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GEOGRAPHIC TRENDS IN VOLES IN FINLAND
IN THE YEARS 1973-80

MYRRÄTUHOJEN ESIINTYMISALUEEN SIIRTYMINEN
SUOMESSA VUOSINA 1973-80

HERBIVORE-PLANT INTERACTIONS AT NORTHERN LATITUDES
A SYMPOSIUM WORKSHOP AT KEVO FINLAND
14-18 SEPTEMBER 1981

1. INTRODUCTION

Many field studies on cyclic fluctuations of vole populations have been done during recent decades but most of them consist of materials collected from rather restricted or local areas. The availability of material covering long periods of time has made it possible to state with some certainty that local variations in the size of vole stocks exhibit a certain degree of regular periodicity, in which the peaks generally follow each other at intervals of three or four years, although the intervals may sometimes be either shorter or longer (e.g. WILDHAGEN 1949, 1952, 1954 cited by MYRBERGET 1973, KALELA 1962, MYRBERGET 1965, LAHTI et al. 1976).

After analysing material covering vole stocks in different years in Norway, HAGEN (1956 cited by MYRBERGET 1973) found that the vole peak in southern Norway occurred one year before that in Central Norway and two years before that in northern Norway. According to MYRBERGET (1965), the vole peak moved from region to region during the three cycles occurring in the period 1946-60, in the same way as described by HAGEN, but not during the fourth cycle. In the 1960's there was again one cycle in Norway (MYRBERGET 1973) in which the peak in the south was one year earlier than in the north and two cycles in which the regional differences were random.

The asynchronisation of vole peaks in different areas has also been observed in Finland. According to KALELA (1962), there were three peaks during the period 1946-61 in northern Lapland and four in southern Lapland. He stated that the synchronisation of vole peaks in different regions throughout the country decreased on moving southwards while at the same time the fluctuation in vole populations becomes less and less pronounced.

The increase in the amount of young plantations especially on old fields, has been followed by an increase in the amount of damage caused by voles to forest tree seedlings in the Nordic Countries (cf. KANERVO & MYLLYMÄKI 1970, TEIVAINEN 1974, 1978, CHRISTIANSEN 1975, LARSSON 1975). The damage has risen

to such proportions that it has been considered necessary to carry out studies into the periodicity of the variations in vole abundance by means of extensive systematic trapping (MYLLYMÄKI 1977, MYLLYMÄKI et al. 1977). In addition to methods based on direct trapping, vole density can also be followed by inventorying the damage caused by voles, the frequency of damage thus indicating the relative abundance of voles (cf. MYLLYMÄKI 1959).

Over 200 million seedlings are planted annually in Finland. This means that about 100 000 ha of new planting areas, which are more or less distributed evenly throughout the country, are established each year. Finland is therefore continuously covered by a fairly uniform network of plantations containing seedlings which are only a few years old. These young stands are generally watched and tended rather closely by professional foresters or plantation owners during the first few years after planting. There is therefore good reason to assume that vole damage, which is in most cases directed at seedling stands during the first few years after planting and which is often alarmingly evident, will be readily noticed in such stands. Seedling stand damage can therefore be considered to be a good indicator of the relative number of voles, to the extent that the different species of vole are important damaging agents.

This talk is based on the results of the nationwide inventory of damage caused by voles to forest tree seedlings carried out annually (TEIVAINEN 1978). However, control trapping and observations on the wintering signs of voles are also made annually in different parts of Finland. The aim of the research work has been to determine the temporal and regional regularities of vole damage in order to provide a basis for making forecasts, which have been published every year since 1975, for use in practical forestation work (e.g. TEIVAINEN 1975, 1976, 1977a, 1977b, 1979, 1980).

2. MATERIAL AND METHODS

The material presented here concerning the damage caused by voles to forest tree seedlings has been collected during 1973-80 using methods which have been described elsewhere (TEIVAINEN 1978). The material consists of the 2121 cases of vole damage occurring in seedling stands during a period of eight years, damaging a total of 7,4 million seedlings.

Vole control trapping was usually carried out in the autumn and wintering signs were examined in the spring during the snow melt. These field studies were carried out in order to check and control the picture given by the damage survey about the areas where vole stocks are high.

3. DISTRIBUTION OF DAMAGE AND REGIONAL RHYTHM

The areas where vole damage occurred have varied every year. In 1972/73 they were concentrated in the central parts of southern Finland (Fig. 1). The next year the damage epicentre moved further to the east and the north, extending right upto the western part of Lapland (Fig. 2). However, the amount of damage along the south-western and southern coasts increased at the same time in comparison to the previous year's damage (Fig. 9C). In 1974/75 the trapping figures indicated that the vole peak had now reached the eastern and northern parts of Lapland although no damage had occurred there. On the other hand, the damage centre in Central Finland was confined to a small area (Fig. 3). In 1975/76 damage occurred over a wider area in Central Finland, on the southern and eastern side of the previous year's epicentre (Fig. 4). The damage centre in the following year had moved, on the one hand, to the east and to the north, and on the other, to the south-west and to the south (Fig. 5), the most serious damage occurring in almost the same area as in 1973/74, but more to the south.

In 1977/78 the damage centre had moved to Lapland, further north and more to the east of the previous year's damage

centre (Fig. 6). Simultaneously the vole stocks in south-western Finland and along the western half of the coast of the Gulf of Finland were high and on the increase in Central Finland (Fig. 9C). The next year (in 1978/79) the damage area spread, starting from the concentration in Central Finland, in the same way as it had done three years earlier, to the south and to the east (Fig. 7). In 1979/80 the damaged areas were restricted to a dense cluster touching the eastern border (Fig. 8) but damage did not spread to western Lapland as had happened three and six years earlier. At the present time, there are large plenty of voles in Kainuu and in western Lapland, i.e. the area which lies to the north of the previous concentration.

During these years, the damage centre appeared to move in a rather regular fashion from one area to the next in successive years. If the starting point is taken as the rather restricted area in Central Finland, in the second year the damage centre spread to the south and to the east. In the third year it moved even further to the east and to the north, right up to the southern and western parts of Lapland (Fig. 9A). The peak appeared in the eastern and northern parts of Lapland in the fourth year, while at the same time a new cycle was starting in Central Finland. The spread of the damage wave towards the western and southern coasts of South Finland was not so clear as in the eastern and northern directions (Fig. 9 B and C). However, the clear but small damage peaks along the south-western and southern coastal regions during the study period occurred at the same time as those in the North-Karelian - North Ostrobothnian zone.

The results thus indicate that the spread of the damage wave, which started in Central Finland, spread out more or less in all directions. However, the actual progression of the wave followed, on the one hand, the distribution of fertile land and, on the other, was more apparent in areas where there is slight variation in the snow conditions in different years.

The rhythm of cyclic fluctuation in the vole stocks in Central Finland is, according to MYLLYMÄKI (1977), triennial. Accord-

ing to our material, too, the damage peaks in that area occurred at intervals of three years. In Finland's northernmost corner, at Kilpisjärvi, the study (LAHTI et al. 1976) carried out using the material which KALELA et al. collected during a period of 25 years showed that the vole peaks occurred at intervals of 4 - 5 years. The longer cycle, characteristic of northern Finland, was also evident in the damage survey material as both successive peaks at four-year intervals, and as a gradual shift in the area of the damage centre to the south calculated according to three year cycles. If the observed regional order in the movement of the damage wave takes place regularly, as the material collected upto now indicates, the difference in the duration of the cycles in southern and northern Finland caused a regional multiple rhythm of longer duration. Thus the similar regional appearance of a vole peak would recur between intervals longer than one cycle. Respectively, the areal extent of vole peak will vary between successive cycles.

4. THE REGIONAL RHYTHM IN RELATION TO BIOMASS PRODUCTION

Periodicity is a very common phenomenon in nature. The change over from day to night causes photoperiodicity, alternation of seasons produce changes in day-length, winter and summer, coldness and warmth. The further north we go, the greater the amplitude of the variation. The length of the growing season shortens, but the intensity of plant biomass formation increases as a result of the increased length of the daylight period.

This periodicity, the intensive but short period of plant biomass production and the long period of winter dormancy cannot be considered to have had no effect on the development of a fluctuating type of ecosystem. In order that the food cycle of this ecosystem from green plant biomass to mammalian herbivores and to carnivores could have evolved under these conditions, plant production will have had to have been utilized as efficiently as possible and the transfer of energy, too,

fixed in the plant biomass as efficiently as possible. As, however, the bearing capacity of the first trophic level and regeneration is the weaker, the further north the location is, the energy flow from plants to herbivores and to predators has had to adapt to the basic rhythm, while at the same time, however, adapting to exploitation of plant biomass as efficiently as possible. The evolutionary selection value of the variation in the size of the vole population can be interpreted from this by assuming that it consists of two components - temporal rhythm (length of the cycles) and geographical rhythm (movement of the vole peak epicenters from area to area in a specific order). The interaction between these two components permits the vegetation to be exploited as efficiently as possible right up to over-grazing-level, as a result of which the vole population increases to overdense levels and then collapses. However, destruction of the vegetation cover is not permanent as there is a period lasting for three years at least before the peak again develops in the same area, and hence the vegetation has time to recover. In the north where regeneration is slower, the time interval between peaks is longer.

As a matter of fact the movement of the vole peak epicenter from one area to another in a specific order is a rather similar phenomenon to the nomadic grazing of large herbivores according to the season. However, movement of the density center of the vole population from one area to another occurs in successive years, in different generations and in different populations. The system represents, on the one hand, retention of the trophic level occupied by the voles, and on the other, a continued supply of food to predators, from the point of view of successful nesting. According to this study, the distance between successive density centers is so short that the movement of many predators with specialised food requirements, especially predacious birds, along with the density centers to new nesting grounds is completely possible. As a matter of fact it follows from this that variations in the size of the populations of the prey and predators with special food requirements are partly, at least, synchronised, these predators "riding on the crest of the vole peak wave".

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Fig. 1-8. Total area (ha) of plantations damaged by voles during 1973-80 in different communes.

Fig. 9. Cyclical rhythm of vole damage in different parts of Finland during 1973-80.

Kuvat 1-8. Istutettujen metsäpuiden taimistojen myyrätuhot vuosina 1973-80 kunnittain.

Kuva 9. Myyrätuhojen rytmi Suomen eri osissa ilmaistuna kunkin osa-alueen tuhojen kokonaismäärän prosenttisena jakautumana eri vuosien osalle.

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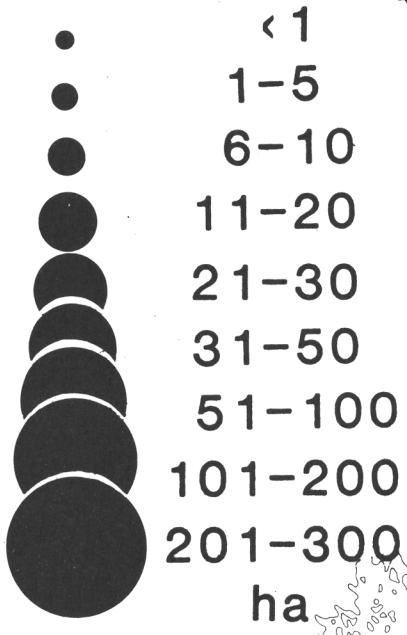
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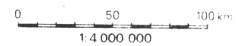
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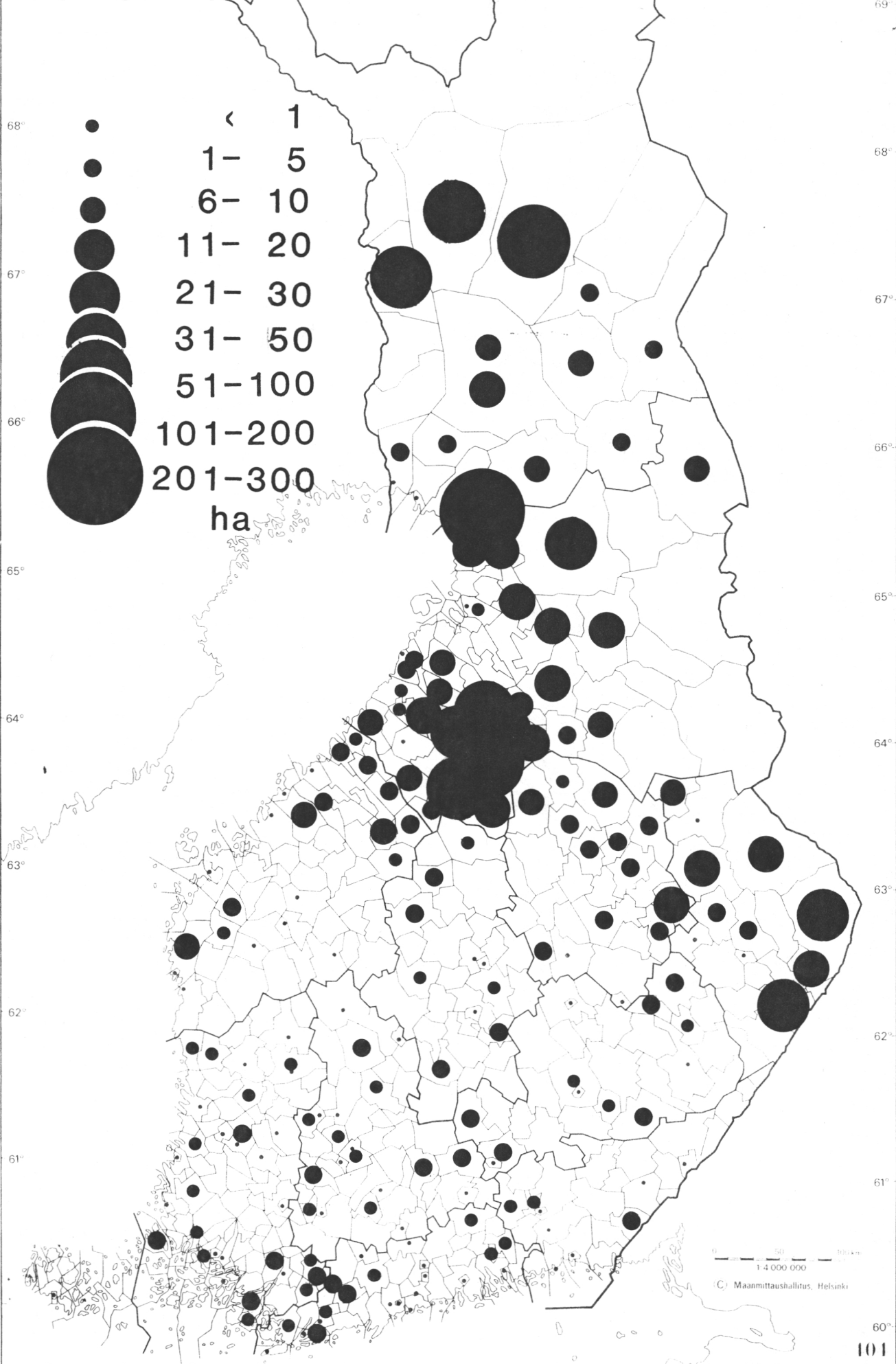
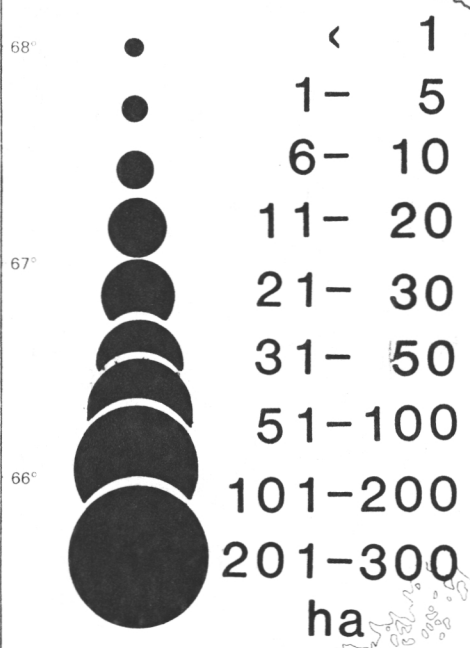
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69° **1973/74**



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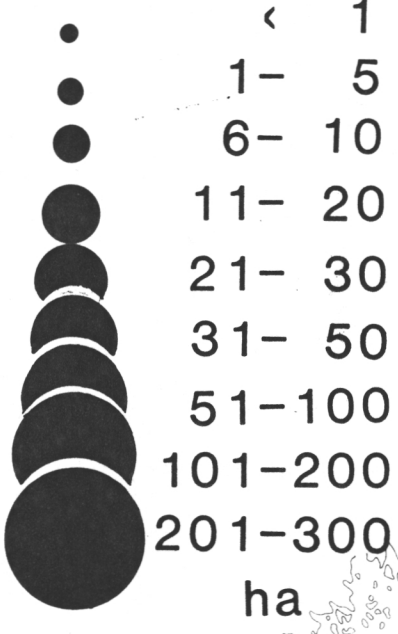
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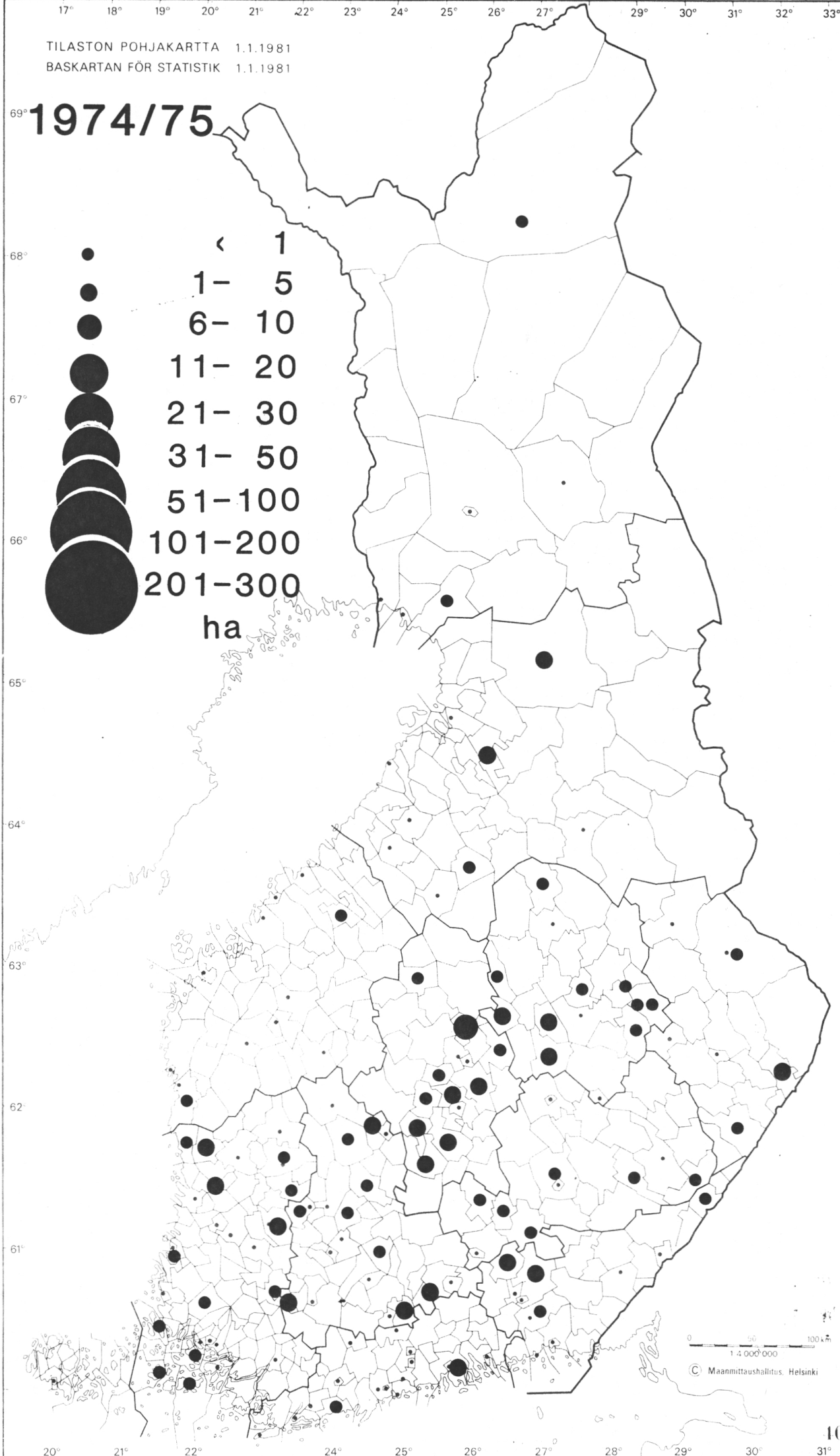
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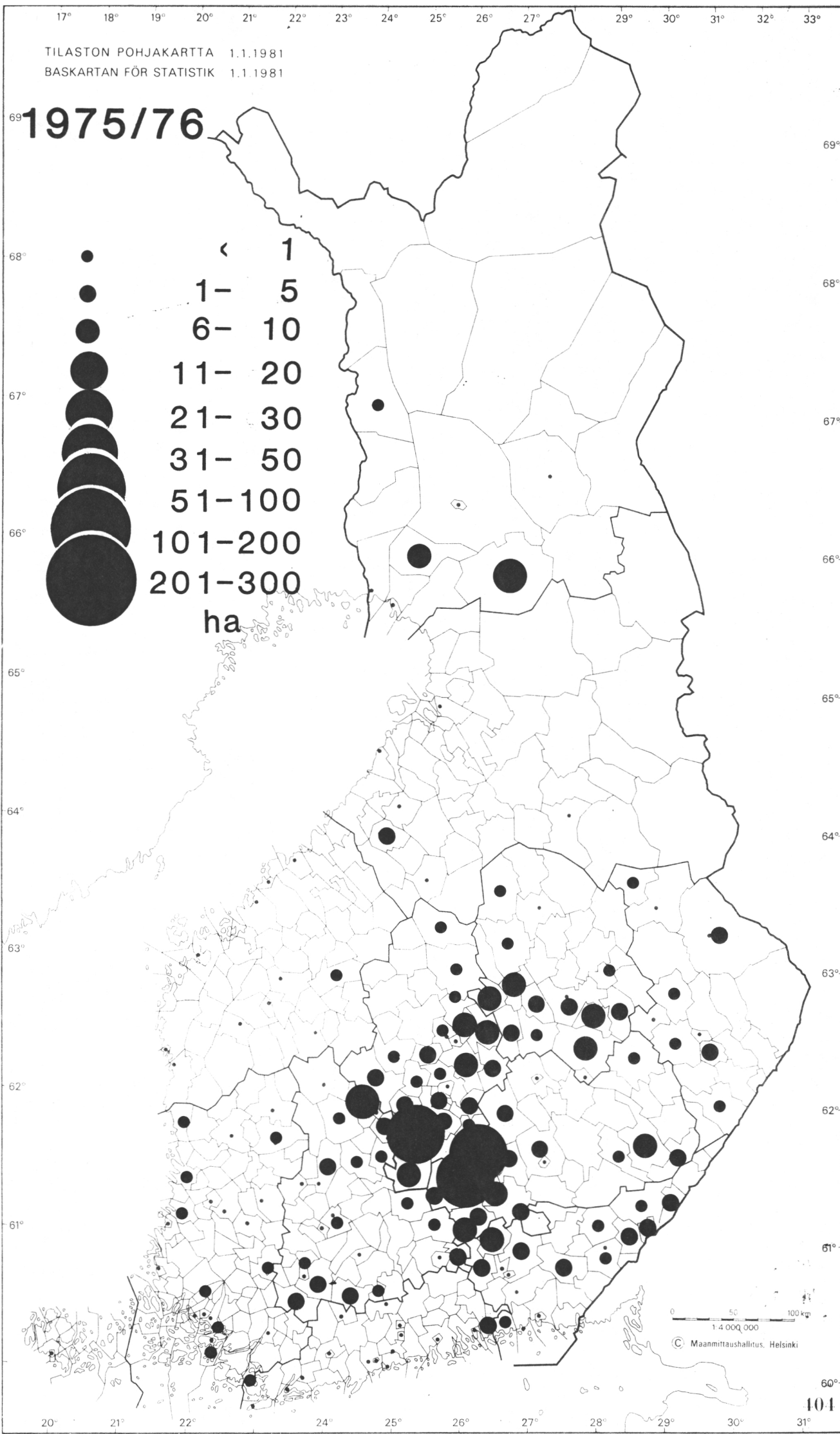
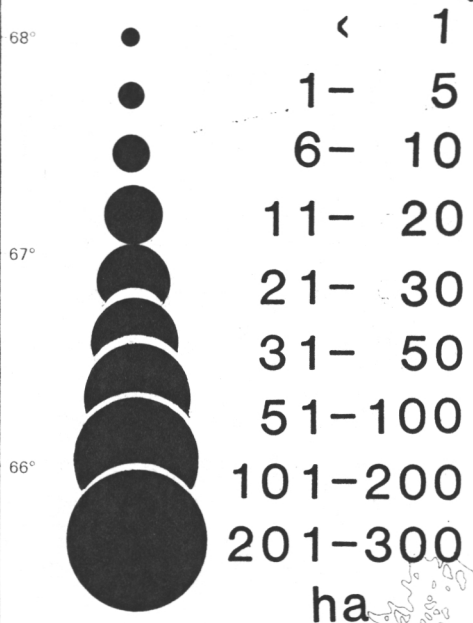
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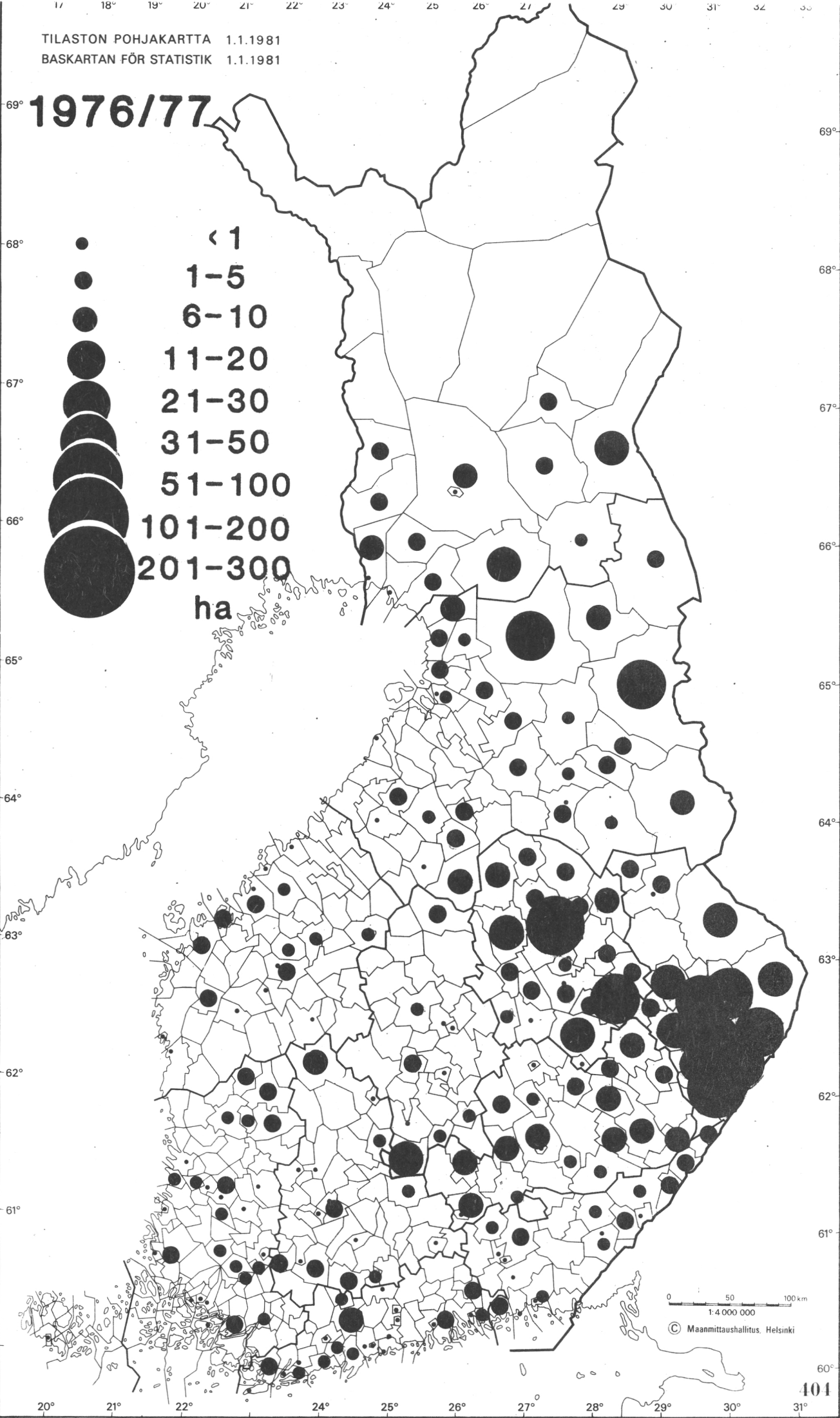
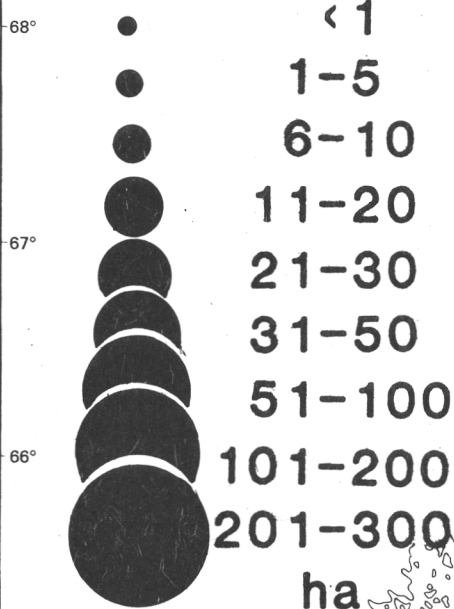
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69° **1976/77**



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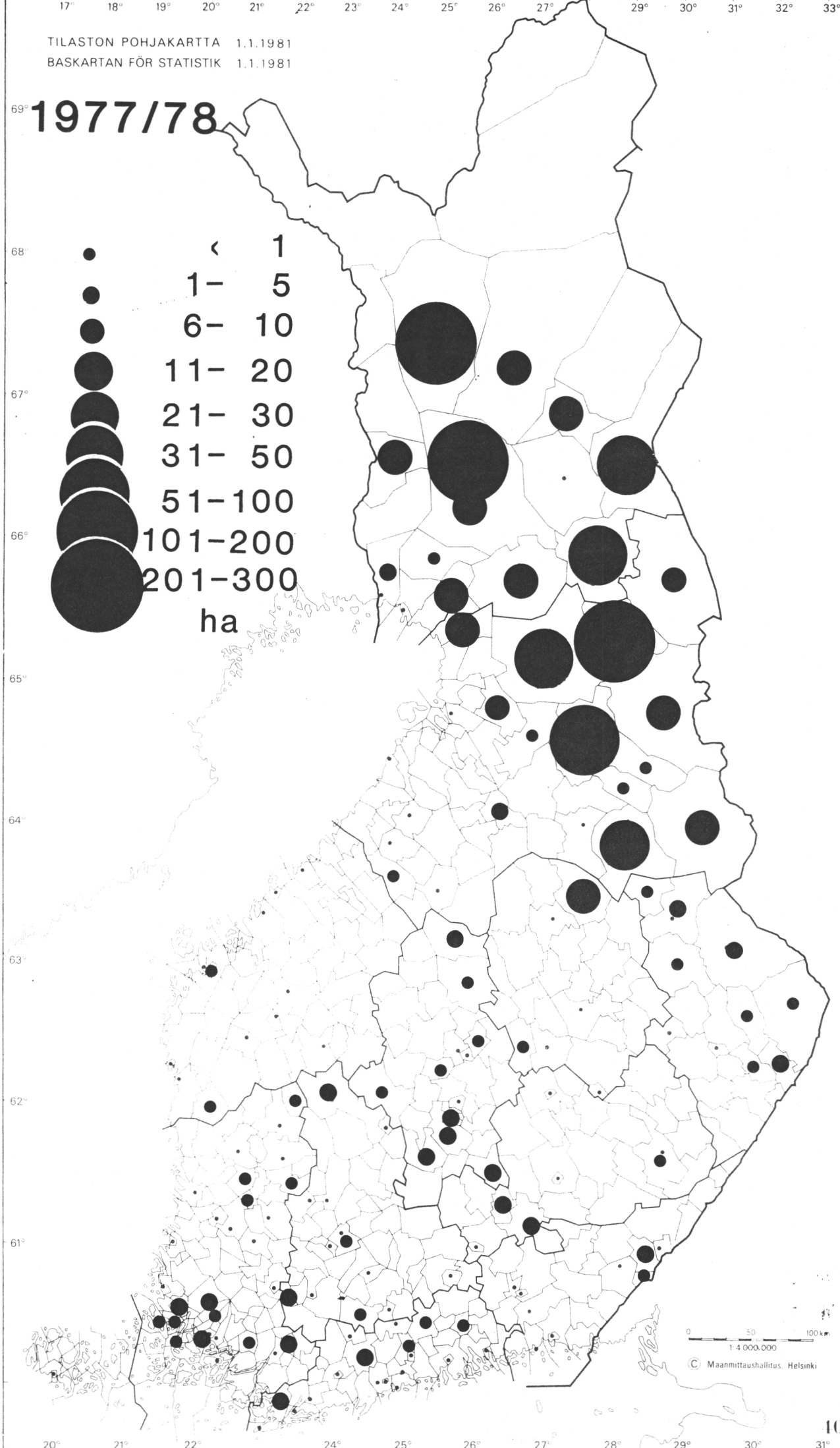
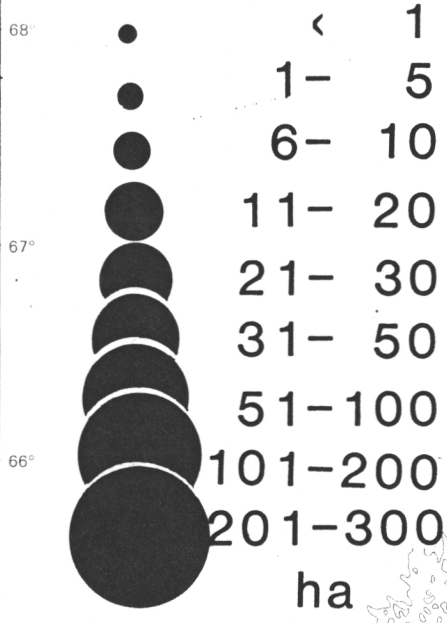
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69° **1977/78**



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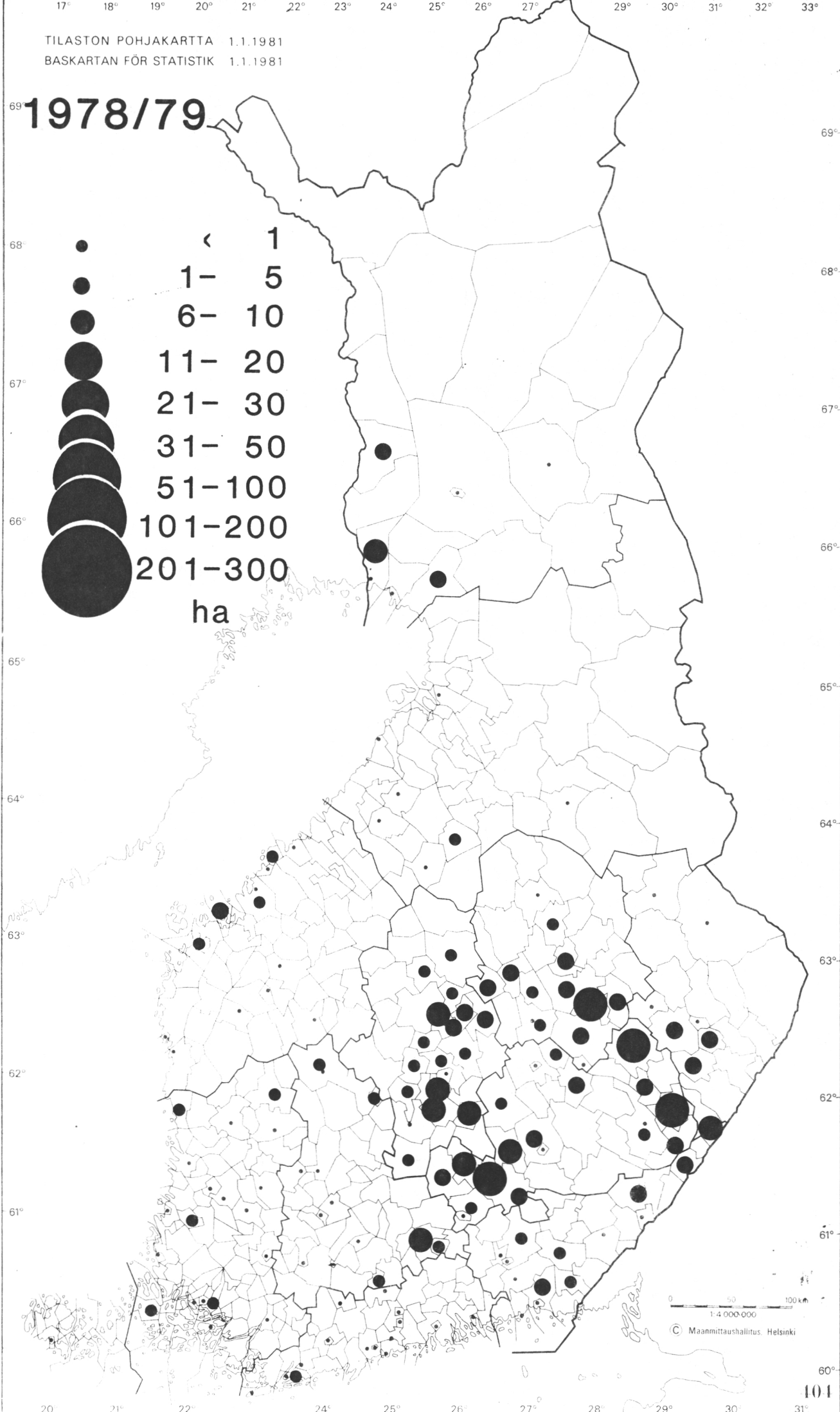
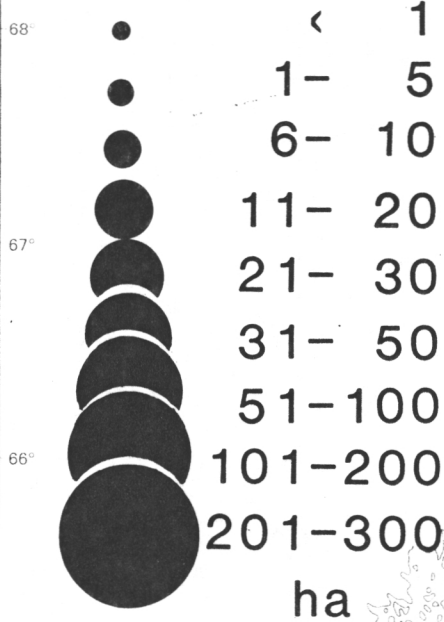
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69° **1978/79**



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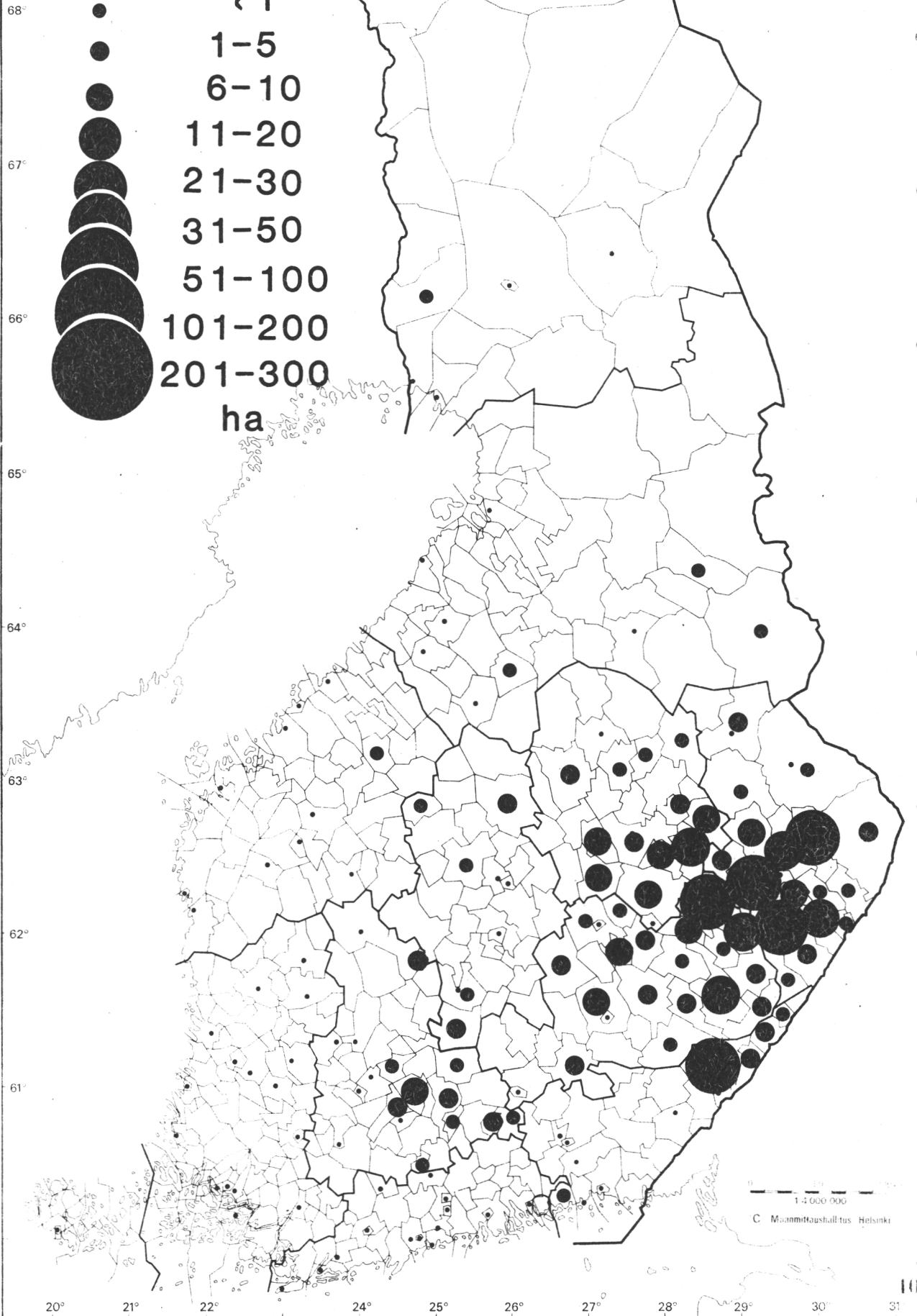
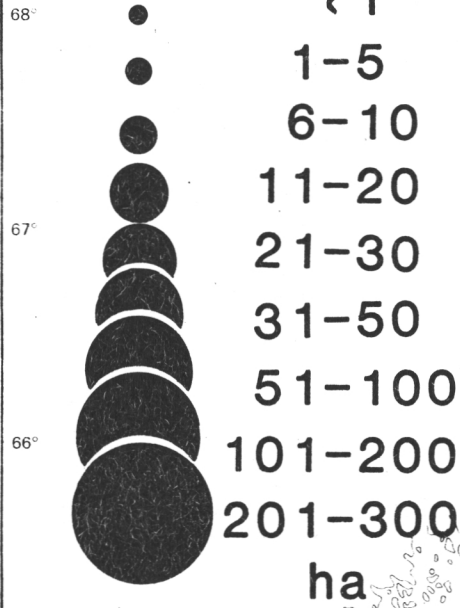
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69° **1979/80**



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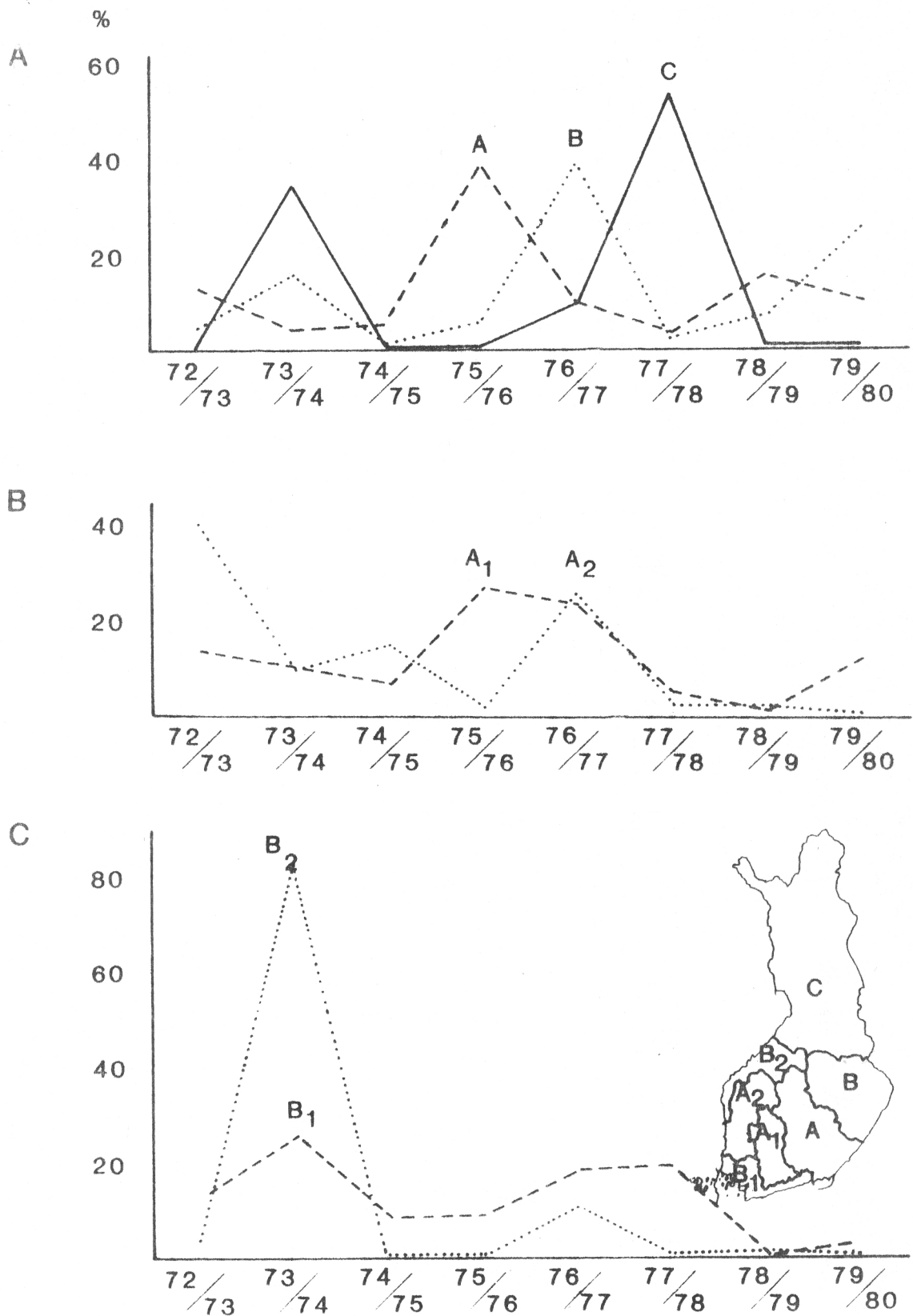


Fig. 9. Cyclical rhythm of vole damage in different parts of Finland during 1973-80.

Kuva 9. Myyrätuhojen rytmi Suomen eri osissa ilmaistuna kunkin osa-alueen tuhojen kokonaismäärän prosenttisena jakautumana eri vuosien osalle.

TIIVISTELMÄ

Kahdeksan vuoden aikana (1973-80) kootun tiedusteluaineiston mukaan, joka käsittää tiedot 2 121 istutetusta taimistosta, myyrät vioittivat tai tuhosivat 7,4 miljoonaa tainta, yhteensä 4 000 ha.

Tuhokeskittymä oli peräkkäisinä vuosina eri alueilla ja siirtyi huomattavan säännönmukaisessa järjestyksessä alueelta toiselle. Jos lähtökohtana pidetään suppeata aluetta Keski-Suomessa, laajeni tuhokeskittymä toisena vuonna toisaalta kohti Hämettä, toisaalta kohti Savon ja Karjalan eteläosia, kolmantena vuonna Pohjois-Karjalaan, Pohjois-Savoon, Kainuuseen ja/tai Pohjanmaalle. Samanaikaisesti Lapin länsi- ja eteläosissa oli myyräkanta nousussa. Neljäntenä vuonna tuhokeskittymä oli Lapissa ja samanaikaisesti uusi sykli oli alkamassa Keski-Suomessa.

Tuhoaallon eteneminen länsi- ja etelärannikolle ei ollut yhtä selvää kuin itä- ja pohjoissuuntaan. Kuitenkin myös näillä alueilla oli havaittavissa kohti lounasta etenevä "myyräaalto". Tuohuhiippu lounaisrannikolla oli samaan aikaan kuin Lapissa.

Tuhoaalto Keski-Suomen keskuksesta alkaen eteni siis enemmän tai vähemmän säteittäisesti eri suuntiin. Aallon eteneminen noudatti viljavien ja viljeltyjen maiden levinneisyyskuvaa ja huiput ilmenevät selvimmin alueilla, missä ilmasto oli mantereisinta.

Keski-Suomessa tuohuhiiput seurasivat toisiaan kolmen vuoden välein, mutta Pohjois-Suomessa harvemmin. Tämä Pohjois-Suomelle luonteenomainen pitempisyklisyys näkyi aineistossa tuhokeskittymäalueen vähittäisenä siirtymänä etelään päin kolmivuotisjaksojen mukaan laskien.

Mikäli todettu tuhoaallon etenemisen alueittainen järjestys toteutuu säännönmukaisesti, niin kuin tähänastisen aineiston mukaan näyttää, syklien pituusero Etelä- ja Pohjois-Suomessa aiheuttaa pitempijaksoisen alueellisen kerrannaisrytmin, mikä ilmenee myyrähuipun esiintymisalueen samankaltaisena toistumisena kolmea neljää vuotta pitemmin aikaväleihin, samalla kun esiintymisalueen laajuus vaihtelee peräkkäisten syklien vastinvuosina.

