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ERAST PARMASTO

Distribution Mapping of Fungi

(With sample distribution maps of *Hymenochaete* species in Estonia)

Zusammenfassung:

Der Verfasser gibt einen kurzen Überblick über bisherige Aktivitäten bei der Pilzkartierung, vor allem in Europa. Dank der Bibliographien von KREISEL (1971 ff.) sind bisher veröffentlichte Verbreitungskarten von Pilzen gut bekannt. Wegen unterschiedlicher Methodik sind die Karten jedoch oftmals nicht vergleichbar. Es wird deshalb mit Nachdruck für Einheitlichkeit oder wenigstens Vergleichbarkeit bei den laufenden Kartierungsprojekten bezüglich der angewandten Methodik plädiert.

Kartierungsvorhaben werden heute meist mit Hilfe von Personalcomputern nach der Gitternetzmethode durchgeführt, wobei zwei unterschiedliche, nur mit Schwierigkeiten vergleichbare Systeme Anwendung finden. Das in der DDR und anderen Ländern verwendete, an den geographischen Längen- und Breitengraden orientierte System ist auf PC's schwer zu handhaben wegen der nach Norden immer geringeren Entfernung der Längengrade untereinander. Der Verfasser favorisiert deshalb das sogenannte UTM-System, bei dem Quadrate von 50×50 km² zugrunde gelegt werden, die ihrerseits in kleinere Quadrate von 10×10 km² bzw. von 1×1 km² unterteilt werden können. Wegen der Krümmung der Erdoberfläche sind zwar auch hier „Störungslinien" vorhanden, aber das System ist mit Computern wesentlich leichter handhabbar. Der Verfasser regt ein neues gesamteuropäisches Kartierungsprojekt für Großpilze auf der Basis von 50×50 km² – Quadranten an.

In Estland wurde ein Kartierungsprojekt auf der Basis von 10×10 km² – Quadranten begonnen. Die Datenspeicherung und -auswertung erfolgt mit einem Computerprogrammpaket, welches auch erlaubt, Verbreitungskarten unter verschiedenen Optionen auf einem Matrixdrucker auszudrucken. Als Beispiele werden einige Verbreitungskarten von *Hymenochaete*-Arten in Estland vorgestellt. (Red.)

Mycogeography as a part of biogeography is much less developed than other parts of this science dealing with other groups of organisms. Only one textbook on fungal geography has been published up to now, and this is in Norwegian (ECKBLAD, 1981).

The main reason for such a situation is inadequate knowledge of the geographical distribution of species, and inadequate expression of this knowledge as distribution maps. Professor Hanns KREISEL, to whom this small contribution is dedicated, has paid much attention to this problem. He was a founding member of the Committee for Mapping of Macromycetes in Europe from 1960, and has published a series of bibliographies of distribution maps of fungi (1971–).

Only one series of world distribution maps of fungi has been published up to now, the CMI Distribution Maps of Plant Diseases. There is also the first and possibly the last collection of distribution maps of European macromycetes (L. LANGE, 1974), and also a number of distribution maps scattered over mycological and other biological literature. These data are available thanks to KREISEL's bibliographies, but are not easily comparable. Different mapping schemes have been used, and even Europe has been covered very inadequately from the geographical point of view as well as for different groups of fungi.

At the same time, activities in fungal mapping are growing considerably during recent decades in Europe. The main problem now is how to achieve uniformity or at least comparability of mapping schemes – before it is too late.

When KREISEL published the first part of his bibliographies of distribution maps (1930–1969), only 8 species out of the 470 mentioned there were mapped using a grid system (Gitternetzkarte), namely by D. THOEN (1967) and V. DEMOULIN (1968). Most of the species were presented as dot maps. However, data for distribution maps of European macromycetes (LANGE, 1974) were collected with an indication of geographical coordinates of localities, and were only transformed to grid system dots afterwards. Following this, more and more distribution maps have been compiled and published using some kind of grid system, and this trend seems to have turned prevalent. This trend is connected with a wider use of personal computers in mapping practice.

Two types of grid systems have been used in distribution mapping of fungi in Europe in recent years: one based on geographical coordinates, and the other based on map squares of equal size (area), i. e. on the UTM system. Both types have short-comings and advantages; the main problem in distribution mapping is not which of them is better but how to avoid parallel use of two main mapping systems compatible only with difficulty and with some loss of precision.

The distribution maps based on geographical coordinates have been used mainly in Central Europe. A. BRESINSKY (1969) proposed the division of the map of the German Federal Republic into mapping squares (Grundfelder) where the distance of any longitude degree is divided into 6 parts and that of a latitude degree into 10 parts. One square of such a division corresponds to a topographic map sheet 1 : 25000 in use in several countries in Central Europe. This grid system has been adopted by G. J. KRIEGLSTEINER (1977) and used, for example, for the mapping of polypores of Czechoslovakia by F. KOTLABA (1984), and for other fungi of the same country by several other mycologists in their publications. The size of the squares of this system is about 12×12 km, which is considered to be too large for detailed mapping or projects in smaller areas. Quadrants (about 33 square km) of the main (basic) squares have therefore been used in the mapping of macromycetes of the GDR by H. KREISEL, H. DÖRFELT & D. BENKERT (1980); of Gastromycetes of Germany by G. GROSS, A. RUNGE, W. WINTERHOFF & G. J. KRIEGLSTEINER (1980); in a series of papers published in the „Beihefte zur Zeitschrift für Mykologie" vol. 3–7 (1981–1987) by KRIEGLSTEINER and H. CLÉMENÇON; in the mapping of fungi of Saarland by H. DERBSCH & J. A. SCHMITT (1984); of polypores of Oberlausitz (DUNGER, 1989). A similar scheme was used by V. DEMOULIN in Belgium in 1969 already.

This system is suitable for use in areas restricted in the S-N direction and only then where sheets of the Central European standard map projection are readily available.

A similar mapping scheme has already been used in Mapping of Macromycetes in the Europe Project (LANGE, 1974): dots on maps, indicating localities, were situated, 6 between each degree of latitude and 5 to 2 dots between two degrees of longitude (depending on the degree of latitude between 40–70°). Even when the number of squares between meridian lines depends on the degree of latitude, the squares are nevertheless unequal. This fact hinders the effective use of simple programs for personal computers.

Another type of distribution mapping is based on the 50×50 km squares of the Universal Transverse Mercator (UTM) Grid map sheets. The grid squares may be subdivided into 10×10 km squares, and these into 1×1 km units. This grid is related to but not exactly compatible with meridian and latitude lines. This system (with 50×50 km basic squares) has been used for the mapping of Spanish Aphyllophorales by TELLERIA (1980), and a similar Finnish National Uniform Grid System with 10×10 km squares for Finnish polypores (NIEMELÄ, 1982 and subsequent papers of the same series).

1×1 kilometre squares based also on the UTM system have been used in the data bank of ecological and geographical data of Switzerland, which will in the future also include data on the distribution of fungi (CLÉMENÇON, 1987). L. LANGE in her introduction to the distribution maps of the Mapping of European Macromycetes Project says: ". . . if a grid system should be adopted for further studies it should rather be of the UTM type . . ."

A UTM based grid has squares of equal size; nevertheless, due to the form of our Globe they do not form a rectangular matrix. With 6° longitude intervals, there are the **disturbance lines** where the "upper" (northern) part of a square column forms an acute-angled triangle. On the other hand, the geometrically accurate squares enable the development of comparatively simple programs for personal computers, whilst the inexactness caused by disturbance lines is rather small.

Unquestionably, personal computers will play a very important role in distribution mapping of fungi in future. But this is not the main consideration when choosing the "best" system for fungal mapping; nor is it most important that the majority of distribution maps published have been based on geographical coordinates. The main question is:

What is mycogeography? A component of mycology, or of biogeography?

Even when the answer would be "mycology", another question arises: are we interested

in the distribution of fungi themselves, or in relation to the distribution of host plants (substrata), other organisms and ecological factors? In other words: we have to compare not only fungal mapping schemes, but also these schemes with those used for the mapping of the distribution of plants, lichens, etc.

"Atlas Florae Europaeae" has been compiled using the UTM-based 50×50 km grid (JALAS & SUOMINEN, 1967). The lichen mapping in Europe project will use the same grid (SØCHTING, 1989). Ornithologists, mammalogists and several other zoologists in various countries are using the UTM grid.

Proceeding from the need to have a joint project for the mapping of the distribution of all groups of fungi, animals, plants and lichens of Estonia, the recommendation by the Institute of Zoology and Botany of the Academy of Sciences of Estonia is to use the UTM-based 10×10 km grid in this country.

One may ask, why not a 5×5 or even 1×1 km grid? Firstly, the number of professional as well as amateur mycologists is not high in Estonia. Distribution mapping is neither the only nor the main task of Estonian mycologists, interested in several more complicated problems. Secondly, we hope that the result of our efforts will not only be a great number of small dots on distribution maps of Estonia, but also a contribution to the dots on the 50×50 km square grid distribution maps of Europe. I am sure that the sadly ended Project I for Mapping of Macromycetes in Europe (1960–1974 (its funeral oration having been read by Derek A. REID; see REID, 1975)) will be replaced by Project II. It is to be hoped that it will use the same UTM-based grid system as has been used by botanists and which will be used by lichenologists.

We did not use a **national** 10×10 km UTM grid as has been done by Finnish biologists (see HEIKINHEIMO & RAATIKAINEN, 1971 and NIEMELÄ, 1982). A local ("national") grid enables the avoidance of undesirable consequences of the "disturbance line" at 24° Ebut about 100 squares will be slightly displaced. Instead of this, two triangular columns of squares at 24° E were replaced by one column of normal-size squares (see fig. 1). As a result, dots representing occurrence of species in only some 6–10 squares are slightly biased (about 5–10 km), and the outline of Western Estonia is very slightly turned counterclockwise.

For distribution mapping, Alan MORTON's program DMAP (A Computer Program for Distribution and Coincidence Map Plotting) was used by us. This program has a number of advantages:

It is very simple to use; instructions for its use are included as a documentation file;

It needs only about 170 KB RAM; it will be run on all IBM-compatible personal computers including one-drive ones;

Data files are not voluminous; for example, 180 localities of one species take only about 1 KB space on a floppy disk;

9 different symbol types are available for mapping both round and square dots;

Maps may be printed using 9- or 24-dot matrix printer, ink-jet or a laser printer;

The same data file may be used for several types of maps, including the transformation of 10×10 km square grid maps to 50×50 km square maps of the type used in the "Atlas Florae Europaeae";

It is a program of "public domain", i. e. available for a small payment (£ 10.00) from the author (Alan MORTON, Dept. of Pure and Applied Biology, Imperial College, Silwood Park, Ascot, Berks SL5 7PY, U. K.).

Data files for DMAP may be written using any text processor in non-document mode (i. e., in ASCII code). Boundary files (including grid references of inflection points of boundaries, rivers, etc.) for maps are compiled by the user.

Sample data files for four *Hymenochaete* species (see maps 9–17) are given in fig. 2. Samples of maps showing the scheme used in distribution mapping of Estonian fungi are presented in figs. 5–8; the UTM grid of Estonia is given in fig. 3, the European plant mapping scheme 50×50 km square grid (as used in the "Atlas Florae Europaeae") in fig. 4. As an example of distribution mapping of Estonian fungi using DMAP, maps of all *Hymenochaete* species (Hymenomycetes: Aphyllophorales: Hymenochaetaceae) are given in two versions: one in 10×10 km square grid in figs. 9–13, another in 50×50 km grid

in figs. 14–17.

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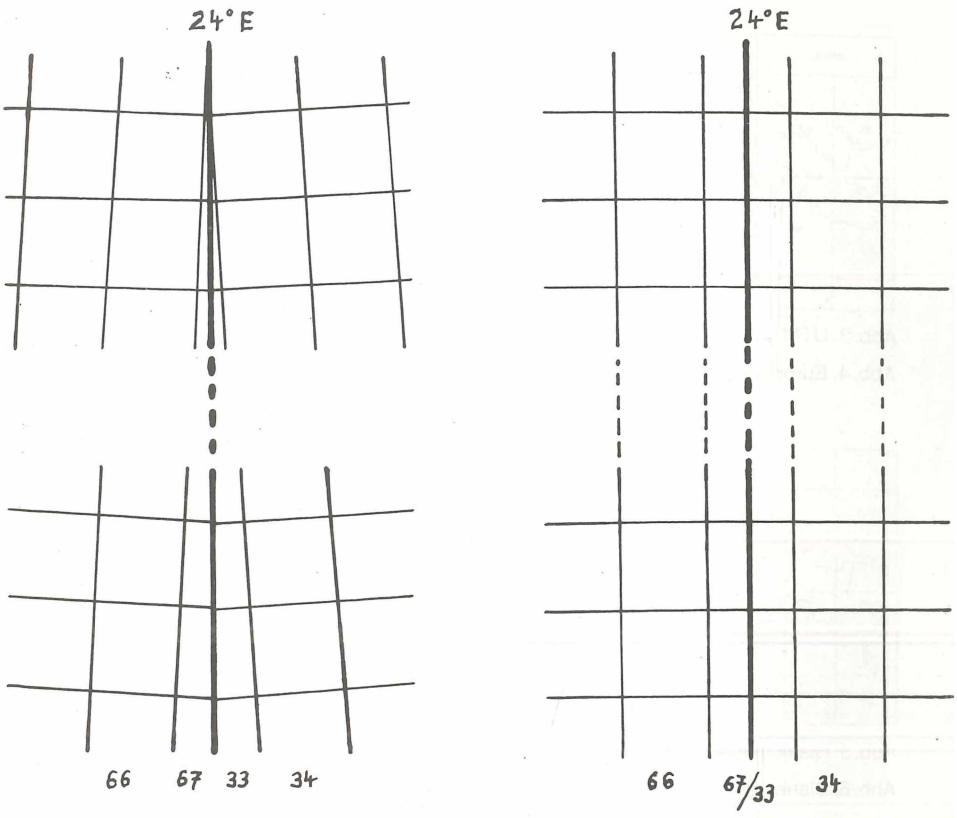
Abb. 1 u. 2: S. 81

Abb. 1. The columns of UTM grid squares at disturbance line (24° E) in Estonia: left – position of squares according to the true UTM grid system; right – compromise used in Estonian species distribution mapping scheme. The column numbers are these of the UTM system.

Abb. 2. Sample DMAP data files for distribution mapping of Hymenochaete species in Estonia



FILE NAMES.TXT

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1 Hymenochaete cinnamomea (Pers.: Fr.) Bres.
2 Hymenochaete fuliginosa (Pers.) Lev.
3 Hymenochaete rubiginosa (Dicks.: Fr.) Lev.
4 Hymenochaete tabacina (Sow.: Fr.) Lev.
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   3
0716 0617 1117 3127 0616 1820 2328 2128 1016 1820 3026 3027
0713 -1
   4
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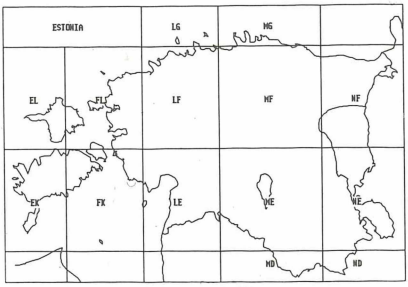


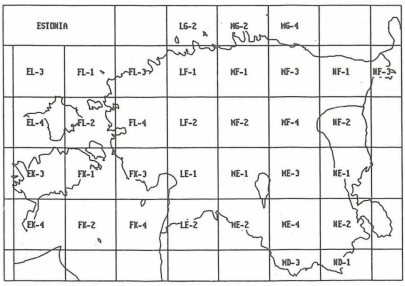
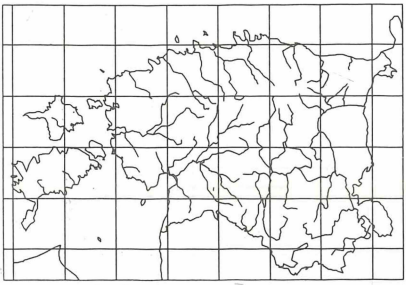


Abb. 3. UTM grid

Abb. 4. European plant mapping scheme based on UTM grid



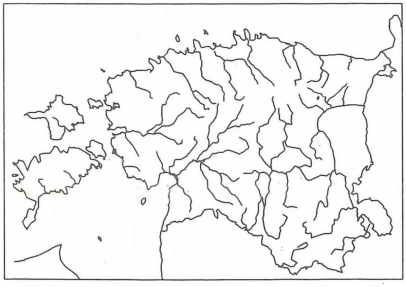
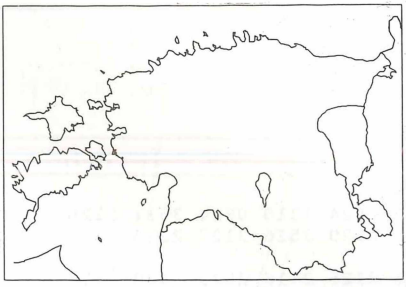


Abb. 5. Blank map for distribution mapping of species in Estonia, version one

Abb. 6. Blank map for distribution mapping of species in Estonia, version two



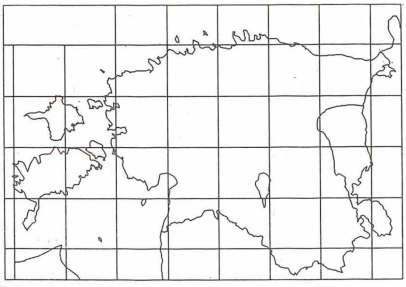
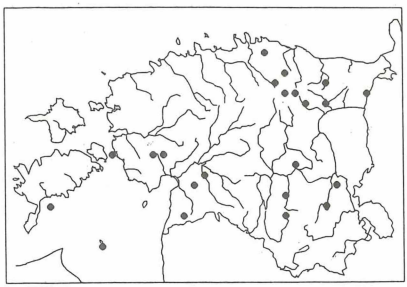


Abb. 7. Blank map for distribution mapping of species in Estonia, version three

Abb. 8. Blank map for distribution mapping of species in Estonia, version four



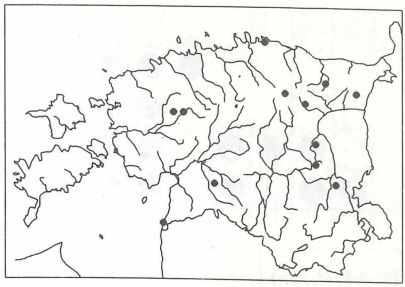
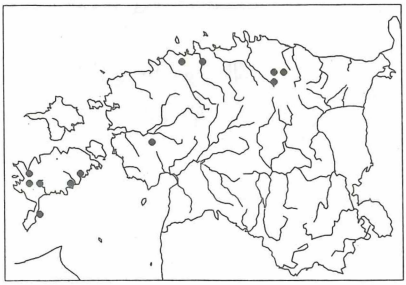


Abb. 9. *Hymenochaete cinnamomea* (PERS.: FR.) BRES.

Abb. 10. *Hymenochaete fuliginosa* (PERS.) LÉV.



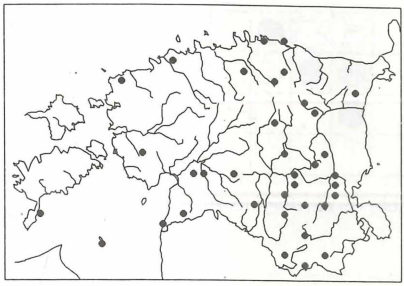


Abb. 11. *Hymenochaete rubiginosa* (DICKS.: FR.) LÉV.

Abb. 12. *Hymenochaete tabacina* (SOW.: FR.) LÉV.

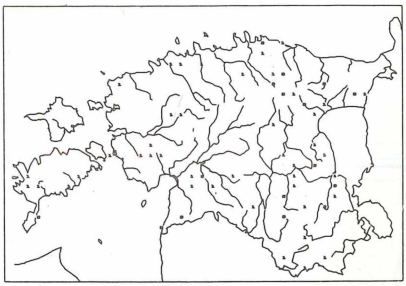


Abb. 13. Number of *Hymenochaete* species, collected in 10×10 km squares of Estonia

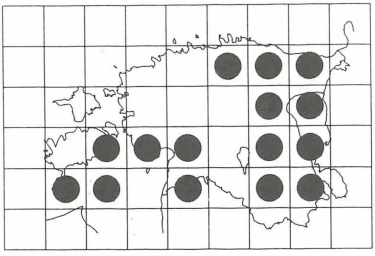


Abb. 14. *H. cinnamomea*

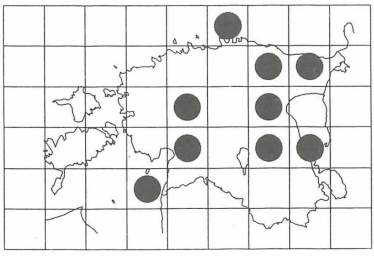


Abb. 15. *H. fuliginosa*

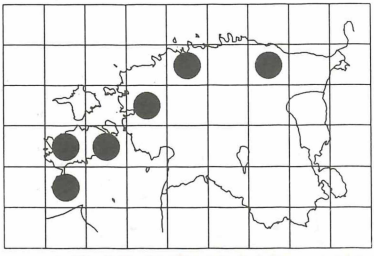


Abb. 16. *H. rubiginosa*

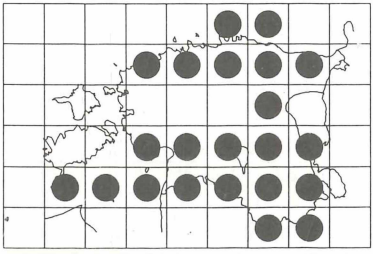


Abb. 17. *H. tabacina*

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