossa oli myös kaadettujen puiden juurtuneita alaoksia. Näiden osuus pihtojen koko lukumäärästä oli molempina havaintovuosina yli 50 %. Lehtipuiden joukossa esiintyi varsin runsaasti vesasyntyisiä yksilöitä. Niinpä kaikki haavat olivat juurivesoja ja lepät pari vuotta aikaisemmin kaadettujen emopuiden tyvivesoja, samoin kuin kaikki tuomet. Sitä vastoin yli 90% pihlajista, rauduskoivuista, hieskoivuista sekä paatsamista oli siementaimia.

Havupuista mänty, kuusi ja kataja olivat tutkimuspaikalla luontaisesti kasvavia, sembra ja pihta viljeltyjä ulkomaisia alkuperiä. Lehtipuut olivat kaikki paikallista alkuperää.

Taulukko 1. Koepuiden lukumäärät ja keskipituudet
Table 1. The number of sample trees and their mean height

Puulaji *Tree species*	1964		1965	
	Puita, kpl *Number of trees*	Keskipituus, m *Mean height, m*	Puita, kpl *Number of trees*	Keskipituus, m *Mean height, m*
Havupuut — *Conifers*				
Mänty (*Pinus sylvestris* L.)	19	1.60	55	1.95
Sembra (*Pinus Cembra* L.) [1]	—	—	2	2.15
Kuusi (*Picea abies* (L.) Karst.)	18	2.10	83	2.60
Pihta (*Abies sibirica* Ledeb.)	7	1.65	24	2.05
Kataja (*Juniperus communis* L.) [1]	—	—	2	1.90
Lehtipuut — *Deciduous trees*				
Rauduskoivu (*Betula verrucosa* Ehrh.)	24	1.65	26	2.20
Hieskoivu (*Betula pubescens* Ehrh.)	16	1.80	45	2.40
Harmaaleppä (*Alnus incana* (L.) Moench.)	10	2.00	49	2.50
Pihlaja (*Sorbus aucuparia* L.)	15	1.50	47	1.80
Haapa (*Populus tremula* L.) [1]	—	—	20	1.80
Tuomi (*Prunus padus* L.) [1]	—	—	3	1.50
Paatsama (*Rhamnus frangula* L.) [1]	—	—	11	1.90
Yhteensä — *Totals*	109		417	

[1]) Havainnot yksityisistä puista — *Observations on individual trees*

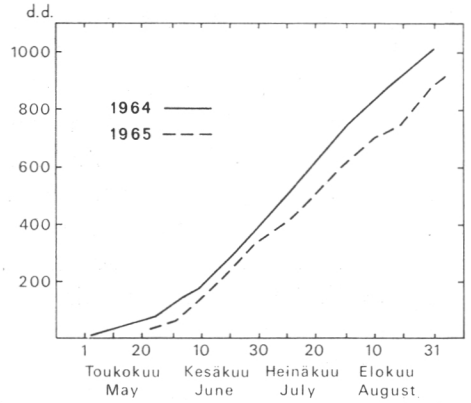
Koepuut merkittiin oksaan kiinnitetyllä, numeroidulla muovinauhalla. Latvakasvaimen pituuden mittaus toistettiin kasvukauden aikana 5—10 vuorokauden välein. Havupuiden kasvaimen mittaus suoritettiin aina viimeisen vuosikasvaimen tyvestä sen ylimpään kärkeen, jolloin syntyvä uusi silmu tuli mukaan luetuksi. Lehtipuilla kasvaimen mittauksen kiinteänä alkukohtana toimi päärankaan maalattu merkki (vrt. esim. Kozlowski ym. 1957, Wilhelmi 1957, Walters ym. 1963). Pituusmittaukset suoritettiin tasaavasti yhden millimetrin tarkkuudella.

Ilman lämpötila mitattiin sääasemalla, joka sijaitsi aukealla pellolla noin 500 metrin etäisyydellä kauimmaisista koepuista. Lämpötila rekisteröitiin juoksevasti sääkojussa 2 m:n korkeudella olleen termografin avulla. Termografi tarkistettiin säännöllisesti kaksi kertaa vuorokaudessa sääkojussa olevan tarkkuuslämpömittarin avulla.

Yksittäisten puiden latvakasvainten pituushavainnoista laskettiin aluksi puulajeittain keskimääräinen pituuskasvu millimetreinä ja sadanneksina kasvaimen lopullisesta kokonaispituudesta eri mittausajankohtina. Pituuskasvun määrää tarkasteltiin tämän jälkeen graafisesti lämpösumman funktiona. Lämpösummaa laskettaessa käytettiin mm. Keräsen ja Lunelundin esittämää koostamismenettelyä (kynnysarvo + 5°C) (mm. Sarvas 1965, 1972). Lähtöarvoina käytetyt vuorokautiset keskilämpötilat laskettiin termogrammeista parittomien tuntien kohdalta luettujen lämpötilojen keskiarvoina. Näin saadut vuorokautiset lämpötilan keskiarvot summattiin juoksevasti vähentäen samalla kustakin yhteenlaskettavasta kynnyslämpötila + 5°C. Lämpösumman koostaminen alkoi silloin, kun päivittäinen keskilämpötila ensimmäisen kerran ao. vuonna ylitti kynnyslämpötilan. Lämpösumman yksikkönä on d.d. (degree days).

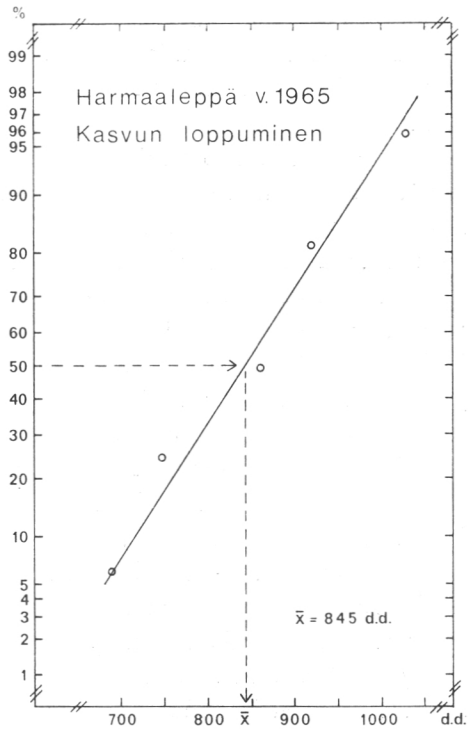
Puiden pituuskasvun alkamis- ja loppumisajankohdan määrittämistä on yleensä totuttu pitämään paitsi mittaus- myös jossakin määrin sopimuksenvaraisena määrittelyongelmana. Koska myös silmun muodostumisen voidaan katsoa kuuluvan pituuskasvuun olennaisena osana, kasvu itse asiassa on tämän mukaan aina alkanut viimeistään jo edellisen vuoden keskikesällä, ja ollut välillä vain talvihorroksen keskeyttämänä (vrt. Kozlowski 1971 ss. 254—256). On kuitenkin mielekästä ymmärtää vuotuisen pituuskasvun koskevan vain talvihorroksen jälkeen tapahtuvaa verson kehitystä. Näin voidaan pituuskasvun katsoa alkaneen vasta, kun silmunsisäisessä kasvusolukossa ensimmäiset horroksen jälkeiset solunjakautumiset ovat näkyvissä, tai kun kasvusolukko on selvästi suurentunut horroksen aikaisesta koostaan (esim. Romberger 1963 ym.).

Päätesilmun keväistä puhkeamistakin on käytetty melko yleisesti pituuskasvun alkamisen ajankohtana, niin vaikeata kuin tämän vaiheen rajaaminen ulkonaisin havainnoin onkin (esim. Romell 1925, Schober 1967, Hoffmann 1972). Pituuskasvun loppuminen on vastaavasti mää-



Kuva 1 (yllä). Kasvukauden lämpösumma Punkaharjulla vuosina 1964 ja 1965.

Fig. 1 (above). The temperature sum at Punkaharju in 1964 and 1965.



Kuva 2 (vieressä). Harmaalepän pituuskasvun loppumisen lämpösummajakaantuma ja sen keskiarvo ($\bar{x}$) v. 1965. Vaaka-akseli = lämpösumma; pystyakseli = pituuskasvunsa lopettaneiden puiden kumulat. sadannes.

Fig. 2 (on right). The temperature sum of the average cessation of height increment of Alnus incana at Punkaharju in 1965. Abscissa = temperature sum, ordinate = termination of height increment, per cent of the total population.

ritetty vaiheeksi, jolloin kasvua ei enää tapahdu. Näin menetellen on kuitenkin pidettävä mielessä, että verson pituuskasvu on tarkasti ottaen aina alkanut merkittävästi aikaisemmin ja päättynyt myöhemmin kuin pelkästään kasvainta ulkonaisesti tarkkailemalla on voitu päätellä.

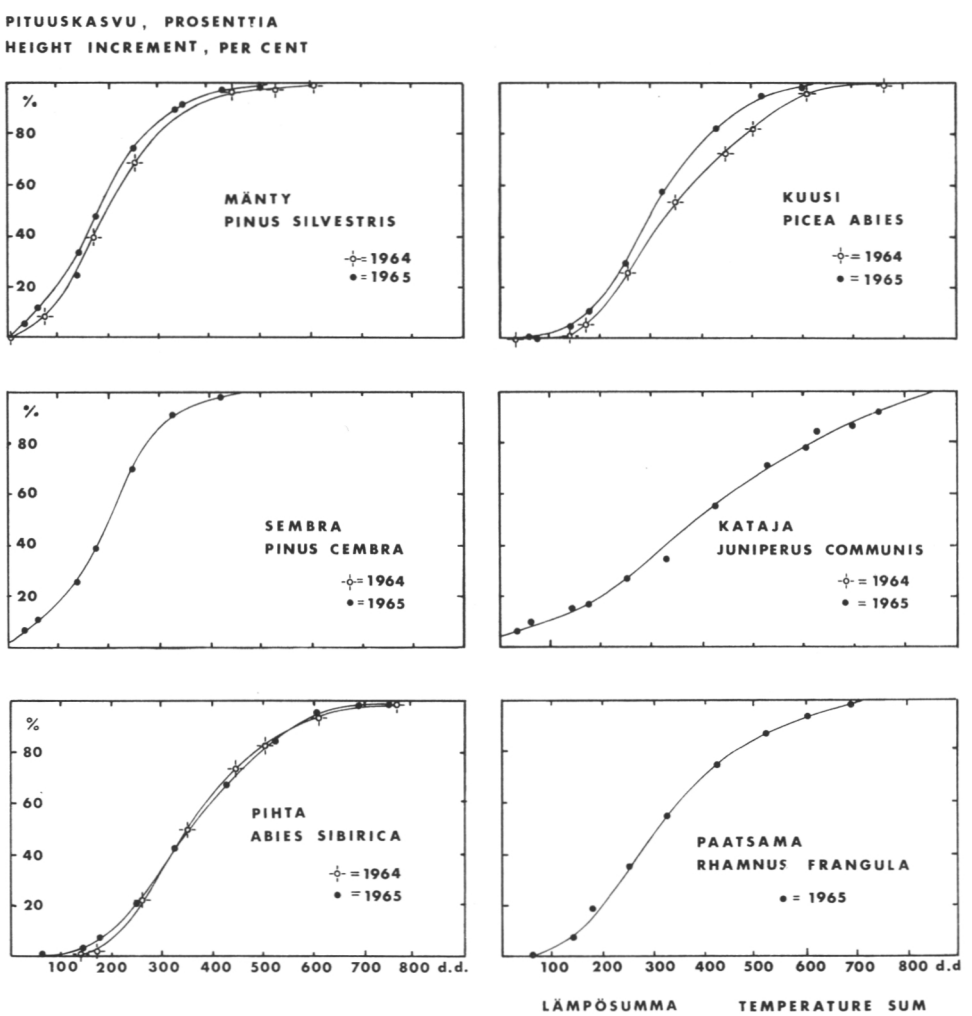
Pituuskasvun alkamis- ja loppumisajankohdan määrittämisessä on erittäin usein käytetty apuna sitä, että kasvun kulun kumulatiivinen perusmalli tunnetusti noudattaa ajan suhteen likimain sigmoidista muotoa (esim. Romell 1925, Burger 1926, Odin 1972). Mm. pyrkimys mahdollisimman vähäisen koepuumäärän käyttöön on johtanut ilmiön tulkitsemiseen vähittäiseksi, vailla selviä rajakohtia olevaksi kestotapahtumaksi (segment event; Sarvas 1972), ja kasvun alku- ja loppukohdat on määritetty erikseen kussakin tapauksessa sopimusteitse. Verson on siten voitu katsoa alkaneen kasvunsa vasta, kun uuden kasvaimen pituus on ylittänyt tietyn absoluuttisen tai suhteessa kasvaimen kokonaispituuteen määrätyn rajan, esim. 1 mm, tai kun pituuskasvun kumulatiivisen kuvaajan tangentti ajan suhteen on pysyvästi ylittänyt jonkin sovitun arvon (esim. Hari 1972).

Vaikka on tunnustettava, että kaikki käytännössä mahdolliset yritykset pituuskasvun alku- ja loppuhetken määrittämiseksi jäävät epätäydellisiksi, ilmeisesti käsitteellisesti selvintä menettelyä edustaa seuraava tapa. Tutkimalla silmunäytteitä jatkuvasti mikroskoopin avulla seurataan, milloin aineistoksi valitussa silmussa ensi kerran näkyy jakaantumisvaiheessa olevia soluja. Pelkistämällä vaadittava havainnointi vaihtoehtoon: »esiintyy»/»ei esiinny», ja perustamalla havaintosarjat riittävän suureen ja yhtenäiseen materiaaliin, voidaan halutun metsikön (populaation) pituuskasvun keskimääräinen alkamishetki (50 % populaatiosta) määrätä suurella luotettavuudella (vrt. S a r v a s 1972). Samaa periaatetta voidaan soveltaa myös silmujen ulkonaiseen tarkkailuun. Niin kauan kuin silmu ei ole selvästi suurentunut edellisiin havaintoihin verrattuna, se saa merkinnän: »ei kasva», ja kun silmu on selvästi edellisiin mittauksiin verrattuna suurentunut, se tulkitaan kasvavaksi. On kuitenkin painotettava sitä, että havainnot on aloitettava riittävän aikaisin keväällä, ja että havaintotiheyden tulee olla suurehkon (mieluimmin 2—3 kertaa/vrk), jotta tulos vastaisi odotuksia.

Tässä tutkielmassa pyrittiin aineistoa käsiteltäessä viimeksi esitettyyn menettelyyn, mutta todettiin, että havaintotiheys ei riittänyt alkamisajankohdan määrittämiseen tällä tavoin. Sen vuoksi määritettiin kunkin puulajin pituuskasvun alkuhetki pituuskasvun keskimääräistä kulkua osoittavista piirroksista (kuvat 3 a ja 3 b) ottamalla kasvun alkamishetkeksi se ajankohta, jolloin käyrä (tai sen jatke) leikkaa vaaka-akselin. Kasvun lop-

Taulukko 2. Eri puulajien pituuskasvun alkamis- ja loppumisajankohtien lämpösummat
Table 2. The temperature sums in the beginning and at the cessation of the height growth of the sample trees

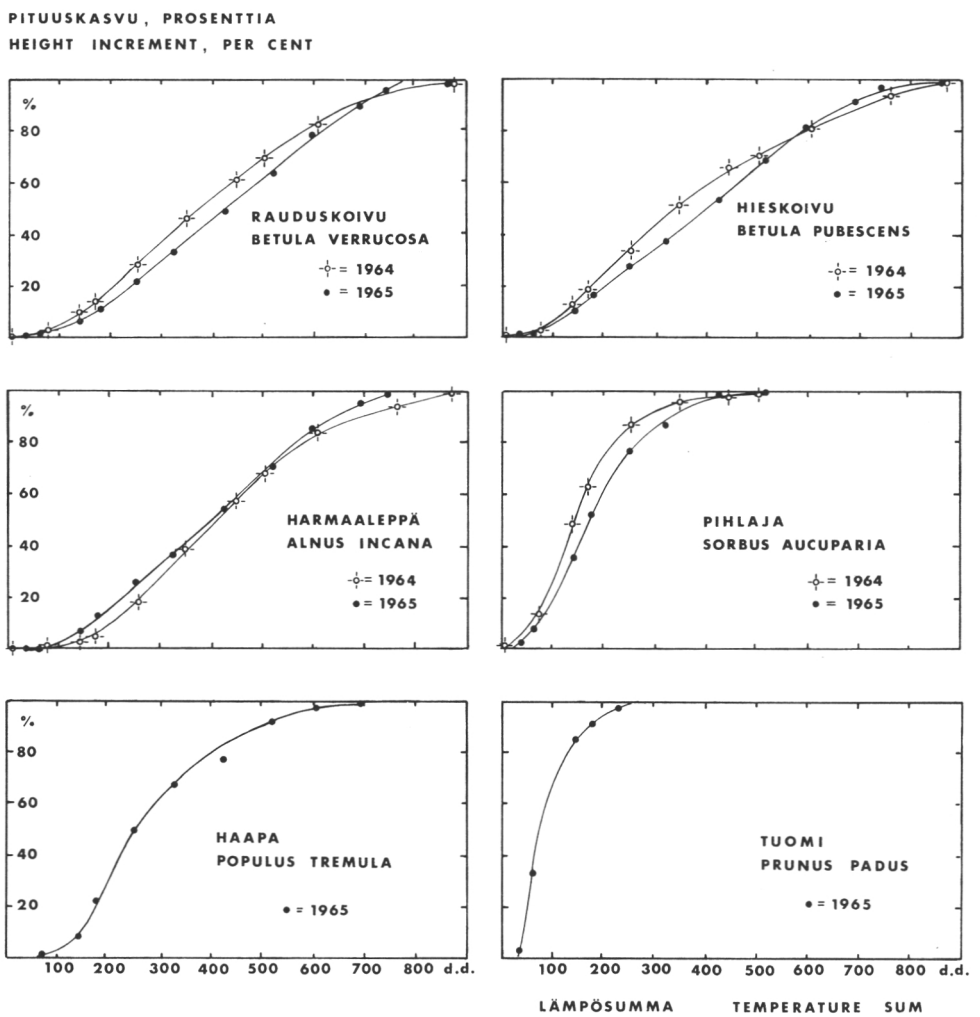
Puulaji *Tree species*	1964			1965		
	Alkaminen, d.d. *Initiation, d.d.*	Loppuminen, d.d. *Cessation, d.d.*	Kesto, d.d. *Duration, d.d.*	Alkaminen, d.d. *Initiation, d.d.*	Loppuminen, d.d. *Cessation, d.d.*	Kesto, d.d. *Duration, d.d.*
Mänty (*Pinus sylvestris* L.) ..	10	520	510	5	510	505
Kuusi (*Picea abies* (L.) Karst.)	60	780	720	50	660	610
Pihta (*Abies sibirica* Ledeb.) ..	120	780	660	115	770	655
Sembra (*Pinus Cembra* L.) ..	—	—	—	10	560	550
Kataja (*Juniperus communis* L.)	—	—	—	5	850	845
Rauduskoivu (*Betula verrucosa* Ehrh.)	30	880	850	50	850	800
Hieskoivu (*Betula pubescens* Ehrh.)	20	880	860	30	825	795
Harmaaleppä (*Alnus incana* (L.) Moench.)	40	850	810	35	845	810
Pihlaja (*Sorbus aucuparia* L.) .	15	510	495	20	445	425
Haapa (*Populus tremula* L.) ..	—	—	—	60	700	640
Tuomi (*Prunus padus* L.)	—	—	—	20	250	230
Paatsama (*Rhamnus frangula* L.)	—	—	—	60	750	690



Kuva 3 a. Eri puulajien pituuskasvun kumulatiivinen kulku vuosina 1964 ja 1965. Mänty, kuusi, sembra, kataja, pihta ja paatsama.

Fig. 3 a. The development of the cumulative height growth of different tree species in 1964 and 1965.

pumisajankohdan määrittämisessä voitiin sen sijaan käyttää edellä esiteltyä, käsitteellisesti selvää menettelyä. Niiden puulajien osalta, joista oli riittävästi havaintoja, laadittiin taulukko, josta ilmeni kunkin yksityisen koepuun kohdalla, milloin sen katsottiin lopettaneen pituuskasvunsa. Saadut tulokset siirrettiin frekvenssipaperille, jonka avulla määritettiin ao. puulajin pituuskasvun keskimääräinen loppumisajankohta lämpösumman suhteen (kuva 2). Viiden puulajin osalta koepuiden lukumäärä oli niin vähäinen, että edellä kuvattua menettelyä ei katsottu voitavan käyttää. Näiden puulajien kasvun loppumisen ajankohta määrättiin graafisesti samalla tavoin kuin kasvun alkaminenkin.



Kuva 3 b. Eri puulajien pituuskasvun kumulatiivinen kulku vuosina 1964 ja 1965. Rauduskoivu hieskoivu, harmaaleppä, pihlaja, haapa ja tuomi.

Fig. 3 b. The development of the cumulative height growth of different tree species in 1964 and 1965,

3. TUTKIMUSTULOKSET

Eri puulajien pituuskasvun keskimääräisten alkamis- ja loppumisajankohtien lämpösummat on esitetty taulukossa 2. Eri puulajien pituuskasvun alkamisen järjestys aikaisimmasta myöhäisimpään muodostuu tämän tutkimuksen mukaan seuraavaksi: mänty, kataja, sembra, tuomi, pihlaja, hieskoivu, harmaaleppä, rauduskoivu, kuusi, haapa, paatsama ja pihta. Silmun sisäisessä kehityksessä puulajin kasvun alkamisjärjestys saattaa kuitenkin olla toinen.

Taulukko 3. Eri puulajien pituuskasvun kesto, kasvaimen pituus sekä keskimääräinen kasvunopeus

Table 3. The duration of the height growth, the lenght of the annual shoot, and the average rapidity of the growth

Puulaji *Tree species*	1964			1965		
	Pit.kasvun kesto, d.d. *Duration of height growth, d.d.*	Kasvaimen kokon.pit., cm *Height of the annual shoot, cm*	Keskim. kasvu, mm/100 d.d. *Increment, mm/100 d.d.*	Pit.kasvun kesto, d.d. *Duration of height growth, d.d.*	Kasvaimen kokon.pit., cm *Height of the annual shoot, cm*	Keskim. kasvu, mm/100 d.d. *Increment, mm/100 d.d.*
Mänty *(Pinus sylvestris* L.) ..	510	40.6	79.6	505	19.0	37.6
Kuusi *(Picea abies* (L.) Karst.)	720	41.3	77.4	610	29.5	48.4
Pihta *(Abies sibirica* Ledeb.) ..	660	30.3	45.9	655	29.5	45.0
Sembra *(Pinus Cembra* L.) ..	—	—	—	550	22.1	40.2
Kataja *(Juniperus communis* L.)	—	—	—	850	8.2	9.6
Rauduskoivu *(Betula verrucosa* Ehrh.)	850	54.9	64.6	800	48.3	60.4
Hieskoivu *(Betula pubescens* Ehrh.)	860	47.6	55.3	795	49.2	61.9
Harmaaleppä *(Alnus incana* (L.) Moench.)	810	58.7	72.5	810	43.1	53.2
Pihlaja *(Sorbus aucuparia* L.) .	495	29.2	56.9	425	39.7	93.4
Haapa *(Populus tremula* L.) ..	—	—	—	640	38.2	59.7
Tuomi *(Prunus padus* L.)	—	—	—	230	20.7	90.0
Paatsama *(Rhamnus frangula* L.)	—	—	—	690	24.0	34.8

Pituuskasvun loppumisen osalta eri puulajien välinen järjestys on seuraava: ensin tuomi ja sitten pihlaja, mänty, sembra, kuusi, haapa, paatsama, pihta, harmaaleppä, hieskoivu, rauduskoivu ja viimeiseksi kataja.

Taulukkoon 2 on edelleen laskettu pituuskasvun kesto kasvun alkamis- ja loppumislämpösummien perusteella. Lyhin kesto on tuomella, vain 230 d.d., sitten seuraavat järjestyksessä pihlaja, mänty, sembra, pihta, haapa, kuusi, paatsama, harmaaleppä, hieskoivu ja rauduskoivu sekä viimeisenä pisimmän pituuskasvukauden omaava kataja.

Kuviin 3 a ja b on koottu eri puulajien pituuskasvun keskimääräinen kulku sadanneksina vuoden koko pituuskasvun määrästä. Verrattaessa toisiinsa vuosina 1964 ja 1965 tehtyjä havaintoja, huomataan eri vuosien kasvuhavaintojen vastaavan toisiaan melko hyvin niin, että jopa yhteisen, silmävaraisen kuvaajan piirtäminen olisi ehkä ollut oikeutettua. Kun verrataan lämpösummien lisääntymistä kumpanakin vuonna (kuva 1) on selvää, että ilmaistaessa eri puulajien kasvun ajoittuminen esim. kalenteripäiviin sidottuina havaintoina, yhdenmukaisuus eri vuosien välillä on paljon vähäisempää (vrt. esim. R o m e l l 1925, S c h o b e r 1967).

Verrattaessa toisiinsa puiden vuotuisen pituuskasvun määrää ja kasvun aikana kertynyttä lämpösummaa (taulukko 3), osoittautuivat tuomi ja

pihlaja nopeimmin kehittyviksi puulajeiksi. Tämän jälkeen seuraavat järjestyksessä hieskoivu ja rauduskoivu, haapa, harmaaleppä, mänty, kuusi, pihta, sembra, paatsama sekä viimeisenä perin hidaskasvuinen kataja. Huomattava on varsinkin männyn kasvuvauhdin erilaisuus peräkkäisinä vuosina. Vaikka pituuskasvaimen muodostumiseen on kumpanakin vuonna kulunut keskimäärin lähes sama lämpösumma, syntyneen latvakasvaimen pituus on v. 1965 ollut vain vajaa puolet vuonna 1964 syntyneestä. Pihdan, rauduskoivun ja hieskoivun pituuskasvu on määrältään ollut vuodesta toiseen tasaista, kun taas esim. pihlajan ja harmaalepän kasvainten pituuksissa on suurta vaihtelua.

4. TULOSTEN TARKASTELUA

Latvasilmun tiedetään olevan juuri sen verson osan, jonka kautta niin primaarinen kuin sekundaarinenkin kasvusolukko keväällä saa hormoni-impulssin vuotuisen kasvun alkamiseksi (esim. Romberger 1963, Kozlowski 1971). Latvasilmu on myös välittömästi alttiina ilman lämpötilan vaihteluille, joten voidaan ymmärtää, että juuri puiden silmujen puhkeamista ja pituuskasvun ajoittumista on voitu käyttää eräänä tärkeimmistä fenologisista indikaattoreista (esim. Schnelle 1955 ym.). Myös metsäpuiden provenienssikokeissa on pituuskasvun ajoittuminen katsottu tärkeäksi ja monessa mielessä myös parhaaksi tunnusmerkiksi yritettäessä mitata provenienssien sopeutumiskykyä niille uuteen ilmastoon (esim. Hagner 1970 a, b, Dietrichson 1969, 1971). Yleisesti on menetelty siten, että alku- tai keskikesän tiettynä päivänä on mitattu puiden kasvaimen pituus. Kunkin puun latvakasvaimen tuohon mennessä saavuttaman pituuden prosenttista osuutta kasvaimen kokonaispituudesta on sitten käytetty provenienssia kuvaavana tunnuslukuna.

Niin kuvaavia suhteellisia arvoja kuin tällä tavoin saadaankin, on erilaisissa ilmasto-oloissa tehtyjen kokeiden vertaaminen toisiinsa hyvin vaikeata. Pelkän päivämäärän käyttö ajan yksikkönä, jota tapaa tähän mennessä on noudatettu, ei vielä ilmaise juuri mitään vuotuisen pituuskasvun ajoittumisesta ao. tutkimuspaikalla, ja paremman vertailupohjan saamiseksi on käytettävä puiden pituuskasvun luontaiseen rytmiin joustavammin soveltuvia ajan määrityskeinoja. Tämän tutkielman tulokset viittaavat siihen, että eri puiden pituuskasvun ajoittuminen olisi lämpösumman avulla kuvattavissa jokseenkin luotettavasti vuodesta toiseen. Tämän perusteella voidaan olettaa, että esim. provenienssikokeiden standardoinnissa siirtyminen lämpösumman käyttöön pituuskasvumittauksissa auttaisi huomattavasti poistamaan eri vuosien sääsuhteiden ja eri paikkojen ilmasto-olojen aiheuttamaa, usein huomattavaa vaihtelua.

Pituuskasvun alkamista ja myös sen kulun nopeutta säätelee lämpötekijä niin selvästi, että yksinkertaisenkin lämpösumman käyttö on tässä suhteessa oikeutettua. Sen sijaan pituuskasvun loppumiseen, uuden silmun muodostumiseen ja sen verson talveentumiseen vaikuttavia syitä on esitetty useita, kuten esim. päivien lyheneminen syksyä kohti siirryttäessä, ilman lämpötilan minimiarvot jne. (esim. Langlet 1943, Dormling 1973, ym. 1968, Magnesen 1969, 1971, 1972, Leikola 1970 ja Sarvas 1972). Tähän monitahoiseen kysymykseen ei tämän tutkielman yhteydessä ole kuitenkaan aihetta puuttua syvemmälti.

Eri puulajien pituuskasvun keskinäinen ajoittuminen noudatti tässä tutkielmassa pääpiirtein niitä tuloksia, joita mm. Romell (1925) sekä Huikari ja Paarlahti (1967) ovat esittäneet. Muutamia eroja Heikinheimon (1956) julkaisemiin havaintoihin voidaan kuitenkin osoittaa.

Lyr ja Hoffmann (1965, Hoffmann 1972, Hoffmann ym. 1973) ovat jakaneet eri puulajit niiden pituuskasvun ajoittumisen ja keston perusteella kahteen ryhmään: Quercus-tyyppiin, jota luonnehtivat lyhytaikainen ja voimakas pituuskasvu alkukesällä (ryhmään kuuluvat mm. *Quercus*, *Fagus*, *Pinus* ja *Abies*-suvut), sekä Populus-tyyppiin, jonka pituuskasvu kestää pitkälle loppukesään (ryhmään kuuluvat mm. *Populus*, *Robinia*, *Larix* ja *Betula*-suvut). Jos tämän tutkielman aineistoon sisällytettyjä puulajeja tarkastellaan esitetyn ryhmäjaon puitteissa, mänty, sembra, pihlaja ja tuomi asettuvat selvästi edelliseen, lyhyen pituuskasvun keston omaavaan tyyppiin. Kuusi, pihta ja haapa ovat tavallaan välittävänä ryhmänä, ja kataja, rauduskoivu, hieskoivu, harmaaleppä ja paatsama kuuluvat selvästi jälkimmäiseen, pitkän pituuskasvun keston omaavaan tyyppiin.

Pituuskasvun ajoittuminen on eräs selvimpiä puiden perimän ilmauksia, ja se on myös eräs käyttökelpoisimmista tunnuksista arvioitaessa puiden sopeutumista ilmastoon ja menestymistä kasvupaikalla. Toistaiseksi ovat tietomme edes pääpuulajiemme pituuskasvun ajoittumisesta vaatimattomat, ja mittausmenetelmät vielä vailla tarpeellista standardointia. Tällaisen perustyön jälkeen pituuskasvun ajoittuminen on epäilemättä eräs monikäyttöisimpiä puiden vuotuisen sykluksen biologisia indikaattoreita.

SUMMARY

The purpose of the study is to investigate the timing and sequence of the annual height growth of five coniferous and seven deciduous tree species and its dependence on the temperature sum. Field work for the study has been done at Punkaharju (61°47 N, 29°19 E, height 80 m. o.s.l.).

The order of commencement of height growth from the earliest to the latest was as follows: *Pinus sylvestris* L., *Juniperus communis* L., *Pinus Cembra* L., *Prunus padus* L., *Sorbus aucuparia* L., *Betula pubescens* Ehrh., *Alnus incana* (L.) Moench., *Betula verrucosa* Ehrh., *Picea abies* (L.) Karst., *Populus tremula* L., *Rhamnus frangula* L., and *Abies sibirica* Ledeb. The order of termination of height growth was, respectively, as follows: *Prunus padus* L., *Sorbus aucuparia* L., *Pinus sylvestris* L., *Pinus Cembra* L., *Picea abies* (L.) Karst., *Populus tremula* L., *Rhamnus frangula* L., *Abies sibirica* Ledeb., *Alnus incana* (L.) Moench, *Betula pubescens* Ehrh., *Betula verrucosa* Ehrh., and *Juniperus communis* L.

The order of duration of the period of height growth from the shortest to the longest was as follows: *Prunus padus* L., *Sorbus aucuparia* L., *Pinus sylvestris* L., *Pinus Cembra* L., *Abies sibirica* Ledeb., *Populus tremula* L., *Picea abies* (L.) Karst., *Rhamnus frangula* L., *Alnus incana* (L.) Moench, *Betula pubescens* Ehrh., *Betula verrucosa* Ehr., and *Juniperus communis* L.

The temperature turned out to characterize the timing of the height growth in the two successive years. The possibilities of using temperature sum in provenance trials are discussed. Also the two types of timing of the height growth, proposed by L y r and H o f f m a n n, are valuated.

TIIVISTELMÄ

Tutkimuksen tarkoituksena on esitellä viiden havupuu- ja seitsemän lehtipuulajin pituuskasvun ajoittumista ja sen riippuvuutta lämpösummasta. Mittaukset on suoritettu Punkaharjulla vv. 1964 ja 1965.

Eri puulajien pituuskasvun alkamisen järjestys aikaisimmasta myöhäisimpään osoittautui seuraavaksi: mänty, kataja, sembra, tuomi, pihlaja, hieskoivu, harmaaleppä, rauduskoivu, kuusi, haapa, paatsama ja pihta. Pituuskasvun loppumisen osalta eri puulajien vastaava järjestys oli seuraava: tuomi, pihlaja, mänty, sembra, kuusi, haapa, paatsama, pihta, harmaaleppä, hieskoivu, rauduskoivu ja kataja.

Pituuskasvun kestoajan järjestys lyhimmästä pisimpään oli seuraava: tuomi, pihlaja, mänty, sembra, pihta, haapa, kuusi, paatsama, harmaaleppä, hieskoivu, rauduskoivu ja kataja.

Lämpösumma osoittautui tyydyttäväksi eri vuosien pituuskasvun ajoittumisen kuvaajaksi. Tulosten tarkastelussa pohditaan mahdollisuuksia käyttää lämpösummaa provenienssikokeiden pituuskasvumittausten ajankohdan standardoimiseen.

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DETERMINATION OF THE RADIAL GROWTH OF A TREE FROM CIRCUMFERENCE MEASUREMENTS

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PREFACE

This study was carried out at the Department of Soil Science, Finnish Forest Research Institute, and attempted to find ways of improving the method of radial growth measurement to be used in forest fertilization experiments. Moreover, it is thought that the results may be applicable to other kinds of growth studies, too.

I am indebted to Professors P. J. Viro and Yrjö Vuokila for their valuable advice in preparing the manuscript. Most of the calculations and part of the field work was done by Messrs. Väinö Harjuaho, M.For., and Reijo Jokinen. Messrs. Alpo Heikkinen, Teuvo Levula and Arto Ursin were responsible for the rest of the field work. The figures were drawn by Miss Hillevi Sinkko, who also typed the manuscript. The language was checked by Mr. John Derome, B.Sc. (Birmingham). To all these people I would like to express my sincere thanks.

Helsinki, November 1973

Erkki Lipas

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1. INTRODUCTION

The radial growth of a tree trunk is commonly measured from samples taken with an increment borer. The method is especially suitable for use on temporary sample plots, where the injuries to trees resulting from borings will not affect future results. However, if the same trees are submitted to periodical measurements, as in the case of permanent sample plots, borings should be avoided since the injuries may affect the growth of the trees (Schöpfer 1961, Prodan 1965, p. 458).

If borings are to be avoided, they must be replaced by calculating the difference between two sequential measurements of the thickness of the trees. The thickness can be determined by measuring one or several diameters of the trunk, or by circumference measurements. The latter method is recommended especially for permanent sample plots since the reproducibility of the values is likely to be better than with diameter measurements (Prodan 1965, p. 20).

The circumference growth can be measured either by means of a permanently installed girth band, or with a measuring tape. The former method has been used in Finland in growth studies on peatlands since 1955 (Huikari and Paarlahti 1967), and more recently also in other studies on a small scale (Viro 1967, Leikola 1969). The girth band, however, is by no means a recent invention, since it has been used already in the 19th century, as Leikola (1969) points out.

Huikari and Paarlahti (1967) have reported that the precision of the girth band method is ± 2.9 % for pine, ± 3.2 % for birch and ± 3.2 % for spruce. These figures were obtained as average deviations of the readings of adjacent bands on the same tree during one growth period. Kanerva (1963) also studied the reliability of girth band measurements on 161 pine trees on peatland during one growth period. He obtained the regression equation $y = 0.43 + 4.65x$ between circumference growth (y) and radial growth from core samples (x). The degree of determination of the regression was 71 per cent.

The use of measuring tape is of still older origin than that of girth band, since is has been used in practical forestry already in the 18th century (Prodan 1965, p. 19). More recently, however, it has been replaced by

diameter measurements in most countries, including Finland. For this reason, no recorded information concerning the tape method can be found in this country. However, it has been reported to give more precise results than diameter measurement e.g. by Chaturvedi (1926) and Matérn (1956).

In the fertilizer experiments of the Department of Soil Science, Finnish Forest Research Institute, the radial growth of the sample trees has been measured mostly from core samples, although circumference measurements have also been used on a smaller scale. It is from these measurements that the material of this study has been compiled. The purpose of this study was to examine the reliability of the difference between successive circumference measurements as an indicator of the radial growth. The increment of the circumference has been measured both with girth bands and with measuring tape, and has been compared with the radial growth obtained from core samples.

2. MATERIAL AND METHODS

The material consists of sample trees of Scots pine (*Pinus silvestris* L.) and Norway spruce (*Picea abies* Karst.) in some of the fertilizer experiments of the Department of Soil Science. The sample plots were set up for studying the effect of different doses and brands of fertilizers on tree growth, and the development of the tree diameters has been followed by means of annual circumference measurements.

On the basis of the location, method of measurement, and species of the sample trees, the material is divided into six groups (Table 1). The size of the trees was approximately the same in each group, which thus makes comparison between the groups possible. With the exception of spruces growing in North Finland, the material groups were very homogeneous, and their site types are characteristic of each species (Table 2).

The girth bands of galvanized steel used in this study were of the same type as those used by H u i k a r i and P a a r l a h t i (1967). The band was installed on the smoothed surface of the bark at a height of 1.3 m, with a strip of plastic film placed under the band to reduce friction. The distance between two measuring holes punched in the band was measured using a sliding caliper with the accuracy of 0.01 mm. In order to reduce the error caused by swelling and shrinking of the stem (cf. L e i k o l a 1969), at least two readings (1—2 weeks between each) were taken both before the start of the growing season and after the cessation of it. The averages of the two readings were used in calculating the circumference growth.

The tape measurements were made in the spring and autumn of the first year, and each autumn thereafter. Each time only one measurement was made on each tree. The tape used is made of flexible steel (manufactured by Bayerische Mass-Industrie), and is provided with a scale for direct reading of diameter with the accuracy of 0.1 mm. The measuring levels at a height of 1.3 m were marked on the smoothed surface of the bark with two parallel painted rings, between which the tape was placed for each measurement.

The radial growth figures inside bark were obtained at the end of the study period by taking core samples with an increment borer from opposite

Table 1. The material groups
Taulukko 1. Aineistoryhmät

Group *Ryhmä*	Region *Alue*	Method of measurement *Mittaustapa*	Tree species *Puulaji*	No. of sample trees *Koepuiden lukumäärä*	$\bar{d}_{1.3}$ cm	s cm	Coeff. of var. % *Var.kerroin*
I	South Finland *Etelä-Suomi*	Band — *Panta*	Pine — *Mänty*	434	24.6	5.4	22
II	»	»	Spruce — *Kuusi*	212	24.2	6.1	25
III	»	Tape — *Nauha*	Pine — *Mänty*	200	24.1	3.4	14
IV	»	»	Spruce — *Kuusi*	225	23.9	5.5	23
V	North Finland *Pohjois-Suomi*	»	Pine — *Mänty*	160	23.6	5.0	21
VI	»	»	Spruce — *Kuusi*	119	23.2	8.5	37

Table 2. The experimental stands within the material groups.
Taulukko 2. Koemetsiköt aineistoryhmittäin

Group *Ryhmä*	Location of the stand *Metsikön sijainti*	Site type[1]) *Metsätyyppi*	No. of sample trees *Koepuiden lukumäärä*
I	Punkaharju	VT	434
II	Kuorevesi	MT	212
III	Elimäki	VT	40
	Padasjoki	VT	40
	Pomarkku	VT	40
	Savitaipale	VT	40
	Suomusjärvi	CT	40
IV	Elimäki	MT	40
	Parkano	MT	40
	Pomarkku	MT	40
	Savonranta	MT	40
	Savonranta	MT	20
	Suomusjärvi	MT	45
V	Rovaniemi mlk	EMT	40
	Salla	EMT	40
	Sodankylä	EMT	40
	Ylitornio	EVT	40
VI	Posio	HMT	40
	Sodankylä	HMT	20
	Sodankylä	HMT	20
	Suomussalmi	DeMT	39

[1]) According to Cajander (1949)

sides of the trunk. The radial growth was determined in the laboratory by means of a machine designed for annual ring measurement, the accuracy of the readings being 0.01 mm. The average of the growth figures from the two opposite core samples was taken as the »true radial growth» when comparisons were made with the other methods.

As additional data, diameter and thickness of the bark at breast height were measured on each sample tree at the beginning of the study.

The figures obtained from the circumference measurements were converted into respective radial growth figures, and compared with figures from the core samples. The comparison was made by means of a regression analysis.

3. ACCURACY OF THE CIRCUMFERENCE MEASUREMENTS

31. Growth During a Number of Years

Circumference measurements in the different material groups were carried out in the following years:

Group I: Girth band measurements of pine 1967—70
Group II: Girth band measurements of spruce 1965—69
Groups III—VI: All the tape measurements 1968—72

It was thus possible to study five years' growth in group II, and four years' growth in all the other groups. In order to make the comparison easier, all the growth figures were converted into average annual growth for the period in question.

The correlations between the radial growth values obtained from the circumference measurements and those from the two opposite core samples per tree are shown in Table 3. It can be seen that in general there was a quite good agreement between the two variables. In South Finland, more than 89 per cent of the variation was determined by the variation in circumference growth, and in North Finland 84—88 per cent. The standard deviation of the residual variation (s_e) varied between 0.12—0.18 mm/year, being smaller in North Finland than in the South.

On the average, the radial growth from the circumference measurements was repeatedly higher than that from the core samples, as is shown in

Table 3. The regression of the average annual radial growth during 4—5 years, measured from core samples (y), on that obtained from circumference measurements (x).

Taulukko 3. Kairaamalla (y) ja ympärysmittauksella (x) saadun 4—5 vuoden aikaisen keskimääräisen vuotuisen sädekasvun välinen riippuvuus.

Group *Ryhmä*	Regression equation *Regressioyhtälö*	s_e	100 R^2 %
I	$y = 0.0445 + 0.929x$	0.18	89.4
II	$y = 0.0914 + 0.859x$	0.14	91.6
III	$y = -0.1005 + 0.903x$	0.17	92.0
IV	$y = -0.0030 + 0.938x$	0.13	94.1
V	$y = -0.0555 + 0.862x$	0.13	88.4
VI	$y = 0.0450 + 0.749x$	0.12	83.7

Table 4. A natural explanation for this is that the circumference measurements include the growth of the bark, while core samples give the growth without bark. Consequently, the difference between the two growth figures should indicate the increment of bark thickness. The proportion of bark growth of the total radial growth, calculated in this manner, was on the average as follows:

I	II	III	IV	V	VI
4.6 %	4.9 %	15.1 %	6.3 %	19.4 %	20.4 %

These figures can be compared with the average figures for bark growth presented by Ilvessalo (1965, p. 150), which are, in stands of comparable size, 5—7 per cent for pine and about 5 per cent for spruce. Accordingly, with band measurements as well as tape measurements of spruce (groups I, II, and IV), an approximately correct estimation of bark growth was obtained. On the other hand, the tape measurements of pine in South Finland, and those of both pine and spruce in North Finland (groups III, V, and VI) included an obvious over-estimation of bark growth. Thus the difference between the radial growth values from circumference measurements and from core samples cannot in general be thought to be only due to bark growth, but there must also be other factors involved. Possible causes for the over-estimation are roughness of the bark and deviation of the cross-section of the stem from a circular form (Matérn 1956).

The accuracy in estimation of the radial growth by means of circumference measurements of a single tree was examined by calculating the 95 per cent confidence limits for a single estimate at the average level of growth. The calculation was carried out by multiplying the residual standard deviation of the regression estimate (s_e in Table 3) by the respective t-value. It was possible to replace the standard deviation for a single observation

$$s_y = s_e \sqrt{1 + 1/n + (x - \bar{x})^2/\Sigma(x - \bar{x})^2}$$ (Snedecor 1962, p. 138)

with s_e because of the large number of observations (n) and x being equal to $\bar{x}$. The confidence limits are presented in Table 4.

As is shown in the table, the absolute values of the deviations were slightly higher in South Finland (groups I—IV) than in North Finland. The relative deviation from the mean, however, was in North Finland clearly larger than in South Finland, due to the lower level of growth in the North. With pine, no essential differences were noticed between the accuracies of band and tape measurements, whereas with spruce the tape was more accurate than the band.

Table 4. Reliability of circumference measurements in predicting the radial growth by means of the equations of Table 3.

Taulukko 4. Ympärysmittausten luotettavuus sädekasvun ennustamisessa taulukossa 3 esitettyjen yhtälöiden avulla

Group *Ryhmä*	$\bar{x}$	$\bar{y}$	95 % confidence limits for $\bar{y}$ with single observation *Yksitt. havainnon 95 %luotettavuusrajat $\bar{y}$:lle*	
	mm/year *mm/v.*		±mm	± % of $\bar{y}$ *$\bar{y}$:stä*
I	1.73	1.65	0.36	22
II	1.03	0.98	0.27	28
III	1.79	1.52	0.33	22
IV	1.59	1.49	0.26	17
V	1.03	0.83	0.25	30
VI	0.93	0.74	0.24	33

32. Annual Growth

The annual development of the radial growth was studied from a material reduced by drawing 20—40 per cent random samples from the total population of each material group. Thus the final number of observations varied between 50—87 (Table 5). All the examinations concerning the annual growth are based on this reduced material.

The compatibility of annual means of radial growth from circumference measurements and core samples is illustrated in the graphs of Figure 1. It can be seen that although the circumference measurements generally gave higher growth values than the core samples, the differences varied remarkably from year to year. This may be partly due to differences in annual growth of the bark, but it may also reflect variations in the accuracy of measurements carried out in different years.

The graphs for the band measurements (I and II) deviate from the others in that they indicate that the growth from the circumference measurements has in some years been smaller than that from the core samples. In the case of pine, a corresponding result was obtained during the first year, after which the bark growth began to become apparent. A possible explanation lies in the fact that the stiff metal band was not necessarily tight enough around the trunk in the beginning, so that there were empty spaces between the band and the stem. In such cases it is possible for the tree to grow without producing a respective change in the band readings. Only in the second, or in some cases in the third year has the band started to respond to the tree growth reliably.

In the band measurements of spruce (graph II), the results show a development opposite to that for pine. During the first and second years the growth indicated by the bands was higher than that from the core

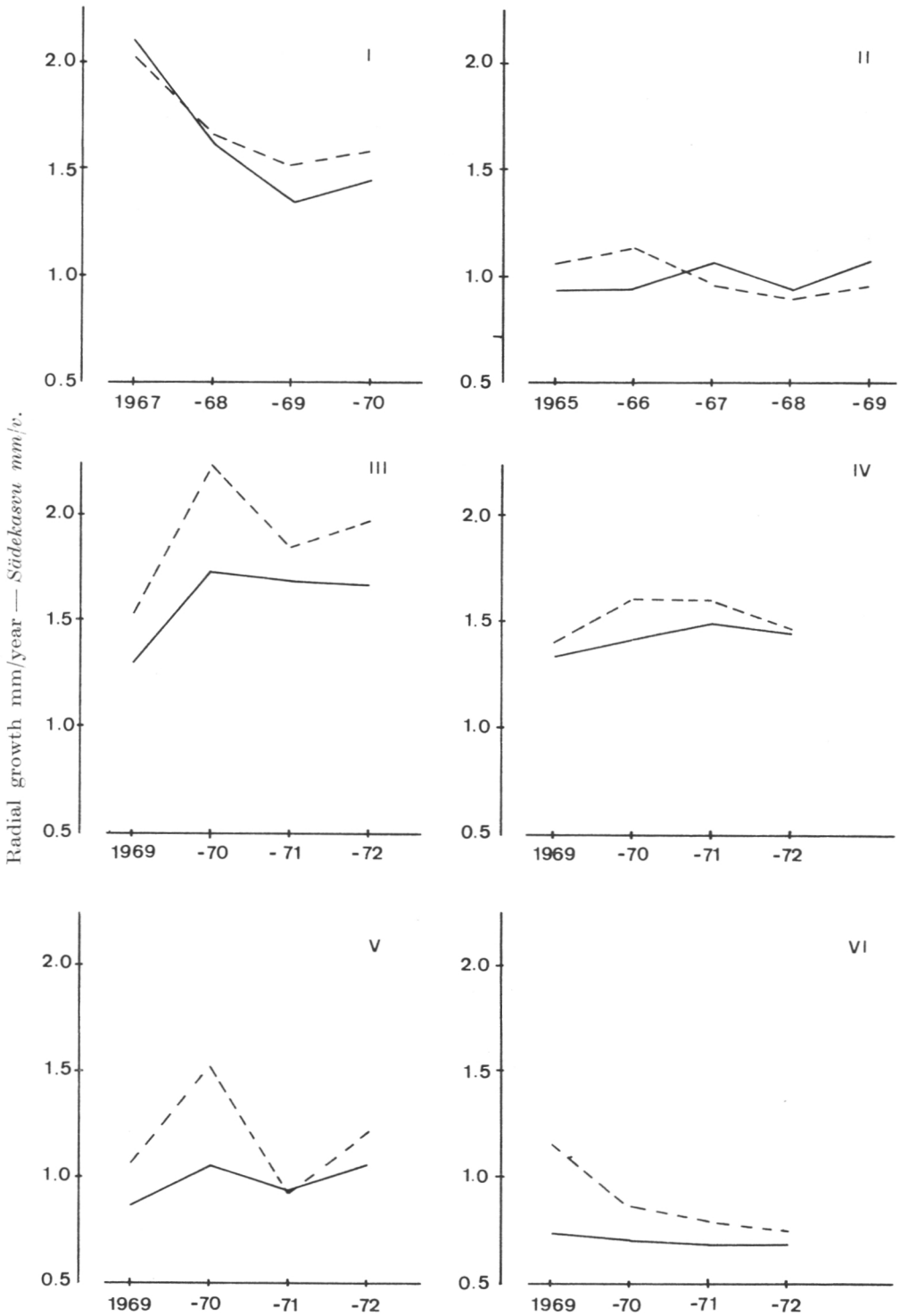


Figure 1. The current annual radial growth obtained from circumference measurements (broken line), and from core samples (continuous line).

Kuva 1. Juokseva vuotuinen sädekasvu ympärysmittauksella (katkoviiva) ja kairauksella (ehyt viiva) määritettynä.

samples, but in the following years it remained lower. The main reason for this may be that the band to some extent sank into the bark, which was evident from the grooves left in the bark when the bands were removed at the end of the experiment. For this reason it must be concluded that band measurements are not to be recommended for spruce, at least for a period lasting several years.

The results from the tape measurements (graphs III—VI) indicate that they were more reliable in responding to radial growth than the band measurements. However, the variation in the apparent annual growth of the bark may be of such a magnitude especially in the case of pine (e.g. graph V) that measuring the annual development of growth with a tape may lead to erroneous conclusions. In the case of spruce the tape seems to be a more reliable tool than in the case of pine.

In order to study the accuracy of the annual observations of the radial growth by means of circumference measurements, regression equations were calculated for each year. Their degrees of determination and the 95 per cent limits of reliability for a single observation are given in Table 5.

The degrees of determination are in good agreement with the results shown in Figure 1. Especially noticeable is the low correlation in band measurements of spruce in the first year, and again in the third year when the depression of the bark began. In tape measurements there is a lower degree of determination in the first year than later on in each material group. This can be interpreted to indicate the important effect technique has on the accuracy. After the »training year» the results became more reliable.

According to Table 5, the error included in one year's measurements of a single tree may produce up to 0.7 mm error in the radial growth inside the bark. In general, the reliability has been ± 0.3—0.5 mm, corresponding to a relative error of ± 30—50 per cent depending on the magnitude of the growth.

33. Effect of Diameter on the Accuracy

In the preliminary examination of the material, both trunk diameter and bark thickness were tried as independent variables in addition to the radial growth from the circumferences. The results of stepwise regression analysis revealed, however, that the two variables did not increase the degree of determination by very much. The following figures from band measurements of pine may serve as an example:

Independent variables	**100 R^2**
Band measurements	89.4
Band measurements and diameter	90.1
Band measurements, diameter, and bark	90.1

Table 5. Reliability of the radial growth from circumference measurements (x) in predicting the radial growth from core samples (y) at the average level of growth in different years.

Taulukko 5. Ympärysmittauksella saadun sädekasvun (x) luotettavuus kairatun sädekasvun (y) ennustamisessa keskimääräisellä kasvun tasolla eri vuosina.

Group *Ryhmä*	No. of observations *Havaintojen lukumäärä*	Year *Vuosi*	100 R^2 %	$\bar{x}$	$\bar{y}$	95 % confidence limits for $\bar{y}$ with single observation *Yksitt. havainnon 95 % luotettavuusrajat $\bar{y}$:lle*	
				mm/year *mm/v.*		±mm	± % of $\bar{y}$ *y:stä*
I	87	1967	90.2	2.03	2.10	0.54	26
		—68	88.2	1.66	1.62	0.45	28
		—69	86.3	1.52	1.35	0.38	28
		—70	83.5	1.58	1.45	0.47	32
II	64	1965	41.0	1.07	0.94	0.63	67
		—66	87.0	1.14	0.95	0.36	38
		—67	56.4	0.96	1.06	0.74	70
		—68	76.9	0.90	0.94	0.42	45
		—69	70.4	0.96	1.07	0.51	48
III	80	1969	68.6	1.53	1.30	0.54	42
		—70	83.5	2.24	1.74	0.56	32
		—71	85.9	1.85	1.69	0.49	29
		—72	80.5	1.97	1.68	0.51	30
IV	80	1969	73.8	1.41	1.34	0.56	42
		—70	87.0	1.62	1.42	0.39	27
		—71	90.4	1.61	1.49	0.41	28
		—72	85.9	1.47	1.45	0.43	30
V	64	1969	63.0	1.06	0.87	0.47	54
		—70	74.3	1.52	1.05	0.49	47
		—71	87.4	0.92	0.93	0.32	34
		—72	74.8	1.22	1.06	0.49	46
VI	50	1969	53.4	1.16	0.74	0.40	54
		—70	63.0	0.87	0.71	0.32	45
		—71	69.1	0.79	0.69	0.30	43
		—72	77.1	0.75	0.68	0.29	43

It can be seen that after diameter was added, the bark thickness did not increase the degree of determination. This was probably due to strong correlation between diameter and bark thickness (cf. Ilvessalo 1965, p. 67). Because of this, only the effect of diameter on the accuracy of the circumference measurements was studied more thoroughly.

For the purpose of this examination, the material was classified in five centimeter classes according to the diameter at a height of 1.3 m on the sample trees at the beginning of the measurements. For each diameter

Table 6. The effect of diameter on the correlation of the radial growth during 4—5 years obtained from circumference measurements with the respective growth from core samples.

Taulukko 6. Läpimitan vaikutus ympärysmittauksella saadun 4—5 vuoden sädekasvun korrelaatioon vastaavan kairatun kasvun kanssa.

$D_{1.3}$ cm	Material group — *Aineistoryhmä*					
	I	II	III	IV	V	VI
	Correlation coefficient — *Korrelaatiokerroin*					
15	0.98	0.98	0.98	0.98	0.92	0.91
20	0.94	0.98	0.96	0.96	0.95	0.93
25	0.95	0.95	0.95	0.98	0.96	0.94
30	0.95	0.94	0.97	0.96	0.90	0.90
35	0.94	0.93		0.96	0.99	
40	0.97					0.89

class, correlation coefficients between the radial growth from circumference measurements and that from core samples were calculated.

As can be seen in Table 6, the correlations did not reveal any dependence of the accuracy of the circumference measurements on the diameter. Since the material was mostly concentrated in the diameter classes 20, 25 and 30 cm (cf. Table 1), it can be concluded that at least within the range 17—32 cm, diameter did not affect the results.

In order to verify the previous conclusion, the equations obtained for the average growth of the period (Table 3) were used to predict the mean growth in the different diameter classes. The predicted values (Table 7) were quite close to the measured values, deviations being in general not more than ± 6 per cent. However, in the measurements of pine (groups I, III and V), a slight tendency for the errors to be systematic is apparent, the deviations being negative with small diameters and positive with large diameters. Although a similar tendency is not seen in the case of spruce, the result suggests that diameter may have a small effect on the accuracy of circumference measurements. A possible reason for the dependence may be roughness of the bark which increases with the diameter.

34. Effect of the Number of Sample Trees on the Accuracy

In Tables 4 and 5, the accuracy of circumference measurements of a single tree has been examined. In most cases, however, the growth of a stand rather than that of a single tree is of interest, so that the number of sample trees needed to reach a certain level of accuracy should be known. For this purpose, the 95 per cent confidence limits were calculated for the

Table 7. Applicability of the regression equations presented in Table 3 to predict the average annual radial growth inside bark for 4—5 years in different diameter classes.

Taulukko 7. Taulukossa 3 esitettyjen regressioyhtälöiden soveltuvuus 4—5 vuoden keskimääräisen kuorettoman sädekasvun ennustamiseen eri läpimittaluokissa.

Group *Ryhmä*	$D_{1.3}$ cm	No. of obs. *Hav. lukum.*	Radial growth, mm/year *Sädekasvu, mm/v.*		Deviation of predicted from measured values *Ennusteen poikkeavuus kairatusta*	
			From borings *Kairattu*	Predicted *Ennuste*	mm	%
I	15	34	1.44	1.35	—0.09	—6
	20	124	1.58	1.54	—0.04	—3
	25	147	1.64	1.64	0.00	0
	30	94	1.78	1.82	+0.04	+2
	35	31	1.83	1.90	+0.07	+4
	40	4	1.71	1.83	+0.12	+7
II	15	26	0.70	0.74	+0.04	+6
	20	61	0.92	0.90	—0.02	—2
	25	63	1.00	1.00	0.00	0
	30	44	1.16	1.16	0.00	0
	35	18	1.05	1.04	—0.01	—1
III	15	6	1.45	1.39	—0.06	—4
	20	62	1.44	1.42	—0.02	—1
	25	98	1.54	1.55	+0.01	+1
	30	34	1.61	1.62	+0.01	+1
IV	15	25	1.19	1.16	—0.03	—3
	20	63	1.43	1.42	—0.01	—1
	25	82	1.55	1.57	+0.02	+1
	30	39	1.54	1.53	—0.01	—1
	35	15	1.74	1.74	0.00	0
V	15	18	0.86	0.83	—0.03	—3
	20	50	0.73	0.70	—0.03	—4
	25	53	0.80	0.80	0.00	0
	30	34	0.98	1.03	+0.05	+5
	35	5	1.00	1.04	+0.04	+4
VI	15	33	0.64	0.63	—0.01	—2
	20	28	0.73	0.73	0.00	0
	25	22	0.82	0.82	0.00	0
	30	20	0.83	0.78	—0.05	—6
	40	16	0.78	0.83	+0.05	+6

standard error of the mean. This was done by multiplying $s_e/\sqrt{n}$ with the respective t-value (S n e d e c o r 1962, p. 136), and calculating the result as a percentage of the mean growth obtained from borings.

The results for the average growth of the whole period are given in Table 8. It can be seen that increasing the number of sample trees from 5 to 15 considerably increased the accuracy, whereas the change produced by going from 15 to 25 trees was much smaller. However, there is much

Table 8. The effect of the number of sample trees on the reliability of the estimate of the average annual radial growth for 4—5 years.

Taulukko 8. Koepuiden lukumäärän vaikutus 4—5 vuoden keskimääräisen vuotuisen sädekasvun estimaatin luotettavuuteen.

Group *Ryhmä*	Ave. radial growth ($\bar{y}$) mm/year *Keskim. sädekasvu* ($\bar{y}$) *mm/v.*	No. of sample trees *Koepuiden lukumäärä*				
		5	10	15	20	25
		95 % confidence limits ± % of $\bar{y}$ *95 % luotettavuusrajat* ± % $\bar{y}$:*stä*				
I	1.65	15.6	8.0	6.2	5.1	4.5
II	0.98	19.7	10.1	7.7	6.5	5.7
III	1.52	13.8	7.9	6.1	5.2	4.6
IV	1.49	11.0	6.3	4.9	4.1	3.6
V	0.83	18.8	10.8	8.4	7.1	6.3
VI	0.74	20.6	11.9	9.2	7.8	6.9

variation between the groups which is partly due to differences in the magnitude of growth, and partly to differences in dispersion. Thus, if ±5 per cent is set as a maximum error, it can be calculated that in different groups the required number of sample trees would be as follows:

I	II	III	IV	V	VI
21	31	22	16	37	45

It can be seen that with the exception of band measurements of spruce (group II), 20 sample trees would be an approximately sufficient number in South Finland. On the other hand, in North Finland twice as many sample trees would be needed to reach an equal accuracy. If 20 trees were used also in North Finland, the accuracy would be ±7—8 per cent according to Table 8.

The effect of the number of sample trees on the accuracy of the annual growth measurements is shown in Table 9, where the accuracies of the estimates of the third year's growth are given. The third year was taken as an example so as to avoid the irregularities in the results which occurred at the beginning (cf. Figure 1).

Comparison of the figures of Tables 8 and 9 indicates that by using 30 sample trees, approximately the same accuracy can be reached in estimating one year's growth as with 20 sample trees in estimating the average growth for the period. An exception is again the band measurement of spruce which seems to be very inaccurate especially in estimating one year's growth. In the other groups ±5 per cent accuracy would be reached with approximately 35 sample trees in South Finland. In North Finland, 48 pine trees or 74 spruces should be measured in order to reach the ±5 per cent accuracy level in the example year.

Table 9. The effect of the number of sample trees on the reliability of the estimate of the radial growth of the third year of measurement.

Taulukko 9. Koepuiden lukumäärän vaikutus kolmannen mittausvuoden sädekasvun estimaatin luotettavuuteen.

Group *Ryhmä*	Year *Vuosi*	Radial growth ($\bar{y}$) *Sädekasvu* ($\bar{y}$) mm	No. of sample trees *Koepuiden lukumäärä*			
			10	20	30	40
			95 % confidence limits ± % of $\bar{y}$ *95 % luotettavuusrajat ± % $\bar{y}$:stä*			
I	1969	1.35	10.4	6.4	5.3	4.5
II	1967	1.06	25.5	16.4	13.1	11.2
III	1971	1.69	10.7	6.9	5.4	4.7
IV	1971	1.49	10.1	6.5	5.1	4.4
V	1971	0.93	12.7	8.1	6.5	5.5
VI	1971	0.69	15.7	10.1	8.0	6.8

The presented limits of error are based on the dispersion of errors in measurements. In order to get the real confidence limits for a stand, the sampling error should be added to the limits of error. However, since the sampling error is in general very small even with 20 sample trees (N y y s s ö n e n 1951), the presented limits of error with 20 or more sample trees may probably be regarded as true confidence limits for the estimate of the radial growth of a stand, too.

35. Comparison with Borings from One Side of the Trunk

All the previous comparisons of circumference measurements have been made using the radial growth values determined from core samples taken from opposite sides of each tree. However, since boring from one side is more commonly used, it seemed logical also to compare the accuracy of circumference measurements with that given by single borings.

For the purpose of the comparison, regression equations were calculated with the average radial growth for the period from two core samples acting as a dependent variable, and that from one core sample as an independent one. The material was obtained from the same trees as used in the examination of the annual growth of groups III—IV. The residual standard deviations of these equations were used in calculating the confidence limits for the means of each group, and were compared with the confidence limits for circumference measurements calculated for the same level of growth. The results are shown in Table 10.

It can be seen that differences between the methods were quite small. With the exception of tape measurements in North Finland, the most accurate was tape, then band, and the least accurate was boring from one

Table 10. Comparison of the reliabilities of the different methods in estimating the average annual radial growth for 4—5 years with 20 sample trees.

Taulukko 10. Eri menetelmien luotettavuuksien vertailu 4—5 vuoden keskimääräisen vuotuisen sädekasvun arvioinnissa 20 koepuuta käyttäen.

Region *Alue*	Tree species *Puulaji*	Method of measurement [1] *Mittaustapa* [1]	Ave. radial growth ($\bar{y}$) *Keskim. sädekasvu* ($\bar{y}$) mm	95 % confidence limits for $\bar{y}$ *95 % luotettavuusrajat* $\bar{y}$*:lle*	
				± mm	± %
South Finland *Etelä-Suomi*	Pine — *Mänty*	1	1.60		
		2		0.089	5.6
		3		0.085	5.3
		4		0.079	4.9
	Spruce — *Kuusi*	1	1.42		
		2		0.083	5.8
		3		0.067	4.7
		4		0.062	4.4
North Finland *Pohjois-Suomi*	Pine — *Mänty*	1	0.98		
		2		0.061	6.2
		4		0.060	6.1
	Spruce — *Kuusi*	1	0.69		
		2		0.044	6.4
		4		0.059	8.6

[1]) Methods of measurement: *Mittaustavat:*

1 Core samples from two opposite sides
Kairaus kahdelta vastakkaiselta puolelta

2 Core sample from one side
Kairaus yhdeltä puolelta

3 Girth band measurement
Mittaus kasvupannalla

4 Circumference measurement with a tape
Ympärysmitan mittaus nauhalla

side only. However, the accuracies were so similar to each other that the order cannot be taken as definite. At any rate, the results indicate that in general at least the same degree of accuracy can be reached by circumference measurements as obtained from a boring taken from one side of the tree.

4. DISCUSSION

The results show that in general no reduction in accuracy is incurred if circumference measurements are used instead of borings from one side of the trunk in determining the thickness growth of trees during a few years. This holds true in mature pine and spruce stands. As far as birch is concerned the question remains open, but probably the same accuracy can be obtained in the case of birch as in the case of spruce (H u i k a r i and P a a r l a h t i 1967).

Estimation of one year's growth proved to be quite inaccurate in some cases. This is a noteworthy drawback especially in experiments requiring information about the annual development of tree growth. On the other hand, the reliability of the annual growth obtained from a core sample may also be questioned for just as good reasons, because it represents only a minute sample of all possible radii of the cross-section. In order to obtain a reliable picture of the radial growth 4—8 borings should be taken (S i o s t r z o n e k 1958). In permanent sample plots this is not possible because of the injuries to trees resulting from borings.

An important advantage of borings in comparison to circumference measurements is in the saving of labour. Annual growth figures for several years can be measured from a core sample, whereas circumference measurements must be done each year separately in the forest. A possible compromise for saving labour as well as trees would be to use circumference measurements in periodic inventories of the sample plots, and to take core samples according to a less frequent schedule. If this method were used, no information would be lost, although the data concerning annual growth would be delayed.

Of the methods of circumference measurements, the tape method seemed at least as reliable as the girth band method. Since a tape is more convenient to use than a girth band, it is therefore to be preferred. On the other hand, the accuracy depends more on the measurer, thus a thorough training of the personnel is necessary.

Possible sources of error in tape measurements as listed by C h a p m a n and M e y e r (1949, p. 191) are the following:

1) error in the height of measurement
2) deviation of tape from horizontal plane

3) deviation of cross-section of stem from a circular form
4) loose tape
5) protuberances and irregularities of bark surface.

Of these, the first two errors can be eliminated by marking the measuring level permanently with two painted rings, between which the tape is placed. The non-circular form of the cross-section induces a systematic over-estimation of mean diameter, but since it is included both in the initial and in the final values, its effect on the difference is small (B r u c e and S c h u m a c h e r 1950, p. 8). The bark surface can be smoothed off before marking the measuring level on the trunk. The responsibilities of the measurer will therefore be reduced to ensure that the tape is placed properly between the painted rings and the tightness is the same each time.

As was mentioned earlier, borings even from two opposite sides may not necessarily give the correct value for the radial growth. In interpreting the results, it must therefore be taken into account that the errors included in the comparison material may have widened the calculated confidence limits to same extent. Nevertheless, a comparison of this kind was regarded as justified, since the only existing alternatives in permanent sample plots are differential methods and borings.

5. SUMMARY

The purpose of the study was to examine the reliability of the difference of circumference measurements as an indicator of the radial growth of a tree trunk. Girth bands and measuring tape were used in the measurements, and the results were compared with the radial growth obtained from two opposite core samples per tree. The material consisted of 1 350 sample trees, of which 794 were Scots pines and 556 Norway spruces. About 4/5 of the material was from South Finland, and 1/5 from North Finland. Average diameter of the sample trees was about 24 cm. The 95 per cent confidence limits of the estimates were used as criteria for the accuracy of the methods.

The accuracy in estimating the radial growth inside the bark during 4—5 years from circumference measurements was ±17—33 per cent with one sample tree, corresponding to ±4—8 per cent with 20 sample trees. It appeared that the increment of bark thickness is over-estimated in tape measurements, whereas the band method is more accurate in that sense.

The estimation of annual growth was quite uncertain with band measurements of spruce because of the relative softness of the bark. In the other material groups, the accuracy of ±30—50 per cent was common in the case of single measurements, corresponding to ±6—10 per cent with 20 sample trees.

With the exception of band measurement of spruce, 20 sample trees appeared to be a recommendable number for studying the growth during 4—5 years. Such a number would guarantee an accuracy of about ±5 per cent in South Finland, and ±7—8 per cent in North Finland. In estimating the annual growth, 30 sample trees would give approximately the same accuracy as 20 trees for the periodic growth.

The results of this study indicate that in general at least the same accuracy can be reached by circumference measurements as by borings taken from one side of the trees only. Tape appeared to be more recommendable than girth band.

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SELOSTE

Puun sädekasvun määrittäminen ympärysmittauksella

Tutkimuksessa on selvitetty, kuinka tarkka arvio rungon sädekasvusta saadaan mittaamalla ympärysmitan kasvu metallisella kasvupannalla tai mittanauhalla. Vertailuarvoina käytettiin kuorettomia sädekasvuja, jotka saatiin kairaamalla kukin koepuu kahdelta vastakkaiselta puolelta. Aineisto käsitti männiköitä ja kuusikoita Etelä- ja Pohjois-Suomesta, yhteensä 1 350 koepuuta (taulukot 1 ja 2). Koepuiden keskiläpimitta oli noin 24 cm. Sädekasvun arvion tarkkuuden mittana käytettiin tälle laskettuja 95 prosentin luotettavuusrajoja.

Arvioitaessa kuoretonta sädekasvua 4—5 vuoden jakson aikana, voitiin taulukossa 3 esitettyjä yhtälöitä käyttäen päästä yhden puun ympärysmittauksella ±17—33 prosentin tarkkuuteen, joka vastaa ±4—8 prosentin tarkkuutta 20 koepuulla. Nauhamittauksella saatiin kuoren paksuuskasvusta yliarvio, kun taas pantamittaus oli tässä suhteessa tarkempi.

Vuotuisen kasvun arvio osoittautui erittäin epäluotettavaksi kuusen pantamittauksella kuoren pehmeyden vuoksi. Muissa aineistoryhmissä tarkkuus oli yhden puun mittauksessa yleensä ±30—50 %, joka vastaa ±6—20 prosentin tarkkuutta 20 koepuulla.

Kuusen pantamittausta lukuunottamatta 20 koepuuta osoittautui suositeltavaksi 4—5 vuoden jakson sädekasvua arvioitaessa. Tällä saavutetaan taulukon 8 mukaan noin ±5 prosentin tarkkuus Etelä-Suomessa ja ±7—8 prosentin tarkkuus Pohjois-Suomessa. Vuotuisen kasvun arviolle saatiin 30 koepuulla suunnilleen sama tarkkuus kuin 20 koepuulla 4—5 vuoden jakson kasvulle.

Tulokset osoittivat, että ympärysmittauksella päästiin yleensä sädekasvun arvioinnissa ainakin samaan tarkkuuteen kuin yhdeltä puolen kairaamalla (taulukko 10). Menetelmistä on nauhamittaus asetettava etusijalle lähinnä sen yksinkertaisuuden vuoksi.

FERTILIZATION OF BIRCH

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INTRODUCTION

Systematic fertilization experiments in Finnish mineral soil stands were started in 1958, earlier experiments having been restricted to a few small scattered trials. The number of experiments has grown from a modest beginning to a rather large number, and the network of plots now covers the country from south to north and from west to east. The results of experiments carried out on Scots pine and Norway spruce have been presented in a number of publications and addresses both here in Finland and abroad (*cf.* Viro 1972).

It can be stated as the general result of the experiments that fertilization on mineral soil sites at the time of planting has shown to be almost exclusively detrimental: quite small dosages of certain fertilizers may even be fatal to both coniferous and deciduous seedlings. The most readily soluble fertilizers, nitrogen and potassium compounds, have proved to be lethal at very low dosage levels and, especially when the fertilizer is spread before a dry period, extensive damage may occur (Viro 1966). The tolerance limit for phosphorus fertilizers is much higher.

During the reforestation of mineral soil sites, fertilization obviously can more easily cause disadvantages than benefits. On the other hand, once the seedling stage of the stand has passed, a reasonable fertilization has not caused any damage to the trees, and in mature stands correct fertilization treatment has proved in most cases to be economically remunerative. As a general rule, almost all Finnish mineral soil stands require more nitrogen, on the best sites also phosphorus, but potassium fertilization has increased growth only in exceptional cases (Viro 1972). Lime has not given any positive results in short-term experiments but experiments lasting a few decades have given a distinct positive reaction (Viro 1958). It is assumed that the positive effect of lime is due to increased nitrogen mobilization which in the Finnish climate starts slowly.

The information available from the literature concerning the reaction of birch to fertilization is extremely scant. According to Bjorkbom (1973 a and b) nitrogen is the most important fertilizer for birch seedlings, whereas Becker-Dillingen (1939) has shown that potassium noticeably improves the growth of birch, and Trillmich and Uebel (1970)

and Junack (1966) have observed in minus experiments that the effect of potassium in birch stands is greater than the effect of nitrogen. According to Penningsfeld (1964) also, birch is especially grateful for potassium fertilization. According to Tamm (1965 and personal communication), the reaction of birch to nitrogen fertilization can be stronger than that of conifers.

Attempts have been made already in the initial stage of our fertilization experiment activity to determine how birch reacts to fertilization. However, the results of these experiments have not yet been presented in any publication. The strongly increasing interest in birch, which has occurred over the last few years, has made the increase of birch production a topical subject. It has thus appeared necessary to publish the information that has been obtained up to now about the reaction of birch to fertilization on mineral soils, in spite of the fact that the number of our experiments with birch is small and the results from them to some extent contradict each other. This article deals with both warty birch (*Betula verrucosa* Ehrh.) and hairy birch (*Betula pubescens* Ehrh.).

The proportion of birch trees in the total volume of Finnish forests is noticeably large, 16,4 p.ct. (Kuusela 1972), the greater part of them present as mixed trees in coniferous stands. Present day mature birch stands have almost exclusively been naturally regenerated on swaled or prescribed burned areas, or on areas burnt by wild fires. They have subsequently been treated with several selection high-thinnings, and these stands in general give a greatly reduced yield. The highly increased demand for birch in the recent years has encouraged the cultivation of birch on quite a large scale, and planting of birch is nowadays generally used in the afforestation of abandoned agricultural lands. Similarly, more attention than ever has begun to be paid to the quality of the birch stock. Warty birch is exclusively used in planting, the seed being taken solely from fast growing, well-shaped individual trees.

In the last few years, fertilization has begun to be used on a large scale for the improvement of the growth of conifers. According to advance information, the annual area of mineral soil fertilization in Finland in 1972 was 120 000 hectares. However, there is almost no published information available about the reaction of birch to fertilization, and hardly any birch stands have been fertilized in forestry practice. This article is mainly concerned with mature birch stands which have been exclusively naturally regenerated. It attempts to shed some light on the behaviour of birch to fertilization. The location of the experiments is shown in Fig. 1.

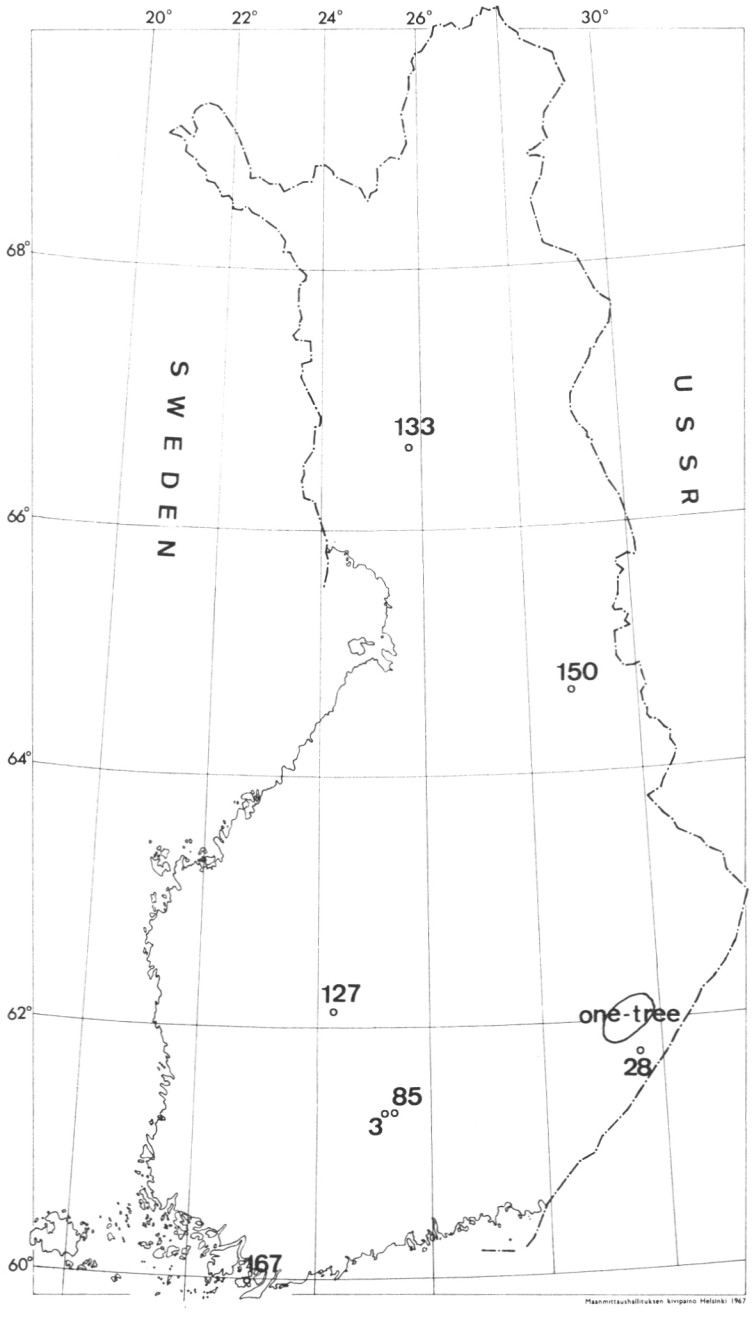


Fig. 1. Location of the sample plots.
Kuva 1. Koealojen sijainti.

Experiment 3, Padasjoki. Fine-sand moraine soil. This first hairy birch fertilization experiment was established at the end of September 1957 on a *myrtillus* type site, using a very old-fashioned experimental technique. (For the Finnish forest site classification see Cajander 1949.) The age of the stand at the start of the experiment was 30 years, the average height 14.0 m, the mean volume 107.0 cu.m, and the number of stems 750/ha (ha = hectare = 100 m by 100 m) There were three units in the experiment: one was left unfertilized, the second unit received per hectare 2 000 kg limestone, 100 kg K_2O as potassium chloride, 100 kg P_2O_5 as superphosphate, and 25 kg nitrogen as ammonium sulphate, and the third unit 6 000 kg lime and a similar NPK treatment as the second plot. Additional nitrogen fertilizer was given in June 1960, 82 kg nitrogen as ammonium sulphate, and in 1967, 92 kg nitrogen as urea per hectare.

The experiment was inventoried in the years 1961, 1966 and 1971. The average yield of the control unit during 15 years was 4.6 cu.m/ha/year, and the difference between the yield of the fertilized and unfertilized units during the 15-years experiment showed the following fertilizer effects: 2 000 kg of lime + NPK increased the yield by 30 cu.m/ha, and 6 000 kg of lime + NPK by 37 cu.m/ha. Fig. 2 presents the annual ring diagrammes for different treatments.

As the experimental technique was defective, and the first nitrogen fertilization was very weak, not very much significance can be given to these results. In addition, the control plot was obviously situated on the most barren site. The only logical conclusion that can be made, is that liming evidently had a beneficial effect on the growth of birch, and that increasing the lime dosage further improved growth. The first nitrogen fertilization did not affect growth, the second and third perhaps improved it to some extent.

This experiment is a good example of poor experimental technique and draws attention to the need for correct technique. Factorial designs have generally been used in the other presented experiments. An experimental 2^3 design was almost always used with normal-sized experimental units, which in the case of these eight-unit experiments gives four replications for

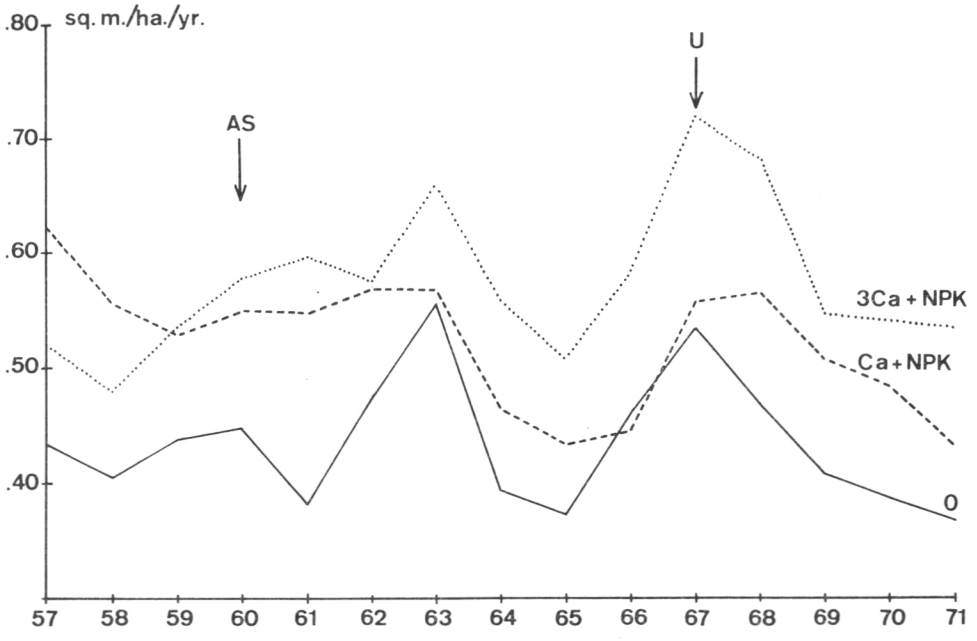


Fig. 2. Annual ring diagrammes on experiment 3.
Kuva 2. Koealan 3 vuosilustodiagrammit. Hieskoivu.

the study of the main effect of all three fertilizers, and two replications for the study of the combined effect of any two fertilizers.

Experiment 28, Punkaharju. Sandy soil. A drained grove-like *oxalis-myrtillus* type site with a thick humus layer. Hairy birch. At the start of the experiment in 1958 the age of the stand was 30 years, the average height 14.7 m, and the mean volume 90.1 cu.m/ha. The number of stems per hectare was originally 814, but after thinning (1962) it fell to 579. A factorial NPCa experimental design was used. The experiment was fertilized in July 1958 with the following amounts (kg/ha): nitrogen — 82 kg as ammonium sulphate, phosphorus — 66 kg P_2O_5 as ground rock phosphate, and limestone — 2 000 kg. Nitrogen fertilization was renewed in 1963 with 200 kg/ha of urea (92 kg N). The experiment was inventoried in the years 1962, 1967 and 1972. Lime had a slight positive (not significant) effect on the yield, 7,2 cu.m/ha more than the control unit during the experiment (15 years). Both nitrogen and phosphorus, applied separately, showed a clearly negative effect on the yield. Applied together, the yield initially appeared to be somewhat greater than the effect of each alone,

but this quickly changed as can be clearly seen from the yield data during 15 years of the experiment, to be found in the following table (cu.m/ha/year):

	O	N	P	NP
1953—57	8.1	5.2	4.5	6.2
1958—62	10.0	6.7	6.3	8.2
1963—67	6.6	5.0	3.8	4.3
1968—72	5.0	4.2	4.0	4.0
1958—72	7.2	5.3	4.9	5.5

The table shows in different periods some small differences that are caused by the small size of the material and the fact that the control and Ca-units were evidently situated on the most fertile points in the stand. At first sight it would appear that the figures indicate that fertilization had a reducing effect on the yield of this birch stand. Therefore, the growth reactions have been further elucidated using the relative annual ring diagrammes, shown in Fig. 3.

Before the experiment was started, the growth varied from unit to unit, and this affects the interpretation of the results. Therefore, the relative annual radial growth reaction for the O-, N-, P- and NP-treatments as

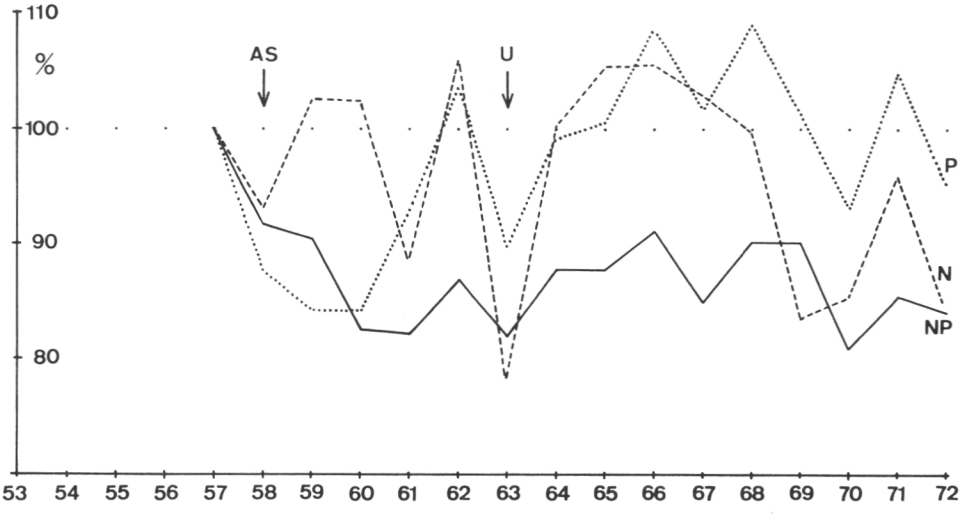


Fig. 3. Relative annual ring diagrammes on experiment 28. Control growth is marked with dots in this and the next figures.

Kuva 3. Koealan 28 suhteelliset vuosilustodiagrammit. Vertailualojen kasvu on merkitty pisteillä tässä ja seuraavissa diagrammeissa. Hieskoivu.

compared to the average reaction of the same plot before fertilization, and the ratio between the thus obtained values of the fertilized units and the values of the control units were calculated and presented in the diagrammes (V i r o 1950, T a m m 1965, F a h l r o t h 1969). As the figures in the table, these diagrammes also would indicate that all fertilizer treatments, especially the NP, and on a smaller scale the N treatment, had a detrimental effect on the yield. A closer inspection however, showed that this conclusion was wrong. When the correlation between the volume growth before and after fertilization was calculated, the coefficient for the first 5-year period was 0.99, for the second period was 0.95, and for the third period still as high as 0.82. Growth on the individual experimental units thus continued at relatively the same rate as earlier, independently of treatments.

This experiment is on an exceptionally fertile site from both the nutritional and hydrological point of view. Obviously the addition of nutrients could not increase the yield any further because the natural fertility was already noticeably above the optimum level for hairy birch.

Experiment 85, Vesijako. Sandy moraine. *Myrtillus* type site, warty birch. At the start of the experiment in June, 1960, the age of the stand was 25 years, the average height 7.1 m, and the mean volume 14.9 cu.m/ha. The number of stems was originally 2 650/ha, after thinning (1964) it was reduced to 1 720/ha. The volume growth has been obtained using the difference between successive inventories, not from increment borings. The experimental design and the amounts and types of fertilizers used were the same as those used in experiment 28. Nitrogen fertilization was renewed in 1963 and 1967 using 200 kg/ha of urea (92 kg N/ha). The experiment was inventoried in 1964 and 1969.

The attached two-way-table, which presents the average annual yield during ten years, shows that the inherent yield of the stand has been quite good. Calcium in this and the next experiments did not affect the yield, and it is omitted in the discussions. Thus, we have two replication for the O-, N-, P-, and NP-treatments.

	N_0	N_1	
P_0	4.1	4.5	4.3
P_1	4.2	6.0	5.1
	4.2	5.2	

Fertilization with phosphorus alone hardly affected tree growth, fertilization with nitrogen alone did to some extent (10 p.ct.), while growth was noticeably improved when both N and P fertilizers were used: growth on the NP-units during the experimental period was 50 p.ct. greater than on the control units. Annual ring diagrammes, constructed in the same way

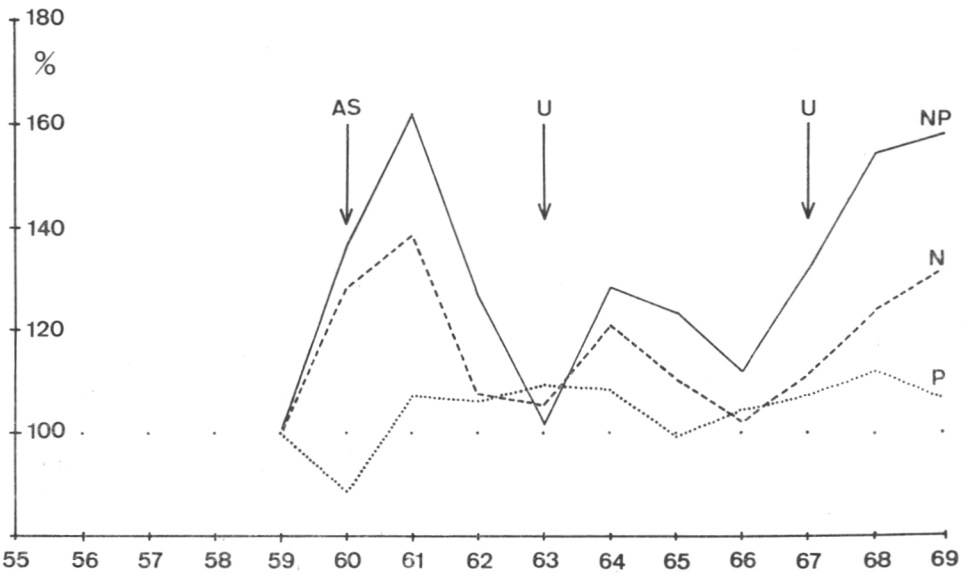


Fig. 4. Relative annual ring diagrammes on experiment 85.
Kuva 4. Koealan 85 suhteelliset vuosilustodiagrammit. Rauduskoivu.

as earlier (*c.f.* p. 10) from increment core information, that was obtained a year later (Fig. 4), support the results which have been presented above.

The trees of this experiment are quite small, as can be concluded from the data on the number of stems and the volume. Only cord-wood can be obtained from this stand for the time being, and the value of the increased yield will not cover the fertilization costs.

Experiment 133, Rovaniemi. Fine-sandy moraine. Rich *myrtillus* type site, warty birch. The age of the stand at the time of fertilization was 40 years, the average height 10.8 m, the volume 51 cu.m/ha, and the number of stems 868/ha. The experimental design and fertilizers were the same as those used in experiment 28, re-fertilization with urea — 92 kg N/ha — in May 1967. The experiment was inventoried in 1966 and 1971. The stand has been regenerated by free seeding on a burnt area. Pines are present to some extent on the experiment as a mixed tree, but as nearly all of them are on the units fertilized with nitrogen, the effect of fertilization on different tree species can not be compared.

Due to the mode of regeneration of this stand, nitrogen mobilisation in the soil is obviously still rather rapid and the general nutrient status also satisfactory (V i r o 1969). This is the reason for the good natural growth of the quite small standing crop in the far North. The following

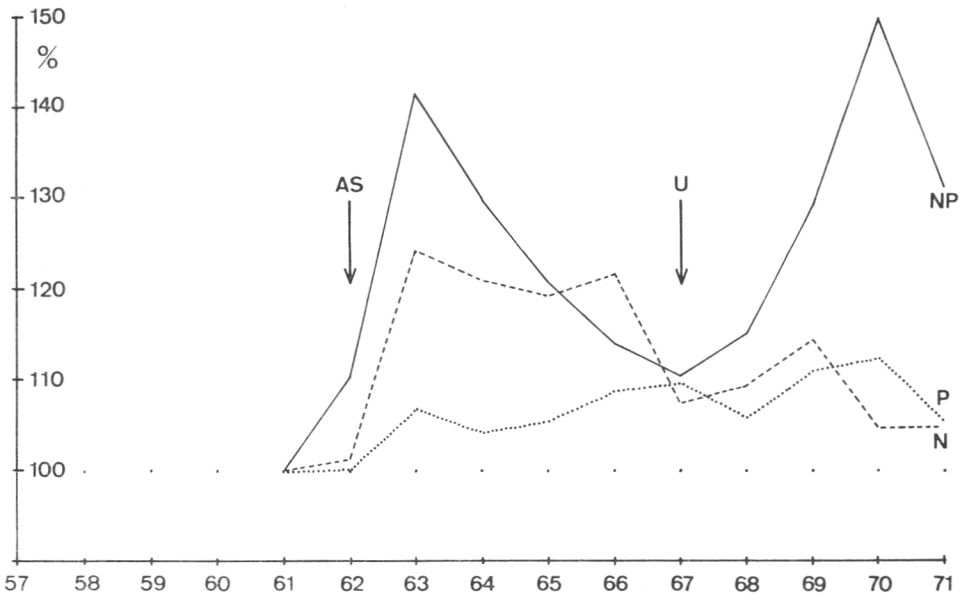


Fig. 5. Relative annual ring diagrammes on experiment 133.
Kuva 5. Koealan 133 suhteelliset vuosilustodiagrammit. Rauduskoivu.

two-way-table shows the average annual volume growth over ten years (cu.m/ha/yr):

	N_0	N_1	
P_0	5.0	5.4	5.2
P_1	4.6	6.0	5.3
	4.8	5.7	

During ten years of experiment, the effect of the two nitrogen fertilizations on the total yield (birch + pine) has been according to these figures only 3.8 cu.m/ha, the effect of phosphorus alone showing an equally negative figure. The combined effect of nitrogen and phosphorus has on the contrary been clearly positive, 9.8 cu.m/ha. However, the presented yield figures obviously do not give a fully correct picture of the effect of phosphorus fertilization, as can be concluded from annual ring diagrammes, presented in Fig. 5. As the table, also the relative annual ring diagrammes show, that the NP-effect has been clearly greater than that of nitrogen alone, and that phosphorus alone has also increased the growth to some extent. — The effect of ammonium sulphate and urea on the NP units was equally great, on the N unit the effect of urea was weaker.

Owing to the effects of burning, this stand is growing on a rather luxuriant site in which the subsequent fertility is near to the optimum for

birch. Although the effect is quite clear, NP fertilization has caused a growth increase on average of only one cubic meter per year in the yield, or 20 p.ct. — The results from this experiment support the results given by experiment 85, in that there would be a deficiency in the birch stands in addition to nitrogen, also of phosphorus.

As the diameter at breast height of the thickest trees in the stand was 23 cm at the end of the experiment, and the average diameter of all the trees 15 cm, almost only cord-wood could be obtained from the stand. Fertilization has thus not — at any rate yet — shown to be economically profitable.

ONE-TREE-PLOT STUDIES

Fertilization of seedlings

In 1966, the Forest Research Institute with the support of Koivukeskus Oy (Birch Center Ltd.) started setting up fertilization experiments in birch stands. The experiments with seedlings were carried out in the Department of Silviculture, and those with mature birch stands in the Department of Forest Soils.

It has been shown in earlier experiments that on mineral soil coniferous seedlings withstand only quite small amounts of N- and K-fertilizers at the transplanting stage, and that it is not recommendable to fertilize at this stage (V i r o 1966). The same observation was now made in the case of birch. When birch seedlings were fertilized simultaneously with planting, so that the fertilizer was mixed with the soil in the planting hole, a great increase in seedling mortality resulted. On the other hand, there was no effect on growth when fertilizer was spread on the surface of the ground. When fertilization was carried out one year after planting, nitrogen fertilization increased the growth of the seedlings very much without causing any damage to the plants (R a u l o 1969). Nitro-chalk (NH_4NO_3 with limestone, 26 p.ct. N), ammonium sulphate, and urea were used as fertilizers in these experiments. The effect of the largest fertilizer dosage used, 8 g N per seedling, on the height growth was 70—80 p.ct., depending on the fertilizer. The strongest growth reaction was obtained with ammonium sulphate, the smallest with urea, but the differences between different fertilizers were not significant. The effect of fertilization appeared only during the year of fertilization, in the following year the growth of the fertilized seedlings was found to be even a little less than of the unfertilized ones. These results are very similar to those obtained in earlier fertilization experiments carried out on mineral soils with coniferous seedlings (V i r o 1966), except that the reaction of conifers was much modester than that of birch.

Fertilization of mature stands

Experimental technique

Fertilization experiments in mature birch stands on a wider scale than earlier were started in 1967. These experiments were situated in SE Finland. Soils in this area are different moraines.

The minimum size of the experimental units in our experiments is usually 30 m × 30 m. However, as it has earlier been pointed out, it is obviously very difficult to find enough pure birch stands of such a size that the quite large number of experimental units, required by the normal experimental technique, could be set up. For this reason the so-called one-tree-plot method was used in setting up these fertilizer experiments in birch stands (Viro 1967). Each experimental unit consisted of a circular area with a radius of 6 m around the sample tree, *i.e.* 113 sq.m.

Swaling has earlier been the main cultivation practice used in Finland, and in the south-eastern parts of the country, where these experiments are situated, it has been used more recently than elsewhere, quite frequently still during this century (Heikinheimo 1915)[1]. The older birch stands of this study might have been regenerated after swaling, and most of the younger ones after selection cuttings on such stands. These experiments were established in 20 to 40 year-old warty and hairy birch stands, and in 60 to 80 year-old warty birch stands. It was very difficult to obtain material for the study and therefore a reduction in the standard of the experimental sites became necessary. Thus, only one replication was in a pure birch stand. Grey alder was the most common admixed tree species, although Scots pine and Norway spruce, too, were quite common. Other admixed species which were present were, in order of abundance, aspen, rowan, and black alder.

Potassium chloride, superphosphate, and urea were used as fertilizers. The fertilizer dosages per hectare were 0, 75 and 150 kg of K_2O, 0, 40 and 80 kg of P_2O_5, and 0, 80 and 160 kg of N. Nitrogen fertilization was renewed in 1970 using an equivalent amount of N as ammonium sulphate.

A factorial 3^3 design was used in the experiments. This means that in every replication each of the three fertilizers (NPK) was present at three dosage levels in all the possible combinations with the other two fertilizers. Thus, there were 27 sample trees for each replication, all treated in different ways.

When treating the material, this lay-out gave in this case for each main effect of any fertilizer a 36 to 99-fold replication, depending on whether the site types were discussed separately or together. For the combined effect

[1]) It is rather curious to mention that the last burning for acricultural purposes, known to the author, was made as late as 1948.



Fig. 6. Typical stand of the 1-tree-plots.
Kuva 6. Tyypillinen yhden-puun-koeala-metsikkö.

of two fertilizers it gave a 12 to 33-fold replication. Due to the large number of experimental units, a 10 p.ct. difference in the annual diameter growth was almost always significant at the 5 p.ct. level.

Earlier experiments using the one-tree-plot method have shown that there must be a great number of experiments if precise results are to be obtained (V i r o 1967). However, in pioneer work the method has shown great advantages. It permits a large number of experimental units and thus several fertilizers and dosages can be studied on quite a small area. On the basis of this preliminary knowledge, the number of fertilizers, their combinations, and dosages can be greatly reduced in the final experiments.

The sample trees were measured at the start of the experiment in May-June 1967, and every autumn afterwards. On each of the trees there were two parallel lines passing around the tree at breast height, and the measurement was always taken between these two lines. The circumferential growth during a specific period was obtained by subtracting the value obtained in previous measurements from the later measurement. The

circumference of the trees was measured to an accuracy of 1 mm and the diameter subsequently to within 0.32 mm. The total growth during the three and six year-periods of the experiment were also calculated using the difference between the initial and final measurements. — Fig. 6 gives a view of a typical stand of the one-tree-plots.

The annual diameter growth of the tree can thus be obtained using the measurement technique described above. As the diameter of the trees and the number of stems per hectare at the beginning of the experiment are known, the basal area increment per hectare can be calculated for the observation period, and if the height increment is known, the volume increment per hectare can be calculated. The estimation of the height increment of birch is difficult, and increment tables are generally used to give the average height growth value. In this case it was considered enough to show only the order of magnitude of the effect which the different fertilizers and amounts of fertilizers have had on the diameter growth of individual trees, as well as to get some clues about the possible interactions between the fertilizers. The material is too heterogeneous to make valid observations about the volume growth of the stand.

It was originally intended to set up series of experiments for young and mature hairy and warty birch growing on a *myrtillus* type (MT) and on an *oxalis-myrtillus* type (OMT) site. However, it turned out that not enough mature hairy birch stands could be found on this area that could have met even the modest standard required. When the results were being examined, it also turned out that distinguishing MT and OMT sites from each other in the birch stands is obviously often difficult to do. The material consists of 4 young (20—40 years) warty birch stands growing on an MT site and 6 on an OMT site, and 5 old warty birch (60—80 years) stands growing on each of the above site types. Of the young hairy birch stands 5 were growing on an MT site, and 6 on an OMT site. The growth in the experiments classified as being of the same site type varied greatly, as did the reaction to fertilization, and the difference between the figures of different site types were often far from significant, when the growth in individual years was examined. The resulting dispersion of the material is illustrated by the fact that there was frequently a highly significant difference between the growth reactions of replication on sites estimated to be of the same site type.

The average diameter at breast height of the sample trees at the beginning of the experiment was as follows:

	MT	OMT
warty birch, 20—40 yr.	17.9 cm	21.5 cm
warty birch, 60—80 yr.	25.4 »	26.2 »
hairy birch, 20—40 yr.	17.1 »	18.6 »

In the young warty birch stands growing on the OMT site the natural growth was greater than the growth on the MT site, but the difference in annual growth was significant only in three years out of six. The total growth during six years on the OMT site was greater than that on the MT site at the 1 p.ct. risk level. The natural growth in the old warty birch stands, on the other hand, was *smaller* every year on the OMT site than on the MT site. The difference during the year of fertilization was significant only at the 1 p.ct. level, but during other years at the 0.1 p.ct. level. The observed growth during the 6 years was greater on the MT site than on the OMT site at the 0.1 p.ct. level. As in the young warty birch stands, the natural growth in the hairy birch stands (all young stands) was also greater on the OMT site than on the MT site, but the difference between the site types was significant only during the year of fertilization, and even then only at the 5 p.ct. level. The total growth during 6 years in the hairy birch stand on the OMT site was greater than on the MT site at the 1 p.ct. risk level. As the total natural growth during the experiment on a site estimated as being fertile could have been even smaller than on an infertile site, the effect of fertilization was generally studied for the whole tree species-age class group together.

Effect of fertilization

In pine and spruce stands, when carrying out fertilization experiments using the one-tree-plot method, the variation percentage of the annual radial growth has usually been 25 to 30 p.ct. (V i r o 1967). Thus, there must be a large number of replications in the experiment if the effect of fertilization is to be obtained with a sufficient accuracy. When examining the reaction in groups of tree species-age class, with both site types together, an error mean square was now obtained with 222 to 246 degrees of freedom. When the examination was made within the different age groups of the individual site types, the number of degrees of freedom was 78 to 126. The percentage of variation varied in young warty birch stands from year to year between 24.4 and 33.7 p.ct., in old warty birch stands between 25.7 and 38.0 p.ct., but in young hairy birch stands between 40.1 and 43.7 p.ct., and between these limits it was also when studying the whole observation period. Owing to the large number of experimental units, a 10 p.ct. difference in growth in the warty birch experiments between the different fertilizer dosages was significant at the 5 p.ct. level, and in the hairy birch experiments a difference of 12.5 p.ct.

The main effect of different fertilizers on the diameter growth is presented in Table 1, of nitrogen also in Fig. 7. As is seen, in these experiments nitrogen had the clearest positive effect on growth, similarly as in coniferous stands,

Table 1. Annual and 6 years' diameter growth with different fertilizer dosages, mm.
Taul. 1. Vuotuinen ja 6 vuoden läpimittakasvu eri lannoiteannoksilla, mm.

Year	N			P_2O_5			K_2O			LSD 5 %
	0	80	160	0	40	80	0	75	150	
	Warty birch, 20—40 yrs. — *Rauduskoivu, 20—40 v.*									
67	4.1	4.5	4.6	4.3	4.5	4.4	4.2	4.3	4.7	0.39
68	3.6	3.8	4.3	3.9	4.0	3.7	3.7	3.7	4.3	0.41
69	3.7	3.7	4.1	3.8	4.0	3.7	3.8	3.8	4.0	0.34
70	3.4	3.7	4.1	3.7	3.8	3.6	3.7	3.6	3.9	0.39
71	3.6	3.8	4.5	3.8	4.2	3.8	3.8	3.8	4.2	0.46
72	3.4	3.4	3.6	3.5	3.6	3.4	3.4	3.4	3.6	0.41
67—72	21.8	22.9	25.2	23.0	24.1	22.6	22.6	22.6	24.7	2.07
	Warty birch, 60—80 yrs. — *Rauduskoivu, 60—80 v.*									
67	3.6	3.8	3.9	3.8	3.8	3.6	3.7	3.5	4.0	0.42
68	3.0	3.3	3.6	3.3	3.5	3.2	3.3	3.2	3.4	0.35
69	3.3	3.5	3.6	3.5	3.5	3.4	3.5	3.3	3.6	0.52
70	3.0	3.3	3.5	3.2	3.5	3.4	3.2	3.2	3.4	0.38
71	3.0	3.5	3.7	3.4	3.4	3.4	3.5	3.3	3.4	0.39
72	3.1	3.2	3.4	3.2	3.4	3.2	3.2	3.2	3.4	0.35
67—72	19.0	20.6	21.7	20.4	21.1	20.2	20.4	19.7	21.2	1.91
	Hairy birch, 20—40 yrs. — *Hieskoivu, 20—40 v.*									
67	2.6	2.8	3.1	3.0	2.8	2.8	2.8	2.8	2.7	0.36
68	2.3	2.7	3.2	2.8	2.8	2.7	2.7	2.7	2.9	0.32
69	2.2	2.3	2.8	2.5	2.4	2.3	2.4	2.3	2.4	0.27
70	2.4	2.6	3.2	2.7	2.7	2.7	2.8	2.5	2.8	0.33
71	2.2	2.6	3.4	2.8	2.8	2.5	2.8	2.7	2.7	0.35
72	2.4	2.5	3.0	2.6	2.7	2.6	2.6	2.7	2.6	0.29
67—72	14.1	15.5	18.7	16.4	16.2	15.6	16.1	15.7	16.1	1.79

and the strongest reaction was always obtained in the year following fertilization. Both of the nitrogen dosages increased the growth in every year. In young stands the double dosage induced a more than double growth increase, as compared with the single dosage, in the old stands the difference was much smaller. The annual effect of the smaller dosage was seldom significant, that of the larger one in most cases.

The total growth reaction during the 6 years of experiment to the smaller dosage of nitrogen was not significant in any case. The reaction to the larger dosage, on the other hand, was significant at the 0.1 p.ct. level for both species of young birch, but for old birch only at the 5 p.ct. level. The difference between dosages was significant only for both species of young birch. The growth reaction of hairy birch was always the highest significant. In addition, the duration of the effect of nitrogen fertilization was longest for hairy birch: for the both groups of warty birch the reaction lasted at most for three years, for hairy birch it would obviously have been still noticeable during the two years following the end of the experiment. The reaction in the young warty birch stands in the third year after the

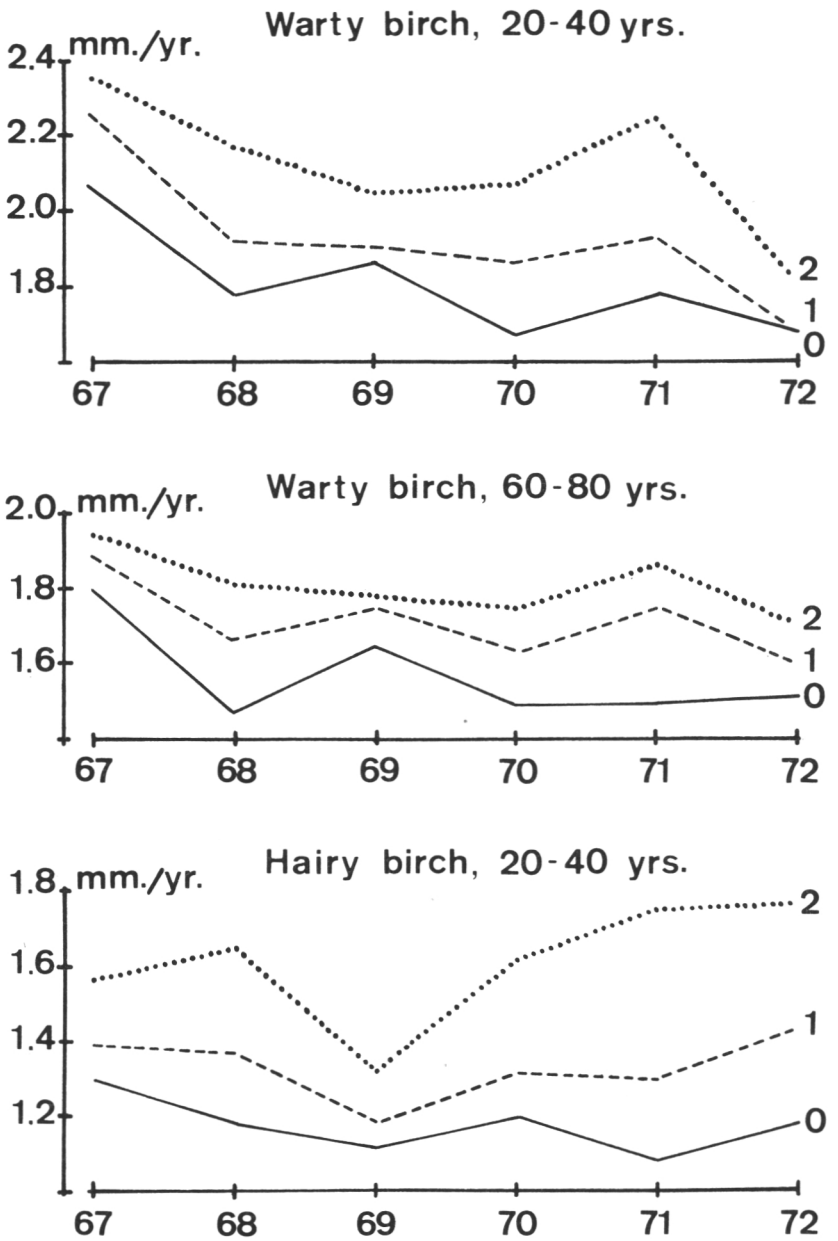


Fig. 7. Effect of nitrogen on diameter growth in one-tree-plot experiments.
Kuva 7. Typen vaikutus läpimitan kasvuun yhden-puun koealoilla (warty birch = rauduskoivu, hairy = hies).

first fertilization was significant only at the 5 p.ct. level, and in the third year after the second fertilization it was no longer significant. The reaction in the old warty birch stands showed a similar trend as in the young stands, except that also in the year of the first fertilization and in the third year of the first fertilization the reaction was not significant. In hairy birch stands the difference in growth reaction between the nitrogen dosages 80 and 160 kg was highly significant (0.1 p.ct. level), in young warty birch stands at the 5 p.ct. level only, and in old warty birch stands not at all.

It can be seen that natural growth was greatest in young warty birch stands, smallest in hairy birch stands, and the absolute reaction to nitrogen fertilization followed the same order. The relative reaction to the smaller N-dosage of all the tree groups was almost as great in every case, wheras the relative reaction of hairy birch to the larger dosage was twice as great as that of warty birch. The relative reaction values of young and old warty birch trees to individual fertilizer dosages were almost as great, as can be seen in the following table:

	dosage		
	0	1	2
Young warty birch	100	106	116**
Old warty birch	100	108	114*
Hairy birch	100	110	133***

These figures show that the relative reaction of warty birch to two 160 kg/ha dosages of nitrogen was of the same order of magnitude (14 to 16 p.ct.) as that observed in spruce stands growing on fertile sites which have received a single 80 kg dosage, and similarly that of hairy birch about equal as observed in pine stands on average sites (*c.f.* Viro 1967, 1972). The largest observed figures of relative growth improvement were of the same order of magnitude as in the previously presented experiments about birch stands, made with the normal method.

The effect of phosphorus on the growth of birch was small, and the greatest growth reaction was almost without exception obtained with the smaller dosage. In most cases the double dosage produced a smaller growth reaction than the controls. For potassium, there was a trend that the bigger dosage encouraged the growth whereas the smaller one did not have any effect. Only in the case of young warty birch was the effect significant in the two first years and during the whole experiment.

These experiments clearly show, that in the case of birch, the further need for potassium, and especially for phosphorus, is quite small. A single dosage of phosphorus perhaps initially caused a small growth increase in the two cases of warty birch, whereas a double dosage caused a slight *decrease* (both not significant) in growth in all the groups examined. For hairy birch the negative effect of the double dosage was significant. The larger potassium dosage produced in the case of young warty birch stands a

significant positive growth reaction during the first two years, and in the case of both the warty birch groups throughout the course of the experiment. In the hairy birch stands potassium did not affect growth.

The observed weak reaction of birch to potassium and phosphorus fertilization can be considered to indicate that, due to the swaling carried out quite recently (50 to 80 years ago), these nutrients were fairly abundant in the soil, especially phosphorus. On the other hand, Ingestad (1957) has shown that birch is relatively unpretentious as regards its potassium and phosphorus requirements. — It has been observed in coniferous stands growing on the most fertile sites that there is often a deficiency of phosphorus (Viro 1972), whereas a potassium deficiency has been very rarely noticed.

As has been mentioned, the first nitrogen fertilization carried out in these experiments was with urea, and the second with ammonium sulphate. Of these fertilizers, urea has not generally shown to be a suitable fertilizer if it is applied during dry spells. At the time when the experiments were set up, precipitation on the experimental area was near to normal. As a result of this, the diameter growth in the experiments in the following three-year-period after both fertilizations has been almost equal. The natural diameter growth in these birch stands, estimated on the basis of growth on the control plots, was 7 p.ct. smaller during the second three-year-period (fertilized with ammonium sulphate) than during the first period (fertilized with urea). However, when smaller fertilizer dosages were used, urea gave a 5 p.ct. greater growth yield, and with a larger dosage a 2 p.ct. greater growth yield, than when corresponding amounts of ammonium sulphate were used. Volatilization of urea in these experiments has obviously thus been quite negligible.

The effect of fertilization on the growth of birch in these experiments became apparent already in the year when fertilization was carried out, while the reaction of conifers to fertilization does not usually appear to any great extent until the year following fertilization. In coniferous stands the effect of fertilization becomes apparent initially as an intensification of the green colour of the needles and then as an increase in their size, and the effect on tree growth is observed only in the following year. In the case of birch, the surface area of the foliage obviously increases immediately, since the effect of fertilization in growth usually became apparent already during the year of fertilization. These experiments also point out that the reaction of young trees to fertilization is relatively stronger than that of old ones. The effect of tree size on the fertilization reaction in the same age class was also examined, and the effect was found to be very small or non-existent.

STUDIES IN MIXED STANDS

Some of the Department's experiments also gave the opportunity to study the effect of fertilization on the growth of birch in mixed stands. Birch was present as a mixed tree generally in small amounts, but when the plots were measured, extra sample trees were taken as far as possible from the mixed trees species. When the effect of nitrogen fertilization alone was studied, so much material was obtained from certain plots, that it was possible to obtain at least some exploratory additional information about the reaction of birch to fertilization in mixed stands. These studies are made exclusively on the basis of annual ring diagrammes because the mixed trees were present in small amounts and unevenly distributed on different units. These diagrammes show the relative annual radial growth of the tree species, each calculated in the same way as earlier (*cf.* p. 10).

Experiment 127, Kuorevesi. Sandy soil layer of 1.5 m upon a hard, water-impervious fine-sand moraine. Rich *myrtillus* type site. A mixed pine-warty birch stand which has been regenerated after a forest fire, and where spruce has later appeared as an undergrowth. The age of the pines and birches at the start of the experiment was 100 years, and that of the spruces 70 years. The number of stems at the beginning of the experiment was 692/ha, of which 29 p.ct. were pine, 65 p.ct. spruce, and 6 p.ct. birch. The volume with bark was 274 cu.m/ha, pine representing 58 p.ct., spruce 33 p.ct., and birch 9 p.ct. of this volume. These figures show that the pine and birch trees were much larger than the spruces. The yield prior to the experiment was 7.2 cu.m/ha/year. The experiment was started in 1962, and a similar fertilization treatment and experimental design to that of experiment 28 was used. Nitrogen fertilization was repeated in 1967 using 200 kg/ha of urea.

During the ten years of the experiment only nitrogen fertilization had an effect on the total yield of the stand. The yield without nitrogen fertilization during this time was on average 6.7, and with nitrogen 9.5 cu.m/ha/year. The reaction of different tree species to the nitrogen fertilization is shown in Fig. 8.

As is known, the growth of conifers does not usually increase much during the year of fertilization, and the same was true here. Also, as usually

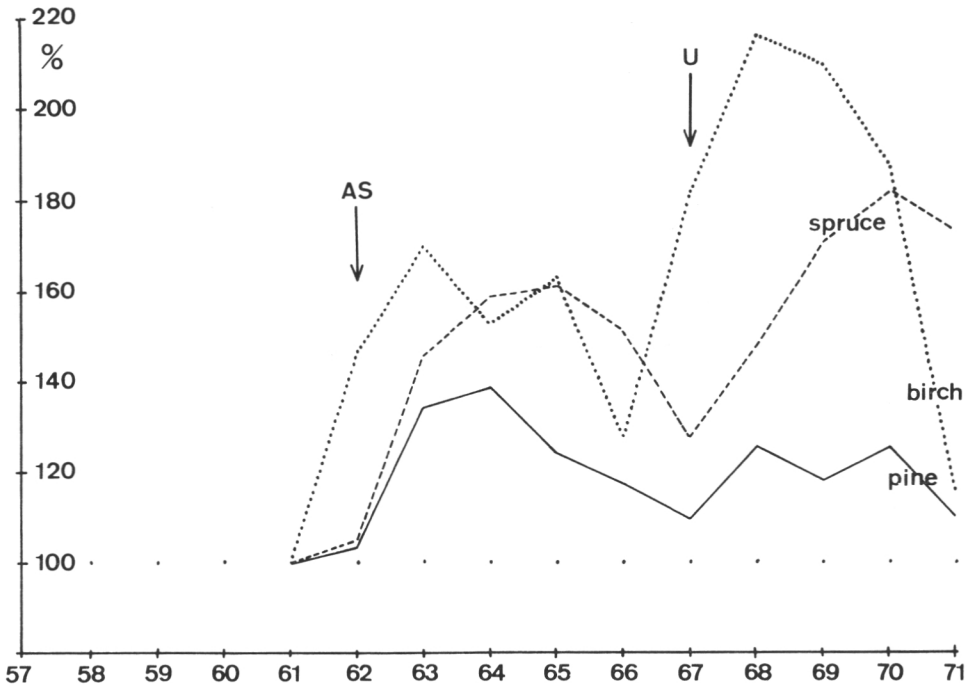


Fig. 8. Relative annual ring diagrammes for experiment 127.
Kuva 8. Koealan 127 suhteelliset vuosilustodiagrammit.
(spruce = kuusi, pine = mänty, birch = koivu).

occurs, the effect became quite clear during the following 2 to 5 years, particularly in the case of spruce. In the sixth year, in which re-fertilization with nitrogen was carried out, the annual rings of pine from the fertilized areas were still a little wider on the nitrogen units. On the whole, pine reacted quite moderately in this experiment to fertilization, for spruce, the effect of fertilization was much stronger. In the case of pine the effect of the second fertilization was found still in the tenth year, though very weak, but obviously it would not have been at all noticeable during the following year. In the case of spruce, the continuing effect of fertilization was still very clear after ten years, and will probably still be noticeable during the following two years. Birch reacted to fertilization more strongly than conifers, although the diagrammes show that the effect of fertilization on the growth of birch was of shorter duration than on the growth of spruce, being almost as long as the effect on that for pine. The average relative annual increase in the radial growth of the tree species throughout the experiment was 21 p.ct. for pine, 50 p.ct. for spruce and 69 p.ct. for birch. The weakest reaction of pine is probably caused by the fact that in these

plots, the site quality is already above the optimum level for pine, and pine cannot any more, unlike more exacting spruce and birch, gain full benefit from the increase in fertility. The average diameter of the pines at the start of the experiment was 29.7 cm, of the birches 24.5 cm, and of the initially undergrowth spruces 18.5 cm. Thus, there is a much smaller difference in the volume growth of pine and spruce than in the observed radial growth.

According to the annual ring diagrammes, birch and spruce reacted to the second fertilization much more strongly than to the first, pine on the other hand showed an opposite trend. These differences are probably caused by the different requirements of these tree species for nutrients.

Experiment 150. Ristijärvi. Sandy moraine. An *empetrum-vaccinium* type site. A 130 year-old spruce stand, treated with several high thinnings. 795 stems/ha, volume 54 cu.m/ha, 5 p.ct. hairy birch present as a mixed tree. A factorial NPK experiment, doubly replicated. Initially fertilized in 1963 in the same way as experiment 28, except that Ca was replaced by K. Nitrogen fertilization was renewed in 1969 with 200 kg/ha of urea.

Due to the poor type of high-thinning treatments, the small volume, and the old age of the stand, the growth before fertilization has been rather small, only 1.6 cu.m/ha/year. As a result of the thinning six years before fertilization, the growth during the experiment on the units which were

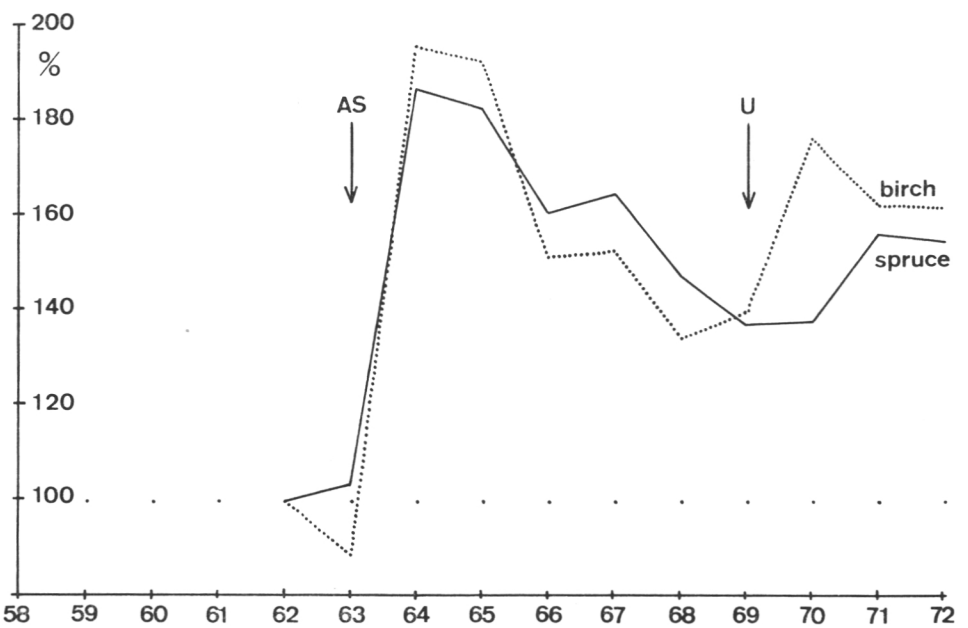


Fig. 9. Relative annual ring diagrammes on experiment 150.
Kuva 9. Koealan 150 suhteelliset vuosilustodiagrammit.

not treated with nitrogen was 2.1 cu.m/ha/year. Nitrogen fertilization improved the growth during ten years of experiment by an average of 1.1 cu.m/ha/year, whereas potassium and phosphorus fertilizations had no effect on the growth.

The fertilization reaction of birch was elucidated by taking increment cores from all the birches growing on the experiment but because there was only a few of them and they were distributed unevenly, only the effect of nitrogen fertilization on the radial growth could be examined. On this experiment also, the fertilization effect was examined on the basis of the relative annual ring diagrammes obtained in the previously presented way (Fig. 9). It can be seen that in this case fertilization did not affect the growth of either of the tree species during the year of fertilization, but that the reaction to nitrogen fertilization during the following two years was quite strong. The fertilization effect was still clearly discernible after six years. The relative reaction of both spruce and birch to fertilization was of about equal strength, and the effect of nitrogen fertilization on the growth of the both tree species was still clearly evident at the end of the experiment. As a whole, the relative reaction of birch to fertilization on this plot was evidently about as great as the reaction of spruce (the annual growth reaction of birch was on average 64 p.ct., and that for spruce 61 p.ct.).

Experiment 167. Bromarv. Fine-sandy-moraine. *Oxalis-myrtillus* type site. A spruce-pine-birch mixed stand, 60 years old. The volume of the stand at the beginning was 157 cu.m/ha, 62 p.ct. of which was spruce, 20 p.ct. pine, and 18 p.ct. warty birch. The yield prior to the experiment was 9.6 cu.m/ha/year. Pine and birch were unevenly distributed on the different plots. The experiment was started in 1964, and fertilized with a combined fertilizer (NPK 18, 12, 6 p.ct.) at dosages of 0, 400, 800 and 1 200 kg/ha (N 72, 144 and 216 kg/ha). A randomized blocks experimental design with a double replication was used. Nitrogen fertilization was again carried out in 1969 using similar dosages of nitrogen in the form of urea. The experiment was measured in 1968 and 1973. The yield figures show, that natural growth in this experiment was exceedingly good, and fertilization still further improved it quite considerably. The relative annual growth reaction to different dosages, as compared to the control plots during two five-year-periods, was on average as follows:

		Pine	Spruce	Birch
Period I	400 kg	+13 p.ct.	+32 p.ct.	+18 p.ct.
	800 kg	+9 »	+61 »	+44 »
	1 200 kg	+35 »	+63 »	+37 »
Period II	400 kg	—1 »	+26 »	—1 »
	800 kg	—7 »	+69 »	+30 »
	1 200 kg	+8 »	+68 »	+25 »

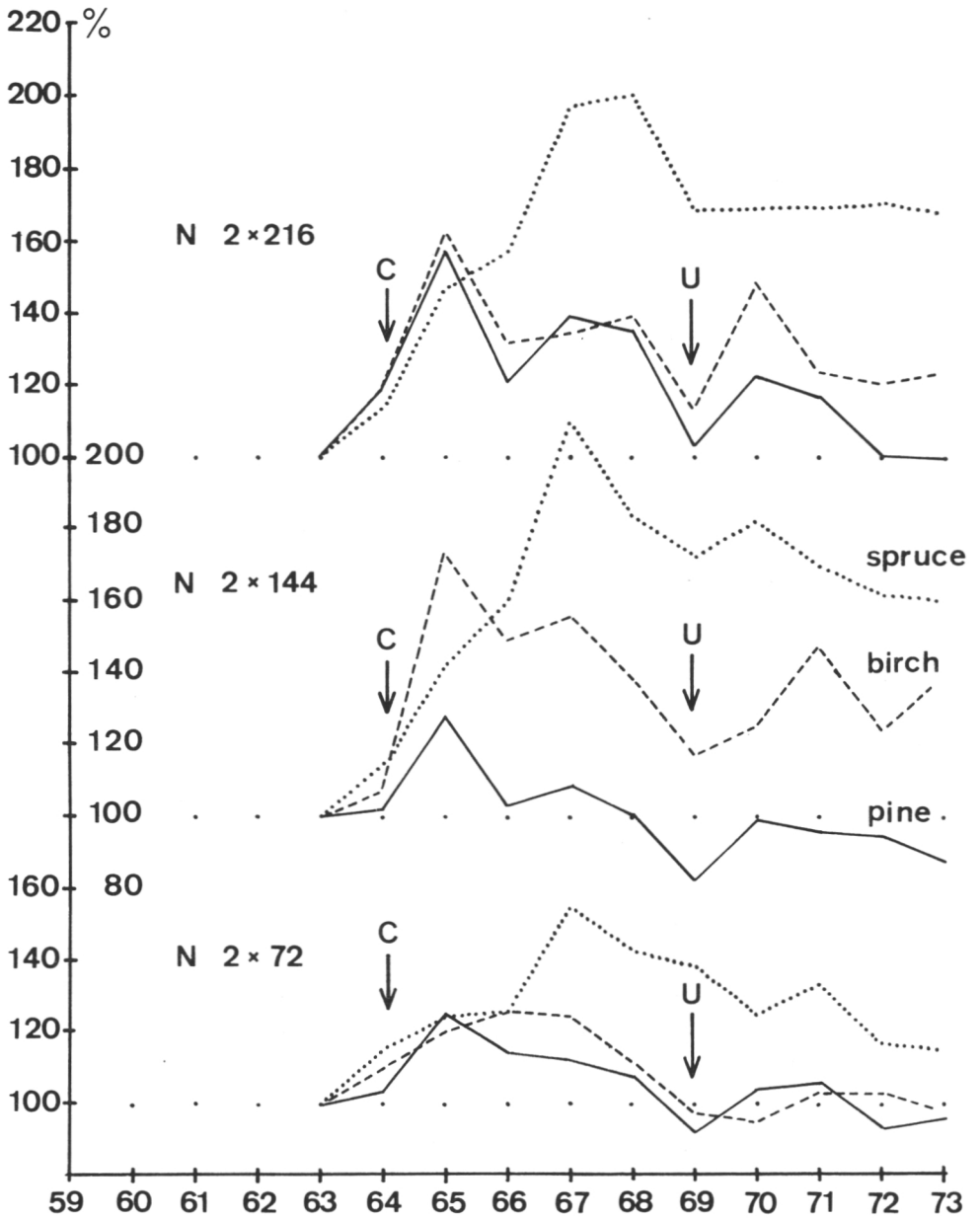


Fig. 10. Relative annual ring diagrammes for experiment 167.
Kuva 10. Koealan 167 suhteelliset vuosilustodiagrammit.

Figure 10 shows the relative annual effect of fertilization for each tree species.

The growth of *spruce* was in this experiment improved already during the year of fertilization, which is an exception to the general mode of reaction of conifers. The effect was at its greatest during the fourth year. The second fertilization did not improve growth, but did stop its reduction. Both of the larger dosages produced a growth reaction of the same magnitude, which at its greatest was 100 p.ct. more than on the control units. The maximum annual reaction to the smallest dosage was 50 p.ct. and the effect of this dosage was obviously of shorter duration than that of the larger ones.

The growth reaction of *pine* was very much smaller than that of spruce, on an average about one third of the reaction in the case of the largest dosage, and still smaller with both of the smaller dosages. In the case of the second nitrogen fertilization in which urea was used, a small positive effect was only noticed for the largest nitrogen dosage.

The reaction of *birch* to fertilization was clearly weaker than that of spruce, but stronger than that of pine. The second largest dosage gave the strongest effect. The effect of the smallest dosage was apparent only after the first fertilization, and it lasted quite weakly for five years. The same dosage at the second fertilization did not improve growth at all. The effect of both of the larger dosages lasted for over five years in the case of both of the fertilizer applications.

NUTRIENT REQUIREMENTS OF THE TREE SPECIES

The foregoing observations give an opportunity to examine the reaction of birch to fertilization in general, and to compare the relative reaction of birch to that of pine and spruce. Experiments 28, 85 and 133, which were situated in pure birch stands, represent different site qualities: 28 an extremely fertile site, 133 an above-average site, and 85 an average site. Of the experiments situated in mixed stands, 167 represents a very fertile site, 127 a fertile site and 150 a barren site. The one-tree-plots represent medium-fertile and fertile sites.

It appears from the results that birch requires the same fertilizers as conifers: primarily nitrogen and only in exceptional cases potassium and phosphorus. The duration of the effect of fertilization on the growth of birch varied: in a pure birch stand it was three years, but in a coniferous stand with birch present as a scattered mixed tree it was almost as long as for conifers, *i.e.* at least five years. Similarly, in the experiments of Tamm (1965) and Hagner &*al.* (1966) the effect of one nitrogen fertilization in mixed stands was noticed in birch for as long a time as in conifers, whereas Langehammer (1973) in pure birch stand noticed it for a short period only. The material available for elucidating the variations in growth, which have been revealed by normal examination methods, is insufficient for the present time at least. Therefore, an attempt will be made to find out more about this problem by means of the growth physiology of trees.

The main part of the nutrients given as fertilizers, which are taken up by the trees, pass to the leaves or needles, a minor part being bound by other parts of the tree. Nitrogen fertilization immediately increases the level of chlorophyll in the leaves and needles, and subsequently an increase in the yield of wood is noticed (Viro 1959, 1965). Only a part of the nitrogen which is transferred to the foliage falls to the ground with it in the autumn, most of it being translocated to the branches and younger foliage. In this way, 83 p.ct. of the nitrogen is transferred from pine needles before they fall, 66 p.ct. from birch leaves, and 62 p.ct. from spruce needles. As pine usually bears simultaneously needles from four consecutive years, and spruce from six or more, the revealing figures about the transfer of

nutrients show that 4 p.ct. of the total nitrogen of the needles is lost to the litter annually in the case of pine, 6 p.ct. for spruce, but for birch, which loses all its leaves every year, 34 p.ct. The loss of potassium and phosphorus from birch leaves in the litter is also greater than that of conifers. Birch loses 49 p.ct. of the phosphorus and 42 p.ct. of the potassium, while the corresponding figures for spruce are 6 p.ct. and 2 p.ct., and for pine 5 p.ct. and 3 p.ct.

The trees and all the other vegetation compete with each other for the nutrients released by litter decomposition. Owing to their shallow root systems, the ground vegetation, especially the herbs and grasses, and also the dwarf shrubs and shrubs, are in a more favourable position to use these nutrients, than the deep rooting trees. If the root systems of different tree species are examined, it can be seen that of the species commonly occurring in Finland, spruce has the shallowest system, and pine and birch have root systems which are as deep as each other (L a i t a k a r i 1927). Of the vascular plants, the root systems of the herb, grass, and dwarf shrub vegetation are the shallowest, the root systems of trees being much deeper. A luxuriant ground vegetation may thus have a noticeable influence on the different effects of fertilization and on the duration of the effect. This was in fact noticed on two of the experiments (127, 167) between the shallow-rooted spruce trees and the deeper-rooted pines and birches. The first fertilization increased the surface area of the foliage of all the tree species, and subsequently the degree of shading in the stand. This further reduced the amount of ground vegetation and improved the nutrient status of the trees: competition from the side of the ground vegetation was decreased and nutrients were liberated as the litter decayed. The most likely explanation for the noticed poor reaction of pine to fertilization is that the site quality of these stands already at the beginning of the experiment was above the optimum for pines. Thus, pine has no longer been able to benefit from the increased fertility to the same degree as the more exacting species spruce and birch, especially in the case of the second fertilization.

In a fully stocked conifer stand, especially spruce, the herb and grass vegetation is very reduced and the trees probably take up most of the nutrients liberated in the decomposition of leaves and needles. Thus, in the previously described cases, birch present as a minor mixed tree in a conifer stand could obviously to a noticeable degree compensate for the nutrients which were lost during leaf fall. Owing to this, the effect of fertilization on the growth was quite large and lasted for at least five years (*cf.* p. 27). The luxuriant herb and shrub vegetation of an open birch stand has a shallower root system than the birch trees. Thus, the ground vegetation is in a better position to take up the nutrients given as fertilizer, and those becoming available from litter decomposition. This obviously

reduces to a large extent the proportion of nutrients which birch receives from fertilization and from the decaying litter, and also shortens the duration of the fertilization effect. Spruce litter decomposes more slowly than that of birch and pine, and from the point of view of the liberation of nutrients from the litter, the herb and grass vegetation in a pure spruce stand would be favoured (Viro 1955).

These mixed stand experiments also shed some light on the mutual site requirements of tree species. Experiment 150 represents a barren site. The addition of nitrogen has in this experiment improved the radial growth of both spruce and birch to almost the same extent. The site quality of this experiment is clearly below the optimum level of these species. The ground vegetation consists almost entirely of mosses and dwarf shrubs which require very little nutrients, and so the effect of fertilization on birch growth has lasted as long as for spruce, *i.e.* for at least six years. Experiments 127 and 167 show that the reaction of pine to fertilization was noticeably weaker than that of birch or spruce. In these cases, especially in experiment 167, the inherent site quality was already obviously above the optimum level for pine. Therefore, a very strong fertilization treatment was required to produce any essential improvement in the growth of pine.

The birches on plot 127 reacted quite well already during the year of fertilization, and the reaction to the second fertilization was almost two times as great as to the first. Spruce reacted quite strongly to both fertilizer applications, although the reaction was clearly weaker than that of birch. The natural growth figures indicate that the site quality was quite good, but it was obviously not yet at the optimum for either of the species. This is evidently due to the stratification of the soil (*c.f.* p. 24). The roots of birch may penetrate to quite a depth, but spruce is shallowrooted. In this case the requirements of pine and birch for water were evidently satisfied whereas spruce during dry summer spells suffered from drought. So, due to the occasional lack of water, spruce could not fully benefit from the addition of nutrients, and fertilization increased the growth of birch more strongly than that of spruce. Thus, the summed-up site quality was obviously nearer to the optimum of birch than of spruce.

The reaction of pine to fertilization in experiment 167 was even weaker than in the previous experiment, which shows that the site quality was still further away from the optimum site quality of pine. The reaction of birch to fertilization in this experiment was definitely quite strong, whereas the reaction of spruce at all dosage levels was clearly much greater than that of birch, and the reaction of spruce was maintained for a longer time. It can be concluded from this that the site quality of this experiment was above the optimum requirement of birch, and possibly quite close to the optimum of spruce.

DISCUSSION

The most important object of forest fertilization is to produce a profitable increase in the yield of wood. Earlier studies have shown, that fertilization of mature conifer stands can be a very worthwhile measure from the economical point of view. The results obtained in this study leave the question of the economy of fertilization, in the case of birch stands, almost completely open. However, it is likely that fertilization of birch is less profitable than that of conifers.

According to the experiments, birch requires addition of the same fertilizers as conifers, primarily nitrogen, although unlike conifers, additional potassium appears to be more important for birch than phosphorus. It is difficult, at the present stage of the experiments, to make any accurate recommendations as regards the types and dosages of fertilizers for use in birch stands. The following figures can be given as a rough guide: N 150 kg, K_2O 100 kg, and P_2O_5 50 kg, all for hectare.

It has been noticed that fertilization at the forestation stage cannot be recommended for any of the tree species, for the seedlings are readily damaged by even quite small dosages of easily soluble fertilizers. Birch seedlings, on the other hand, in contrast to conifers, can be successfully fertilized already in the year following planting, so that the seedlings rapidly become so large that the herb and grass vegetation no longer affects them. In this case, fertilization is evidently required annually for a number of years.

The results from the present experiments show that fertilization of cull-birch stands is obviously not economically worthwhile. This question would possibly be different in a timber sized, fully stocked birch stand, but for the moment, such stands have not been at disposal for experiments. The duration of the fertilization effect in a pure birch stand is, however, evidently much shorter than in the coniferous stands. Birches growing among conifers on a fertile site obviously react well to fertilization, and the effect is of longer duration than that in a pure birch stand.

The presented birch fertilization experiments leave many questions still unanswered. Birches grow fast on fertile sites, and if their growth, as has been the case in mixed stand experiments, could be improved to the

same extent as that of conifers, it would obviously be very remunerative. On the basis of knowledge gained up to now, the fertilization of birch can only be recommended at the seedling stage, although well-shaped birches should under no circumstances be removed from mature mixed stands before fertilization.

The present experiments with the one-tree-plot method further confirm that the use of this method, in spite of its limitations, definitely has great advantages in preliminary studies which are intended to elucidate the requirements of trees in conditions where the number of suitable sites is inadequate for ordinary methods.

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KOIVUN LANNOITUS

Selostus

Johdanto

Suomessa on tutkittu kangasmetsien lannoitusta jo yli 15 vuotta ja tutkimusten tuloksia on esitetty lukuisissa julkaisuissa. Nämä tutkimukset ovat käsitelleet lähes yksinomaan havupuita, koivusta on ilmestynyt vain yksi suppea tiedonanto. Viime vuosina on koivupuun tuotoksen lisäämistarve tullut entistä selvempänä esiin, kun vanhat kaskikaudelta peräisin olevat koivikot alkavat loppua. Uudet koivikot perustetaan hyvärotuista rauduskoivua käyttäen, mutta vaikka nämä taimistot kasvavatkin nopeasti, on kuitenkin ruvettu kokeilemaan myös vanhojen, sekä puhtaiden että sekametsäkoivikoiden kasvun parantamista lannoituksella.

Lannoituksen vaikutus ilmenee puissa ensiksi neulasten ja lehtien vihreän värin tummenemisena, joka johtuu niissä olevan hiilidioksidia yhteyttävän vihreän väriaineen, klorofyllin, määrän lisääntymisestä. Kasvun lisääntyminen havaitaan ensin neulasten ja lehtien suurentumisena ja vuosikasvainten pitenemisenä. Lannoitusvuonna luston paksuneminen havaitaan havupuissa hyvin heikkona, samoin sekametsän koivuissa, mutta puhtaissa koivikoissa hyvin selvänä.

Koivun reaktio lannoitukseen

Kokeiden mukaan koivu vaatii lannoitteina samoja ravinteita kuin havupuutkin, siis ensi sijassa typpeä, mutta toisin kuin havupuilla, kalin lisääminen näyttää olevan koivulle tärkeämpää kuin fosforin. Tutkimuksen nykyvaiheessa on vaikeata tehdä suosituksia lannoitelajeista ja -annoksista koivikoissa, seuraavat luvut osoittanevat käytettävien ravinteiden määrän suuruusluokan hehtaaria kohti: N 150 kg, K_2O 100 kg ja P_2O_5 50 kg.

Havupuun taimia ei pidä lannoittaa, melko pienetkin annokset saattavat tappaa taimet, mutta koivun taimien pituuskasvua on istutuksen jälkeisenä vuonna tehty typpilannoitus parantanut jopa 80 %. Lannoituksen avulla koivun taimet saadaan nopeasti niin suuriksi, etteivät pintakasvillisuus ja vesat häiritse niiden kasvua. Lannoituksen vaikutus koivun taimistossa kestää vain yhden vuoden ja se on toistettava ehkä 3—4 peräkkäisenä vuonna.

Koivikon ravinnetalous

Koivu käyttää ravinteita tuhlaavasti, se pudottaa vuosittain karikkeissa 35—50 % lehvästönsä ravinteista, kun havupuilla vastaavasti luku on 2—5 %. Valoisissa puhtaissa koivikoissa on runsas pintakasvillisuus ja sen lähellä maanpintaa oleva juuristo on lannoituksessa annettujen ja karikkeiden hajonnassa vapautuvien ravin-

teiden otossa edullisemmassa asemassa kuin puut ja varsinkin kuin syväjuurinen koivu. Pintakasvillisuus ilmeisesti ottaakin koivikoissa huomattavan osan tarjolla olevista ravinteista. Sen vuoksi on lannoituksen vaikutus puhtaissa koivikoissa lyhyt ja varsin vaatimaton: kun vaikutus 80—100 kilon typpiannoksella kestää varttuneissa havumetsissä 5—7 vuotta, niin puhtaissa koivikoissa tällaisen annoksen vaikutus kestää vain 3 vuotta, ja myös määrällisesti vaikutus on koivikoissa paljon pienempi kuin havumetsissä.

Varttuneiden havumetsien, varsinkin kuusikoiden, pintakasvillisuus on valon puutteen vuoksi pääasiassa sammalia ja varpuja, jotka ottavat ravinteita paljon vähemmän kuin koivikon ruoho- ja heinäkasvillisuus. Kun koivu on vähäisessä määrin sekapuuna havumetsiköissä, lannoitus vaikuttaa pintakasvillisuuden kilpailun puuttuessa kaikkien puulajien kasvuun lähes yhtä kauan.

Sekametsien lannoituskokeet tukevat yleistä käsitystä, että puulajeistamme mänty on vaatimattomin. Viljavimpien kasvupaikkojen kokeissa lannoitus on pystynyt vielä lisäämään kuusen tuotosta, kun koivu ei ole enää sanottavasti reagoinut lannoitukseen. Kuusta on siten pidettävä vaateliaampana puulajina kuin koivua.

Lannoituksen taloudellisuus

Metsän lannoituksen tärkein tavoite on lisätä taloudellisesti puun tuotota. Aikaisemmat tutkimukset ovat osoittaneet, että varttuneissa havumetsiköissä lannoittaminen saattaa huomattavasti nopeuttaa kasvua ja olla taloudellisesti erittäin edullista. Tämän tutkimuksen tulokset jättävät kysymyksen koivikon lannoituksen taloudellisuudesta lähes täysin avoimeksi. Näyttää kuitenkin ilmeiseltä, että varttuneiden havumetsiköiden lannoitus on kannattavampaa kuin koivikoiden. Taimistoialla koivu sitävastoin reagoi lannoitukseen paljon voimakkaammin kuin havupuut, ja koivun istutustaimistoissa voidaan suositella vuosittain laikkulannoitusta typellä istutuksen jälkeisestä vuodesta alkaen.

Vanhoissa harsintahakkuilla käsitellyissä koivikoissa saattaa runkoluku olla alhainen ja kasvu metsikön iän vuoksi jo hyvin hidasta. Kun niissä lisäksi usein on runsas ruoho-, heinä- ja vesakasvillisuus, joka pinnallisen juuristonsa avulla käyttää huomattavan osan annetuista ravinteista, lannoitus näissä metsiköissä tuskin tulee olemaan taloudellisesti kannattavaa. Asia voi olla kokonaan toinen täystiheissä, nuorehkoissa, rodullisesti nopeakasvuisissa viljelykoivikoissa.