DANISH REVIEW
of
GAME BIOLOGY

Edited by
Jagtfondets vildtbiologiske undersøgelser
and
Vildtbiologisk station, Kalø

Managing editors

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Zoological Museum
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H. M. Thamdrup
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CYCLES

IN

DANISH VOLE POPULATIONS

BY

CARSTEN PEDERSEN

COMMUNICATION NO. 18
FROM THE DANISH GAME RESEARCH STATION
KALØ

COPENHAGEN
1957

Although the all destroying rodent activity experienced in other countries in certain years is unknown in Denmark serious economical problems are associated with the extensive fluctuations in vole density in this country also.

To those concerned with Danish forestry it is a well known fact that in certain years mice and voles occur in far larger numbers than in others. The damage done by small rodents is easier to recognize in the forests than e.g. in corn crops, as the rodent activity may totally alter the appearance of an otherwise promising plantation. It is therefore reasonable that records of rodent damage should first be searched for in the forestry literature. Thanks to a highly developed and well organized state forestry the author has succeeded in extracting so many data on the problem that they would seem well worth publishing.

Through the kindness of the State Forestry Directorate I had the opportunity to utilize all the reports sent to the Directorate from the individual Forest Districts for which I express my sincere thanks, also it is a pleasure to thank all those persons who were helpful in providing other pieces of information which have served as a basis for the present publication.

MATERIAL

The Danish forestry periodicals covering the years 1875 to 1954 have been extracted. All papers and notices have been examined in so far as the headlines indicated that anything of interest might be found in them. For some years yearly or half-yearly notices on the forest conditions are available. They include information on small rodents and the damage done by them, if any but, unfortunately, this service was maintained for shorter periods only. The remaining evidence has been extracted from casual papers. In what follows some examples are given of the character of the information supplied. Comments by the present author are given between brackets.

Tidsskrift for Skovbrug, vol. 1, 1875 p. 163, „Optegnelser om vort Skovbrug i 1875" (Notes on our forestry during 1875): Rodents[1]) and game must surely

[1]) The Danish word „mus" covering mice as well as voles has been translated into „rodents" throughout unless the species of mouse or vole is known.

do considerable damage in our forests, especially on the rich soil as the damage done is mentioned throughout although in few districts only the year 1875 proved worse than other years.

Ibid. vol. 2, p. 100 l. 3 from below; Optegnelser om vort Skovbrug i 1876 (Notes on our forestry during 1876): As usual rodents, roe-deer, and insects have diminished the mast yield.

Ibid. vol. 3. (Nothing mentioned concerning rodent damage).

Ibid. vol. 4, p. 110 below, „Optegnelser om vort Skovbrug i 1878" (Notes on our forestry during 1878): ... rodents have been the most conspicuous natural evil. They have caused such extensive destruction that many an old forester does not remember anything similar. Already early in the autumn of 1878, as soon as the corn crops were removed from the fields, and long before a snow cover was present the destruction commenced and was continued throughout the winter. Apparently no part of the country was spared and in many places very extensive and well closed beech plantings were destroyed, although in some cases something was saved through the partial cutting and nursing of plants which had been gnawed at. Even trees of the diameter of an arm were not spared, and from Frijsenborg reports even mentioned destroyed spruce plantings.

Tidsskrift for skovvæsen, vol. 3, 1891, B, Boas: „Musene i vore skove" (The rodents in our forests): p. 1. ... an external stimulus to choose this moment for publishing a paper like this was supplied by the rather extensive attack by rodents which took place during the winter of 1889—90 ... p. 49, part III: The dry summer of 1889 provided excellent conditions for the rapid multiplication of rodents, and during the autumn of 1889 the woods were crowded with rodents. During the winter I have received several complaints of the damage done by rodents.

... that the winter 89—90 has not been serious to the forests as far as rodents are concerned. ... from ninety-odd districts; among them about 35 report that either no rodent attack took place at all in the district, or that it was negligible in extent; in 40 districts, though, the attack was rather noticeable although not so important that special remedies will be required, only 15 districts among those from which I have had reports (p. 50) mention more extensive damage although, as far as can be judged, total destruction of larger plantings etc. occurred nowhere. ... However, I do not commit any serious error when I summarize the reports received by stating that the feeding activity of rodents in at least its worst form, in beech plantings, has not been very extensive during the winter 1889—90; it has not been much worse than during an average year ... Apparently ... the absence of snow cover has contributed materially in making

the plantings less attractive dwelling places for the rodents ... On the other hand it would seem that the Bank Vole has had an exceptionally "good year".

Ibid. vol. 4 A, p. 51 below, Ed. Bidstrup: „Ræven og Skovbruget" (The Fox and the forestry): But because of my knowledge of the local forests, from where the foxes examined originate, I am forced to interpret the conclusions differently, namely as a proof that during the autumn in question (1886) the forests harboured exceedingly few rodents. This is confirmed by other observations, e.g. by the fact that very few tracks of rodents were seen in the snow during the following winter and that the plants were left ungnawed.

Dansk Skovforenings Tidsskrift, 1926 p. 186, 2nd paragraph, „Vejr og Vækst 1925 II" (Weather and Growth 1925 II): The woods were teeming with rodents, and in places rather extensive damage has already been observed although poison was placed from August. In November a considerable layer of snow was present which was favourable to the rodents and caused a hindrance to the placing of poison and to checking its efficiency. p. 246, „Vejr og Vækst 1926 I" (Weather and Growth 1926 I): Also the damage done by rodents did not become extensive although as usual they were abundantly present in the forests. No doubt the scarce snow cover contributed to this fact. A reporter in North Zealand says that the damage done by rodents was very great in spite of early and copious administration of Ratin.

Ibid. 1927, p. 356, middle of page, „Vejr og Vækst 1927 I" (Weather and growth, 1927 I) ... and as a rule the attacks by rodents were insignificant probably because of the copious mast fall.

In some cases State Forestry District reports are available from 1910 onwards. With the exception of some, by then not established, districts in South Jutland all the State Forest Districts have provided reports from 1915 to the mid-thirties. Thus this period is the one within which the fluctuations are best documented. The reports open by a few pages of special remarks on weather and damage caused by different agencies. For the individual sections of the districts similar remarks are given; notes on all sections consisting partly or exclusively of young plantings of beech or other deciduous trees have been searched for pieces of information. Only one record of damage to conifer plantations has been met with in the Danish forestry literature, therefore the reports on sections consisting of this type of planting were not searched for information. During the year when damage to conifer plantations is reported very severe damage was done to the beech plantations of the same district.

In what follows some examples are given of the information supplied. The years are taken to commence on 1 April, i.e. almost at the time when the breeding

period of small rodents starts. Comments by the present author are given within brackets.

Maarum State Forest District, 1913—1925.

1913: (Nothing mentioned).

1914: With the exception of attack by mildew no damage of importance has been done.

1915: In Valbyhegn rodents occurred in the young beech plantations and destroyed a good many plants.

1916: (No damage by rodents is mentioned although there was a heavy snow cover).

1917. Rodent damage occurred locally only.

1918: In the old beech plantations rodents occurred plentifully but the damage was not catastrophic. In the sections which were grazed by cattle in 1917 the damage done by rodents was negligible.

1919: During the winter rodents occurred plentifully, gnawed in many of the young beech plantings, Ratin was put down, and as found earlier, it showed good action in destroying the rodents.

1920. Rodents and insects caused no damage worth mentioning, the heavy rainfall during April-May probably caused heavy mortality among the young rodents.

1921: During the autumn of 1921 the young beech plantations in Valbyhegn (sects. 12 and 24) were attacked by rodents but Ratin seems to have had a destructive effect.

1922: a good many rodents were present.

1923: also rodents did rather great damage to young beech plants e.g. in sect. 24 in Valbyhegn.

1924: During the first part of the winter rodents did no damage probably because there was some beech mast and consequently some extra food for them. Therefore only small amounts of Ratin was used. However, towards the end of the winter they made themselves felt very forcibly, and seriously, thus they destroyed a large part of the 7 year old beech planting in sect. 131 in Harager Hegn. Probably the rodents reproduced rapidly during the mild and dry winter, and throughout the spring the forest floor was teeming with rodents.

1925: ... before germination took place rodents had eaten a good many seeds off the rows. As exceptionally large numbers of rodents were present in the forests during the spring of 1925, and as the following summer was long and dry—which favoured the reproduction of the rodents—it was

necessary to place Ratin in the beech plantings very early in the autumn of 1925. So the first application of poison took place already about 1 September, and it was continued throughout the winter, accordingly as the poison was taken. In spite of this some damage was done in sects. 12, 24, 131, 169, 189, 263, and a little in sect. 97.

Gurre State Forest District, 1924—38.

1924: In spite of the mild winter and the presence of some beech mast the rodents—which seem to have reproduced vigourously during the preceding good summer—did considerable damage, especially so in Egebæk Hegn and Kelleris Hegn. The attack was met by placing Ratin which had shown a satisfactory effect up till now, but in spite of using amounts larger than ever before the attack was not brought to a complete end.

1925: As in the previous year rodents were locally abundant in the plantings. The attacks were met by placing Ratin and Ratinin and by trapping by means of 300 traps (Langeland). The traps yielded good results but the catch comprised all species of rodents, also those which are considered of less importance or not harmful at all to young trees (Wood Mouse and Bank Vole), and the most harmful one, the Filed Vole, was not preponderant.

1926: Although the winter was mild rodents did some damage particularly in Kelleris Hegn. Traps and Ratinin (made from a species of onion, Allium) were used but without bringing the attack to a complete stop. The damage was not considerable.

1927: The rodents did less damage than during the previous years. Wheat soaked in strychnine was used for baiting the traps.

1928: There were hardly many rodents after the cold and wet summer but because of the heavy snow layer which hampered the countermeasures scattered rodent damage was noticed in beech plantings, particularly so in Kelleris Hegn, sect. 170 where hoeing was used without appreciable success.

1929: Some but not appreciable damage was done by rodents during the winter.

1930: Favoured by the snow cover rodents did considerable damage also towards the centre of the woods where rodent damage has been absent for many years, tarring was used on a larger scale.

1931: The rodents did some but not very great damage in beech plantings, tarring was used solely as a countermeasure.

1932: Rodents were present in inappreciable numbers only and did no damage.

1933: No rodent damage.

1934: No rodent damage.
1935: Still no rodent damage. The rodents being very numerous during the summer and autumn of 33 have probably been decimated from natural causes before the winter 33-34.
1936: No reason for special precautions against pests.
1937: No particular attacks by rodents etc.
1938: Rodents had during the winter done some scattered gnawing in the young plantings, especially in sect. 98 and in sect. 189 (hoeing applied without success).

Unfortunately, most of the reports are not available for the last 20 years. In order to bring the information up to date questionnaires were sent to the forest managers of districts from which the reports had yielded usable data.

An application to firms dealing in rodenticides has given useful supplementary information especially so for the latest years.

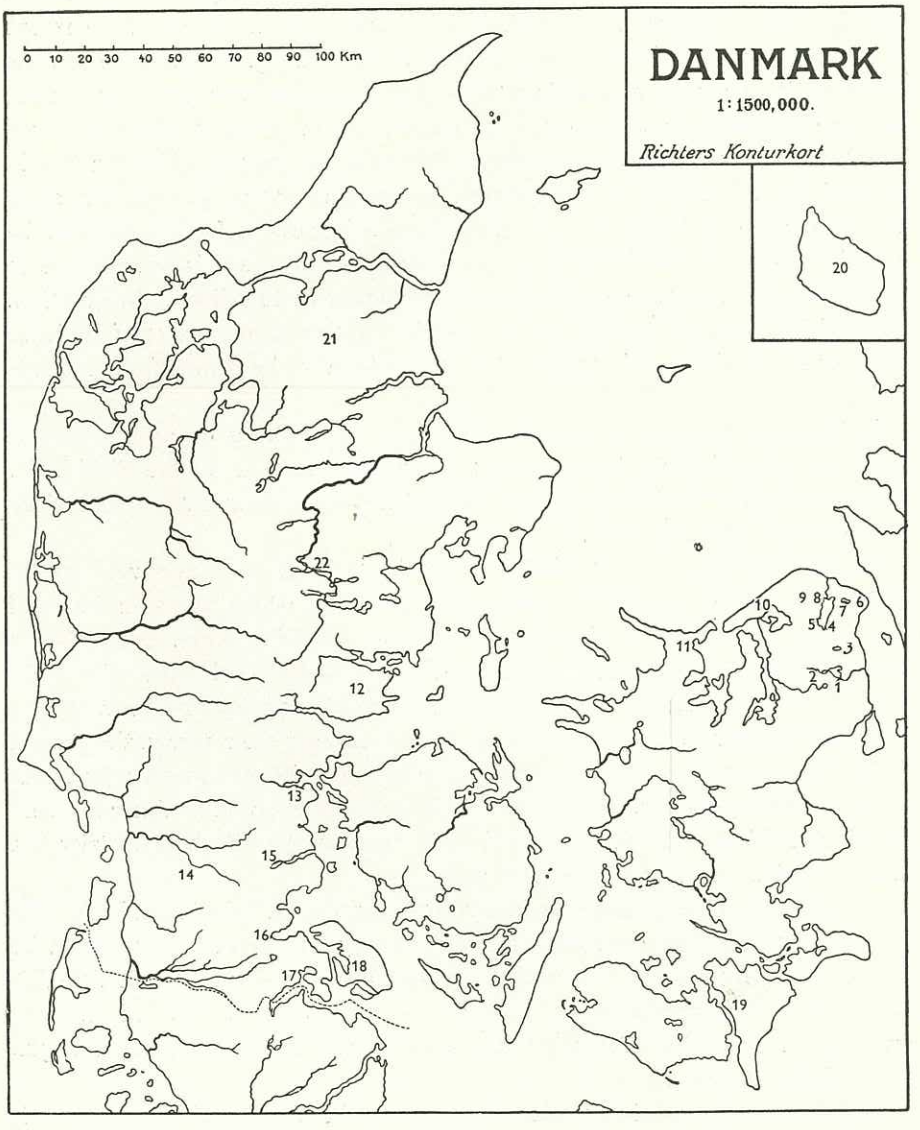
A request for information on rodent fluctuations in private forests was inserted in Forstlig Budstikke (~ Foresters' Weekly). It would be of great value to get some data from those parts of the country where no state forests are present, e.g. from West and South Zealand and from Funen. However, the request only resulted in one answer, and although it was instructive it will be of little value as long as it is the only one.

TREATMENT OF THE MATERIAL

A. State Forest Districts. In Denmark there are 30 state forest districts. Six of these were excluded because by far the greater proportion of them consists of coniferous plantations and, as mentioned above, voles rarely do any damage to conifer plantations in Denmark. All of the six districts are located on the poor soils of the middle and western part of Jutland. Another two districts are not considered in this paper as no information is available from them.

The location of the remaining 22 districts is shown on the map p. 11.

Practically all notes on the occurrence of rodents have been made with a view to the well-being of the forest and the associated economical problems. In most cases the damage was done during the years when rodents were particularly abundant; however, in some instances this correlation does not hold. The items which in particular have been recorded are the damage done by the rodents and other features connected with it, and, in some cases, the personal opinion of the forest manager.



Map showing location of districts from where data are available. District numbers as in the main table.

From the above examples it will be seen how different the entries concerning the occurrence of rodents can be. The damage done is far from being proportionate to the number of rodents present during the year in question; the extent of the damage may also depend on weather conditions e.g. the presence of snow cover, on the presence of plantings of the age classes most subjected to attack, and on the extent of active rodent eradication and the state of cultivation used in the plantings; in addition the size of the mast fall may be of importance in determining the extent of the damage. In order to obtain an approximately correct picture of the abundance of rodents all relevant factors have to be considered for the individual districts and years otherwise it is not possible to decide whether rodents were particularly abundant in the district in question. It is evident that one cannot be too careful in analysing the pieces of evidence in order to provide a safe basis for the conclusions to be drawn from the material.

In the large majority of cases the damage is caused by gnawing the bark at the lower part of young beech plants; this damage is done by the Field Vole. This means that the feature illustrated by the present material is fluctuations in the density of Field Voles.

In Silkeborg State Forest District 4 maxima of rodents collectively are on record. By maximum year is understood a year in which the abundance of rodents exceeded those of the previous and the following years. Among the 4 maxima at least three refer to woodmice. Three maxima coincided with Field Vole maxima throughout the country while a fourth maximum (Wood Mouse) occurred one year before a Field Vole maximum all over the country, the general Field Vole maximum of the following year being noticeable as a smaller maximum in the Silkeborg district. Although the Wood Mouse maxima in this case seem to coincide fairly well with the Field Vole maxima the Silkeborg district has been treated separately in the main table.

Wherever the records supply evidence that they do not refer to the Field Vole this has been considered through a scoring system, to be mentioned later. In the case that in some year the maximum was not caused by the Field Vole this is not likely to introduce any serious error as all small rodents within a given area seem to show a tendency towards synchronized fluctuations (Collett 1912 and Wildhagen 1952).

In Jutland south of Limfjorden two species of Field Voles, Mictrotus agrestis and M. arvalis occur while in the remaining part of Denmark only M. agrestis occurs. M. arvalis is particularly common in the southwestern part of Jutland (Ursin 1952). To what extent this latter species is responsible for the fluctuations in this part of the country cannot be decided through this investigation. How-

ever, the two species are so closely related that there is probably conformity between the fluctuations of either of them, thus it would not seem to change the value of the material if they are dealt with collectively also because of the tendency among all small rodents to show synchronous fluctuations (see above).

In order to compare the different districts and provinces the abundance of voles should be expressed on some numerical basis in the individual years. To each individual district a figure has been allocated each year, the figure indicates the (estimated) vole abundance, „0" indicating very few voles and "3" very many. The district reports which in some years mention voles while in other years they are not mentioned at all have been allocated a "0" during the years where nothing is mentioned as this will probably indicate the abundance of voles to be insignificant. On the other hand the chance of committing certain errors through this procedure cannot be rejected. The main table (p. 16—17) shows the scores obtained in the individual districts.

The body of information obtained directly from the State Forest Managers have been treated in the same way as were the notes from official reports. Often the information is based upon memory reaching a number of years backwards; of course such data will have to be sifted and treated very cautiously. Also this category of information is contained in the main table.

Column A of the main table shows the mean score per district in each year, the mean being calculated from the scores obtained in all districts considered. Diagram I (p. 12) is based upon these means. Even in the case that no common factors were determining the appearance of the series of figures representing the yearly scores obtained in the different districts, the summation of the series would introduce fluctuations of smaller or larger amplitude in diagram 1. In order to find out whether it is justified to pool all the data it is necessary to subdivide the data into a small number of geographical units. This was possible for part of the period covered by collecting all data from the North Zealand districts (7—11 districts) into a common group and by proceding likewise with the 3—7 districts from South Jutland. The mean score per year obtained in these two subdivisions is entered into the main table as columns B and C, B referring to North Zealand and C to South Jutland. These latter mean scores served as a basis for the diagrams II and III. The curves cannot be taken as expressions of absolute numbers of voles each year and serves only to compare relative abundance between years.

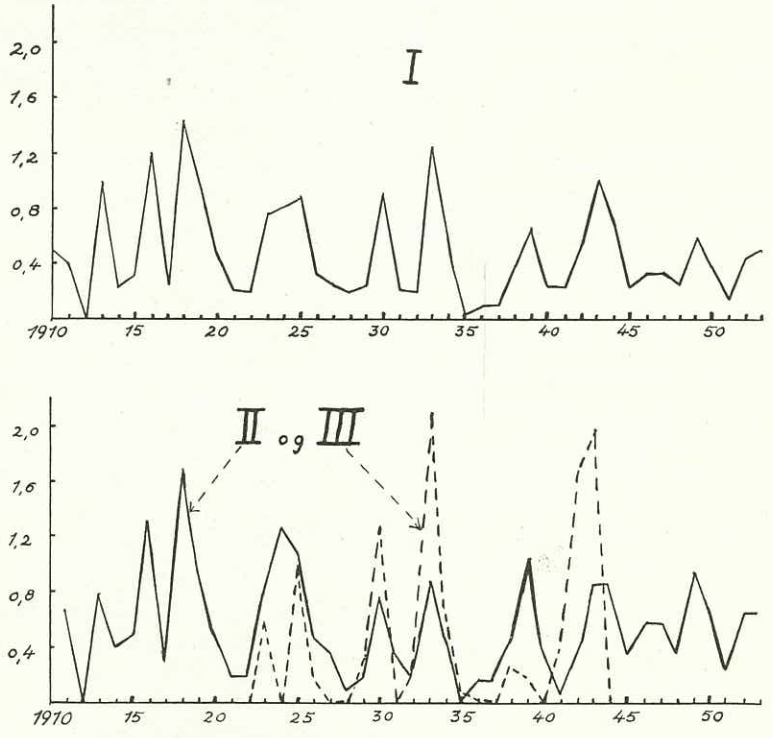
B. Information from sources other than State Forest Districts. Through the forestry periodicals back to 1875 it has been possible to obtain a useful supplement to the data provided by the State Forestry District reports. The difficul-

ties encountered in interpreting this body of information are identical with those mentioned above. Table 1 shows the years to which maxima would have to be allocated, doubtful maxima being given in brackets.

Table 1. The occurrence of years with maxima according to an estimate based upon the Danish forestry periodicals.

1878	(1895)	(1907)	1918
1882	1898	1910	1924
1889	1901	1913	(1927)
1892	1904	1916	1930

Unfortunately it is not possible to extend the series any further than to the early thirties.



Fluctuations in the abundance of Field Voles in Denmark; diagram I based on the whole country, II referring to North Zealand and III to South Jutland. The vertical axis indicates the mean score per district, the horizontal axis the years.

For the years where information is available from the literature as well as from the State Forest Districts there is close agreement, as the reports show the following years of maxima: 1916, 1918, 1925 and 1930. For 1927 there is slight disagreement but judging from the literature this maximum is doubtful; rarely have such small numbers been mentioned from Jutland while at the same time Zealand had severe attacks although, judging from the reports, this was not the case in North Zealand. Also in 1924 and 25 a slight disagreement is apparent. However, this is explained through the fact that in some places 1924 showed a maximum which was not noticeable until 1925 in other places, a fact which will be touched upon again when comparing North Zealand and Jutland. Judging from the periodicals there is some doubt whether 1924 or 25 was the maximum year, most evidence being in favour of 1924.

Although the State Forest Districts only form smaller part of the Danish forests they seem to be representative of the country as a whole, although it would be most desirable to have data from other parts of the country as e.g. South and West Zealand and Funen are not represented at all. A comparison between North Zealand and the remaining part of Zealand would be very valuable; here reference is only made to the example quoted from 1927.

Data on the amount of rodenticides sold are available from 1950 to 1954; they tend to show that more was sold in 1950 than in the two next following years while in 1953 more was sold than in the previous year. However, in contrast to all other data this information refers to the calendar year. There is good agreement with information obatined from the State Forest Districts which record vole maxima in 1949 (i.e. between 1 April 1949 and 31 March 1950) and another increase during 1952—53.

CONCLUSION

The diagrams (p. 00) show that certain years show a very pronounced maximum of Field Voles with much greater abundance than in the previous and the following year while other maximum years are less distinctly separated from the adjoining years; one of these maxima must be considered doubtful (1946—47). Column A of the main table will show that the numerical differences on which this maximum is established are so small that they may well be caused by chance.

Especially in northern countries it has been shown that the interval between two consecutive maxima is often approximately constant (Elton 1942, Kalela 1951, Wildhagen 1952 and Siivonen 1948), 3—4 years. This 3—4 year cycle has been exposed to grave doubts in recent years by Palmgren (1948) and La Mont

Cole (1951 and 54) and there can hardly be any doubt that in many cases too much importance has been ascribed to it. To what extent this cyclic element is present in the Danish material is difficult to assess. If the intervals between the all-country maxima are considered (diagram 1) no periodicity is present; the intervals are as follows: 3, 2, 7, 5, 3, 6, 4, and 6 years. It is possible that the last interval should be subdivided into two but as already mentioned the maximum of 1946—47 is very doubtful.

This applies to the span of years where the best information is avaiable. However, if the information abstracted from the journals is considered an entirely different impression may be obtained. On considering also the less well established maxima the following result is obtained: among 15 intervals 11 had a duration of 3 years, the four intervals remaining were of 2, 4, 6, and 7 years respectively. Here a 3 year periodicity seems obvious. Thus the information might be interpreted in the light of the presence of a distinct periodicity. However, the information obtained from the State Forest Districts cannot be reconciled with this conclusion and this latter body of information is considered much more reliable such that the apparent 3-year periodicity must be ascribed to chance.

A comparison between diagrams II and III (p. 12) shows a strong tendency that the years of maxima are synchronous in North Zealand and South Jutland. This can only be explained through the assumption that one or more common factors must be responsible for this synchronism. This or these synchronizing factors can hardly fail to be of a climatic nature. Andersen (1952) has shown which climatic factors can reasonably be responsible for the fluctuations of Danish hare populations; a direct comparison with Andersen's hare curve shows a very small degree of agreement such that the possible climatic factors operating can hardly be identical with those determining the size of vole populations.

The agreement between the two provinces is not complete. This applies in particular to the periods 1923—1925 and 1939—1940; in North Zealand a maximum occurred in 1924 while South Jutland had two distinct maxima in 1923 and 1925 respectively; in 1939—40 the South Jutland maximum occurred one year in advance of the North Zealand maximum. This may be caused by the fact that climatic conditions may have been different in the two areas. On the other hand it may also be contributed to other than climatic factors. This latter explanation seems the more probable as the main table shows that the period 1915—1953 contains 6 years only (1921, 37, 40, 41, 45, and 51) for which no, small or large, maximum is on record for at least some part of the country. Within an area of this small size the climatic conditions are so uniform that were the fluctuations governed solely by climatic factors one would expect a better agreement between districts.

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Main table:

	North Zealand											total		
	1	2	3	4	5	6	7	8	9	10	11	number of districts (D)	scores (S)	B (S:D)
1910.....	—	—	—	—	—	—	—	1	0	—	—	2	1	0,5
11.....	—	—	—	—	—	—	—	0	0	2	—	3	2	0,7
12.....	—	—	—	—	—	—	—	0	0	0	—	3	0	0,0
13.....	—	—	—	0	—	—	—	1	0	2	1	5	4	0,8
14.....	—	—	—	0	—	—	—	0	0	1	1	5	2	0,4
15.....	1	1	—	0	0	—	—	1	1	0	0	8	4	0,5
16.....	2	3	—	2	0	1	1	2	0	2	0	10	13	1,3
17.....	0	0	1	0	0	0	0	0	0	1	1	11	3	0,3
18.....	2	3	2	3	0	0	1	3	2	2	1	11	19	1,7
19.....	1	2	2	2	0	1	2	2	1	0	0	11	13	1,2
1920.....	0	0	1	1	1	0	1	0	0	0	1	11	5	0,5
21.....	0	0	0	0	0	0	1	0	1	0	1	11	2	0,2
22.....	0	0	1	0	0	0	0	1	0	0	0	11	2	0,2
23.....	2	0	1	1	0	0	0	1	2	1	1	11	9	0,8
24.....	2	2	0	1	0	1	3	0	3	0	2	11	14	1,3
25.....	1	1	0	2	0	0	2	1	2	1	2	11	12	1,1
26.....	1	0	0	0	0	0	2	2	0	0	0	11	5	0,5
27.....	0	1	0	1	0	0	0	0	1	0	1	11	4	0,4
28.....	0	1	0	0	0	0	0	0	0	0	0	11	1	0,1
29.....	0	0	1	0	0	0	1	0	0	0	0	11	2	0,2
1930.....	1	1	0	1	0	0	2	0	2	1	1	11	9	0,8
31.....	1	0	0	0	1	0	1	0	1	0	0	11	4	0,4
32.....	0	0	0	0	0	1	0	0	0	0	1	11	2	0,2
33.....	2	0	0	0	2	1	3	0	2	0	0	11	10	0,9
34.....	2	0	1	0	0	2	0	0	0	0	0	11	5	0,5
35.....	0	0	0	0	0	0	0	0	0	0	0	11	0	0,0
36.....	1	0	0	0	0	1	0	0	0	0	0	11	2	0,2
37.....	0	0	0	0	0	1	1	0	0	0	0	11	2	0,2
38.....	0	0	1	2	0	0	—	1	1	0	0	10	5	0,5
39.....	0	2	0	0	3	2	—	—	—	2	0	8	9	1,1
1940.....	0	0	0	0	2	1	—	—	—	0	0	8	3	0,4
41.....	0	0	0	0	0	1	—	—	—	0	0	8	1	0,1
42.....	0	2	0	0	0	1	—	—	—	0	0	8	3	0,4
43.....	1	1	0	0	2	3	—	—	—	0	0	8	7	0,9
44.....	2	0	0	2	0	1	—	—	—	0	2	8	7	0,9
45.....	0	1	1	0	0	1	—	—	—	0	0	8	3	0,4
46.....	0	2	1	0	0	1	—	—	—	—	0	7	4	0,6
47.....	0	0	2	0	0	2	—	—	—	—	0	7	4	0,6
48.....	0	0	0	2	0	1	—	—	—	—	0	7	3	0,4
49.....	0	2	2	2	0	1	—	—	—	—	0	7	7	1,0
1950.....	1	1	0	2	0	1	—	—	—	—	0	7	5	0,7
51.....	0	1	0	0	0	1	—	—	—	—	0	7	2	0,3
52.....	0	1	0	2	0	2	—	—	—	—	0	7	5	0,7
53.....	0	0	0	1	2	2	—	—	—	—	0	7	5	0,7

Main table:

	South Jutland							total						All districts			Silkeborg
	12	12	14	15	16	17	18	number of districts (D)	scores (S)	C (S:D)	19	20	21	number of districts (D)	scores (S)	A (S:D)	22
1910.....	—	1	—	—	—	—	—	1	1	—	—	—	0	4	2	0,50	0
11.....	—	0	—	—	—	—	—	1	0	—	—	—	0	5	2	0,4	0
12.....	—	0	—	—	—	—	—	1	0	—	—	—	0	5	0	0,0	0
13.....	—	3	—	—	—	—	—	1	3	—	—	—	0	7	7	1,0	0
14.....	—	0	—	—	—	—	—	1	0	—	0	—	0	8	2	0,25	0
15.....	—	0	—	—	—	—	—	1	0	—	0	0	0	12	4	0,33	2s
16.....	—	2	—	—	—	—	—	1	2	—	2	1	0	14	17	1,21	1m
17.....	—	0	—	—	—	—	—	1	0	—	0	0	0	15	3	0,20	0
18.....	—	3	—	—	—	—	—	1	3	—	0	0	0	15	22	1,47	2s
19.....	—	0	—	—	—	—	—	1	0	—	0	1	0	15	14	0,93	0
1920.....	—	1	—	—	—	—	—	1	1	—	0	1	0	15	7	0,47	0
21.....	—	1	—	—	—	—	—	1	1	—	0	0	0	15	3	0,20	0
22.....	—	0	0	—	—	—	—	2	0	—	0	0	1	16	3	0,19	0
23.....	—	2	0	0	—	—	—	3	2	0,6	0	2	0	17	13	0,76	0
24.....	—	0	0	0	0	—	—	4	0	0,0	1	0	0	18	15	0,83	0
25.....	—	2	0	2	0	—	—	4	4	1,0	0	0	0	18	16	0,89	0
26.....	—	1	0	0	0	0	—	5	1	2,9	0	0	0	19	6	0,32	0
27.....	—	0	0	0	0	0	0	6	0	0,0	1	0	0	20	5	0,25	0
28.....	—	0	0	0	0	0	0	6	0	0,0	0	2	1	20	4	0,20	0
29.....	—	1	0	1	0	0	0	6	2	0,3	0	0	1	20	5	0,25	0
1930.....	—	1	0	2	2	2	1	6	8	1,3	1	0	0	20	18	0,90	0
31.....	—	0	0	0	0	0	0	6	0	0,0	0	0	0	20	4	0,20	0
32.....	—	0	0	0	1	0	0	6	1	0,2	0	0	1	20	4	0,20	0
33.....	3	2	0	2	3	2	3	7	15	2,1	1	0	1	21	27	1,24	2s
34.....	3	1	1	0	0	0	0	7	5	0,7	0	0	0	21	10	0,48	0
35.....	0	0	0	0	0	1	0	7	1	0,1	0	0	0	21	1	0,05	0
36.....	0	0	0	0	0	0	0	7	0	0,0	0	0	0	21	2	0,09	0
37.....	0	0	0	0	0	0	0	7	0	0,0	0	0	0	21	2	0,09	0
38.....	0	0	2	0	—	0	0	6	2	0,3	0	0	0	19	7	0,37	0
39.....	0	—	1	—	—	0	0	4	1	0,2	0	0	0	15	10	0,66	0
1940.....	0	—	0	—	—	0	0	4	0	0,0	0	0	—	14	3	0,21	0
41.....	0	—	2	—	—	0	0	4	2	0,5	0	0	—	14	3	0,21	—
42.....	1	—	2	—	—	—	2	3	5	1,7	0	0	—	13	7	0,53	0
43.....	3	—	3	—	—	—	0	3	6	2,0	0	0	—	13	13	1,00	2
44.....	0	—	0	—	—	—	0	3	0	0,0	2	0	—	13	9	0,69	0
45.....	0	—	0	—	—	—	0	3	0	0,0	0	0	—	13	3	0,23	0
46.....	0	—	0	—	—	—	—	3	0	0,0	0	0	—	12	4	0,33	0
47.....	0	—	0	—	—	—	0	3	0	0,0	0	0	—	12	4	0,33	0
48.....	0	—	0	—	—	—	0	3	0	0,0	0	0	—	12	3	0,25	0
49.....	0	—	0	—	—	—	0	3	0	0,0	0	0	—	12	7	0,58	0
1950.....	0	—	0	0	—	0	0	5	0	0,0	0	0	—	14	5	0,36	0
51.....	0	—	0	0	—	0	3	5	0	0,0	0	0	—	14	2	0,14	0
52.....	1	—	0	0	—	0	0	5	1	0,2	0	0	—	14	6	0,43	0
53.....	0	—	1	0	—	0	0	5	1	0,2	0	1	—	14	7	0,50	0

s indicates maximum caused by long-tailed field-mice.

m — — — - field-voles.