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Chorology of the European hypogeous Ascomycetes, I.

Elaphomycetales

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Distribution of hypogeous *Ascomycetes* in Poland with regard to their areals in Europe is discussed in the paper. The results are illustrated on 63 maps. The paper is the second part of a monographic study of the *Elaphomycetales* and *Tuberales* worked out by the author in the Polish Flora – *Mycota* (vol. 18, 1988).

1. INTRODUCTION

Knowledge of the geographical distribution for species of hypogeous fungi, and of their local frequency, is important in the understanding of their living requirements. An analysis of herbarium material concerning the area under investigation helps us in the correct interpretation of changes within a species. This is especially valuable when dealing with either extreme forms or deformed specimens resulting from habitat differences and, indirectly, from the geographical situation. This is why the author's taxonomic studies on hypogeous ascomycetes (Ławrynowicz 1988) refer to the chorological analysis.

The present account takes into consideration both the author's collections, gathered over 12 years or so, and the available herbarium material from the whole of Europe, with the following aims: (a) to gather all available information on the appearance of those species of hypogeous ascomycetes which may extend into parts of Poland; (b) to represent cartographically the current investigative state of these fungi both within Poland and Europe generally; (c) to interpret their geographical distribution and attempt to determine the hypothetical range of particular species within Europe.

All the material collected by the author, together with a card-index of the analysed specimens, is deposited at the Laboratory of Mycology, Institute of Environmental Biology, University of Łódź.

2. STATE OF INVESTIGATION ON CHOROLOGY OF HYPOGEOUS *ASCOMYCETES*

In comparison with the knowledge on higher plant geography, for which maps and distribution atlases are available, the chorology of hypogeous fungi, especially *Ascomycetes*, is poorly understood. The early investigators ignored distribution but concentrated on the taxonomic problems. More recent authors (Knapp, 1950–52; Hawker 1954; M. Lange 1956; Eckblad 1954, 1962; Szemere 1965; De Vries 1971; Kers 1978, 1979a, 1979b, 1980, 1983) include both locality indices and exsiccata citations. Recently, Kers (1983) included in his paper a distribution map of *Elaphomyces anthracinus* and *E. leveillei* in Scandinavia, prepared on the basis of a critical revision of both herbarium material and his own collections.

Attempts to establish distribution schemes for some *Agaricales* have appeared in the literature (Bisby 1933; Vasilkov 1955; Vasileva 1967, 1973; L. Lange 1974; Wasser 1980), indicating some generalizations which could possibly be applied to hypogeous fungi. By analogy to higher plants, these authors attempted to establish range types, concluding that the mycoflora was changing much more in a north-south direction than east-west (Vasilkov 1955). On the other hand the ranges exhibited by fungi are larger

than those shown for higher plants (Vasilkov 1955; Ainsworth 1971). Vasileva (1967, 1973) proposed a revised classification, specifically for fungi, recognising ten range types. These papers on *Agaricales* emphasise the ease of air-dispersal of spores over wide areas, and of the possibility of substratum and mycelial disturbance.

Such criteria, however, do not apply to hypogeous fungi. They cannot release spores either from the asci or from the fruitbody, and spores are therefore not wind disseminated. Most species are mycorrhizal, hence the concept of Raitwiir (1964) should be followed with the starting point for mycogeographical analysis and classification based on the individual range of fungus species. In fact, hypogeous species offer excellent material for the determination of individual ranges of fungi.

Many of the important collections from the last century do not include locality details. However, the early monographs (Vittadini 1831, 1842; Berkeley, Broome 1844; Tulasne 1851; Zobel 1854) as well as later ones (Chatin 1892; Hesse 1894; Fischer 1897; Schroeter 1908; Bucholtz 1902; Hollós 1911) attempt to generalise on the distribution by indicating countries and geographical areas for the species described. The published distribution maps cite only a few references, although the economic importance of edible truffles made them an exception. These latter maps were based on truffle localities related to the commercial sale in Mediterranean countries (Nicolas 1975; Delmas 1978).

The exploration of hypogeous fungi prior to World War 1 in central Europe was limited to the discovery of whether or not edible truffles existed and where they could be found. Numerous records were published, including some from northern Poland and from Silesia, which were analysed by Hesse (1894) and Schroeter (1908) who concluded that only a few were valid. Eichler (1904) reported the occurrence of *Elaphomyces*, *Hydnotrya* and *Tuber*. A comprehensive reference list dealing with the state of investigation within Polish territories was provided by the present author (Ławrynowicz 1988) dealing with *Elaphomycetales* and *Tuberales*.

The earliest data recorded by map for hypogeous fungi in Poland was published by Bucholtz (1902). In a map of Russia, he indicated a locality on the Vistula river, close to Warsaw. Between the two world wars, Teodorowicz (1928, 1933, 1936) undertook an intensive search for underground fungi in Pomerania, Southern Poland and Great Poland, and his collection of *Tuberales* proved to be of especial interest.

The first paper of a chorological character was published by Lubelska (1953), presenting the occurrence in Poland of *Choiromyces meandriformis* and eight taxa of *Tuber* taken from the available literature. This paper summarised all the available data and represents a starting point for hypogeous fungi investigation in Poland.

Taking into account both the published data and a critical revision of the herbarium material, Skirgiełło & Wosińska (1963) published maps of the distribution of localities for four species of *Elaphomyces* in Poland, and Ławrynowicz (1970) provided some additional localities from Central Poland.

From a chorological standpoint, *Choiromyces meandriformis* is one of the best known species for Europe. Distribution has been described by Skirgiełło (1976); Gross (1977); Kreisel, Dörfelt & Benkert (1980); and Babos (1981). In the same paper, Babos also provided the distribution of *Terfezia terfezioides* within Hungary.

Recent monographic accounts have become increasingly orientated towards taxonomic-chorological studies of individual species.

3. MATERIAL AND METHODS

The present account, as far as distribution in Poland and the rest of Europe is concerned, is based upon herbarium studies, and only personally examined exsiccata have been concerned. In a few well documented cases only (e.g. Hawker 1954; Kers 1983), have literature data been mapped by the present author.

The number of exsiccata extending back to the middle of the last century is apparently quite large. In many cases, however, the collections found in various herbaria represent only a few localities. There was extensive interchange of material between the early collectors, and even small collections were divided into many portions. It is not unusual to find on the sheets in various herbaria only a single specimen or even a small part of one fruitbody coming from the same locality. For parts of Europe where there has been no intensive collecting or investigation the number of known localities remains very small, even for the common species.

The herbarium material studied includes all collections available both within and outside the country under investigation, within Europe. About 1500 collections of the author's own material has been studied, together with about 5000 sheets from 44 herbaria. The list of herbaria and the material examined is given in the taxonomic part, along with keys, descriptions and illustrations to 81 species of *Elaphomycetales* and *Tuberales* (Ławrynowicz 1988). When finalising this list, a considerable amount of examined material had to be omitted owing to an unclear taxonomic interpretation, the unlikely occurrence in Poland, the poor state of preservation of the material, or the quality of the material (fruitbodies too young or too old). Quite often a good specimen could not be utilised for the chorological part of the work because the collection details were absent, illegible or unclear in meaning. The

intention has been to use only material accurately identified and accompanied with precise locality details. Collections gathered by the present author form the basis for the distribution maps of hypogeous fungi in Poland, supplemented by other collections coming from Polish and some overseas herbaria.

An initial analysis revealed the majority of records came from areas which had proved geobotanically attractive to naturalists. For this reason, field investigations were directed toward areas and habitats which had been previously ignored, such as Central Poland. Polish exsiccate material came from: Kraków herbaria (**KRA** – 29 sheets, **KRAM** – 48 sheets), mainly from Southern Poland, collected by K. Rouppert, B. Gumińska, W. Wojewoda, et al.; the Warsaw herbarium (**WA** – 23 sheets), from the Tatra Mtns, and the environs of Warsaw, collected by A. Skirgiełło, W. Rudnicka-Jezierska, S. Frejlak, et al.; Lublin herbarium (**LBL** – 20 sheets), from the Lublin Upland and heights of Roztocze, collected by B. Sałata; Poznań herbarium (**POZ** – 2 sheets), from the Baltic coast, collected by M. Lisiewska; Wrocław herbarium (**WRSL** – 60 sheets), from the Sudetes and Silesia (in herb. Schroeter, but owing to illegibility of labels only 60% i.e. 32 sheets could be considered); Łódź herbarium (**LOD** – ca 1500 sheets).

The majority of overseas collections date comes from the last century. The earliest exsiccate collection is dated 1839, and is deposited in the Bratislava museum. The collections of Saccardo in Padua (**PAD**), Tulasne & Tulasne in Paris (**PC**), and Berkeley & Broome in Kew (**K**), contain exsiccata either exchanged or donated e.g. by Vittadini, may be earlier but are undated. Many of the collections include important mycothecas, which are to be found in several of the older herbaria e.g. Thumen, Mycotheca universalis; Saccardo, Mycotheca italica; Sydow, Mycotheca germanica, etc. Within Europe, the Munich herbarium (**M**) houses the richest and well preserved collection, containing the central European collections, including both the older material and well documented contemporary material e.g. E. Soehner and G. Gross. Kew (**K**) also houses very rich collections, including overseas material, and in recent years has acquired the collections of L. Hawker. The many type collections also make the Paris herbarium (**PC**) an important source, with many collections from the last century. In central Europe, the important herbaria include Budapest (**BP**), with the collections of L. Hollós and L. Szemere, and Prague (**PRM**), which houses both Czechoslovakian material and also old and new material from overseas.

Especially significant are the Scandinavian herbaria: Copenhagen (**C**), with the Danish collections revised by M. Lange according to contemporary criteria, and Oslo (**O**) containing Norwegian material collected and examined

by F.-E. Eckblad. In Finland, the collections in Helsinki (**H**, **HFR**), Turku (**TUR**), and Oulu (**OULU**), include abundant material of *Elaphomyces*, both the older collection of Hittonen and more recent material by E. Ohenoja and T. Ulvinen. The Swedish herbaria of Stockholm (**S**) and Uppsala (**U**) also represent some of the richest collections in Europe, with the Swedish collections of *Elaphomyces* and, in addition, *Tuberales* material from several European countries, with both older collections from the last century and more recent specimens e.g. due to L. E. Kers. The collection at Leiden (**LD**), recently revised by De Vries, must also be taken into account. From eastern Europe, the Leningrad herbarium (**LE**) has been analysed, but of the material available to the author, only a few collections originated from within Soviet territory, the majority coming from western Europe by exchange. Collections from the Iberian Peninsula have also been analysed: Madrid herbarium (**MAF**), includes the collections of F. D.-Calonge, and the Lisbon herbarium (**LISU**) houses the Pinto-Lopez collection. Since the majority of the latter specimens belong to *Terfeziaceae*, the collections also illustrate, to some extent, the flora of the north coast of Africa and Asia Minor.

The entire material, analysed microscopically, is arranged according to species locality accounts, and provides the documentation for the species distribution maps. The localities in Poland are shown on maps with a 10 $\times$ 10 km squares grid. As a result of detailed examination, a square on the map may include several localities so, for reasons of completeness, the list of localities found is appended, with the use of abbreviations explained below. The order of localities corresponds to the physico-geographical partition of Poland according to Kondracki (1977). The background grid used for the maps of Poland was originally used in the "Atlas of Vascular Plant Distribution in Poland", **ATPOL** (Zając 1978). The meridian 19°E is the grid axis, the grid being marked on the Poland map 1:1000000. All localities shown on the map were previously identified on detailed topographical maps. The area of Poland is covered by 3437 squares. The cartograms used in this account are in accordance with those adopted by the authors of **ATPOL**.

Collections from other European countries are used to determine the overall distribution of individual species by the point method, whilst aggregation of the points are indicated by cross-hatching. The species locality accounts form an integral part of that section of the account, and each record corresponds to a herbarium label. For purposes of recording the distribution, data from the literature were utilized where they are important for species chorology, but these localities are not marked on the maps.

The maps presented provide only an introduction to fungal chorology, however, even such a limited account indicates the need and effectiveness in searching for hypogeous fungi in specific sites.

4. COMMENTS ON TEXT AND MAPS

The chorological characteristics of the species are arranged systematically according to the taxonomic part of the investigation (Ławrynowicz 1988). Well known species have separate subsections, whilst the others are treated collectively within the genus and may therefore occasionally diverge from the systematic order. Similarly species with few known localities may appear on the same map.

Localities are defined as a point on the terrain whose distance from the next nearest point (place of appearance of the species) is not less than 1 km in the lowlands, and 0.5 km in the mountains. These localities are arranged according to the macroregions proposed by Kondracki (1977). Within a macroregion, the arrangement is alphabetical and the number of squares on the map is provided.

The locality description includes:

a – name of macroregion (acc. Kondracki 1977);
b – map coordinates according to the formula ATPOL i.e. first letter and second numeral correspond to column on map, whilst the second letter and first numeral correspond to the strip, e.g. AB 23 indicates strip B2, column A3; the coordinates appear on map-frame;
c – name of nearest point, reserve, forest range, forest inspectorate, or two points between which the locality occurs, or the name of the mountain, hill, valley, etc.;
d – names of trees, shrubs under/at which the fungus has grown (abbreviations used in forestry, see Trampler, Smykała & Bosiak 1960), finally the plant community abbreviation;
e – date (montn and year) of collection;
f – name or initials of collector;
g – herbarium abbreviation (Index Herbariorum 1981) housing collection, together with herbarium specimen number.

The locality descriptions adopt the following punctuation:

. full stop – completes macroregion description,
; semi-colon – separates successive localities in a mezoregion,
, comma – separates successive localities,
– dash – precedes locality description for subsequent square.

Localities are cited within the list in such a way as to allow the reader to find them on the map. To find the locality in the country, the reader must refer to the species locality accounts for further details.

List of abbreviations

Abbreviations of names of trees, shrubs and plant communities

Aa – *Abies alba*
Ag – *Alnus glutinosa*
Ap – *Acer platanoides*
Aps – *Acer pseudoplatanus*
Bpp – *Betula pendula* and *B. pubescens*
Ca – *Corylus avellana*
Cb – *Carpinus betulus*
Fe – *Fraxinus excelsior*
FQ – *Fago-Quercetum*
Fs – *Fagus sylvatica*
Jc – *Juniperus communis*
Ldp – *Larix decidua* and *L. polonica*

LF – *Luzulo-Fagetum*
Pa – *Picea abies*
PaQ– *Potentillo albae-Quercetum*
PQ – *Pino-Quercetum*
PQp– *Pino-Quercetum*, variant with *Pinus sylvestris*
Po – *Populus* sp.
Ps – *Pinus sylvestris*
Pst – *Pinus strobus*
Pt – *Populus tremula*
Qrp – *Quercus robur* and *Q. petraea*
Qru – *Quercus rubra*
Rp – *Robinia pseudoacacia*
Sa – *Sorbus aucuparia*
Sl – *Salix* sp.
TC – *Tilio-Carpinetum*
Tc – *Tilia cordata*
Ul – *Ulmus* sp.
VmP– *Vaccinio myrtilli-Pinetum*

Abbreviations of collectors names

AS – Alina Skirgiełło
BG – Barbara Gumińska
BS – Bogusław Sałata
KM – Kazimierz Mamos
MK – Maria Kurzac
MŁ – Maria Ławrynowicz
RO – Romuald Olaczek
WW– Władysław Wojewoda

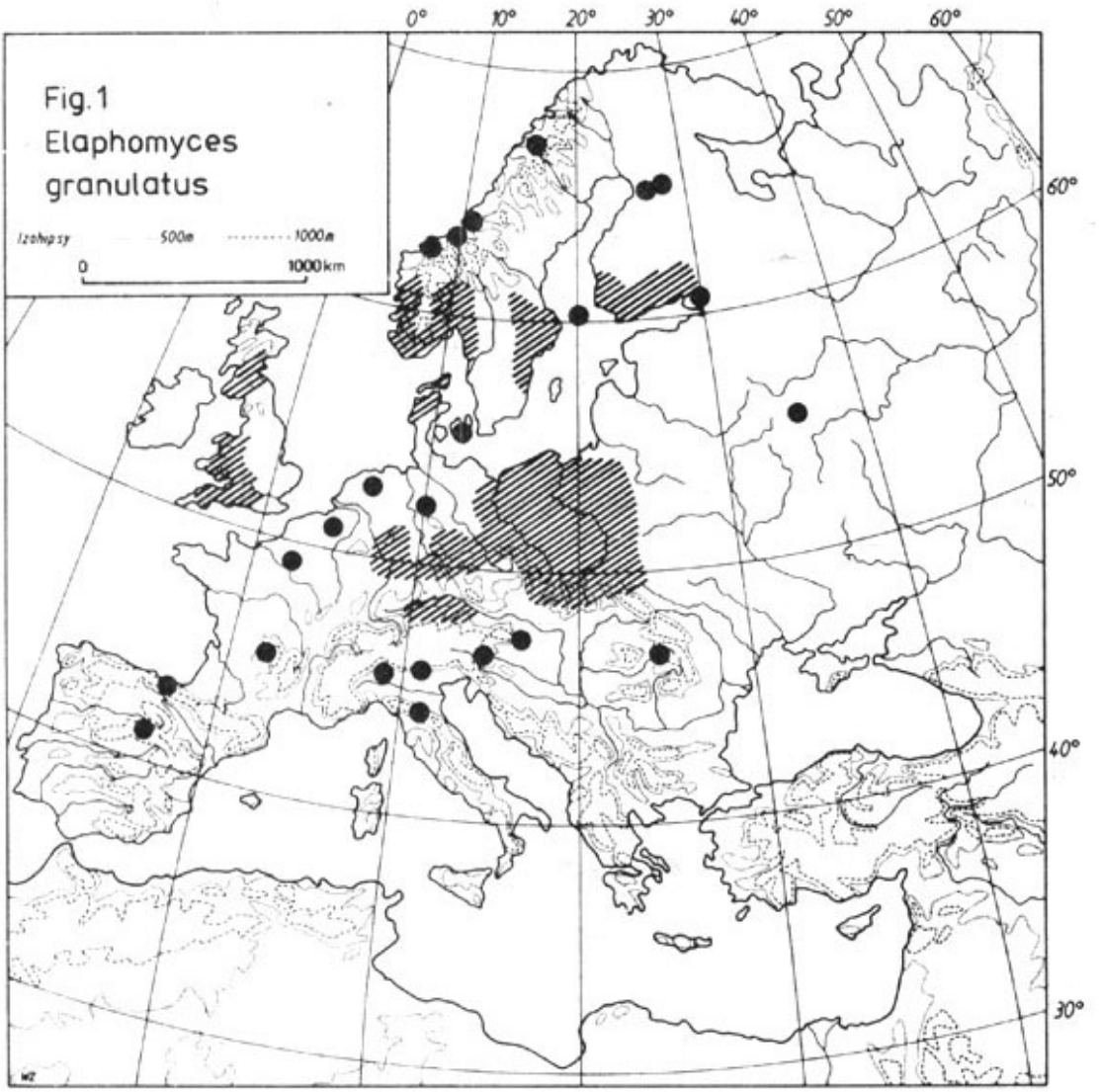
Other abbreviations

alt. – altitude above sea level
BaNP – Babia Góra National Park (in Polish: Babiogórski Park Narodowy)
BiNP – Białowieża National Park (Białowieski Park Narodowy)
C – Central (Środkowy, Środkowa, Środkowe; Środkowe)
ca – circa, about
cl. – clearing in a forest (poręba)
E – East(ern) (Wschodni, Wschodnia, Wschodnie; Wschodnie)
env. – environs
FD – Forest District (leśnictwo)
FI – Forest Inspectorate (nadleśnictwo)
f.r. – forest range (uroczysko)
f.s. – forest sector (oddział)
Herb. – Herbarium (Zielnik)
Mt. – Mountain (Góra)
Mtns – Mountains (Góry)
N – North(ern) (Północny, Północna, Północne; Północne)
n. – near
OjNP – Ojców National Park (Ojcowski Park Narodowy)
prov. – province (in Poland: województwo)
Res. – Reserve (rezerwat)
S – South (ern) (Południowy, Południowa, Południowe; Południowe)
Str. – Street (ulica)
W – West(ern) (Zachodni, Zachodnia, Zachodnie; Zachodnie)
WoN – P Wolin National Park (Woliński Park Narodowy)

5. CHOROLOGY OF SPECIES OF *ELAPHOMYCES*

5.1. *Elaphomyces granulatus* Fr. emend. Holl.

Distribution in Europe (Fig. 1). The species is frequently found in Central Europe and southern Scandinavia in lowlands and low mountain sites. It also occurs in Great Britain (England, Wales, Scotland), southern France, Belgium, The Netherlands, and in European USSR. Northern localities extend to the arctic circle in Finland and Norway; the northernmost site



is at Leirfjord, Nordland prov., at 1000 m alt. It occurs in the Carpathian Mountains, especially frequent in the Tatra and Beskid Mtns, more rarely in Transylvania. In southern Europe, it occurs mostly in the uplands and mountains, along the southern slopes of the Alps (Cavelonte, environs of Turin, Klagenfurt), Vallombrosa, the Central Massif, and the mountains of the Iberian Peninsula). The highest recorded localities are Važec (Tatra Mtns) at 850 m alt., Vallombrosa (Appenine Mtns) at ca 1000 m alt., and environs of Klagenfurt (Alps) at ca 800 m alt.

Hypothetical distribution. All Europe, within borders of nemoral and boreal zones (deciduous, mixed and coniferous forests), and analogous mountainous sites. Absent from Steppe and Mediterranean vegetation areas. Most common in region of oceanic climate.

Habitat. A typical forest species, forming ectotrophic mycorrhizal associations probably with several tree species. Found in deciduous and mixed tree stands, more rarely in coniferous stands. According to some authors *Fagus sylvatica* is the principal mycorrhizal associate, but in its absence will form associations with other deciduous and coniferous trees e.g. *Picea abies* in Norway. Known in Poland from 121 localities. Often occurring with *E. muricatus*, more rarely with *E. asperulus* but (in comparison with the latter) in lower mountain sites. Prefers rather fertile soils, with pH 4-5. Other accompanying species: *Genea hispidula*, *Hydnotrya tulasnei*, and the sclerotia of *Cenococcum geophilum*. The fruitbodies are sometimes attacked by *Cordyceps capitata* and *C. ophioglossoides*.

Distribution in Poland (Fig. 2). Occurring throughout the entire country, including coast, lakelands, uplands and mountains. One of the most common species in the mycoflora.

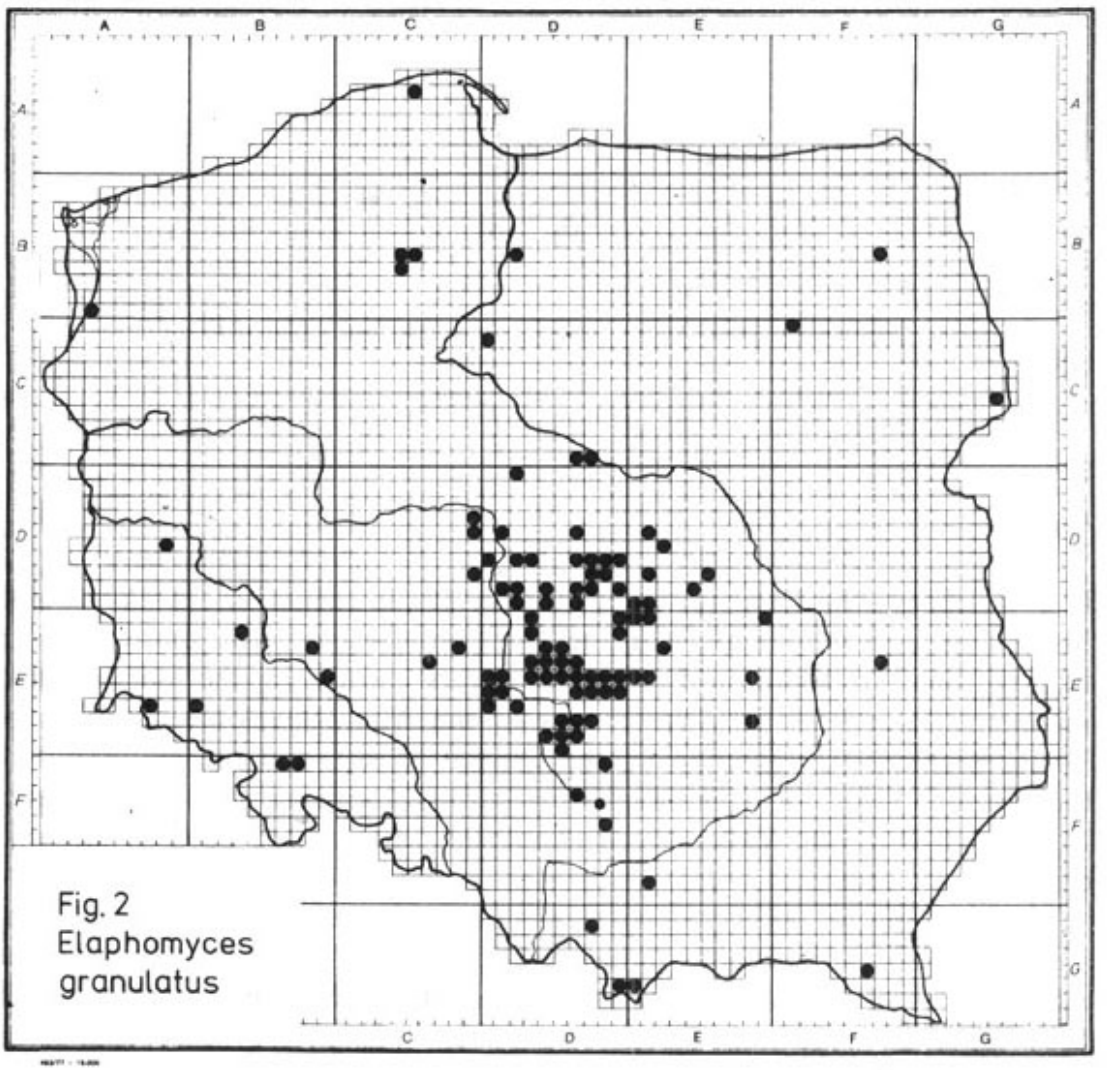


Fig. 2
Elaphomyces granulatus

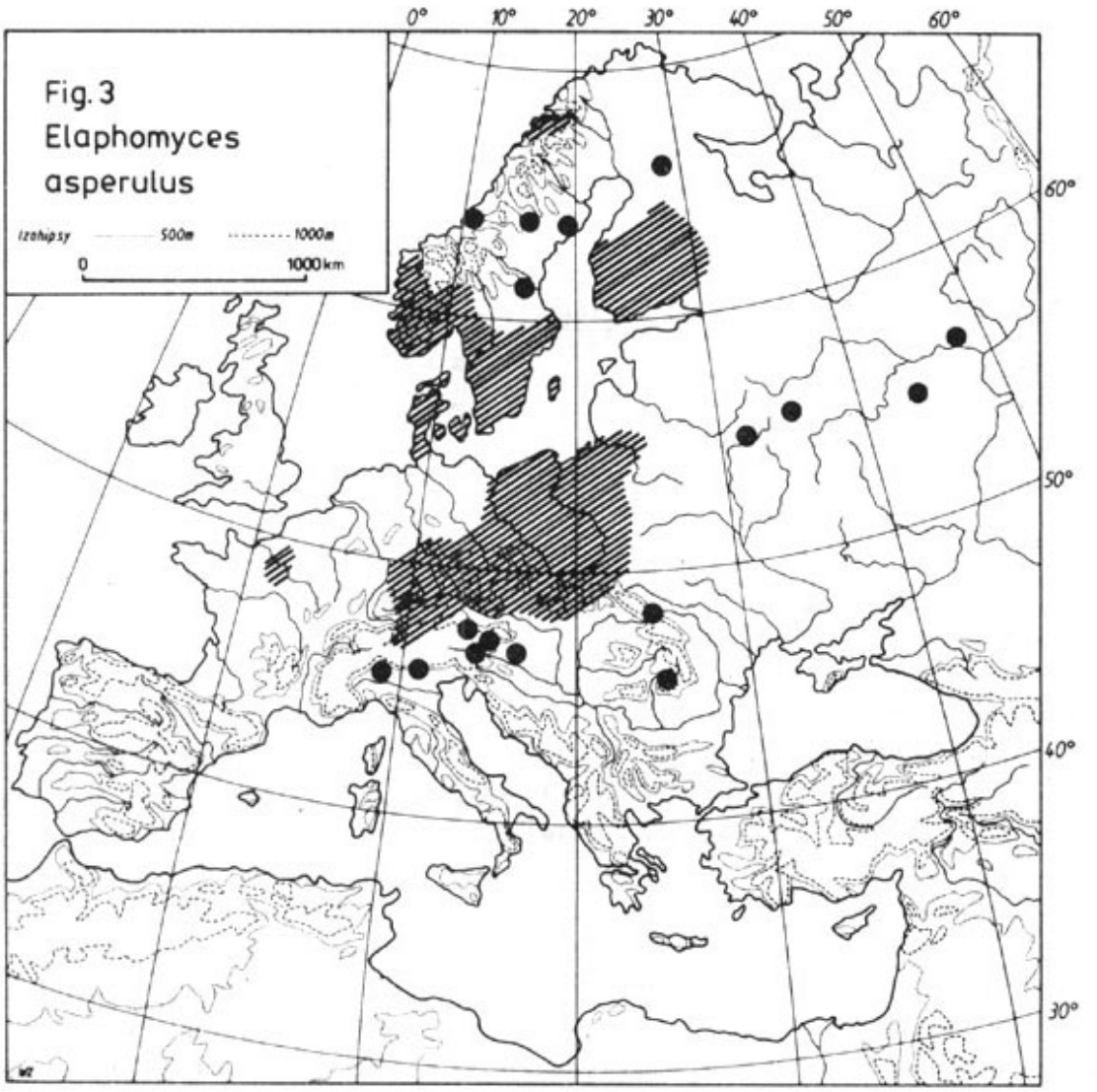
Localities in Poland. Pobrzeże Bałtyckie – AB 93 Puszcza Bukowa Res. Bukowe Zdroje, *Fs Pa Ps Cb Qrp*, 06.74: MŁ, LOD 20179 & 20246; – CA 45 Choczewo, *Pa*, 07.82: MŁ, LOD 20790. Pojezierze Południowopomorskie – CB 54 Bory Tucholskie Konigort – Kłodawa, *Ps Bpp*, 07.73: MŁ, LOD 20318; – CB 55 Żukowo, *Ps*, 07 & 08.74: MŁ, LOD 20445 & 20447; – CB 64 Raciąski Młyn, *Ps* cl., 07.73: MŁ, LOD 20446. Dolina Dolnej Wisły – DB 52 FD Białki n. Kwidzyn, *PaQ*, 04.76: T. Załuski, LOD 20224. Pojezierze Chełmińsko-Dobrzyńskie – DC 10 env. of Chełmża, *Ps*, 06.80: A. Ławrynowicz, LOD 20187. Pradolina Toruńsko-Eberswaldzka – DC 96 Lucień n. Gostynin, *Ps*, 07.79: RO, LOD 20192, – Łąck *TC Ps Cb Qrp*, 07.79: RO, LOD 20184 & 20791. Pojezierze Wielkopolskie – DD 02 Kujawy f.r. Rogoźno, *Qrp Sa*, 09.79: RO, LOD 20494. Wzniesienia Zielonogórskie – AD 58 Zielona Góra, *Ps*, 08.74: MŁ, LOD 20449. Niziny Sasko-Łużyckie – BE 13 Lubin, *VmP*, 06.73: WW, KRAM 14872. Nizina Południowowielkopolska – CD 39 Dąbrowice n. Koło, *Qrp Ps*, 10.78: MŁ, LOD 20185; – CD 49 Małoszyna n. Turek, *Ps Qrp*, 10.78: MŁ, LOD 20186; – CD 79 Sokołów n. Koźminek, *Ul Rp Qrp Fs*, 10.78: RO, LOD 20238; – CE 28 Res. Ryś n. Lututów, *Fs Aa Pa*, 07.79 & 09.80: MŁ & RO, LOD 20223 & 20501; – CE 36 Ustronie n. Kępno, *Ps*, 01.80: RO, LOD 20783; – DD 41 f.r. Wielenin n. Uniejów, *Qrp Cb Ps*, 10.78: MŁ, LOD 20183; – DD 60 Linne n. Dobra, *Ps Qrp*, 10.78: MŁ, LOD 20230 & 20237; – DD 62 Zakrzew n. Poddębice, *Qrp Ps Pt*, 05.80: KM, LOD 20453 & 20455; – DD 63 Sarnów, *Ps Qrp*, 06.82: H. Andrzejewski, LOD 20771, – env. of Res. Jodły Oleśnickie, *Ps*, 07.82: KM & MK, LOD 20772-73; – DD 81 Rossoszyca, *Ps*, 04.75: MŁ, LOD 20370; – DD 82 f.r. Wojsławice n. Szadek, *Pa Bpp*, 10.81: MK, LOD 20770; – DD 84 Jasionna n. Łask, *Ps Qrp Bpp Pa*, 04.75: RO, LOD 20415; – DD 92 Res. Jabłecznik n. Zduńska Wola, *Qrp*, 07.76: KM, LOD 20225; – DD 94 f.r. Ostrów n. Łask, *Ps Qrp*, 06.79: RO, LOD 20457 & 20495; – DE 03 FI Sędziejowice, *Ps*, 11.73: MŁ, LOD 20402; – DE 24 f.r. Słupia n. Bełchatów, *Ps Pt Pa Jc*, 06.80: RO & L. Samosiej, LOD 20175 & 20191; – DE 25 Nowy Świat, *Ps Qrp Bpp*, 06.80: RO, LOD 20174; – DE 33 f.r. Stróża n. Szczerców, *Ps*, 06.80: L. Samosiej, LOD 20178; – DE 34 f.r. Wola Wydrzyna, *Qrp*, 06.79: E. Filipiak, LOD 20220; – DE 35 Huba Ruszczyńska n. Szczerców, *Ps Qrp* cl., 08.78: RO & MŁ, LOD 20236, 20452 & 20491; – DE 36 f.r. Pytlowice FI Kamieńsk, *Ps Cb Pa*, 08.78: MŁ, LOD 20241. Nizina Śląska – BE 28 Oborniki Śląskie, Herb. Schroet. WRSL; – CF 23 Biała n. Prudnik, Herb. Rehm S; – CF 28 Widów, *Ps*, 03.13: Herb. Sydow S & Herb. Saccardo PAD. Nizina Północnomazowiecka – FC 01 Kuzie n. Łomża, *Ps*, 03.76: P. Genow, LOD 20229. Nizina Środkowomazowiecka – DD 46 f.r. Bielawy – Mroga, *Cb*, 10.78: MŁ, LOD 20400; – ED 41 Puszcza Bolimowska f.r. Bolimów, *TC PaQ Ps Cb Bpp Qrp*, 05.82: KM & MK, LOD 20737-38; – ED 52 f.r. Puszcza Mariańska, *Ps Qrp*, 05.82: MK, R. Dąbski, KM & E. Wiącek, LOD 20739-54. Wzniesienia Południowomazowieckie – DD 66 Łódź Las Łagiewniki, *Qrp Fs Cb Pa Ps*, 01-10.74: MŁ, LOD 20207-13, 20216-17, 20406-07 & 20422, 05.77: KM & L. Samosiej, LOD 20287 & 20371; – DD 67 f.r. Janinów n. Brzeziny, *Ps Fs*, 11.73: MŁ, LOD 20412, 10.78: E. Chalcarz, LOD 20188; – DD 68 Syberia n. Brzeziny, *Ps*, 04.74; RO, LOD 20366; – DD 69 f.r. Górki n. Rogów, *Ps*, 05.74: RO, LOD 20369, – Res. Doliska n. Rogów, *Aa Qrp Cb Pa Ps*, 05.74: RO, LOD 20763; – DD 77 f.r. Wiączyń n. Nowosolna, *Ps Fs Pa Pt*, 07.74 & 05-11.75; KM, A. Wiśniewska & Z. Ławnicka, LOD 20214-15, 20233, 20242-43, 20312-16, 20319-21, 20404, 20417-19 & 20755-57; – DD 78 Tadzin n. Brzeziny, *PaQ*, 05.74: RO, LOD 20367; – DD 86 Łódź Starorudzka Str., *Ps*, 04.79: KM, LOD 20244, – Łódź Las Komunalny – Skrajna, *Ps*, 04.79: KM, LOD 20245, – Łódź Zakładowa Str., *Ps*, 11.78: KM, LOD 20190; – DD 87 Justynów n. Łódź, *Qrp Ps Bpp Fs Cb*, 08.80: A. Ławrynowicz, LOD 20239, 08.82: L. Samosiej, LOD 20761-62, – Janówka n. Justynów, *Ps Cb Fs*, 08.82: L. Samosiej, LOD 20758-60; – DD 89 Budziszewice n. Koluszki, *Ps* 11.74: A. Olaczek, LOD 20403; – DD 96 Modlica n. Łódź, *Ps*, 03.80: J. Adamczyk & KM, LOD 20232, – Tuszynek n. Łódź, *Ps*, 03.77: M. Borowska, LOD 20189, – Res. Molenda, *Qrp Ps*,

10.79: MŁ, LOD 20416, – Res. Wolbórka n. Łódź, *Ps Qrp*, 08.74: MŁ, LOD 20450; – DE 09 env. of Tomaszów Mazowiecki, *Ps*, 11.77: MŁ, LOD 20414; – DE 19 Res. Lubiaszów, *Aa Cb*, 08.72: MŁ, LOD 20766, 09.72: B. Rzerzycha, LOD 20365; – DE 44 Piekary n. Sulmierzyce, *Ps Qrp*, 05.79: RO, LOD 20456 & 20498; – ED 71 Podlas n. Rawa Mazowiecka, *Qrp Ps*, 08.81: RO, LOD 20500, 20503-05 & 20767-68; – ED 75 env. of Mogielnica n. Grójec, *Ps Ca*, 09.79: KM, LOD 20424; – ED 84 Res. Tomczyce n. Nowe Miasto, *Ps Qrp Jc*, 07.74: MŁ, LOD 20361; – ED 90 Dąbrówka Fl Lubochnia, *Ps*, 08.81: RO, LOD 20499, – f.r. Cygan n. Tomaszów Mazowiecki, *Ps* cl., 06.80: MŁ, LOD 20177 & 20764; – ED 91 Spała, *Ps*, 05.77: MŁ, LOD 20362, 20408 & 20372, – Teofilów n. Inowłódz, *Qrp Pt*, 08.78: MŁ, LOD 20492; – EE 00 Borki n. Spała, *Ps Qrp*, 11.73: MŁ, LOD 20411; – EE 01 Inowłódz, *Ps*, 05.77: MŁ, LOD 20363. Przedgórze Sudeckie – BE 86 Dzierżoniów, 05.1861: Herb. Schroet. WRSL; – BF 07 Las Sieroszów n. Ząbkowice Śląskie, 06.17: M. Sudety Zachodnie – AE 67 Górzec, 05.1889: Herb. Schroet. WRSL; – AE 67 Świeradów, 05.1888: Herb. Schroet. WRSL; – BE 60 Szklarska Poręba, 08.1882: Herb. Schroet. WRSL. Sudety Środkowe – BF 06 Srebrna Góra – Żdanów, 10.24: M. Wyżyna Woźnicko-Wieluńska – DE 40 f.r. Bukowce n. Załęcze, *Ps*, 07.79: MŁ & RO, LOD 20218-19 & 20496, → Kamionka Fl Mierzyce, *Ps Qrp Pa*, 04.75: MK, LOD 20364, – f.r. Mierzyce, *Ps Qrp Pa*, 07.82: MK, LOD 20778-82; – DE 41 env. of Krzeczów, *Ps*, 08.79: K. Czyżewska, LOD 20308, – f.r. Niżankowice, *Ps*, 09.79: MŁ, LOD 20176, *Ps Fs Qrp*, 05 & 08.82: MK, LOD 20774-77; – DE 43 Res. Murowaniec n. Pajęczno, *Aa*, 04.79: RO, LOD 20458; – DE 50 Załęcze Małe, *Ps Qrp*, 07.79: MŁ, LOD 20497; – DE 51 Res. Węże, *Ps Bpp Jc*, 07.79: RO, LOD 20451; – DE 60 Zajączki n. Krzepice, *Fs Aa*, 04.74: MŁ, LOD 20448; – DE 62 Miedzno n. Kłobuck, *Ps Qrp*, 09.79: MŁ, LOD 20307 & 20309-10. Wyżyna Krakowsko-Częstochowska – DE 84 Mstów n. Częstochowa, *Fs Bpp*, 08.81: RO, LOD 20231 & 20235; – DE 85 Śmiertny Dąb Fl Złoty Potok, *Ps Pa*, 04.75: MŁ, LOD 20311; – DE 95 Potok Złoty, *Fs*, 09.82: KM, LOD 20787; – DF 08 Ołudza Fl Szczekociny, *Qrp Ps*, 09.82: KM, LOD 20788; – DF 26 Rodaki n. Ogrodzieniec, *Fs*, 05.80: MŁ, LOD 20506; – DF 48 OjNP Ojców – Skała ("Miotełka"), *PQ*, 03, 04 & 09.61: WW, KRAM 13110 & 13107-08, *PQp*, 03.61, 06.62 & 63: WW, KRAM 13109 & 13111-12, – Ojców – Smardzewice, *PQp*, 03.61: WW, KRAM. Wyżyna Przedborska – DE 45 Hulanka n. Dobryszyce, *Ps Pa Qrp Jc Ca Bpp*, 09.78: RO, LOD 20454; – DE 46 Kletnia, *Ps Qrp*, 08.79: MŁ, LOD 20180; – DE 47 Kodrąb, *Ps*, 08.79: MŁ, LOD 20181; – DE 48 Bąkowa Góra, *Ps Qrp* cl., 05.80: RO, LOD 20765; – DE 49 f.r. Wilkowice, *Ps Cb*, 07.81: RO, LOD 20502; – DE 56 Przybyszów n. Kobiele Wielkie, *Ps Qrp Cb Tc Sa*, 09.78: RO, LOD 20182, – Res. Jasień, *Ps Pa*, 05.75: MŁ, LOD 20420-21; – DE 57 f.r. Modrzewszczyzna n. Kobiele Wielkie, *PaQ*, 09.78: RO, LOD 20401; – DE 58 Mt. Chełmo, *Qrp Cb Pt Pa*, 08.79: MŁ, LOD 20221 & 20789; – DE 59 env. of Mt. Bukowa n. Przedbórz, *Ps Qrp* plought cl., 10.73: MŁ & RO, LOD 20234, 20317, 20368, 20405 & 20409; – DE 75 f.r. Skrzydlów n. Kłomnice, *Qrp Ps Ldp Bpp*, 06.79 & 04.80: MŁ, LOD 20222 & 20785-86; – DE 76 f.r. Antoninów Fl Dąbrowa Zielona, *Ps*, 08.78: MŁ, LOD 20227; – DE 77 env. of Raczkowice, 11.74: MŁ, LOD 20443; – DE 86 f.r. Smyków n. Święta Anna, *Ps Qrp Bpp Cb*, 05.79: MŁ, LOD 20784; – EE 00 Sługocice Fl Smardzewice, *Qrp Aa Ps*, 05.74: RO, LOD 20322; – EE 22 Res. Białaczów n. Opoczno, *Cb Bpp Qrp Ps*, 08.82: MŁ, LOD 20769; – EE 40 Wygwizdów, *Ps* cl., 10.73: RO & MŁ, LOD 20413; – EE 41 Lipa n. Cieklińsko, *Fs Aa*, 04.74: RO, LOD 20226. Wyżyna Kielecko-Sandomierska – EE 48 Zębiec n. Iłża, *Ps Qrp*, 06.79: MŁ, LOD 20423; – EE 78 Mt. Chełmowa, *Fs Aa*, 07.75: MŁ, LOD 20444. Wyżyna Lubelska – FE 37 Zemborzyce n. Lublin, *Ps*, 10.65: BS, LBL. Pogórze Zachodniobeskidzkie – EF 81 Czasław n. Dobczyce 09.10: K. Rouppert, KRAM 878. Beskidy Zachodnie – DG 17 Zawoja – Widły ca 600 m alt., mixed forest, 09.64: WW, KRAM 15814. Tatry – DG 59 Kościeliska Dale (Dolina K.) mouth of the Smytna Dale, *Pa*, 10.79: MŁ, LOD 20306; – DG 59 Kuźnice, *Pa*, 08.58: AS, WA 011962; – EG 50 Rusinowa Glade (R. Polana), *Pa*, 08.71: S. Frejlak, WA 019641. Bieszczady Zachodnie –

FG 46 Jabłonki n. Cisna, 05.76: MŁ, LOD 20228. Pojezierze Mazurskie – FB 57 Tama n. Rajgród, *Ps Pa Jc*, 08.79: RO, LOD 20410. Nizina Północnopodlaska – GC 55 BiNP f.s. 369, *Ps*, 05.78: MŁ, LOD 20240.

5.2. *Elaphomyces asperulus* Vitt.

Distribution in Europe (Fig. 3). Occurring commonly and frequently in C, E and N Europe, also known from northern France (vicinity of Paris), E Alps, S and N slopes of Alps, and the entire Carpathian Mtns. In the Tatras, it is the most frequent species of *Elaphomyces*, similar to the situation found in Scandinavia. The most northern locality is close to Narvik in Norway, whilst the extreme limits, Kuusamo, in Finland are a little to the south. The highest limits are Štrbské Pleso (Tatras) at 1100 m alt., and Pfronten n. Breitenberg in the Bavarian Alps at 1400 m alt. No data exists



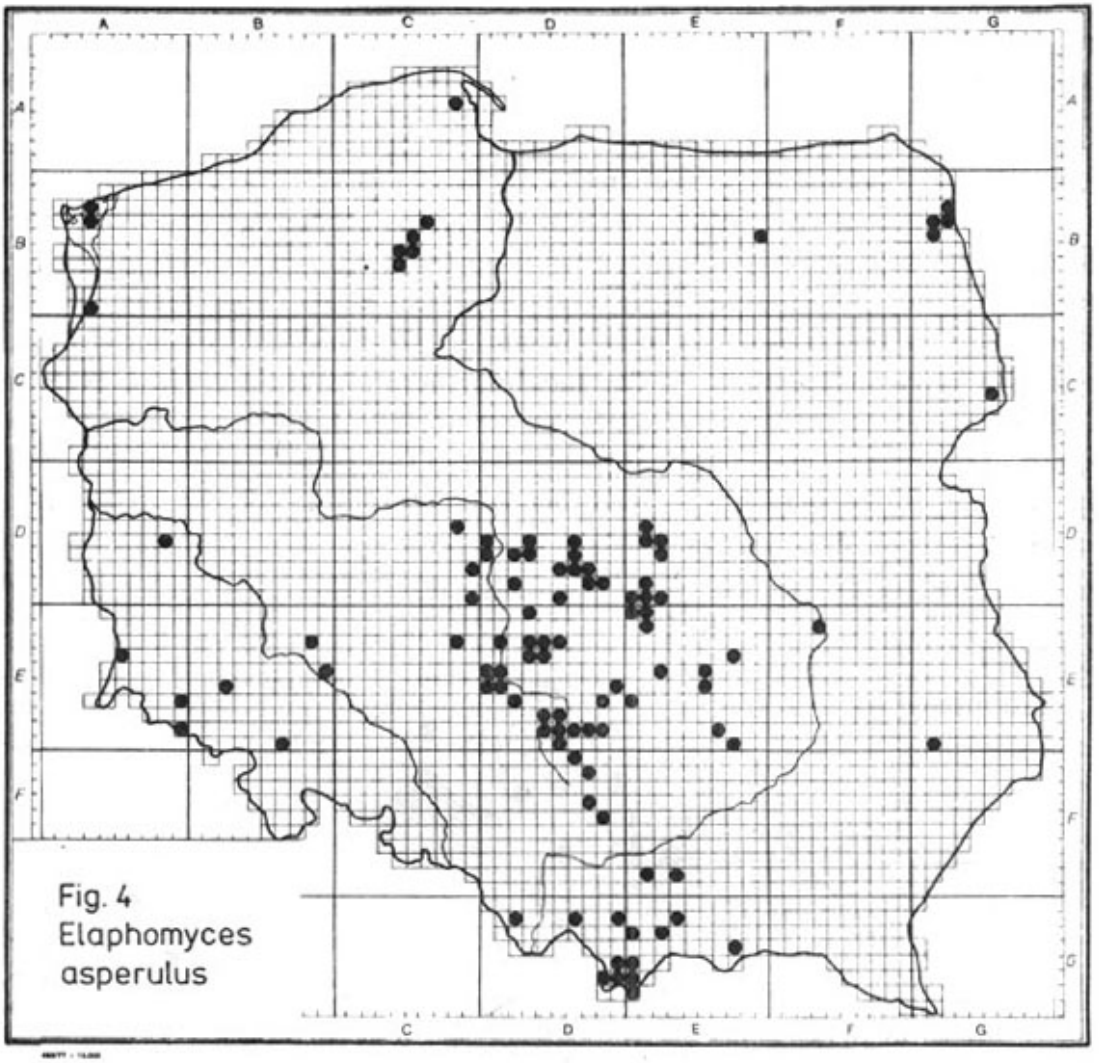


Fig. 4
Elaphomyces asperulus

for southern Europe, the Hungarian lowland, most of W Europe, or the Steppe regions of E Europe.

Hypothetical distribution. Prefers regions with a temperate, cool or continental climate. Probably occurs throughout the range of *Pinus sylvestris* and *Picea abies*. The highest localities occur in montainous regions; in E Europe it represents the most common species of *Elaphomyces*. Absent from areas with a Mediterranean or Atlantic climate, and in the Steppe zone.

Habitat. Ectotrophic mycorrhizal associations formed primarily with conifers: *Pinus sylvestris*, *Picea abies*, and *Abies alba*, sometimes probably also with deciduous trees, such as *Quercus*, *Betula*, *Fagus* and *Carpinus*. Often extreme habitats are attained: over 1000 m alt. in mountainous regions, and within poor habitats for pine forests in lowlands where *E. granulatus* is a rather rare species; pH 4-4.5. It is the species of *Elaphomyces*

most strongly associated with poor, acid habitats of pine and fir forests, and mixed oak-pine forests. It occurs together with *E. granulatus*, more rarely with *E. muricatus*, *Hydnobolites cerebriformis*, and the sclerotia of *Cenococcum geophilum*. Sometimes, but more rarely than in the case of *E. granulatus* and *E. muricatus*, the fruitbodies are attacked by the stromata of *Cordyceps capitata* and *C. ophioglossoides*.

Distribution in Poland (Fig. 4). Currently known from 127 localities distributed throughout Poland. A larger concentration appears in the Bory Tucholskie (Tuchola Coniferous Forests), Puszcza Białowieska (Białowieża Primaeval Forest), regions of older glaciations in the lowlands, as well as in the Beskid and Tatra Mtns. No data are available from regions of the last glaciation and little is known from the Silesian Lowland i.e. regions of mostly loams and loesses.

Localities in Poland. Pobrzeże Bałtyckie – AB 23 WoNP Wickowo, *PQ FQ LF Ps*, 06 & 09.74: RO, LOD 20291 & 20471-72; – AB 33 Lubin – Trzciągowo, *Fs*, 09.74: RO, LOD 20473; – AB 93 Puszcza Bukowa Res. Bukowe Zdroje, *Fs*, 06.74: MŁ, LOD 20254 & 20470; – CA 58 Puszcza Darżlubska n. Reda, *Fs*, 09.69: MŁ, LOD 20292. Pojezierze Południowopomorskie – CB 36 Bory Tucholskie Res. Odry, *Ps*, 07 & 09.74: MŁ, LOD 20474-81; – CB 45 Peatbog (Torfowisko) Kwieki FI Czersk, *Bpp*, 08.74: MŁ, LOD 20298; – CB 54 Spierewnik, *Ps*, 07.73: MŁ, LOD 20466; – CB 55 Żukowo, *Ps* cl., 07.73: MŁ, LOD 20465; – CB 64 Raciąski Młyn, *Ps Bpp* cl., 07.73: MŁ, LOD 20264, 20297 & 20464. Wzniesienia Zielonogórskie – AD 58 Zielona Góra, 06.75: W. Makowski, LOD 20467. Nizina Południowowielkopolska – CD 48 Wrząca n. Turek, *Ps*, 10.78: MŁ, LOD 20204; – CD 79 Sokołów n. Koźminek, *Fs Bpp Cb*, 10.78: MŁ, LOD 20199; – CD 99 Wojkowo FI Brąszewice, *Fs Aa Ps*, 07.75: RO, LOD 20385; – CE 28 Res. Ryś n. Lututów, *Fs Cb Aa Pa*, 07 & 10.79: KM, MŁ & RO, LOD 20248-49, 20265-66, 20274, 20374 & 20489; – DD 50 Ewinów n. Uniejów, *Ps Cb Qrp*, 04.75 & 10.78: MŁ, LOD 20200 & 20386; – DD 53 Gostków n. Poddębice, *Ps Pa Qrp*, 04.75: MŁ, LOD 20349; – DD 60 Linne n. Dobra, *Ps Qrp Pa*, 04.75: MŁ, LOD 20262 & 20359; – DD 62 Poddębice – Uniejów, *Ps Qrp Pa*, 04.75: MŁ, LOD 20679; – DD 63 env. of Res. Jodły Oleśnickie, *Ps*, 07.82: KM, LOD 20723-25; – DD 75 Łódź Park Ludowy, *Ps Bpp Qrp Pt Cb*, 10.79, 06 & 07.82: KM & MK, LOD 20398 & 20674-77; – DD 76 Łódź Park Mickiewicza, *Qrp Bpp Ps Rp*, 10.79: KM, LOD 20399; – DD 82 f.r. Wojsławice n. Szadek, *Pst*, 10.79 & 81: MK, MŁ & KM, LOD 20261, 20380-81, 20393 & 20720-22; – DD 95 Ślądkowice n. Kolumna, *Ps Qrp Bpp*, 06.79: RO, LOD 20441, – f.r. Pawlikowice, *Ps*, 06.79: RO, LOD 20484; – DE 03 FI Sędziejowice, *Ps*, 11.73: MŁ, LOD 20387 & 20392; – DE 21 Konopnica, *Pa*, 07.77: KM, LOD 20288; – DE 23 Bagno n. Żar, *Ps*, 09.78: RO, LOD 20487; – DE 24 Kluki, *Ps Bpp Pa Qrp* cl., 08.78: MŁ, LOD 20482; – DE 24 env. of Kurnos n. Bełchatów, *Ps* cl., 06.80: RO, LOD 20205; – DE 25 Nowy Świat, *Ps* cl., 11.76: MŁ, LOD 20289; – DE 33 f.r. Stróża n. Szczerców, *Ps*, 06.78: RO, LOD 20252; – DE 34 f.r. Wola Wydrzyna, *Ps Qrp Bpp Cb Pa*, 09 & 10.79: KM, LOD 20272-73, 20305 & 20373. Nizina Śląska – BE 49 Wrocław Ogród Botaniczny, 05.1869: Herb. Schroet. WRSL. Nizina Środkowomazowiecka – ED 41 Puszcza Bolimowska f.r. Bolimów, *Ps Cb*, 05.82: MK, LOD 20684-88, – Ruda Sanice, *Ps*, 08.82: RO, LOD 20715; – ED 52 f.r. Puszcza Mariańska, *Ps Qrp Cb*, 09.79, 05 & 06.82: MK, KM & E. Wiącek, LOD 20304 & 20689-714. Wzniesienia Południowomazowieckie – DD 56 f.r. Szczawin FI Grotniki, *Ps* cl., 02.74: J. Józefowicz, LOD 20290; – DD 66 Łódź Las Łagiewniki, *Ps Pa*, 03 & 04.74, 05.77:

M. Paziuk & L. Samosiej, LOD 20247, 20357, 20390-91 & 20823; – DD 77 f.r. Wiączyń n. Nowosolna, *Ps Bpp Fs Aa Qrp Pa*, 05-10.75: KM, LOD 20279-86, 20294-95 & 20382-83; – DD 87 Justynów n. Łódź, *Ps Fs*, 09.77: KM, LOD 20439, *Qrp Bpp Ps*, 10.79: MŁ, LOD 20299; – DD 87 Res. Gałków, *Cb Fs Qrp*, 10.81: KM, LOD 20678; – DD 88 Będzelin n. Rokiciny *Aa Cb*, 05.74: MŁ, LOD 20490; – ED 62 Res. Babsk, *Ps Qrp Cb Tc*, 08.79, 07 & 09.80: KM, LOD 20394, 20463 & 20682-83; – ED 81 Wielka Wola FI Spała, *Ps Qrp*, 08.81: RO, LOD 20509; – ED 90 f.r. Cygan n. Tomaszów Mazowiecki, *Ps* cl., 06.80: MŁ, LOD 20195 & 20681; – ED 91 Res. Spała, *Ps Qrp*, 06.69 & 04.76: MŁ & RO, LOD 20351 & 20468, – f.r. Spała, *Cb Qrp*, 05.77: MŁ, LOD 20353, – Królowa Wola, *Ps Pa*, 05.77: MŁ, LOD 20360. Pogórze Zachodniosudeckie – AE 35 Zgorzelec, M. Sudety Zachodnie – AE 69 env. of Jelenia Góra, M; – AE 89 Pot-hole of Śnieżka Mt. (Kocioł Śnieżki), Herb. Rehm KRAM, M, S, WRSL. Wyżyna Woźnicko-Wieluńska – DE 40 f.r. Mierzyce, *Ps Qrp Fs*, 06.79 & 07.82: RO & MK, LOD 20717-19, – Kamionka FI Mierzyce, *Ps Qrp Pa*, 04.75: MŁ, LOD 20388-89; – DE 41 f.r. Niżankowice, *Qrp Ps*, 09.75 & 05.82: KM & MK, LOD 20268; – DE 50 Załęcze Małe, *Ps Pa Aa Qrp*, 07.79: MŁ, LOD 20276 & 20485, – Kluski, *Qrp Ps*, 09.79: KM, LOD 20300, – Kałuże (= Randały), *Ps Qrp*, 07.79: RO, LOD 20278, – Springs of Revelation (Źródła Objawienia) FI Cisowa, *Pa*, 07.79: RO, LOD 20270; – DE 51 Giętkowizna n. Parzymiechy, *Ps Pa*, 09.76: MŁ, LOD 20507; – DE 62 Miedzno n. Kłobuck, *Pa*, 09.79: MŁ, LOD 20267. Wyżyna Krakowsko-Częstochowska – DE 74 Jaskrów, *Fs Ps*, 10.79: MŁ, LOD 20263; – DE 84 Mirów – Hektary, *Qrp Pt*, 08.81: RO, LOD 20260, – Res. Zielona Góra, *Fs*, 09.82: KM, LOD 20726; – DE 95 Res. Sokole Góry n. Olsztyn, *Fs Ps Cb*, 06.78: MŁ, LOD 20251; – DF 06 Kroczyce Rocks (Skałki Kroczyckie), *Cb Fs*, 09.82: MŁ & MK, LOD 20728-29; – DF 17 Sierbowice – Pradła, *Ps Bpp Pt*, 09.82: KM, LOD 20727; – DF 37 Jaroszowiec Olkuski, *Ps VmP*, 05.63: WW, KRAM 15817; – DF 48 OjNP Ravine (Wąwóz) Korytania n. Ojców, *PQ*, 07.61: WW, KRAM 13106. Wyżyna Przedborska – DE 59 Stara Wieś n. Przedbórz, *Ps Qrp Aa*, 11.73: MŁ, LOD 20350, 20384, 20395 & 20680; – DE 68 Res. Dębowiec n. Maluszyn, *TC Pa Bpp Qrp*, 08 & 11.70, 05.81: MŁ & KM, LOD 20440, 20459-60 & 20508; – DE 75 Skrzydlów n. Kłomnice, *Fs Qrp*, 04.80: LOD 20730; – DE 85 FD Stawki FI Potok Złoty, *Aa Pt Cb Bpp Qrp Ps*, 10.78: RO, LOD 20201-03; – DE 86 f.r. Wielki Las n. Święta Anna, *Qrp Cb Fs Pt Ag Tc*, 10.79: MŁ, LOD 20375 & 20442, f.r. Okrąglik n. Przyrów, *Cb Qrp Pa Bpp*, 10.78: RO, LOD 20206; – DE 87 Res. Borek, *Ps Qrp*, 05.79: RO, LOD 20277; – DE 88 Gabrielów n. Koniecpol, *Ps Pa*, 04.75: MŁ, LOD 20462; – EE 00 Sługocice – Bratków FI Smardzewice, *Aa*, 05.74: RO, LOD 20358, – Sługocice, *Aa Pa*, 05.74: MŁ, LOD 20255; – EE 11 Prymusowa Wola, *Pa Qrp*, 08.73: MŁ, LOD 20356, – env. of Kamień FI Smardzewice, *Qrp Cb*, 05.74: RO, LOD 20352; – EE 42 Sielpia Wielka, *Ps*, 11.73: MŁ, LOD 20293; – EE 60 Żeleźnica n. Przedbórz, *Aa*, 04.74: RO & MŁ, LOD 20296. Wyżyna Kielecko-Sandomierska – EE 37 Osiny – Pomorzany env. of Iłża, *Ps*, 06.79: MŁ, LOD 20378; – EE 45 Res. Dalejów n. Bliżyn, *Aa*, 06.79: MŁ & KM, LOD 20197-98, – Res. Cisowy Majdów, *Ps Aa*, 06.79: MŁ, LOD 20303; – EE 55 Res. Świnia Góra, *Qrp Cb Aa*, 06.79: MŁ & KM, LOD 20488; – EE 86 Daleszyce – Cisów n. Wymysłów, *Aa Fs*, 07.77: MŁ, LOD 20253; – EE 87 Raków – Hańcza, *Qrp Ps*, 07.77: MŁ, LOD 20256, 20269 & 20731. Wyżyna Lubelska – FE 13 env. of Puławy, *Qrp Ps*, 11.53: H. Stasiak, WA 13562. Roztocze – CE 91 Res. Bukowa Góra n. Zwierzyniec, *Aa*, 09.66 & 07.68: BS, LBL. Pogórze Zachodniobeskidzkie – EF 81 Czasław n. Dobczyce, 04.11: K. Rouppert, KRAM 877; – EF 83 Res. Kamienie Brodzińskiego n. Bochnia, *PQ*, 05.74: WW, KRAM 15046. Beskidy Zachodnie – DG 12 Barania Mt., *Aa Pa* 05.58: AS, WA 011956; – DG 16 BaNP 1080 m alt., *Pa*, 06.61: BG, KRA. Beskidy Zachodnie – DG 19 Rabka, *Pa*, 11.79: MŁ, LOD 20196; – EG 13 Kamienica Dale (Dolina Kamienicy), *Pa Aa*, 06.76: MŁ, LOD 20354; – EG 20 Bukowina Obidowska, *Pa*, 07.67: WW, KRAM 13105; – EG 22 env. of Maniowy n. Nowy Targ 700 m alt., 08.63: WW, KRAM 13104; – EG 37 Tylicz, *Aa*, 10.60: BG, WA 009581, 04.61: BG, KRA, – Tylicz – Krynica, *Aa*, 07.60

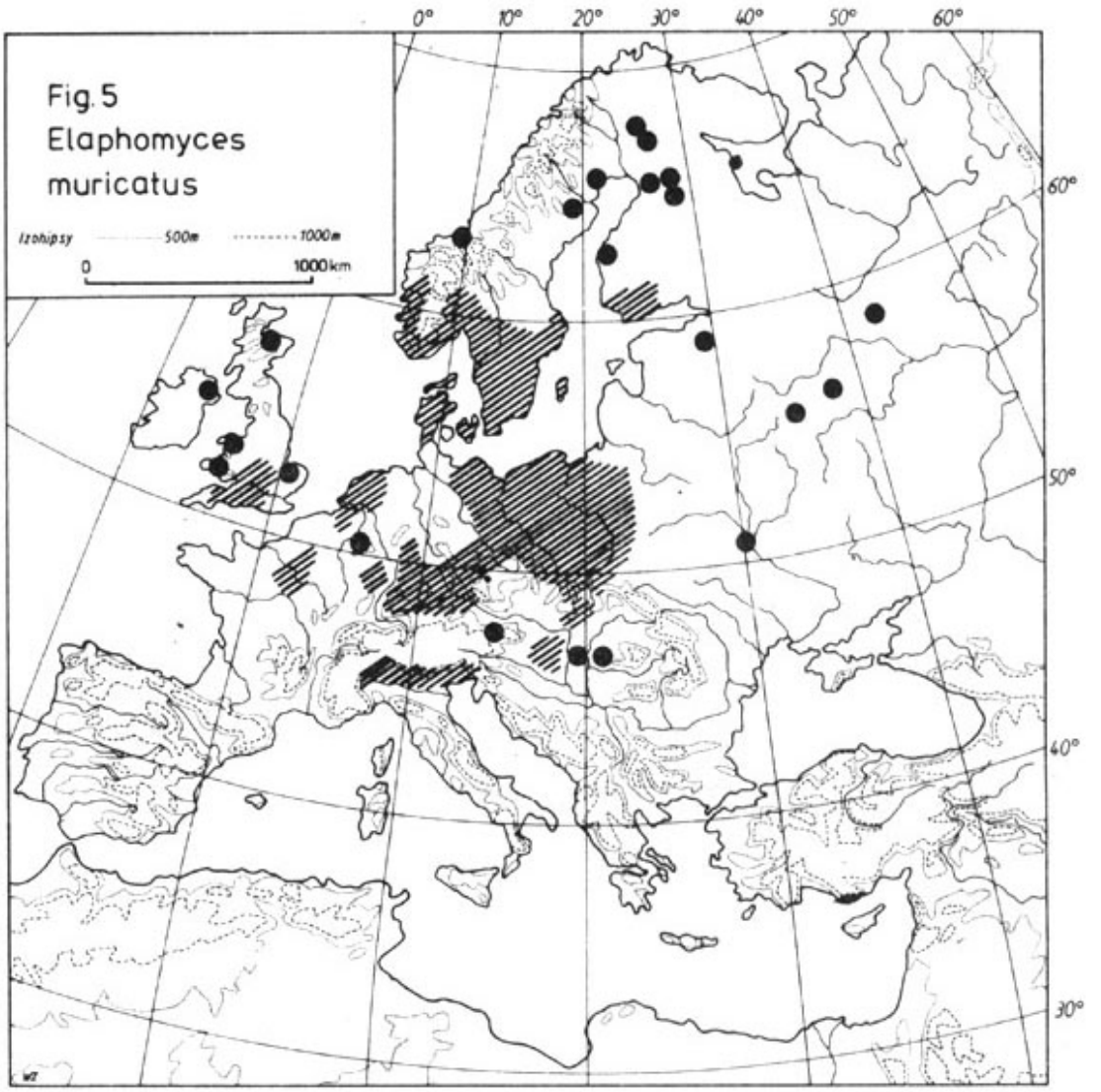
& 09.62: BG, KRA. Tatry – DG 49 Kalatówki ca 1200 m alt., *Pa*, 07.64: WW, KRAM 15818; – DG 58 Chochołowska Dale Molkówka, *Pa*, 10.79: MŁ, LOD 20193, 20257-58 & 20396; – DG 59 Ku Dziurze Dale, *Pa*, 10.79: MŁ, LOD 20301. – Dale of Biały (Dolina Białego), *Pa*, 10.79: MŁ, LOD 20259 & 20302, – Lejowa Dale, *Pa*, 08.82: MŁ, LOD 20734, – Strążyska Dale, *Pa Aa Fs*, 10.79: MŁ, LOD 20486, – Kościeliska Dale mouth of the Smytna Dale 1080 m alt., *Pa*, 10.79: MŁ, LOD 20271, – Mt. Nosal ca 1200 m alt. Zakopane – Kuźnice, *Pa*, 05.73: WW, KRAM 15751; – EG 40 Zakopane Jaszczurówka, *Aa Pa*, 08.58: AS, WA 011964, – env. of Murzasichle ca 850 m alt., *Pa*, 04.71: L. Plewicki, KRAM 15820, – Zakopane Chłabówka, *Pa Aa*, 06.57: W. Rudnicka-Jezierska, WA 011966; – EG 50 Olczyska Dale 892 m alt., *Pa*, 08.80 & 82: BS & MŁ, LOD 20732-33, – Roztoka Dale, *Pa*, 06.79: MŁ, LOD 20194, – Rock over the Łysa Glade (Skałka nad Łysą Polaną), *Pa*, 08.69: S. Frejlak, WA 017181, – Myślenickie Fells (M. Turnie), 08.35: J. Lilpop, KRAM 886; – EG 60 Pot-hole of the Morskie Oko Lake (Kocioł Morskiego Oka), *Pa*, 07 & 08.58 & 66: S. Frejlak, WA 014756-92 & 014805, – Morskie Oko, *Pa*, 06.56: AS, WA 011965, – Włosienica Glade ca 1450 m alt., *Pa*, 07.72: Z. Heinrich, KRAM 15819. Pojezierze Litewskie – GB 22 Puszcza Augustowska env. of Płaskie Lake, *Ps* cl., 08.79: RO, LOD 20379; – GB 31 Res. Mały Borek, *Ps Pa*, 08.79: RO, LOD 20376, – Res. Starożyn, *Pa Bpp Pt Qrp*, 08.79: RO, LOD 20250 & 20377; – GB 32 Rygol, *Ps Pa Bpp*, 08.79: RO, LOD 20397; – GB 41 env. of Res. Kozi Rynek FI Balinka, *Pa*, 06.72: MŁ, LOD 20469. Pojezierze Mazurskie – EB 49 Bobrówko n. Mikołajki, *Aps Ps Pt Ch*, 08.81: RO, LOD 20736. Nizina Północnopodlaska – GC 55 BiNP, *TC Pa*, 05.78 & 10.81: MŁ, LOD 20275 & 20735.

5.3. *Elaphomyces muricatus* Fr.

Distribution in Europe (Fig. 5). Common throughout C Europe, southern Scandinavia, and the British Isles. A lowland-upland species, also of low mountain sites. Many localities extend to the southern slopes of the Alps and to the Lombardy heights, but fewer localities are known for the northern slopes of the Alps and no information exists for the E Carpathian Mtns. Remarkably the species occurs on the Hungarian Lowland and nearby Kiev. Differentiated into distinct ecological forms, also differing with their geographical distribution. The full range of forms is limited to C Europe and southern Scandinavia. Further north, it is found only as f. *muricatus* and f. *reticulatus*, with localities around the Gulf of Bothnia, and the northernmost locality at Kittilä, 100 km beyond the arctic circle (almost 68 N). In the extreme southern localities, only f. *variegatus* and f. *fagicolus* in the *Fagus* range are represented.

Hypothetical distribution. A typical deciduous forest species of the nemoral zone of maritime and submaritime climate. Also, in a more continental climate, approaching the forest-steppe border.

Habitat. Ectotrophic mycorrhizal associations formed with several tree species; often found in mixed forests, occasionally in coniferous forests. Ecological forms with morphologically differentiated fruitbodies are associated with specific trees, such as *Fagus sylvatica*, *Carpinus betulus*, *Quercus robur*, etc. Occurring in lowlands and low mountain sites, in compact, fertile



soils, with a pH 4.5-5. Frequently found together with *E. granulatus*, more rarely with *E. asperulus*, and the sclerotia of *Cenococcum geophilum*. The fruitbodies are sometimes attacked by *Cordyceps capitata* and *C. ophioglossoides*. In the vicinity, *Hydnotrya tulasnei*, *Genea hispidula*, and some species of *Tuber* can often be found.

Distribution in Poland (Fig. 6). Frequent in lowlands but disappearing in low mountain sites. Until now considered rare in the mycoflora, and known only from individual localities. According to the author's investigations, it appeared to be the most common species of the hypogeous *Ascomycetes*, and was found in 140 localities.

Localities in Poland. Pobrzeże Bałtyckie – AB 23 WoNP FD Międzyzdroje, *Fs Qrp FQ*, 10.62: M. Lisiewska, POZ, – Wisełka, *Qrp Cb FQ*, 06.77: MŁ, LOD 20155; – AB 33

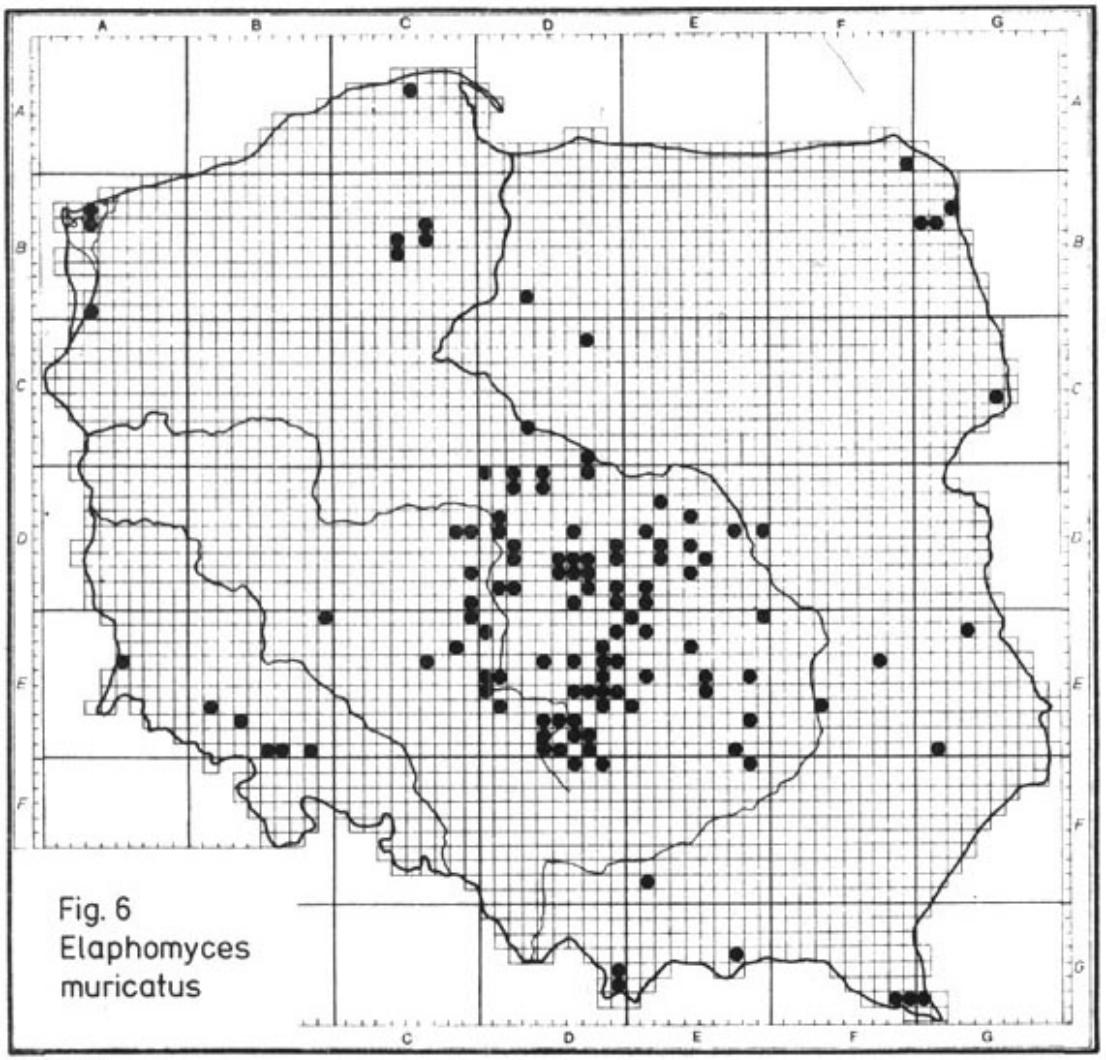


Fig. 6
Elaphomyces
muricatus

Lubin – Trzciągowo, *Fs*, 06.74: MŁ, LOD 20149; – AB 93 Puszcza Bukowa Res. Bukowe Zdroje, *FQ*, 10.61: M. Lisiewska, POZ, – Podjuchy, *Fs*, 06.74: MŁ, LOD 20054, 20082, 20164 & 20332; – CA 45 Choczewo, *Fs*, 07.82: MŁ, LOD 20655-56 & 20656. Pojezierze Południowopomorskie – CB 36 Res. Odry, *Ps Bpp*, 10.73: MŁ, LOD 20167; – CB 44 Bory Tucholskie Konigort, *Cb Qrp Tc*, 08.74: MŁ, LOD 20152; – CB 46 Gotelp, *Fs Qrp*, 07.74: MŁ, LOD 20330; – CB 54 Rytel, *Ps* cl., 07.73: MŁ, LOD 20429, – env. of Głuche Lake, *Bpp Ps*, 08.74: MŁ, LOD 20153. Pojezierze Chełmińsko-Dobrzyńskie – DB 83 Orle FI Ossa n. Rogoźno, *Cb TC*, 07.82: RO, LOD 20657; – DC 17 Res. Las nad Branicą n. Górzno, *Cb*, 07.82: RO, LOD 20673. Pradolina Toruńsko-Eberswaldzka – DC 73 Włocławek, *Fs*, 09.79: RO, LOD 20324; – DC 97 Res. Łąck, *Ps Qrp Cb*, 07.79: RO, LOD 20436; – DD 07 Zdworsk FI Łąck, *Ps Qrp*, 09.79: RO, LOD 20425. Pojezierze Wielkopolskie – DD 00 Res. Kawęczyńskie Brzęki n. Lubotyń, *Cb Ps*, 10.78: MŁ, LOD 20671; – DD 02 f.r. Rogoźno, *Ps Qrp*, 09.79: RO, LOD 20094, 20493 & 20672; – DD 04 Siemianów n. Lubień Kujawski, *Qru PaQ*, 09.79: RO, LOD 20433. Nizina Południowowielkopolska – CD 48 Pątnów, *Tc Po Aps*, 10.78: MŁ, LOD 20159; – CD 49 Małoszyna, *Qrp Ps PaQ*, 10.78: MŁ, LOD 20160; – CD 99 Jasionna n. Błaszki, *Qrp Cb Ps*, 08.79: KM, LOD 20116; – CD 79 Sokołów n.

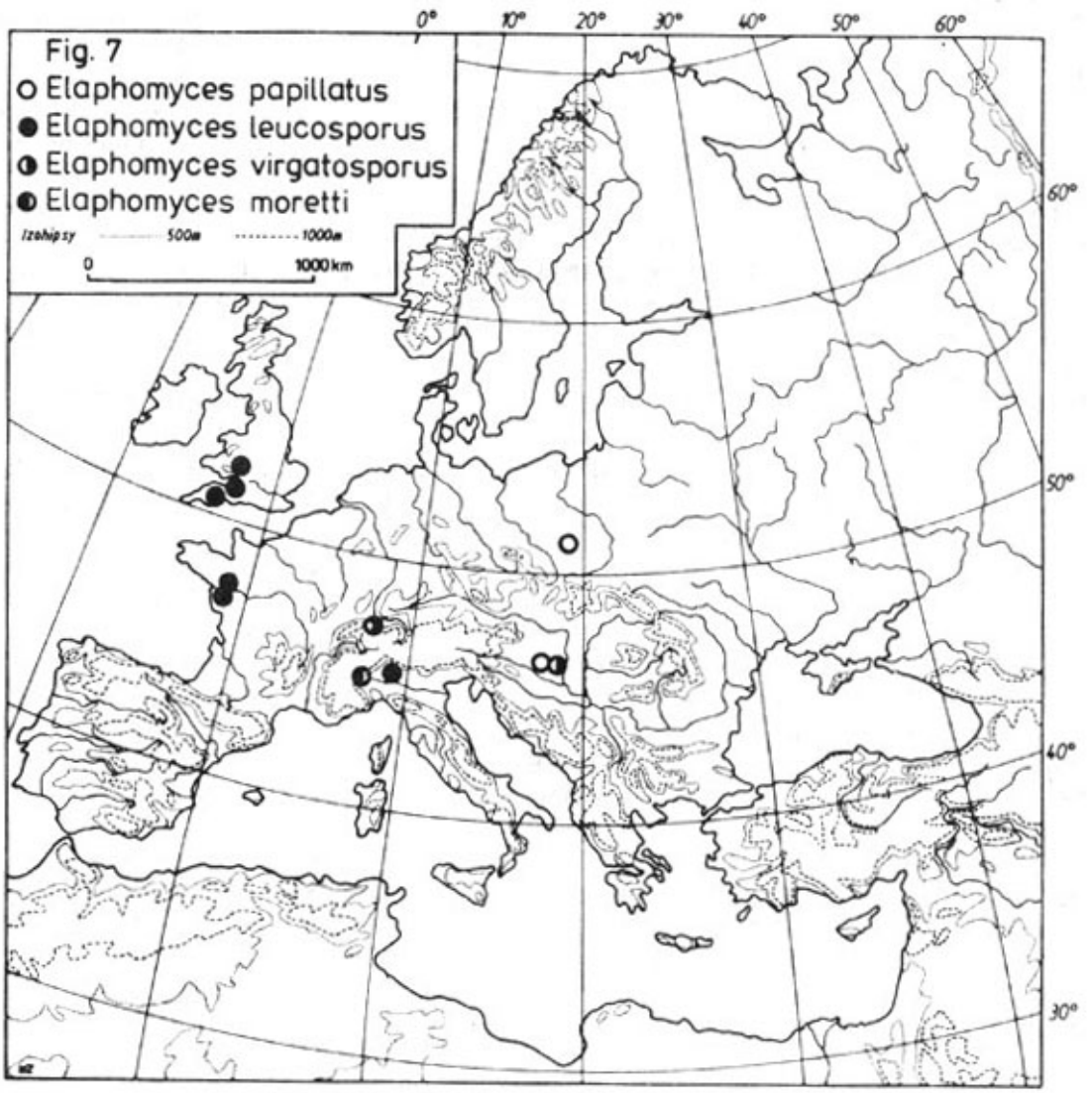
Koźminek, *Ul Pa Rp Qrp Fs*, 10.78: RO & MŁ, LOD 20634-35; – CE 09 Kliczków Forests (Lasy Kliczkowskie) n. Jarozłaj & Sundały, *Ps Qrp*, 08.79: KM, LOD 20006 & 20111; – CE 28 Res. Ryś n. Lututów, *Fs Aa Pa*, 07.79 & 09.80: MŁ & RO, LOD 20081, 20083, 20336 & 20516; – CE 36 Biadaszki n. Opatów, *Qrp Fs Ch*, 01.81: RO, LOD 20172, – Ustronie, *Qrp*, 09.80: MŁ, LOD 20518; – DD 12 f.r. Kobylatka FI Koło, 07.79: RO, LOD 20004, 20075 & 20085; – DD 14 Ostrowy n. Kutno, *Qrp Ch*, 06.79: MŁ, LOD 20090 & 20106; – DD 31 Dąbie, *Qrp Ch* 10.78: MŁ, LOD 20426; – f.r. Wielenin, *Qrp Ch*, 10.78: MŁ, LOD 20158 & 20670; – DD 52 env. of Poddębice, *Qrp*, 04.75: MŁ, LOD 20052; – DD 62 Zakrzew n. Poddębice, *Qrp Ps*, 05.80: KM, LOD 20438; – DD 65 f.r. Krogulec FI Grotniki, *Bpp Ps Qrp*, 07.74: J. Wesołowska, LOD 20028; – DD 75 Łódź Park Ludowy, *Qrp Bpp Ps Ch Pa*, 05.77, 10.78 & 06.82: MŁ, KM & MK, LOD 20042 & 20567-75; – DD 76 Łódź Park im. A. Mickiewicza, *Qrp Ps Bpp Aps*, 10.79: KM, LOD 20025; – DD 81 Rossoszyca, *Ps*, 04.75: MŁ, LOD 20119 & 20347; – DD 82 f.r. Wojsławice n. Szadek, *Qrp Ps Aa Ch Pa*, 10.79, 07 & 10.81: MK, KM, MŁ & RO, LOD 20011-12, 20023, 20096, 20114, 20150-51 & 20636-38; – DE 10 Res. Nowa Wieś, *Fs*, 10.80: MŁ, LOD 20519; – DE 34 f.r. Wola Wydrzyna n. Szczerców, *Ch Qrp Bpp Aa Ps*, 06.78, 09 & 10.79, 08.80: KM, MŁ & RO, LOD 20026, 20084, 20100, 20105, 20166 & 20642; – DE 36 f.r. Pytowice FI Kamieńsk, *Qrp*, 08.78: MŁ, LOD 20087. Obniżenie Milicko-Głogowskie – BE 09 Niezgoda n. Żmigród, *Qrp*, 06.82: E. Wiącek, LOD 20666. Nizina Środkowomazowiecka – DD 46 f.r. Bielawy – Mroga, *Qrp*, 10.58: W. Rudnicka-Jezierska, WA 012650; – ED 22 Teresin n. Szymanów, *Cb Qrp*, 07.81: RO, LOD 20514; – ED 34 Podkowa Leśna, *Qrp*, 10.70: MŁ, LOD 20059; – ED 41 Puszcza Bolimowska f.r. Bolimów, *Qrp Ps*, 05.82: MK & KM, LOD 20578 & 20588; – ED 47 Chojnów, *Qrp Ps*, 10.58: A. Wosińska, WA 008845; – ED 49 f.r. Całowanie, *Ag*, 07.63: K. Nowak, WA 016022; – ED 52 Puszcza Mariańska, *Cb Ps*, 06.82: MK, KM & E. Wiącek, LOD 20579-87, 20590-91, 20595-96 & 21118; – ED 52 Res. Modrzewina n. Mała Wieś, *Cb*, 06.79: MŁ & KM, LOD 20015; – EE 09 Res. Zagożdżon n. Kozienice, *Qrp*, 10.72: BS, LUB. Wzniesienia Południowomazowieckie – DD 59 Res. Bukowiec n. Bobrowa, *Fs Qrp*, 05.74: RO, LOD 20060; – DD 66 Łódź Las Łagiewniki, *Ps Qrp Fs Pa*, 03-10.74 & 07.77: KM, M. Paziuk & Z. Ławnicka, LOD 20027, 20029-30, 20032-40, 20062, 20072, 20108 & 20576-77, – Łódź Rogi, *Qrp Pa Cb*, 12.78: RO, LOD 20513; – DD 67 f.r. Janinów n. Brzeziny, *Fs Qrp*, 04-11.74, 03.75 & 10.78: MŁ, RO & E. Najmanowicz, LOD 20049, 20069, 20089, 20102, 20157, 20325, 20339, 20345 & 20630-31; – DD 69 Rogów, *Qrp Aa*, 11.74: MŁ, LOD 20068, – Res. Zimna Woda n. Rogów, *Qrp Ps Ch*, 05.74: RO, LOD 20328; – DD 77 f.r. Wiączyń n. Nowosolna, *Fs Pa Aa Ps Ch*, 07.74, 05-11.75 & 11.79: KM, MŁ, RO & Z. Ławnicka, LOD 20103, 20123, 20127, 20137-39, 20141-48, 20343 & 20624-28; – DD 87 Res. Gałków, *Cb Qrp Fs*, 10.81: MK, LOD 20629, – Justynów n. Łódź, *Qrp Ps Bpp Cb*, 08.80: A. Ławrynowicz, LOD 20173, – Janówka n. Justynów, *Fs Qrp*, 08.82: L. Samosiej, LOD 20632; – DD 89 Węgrzynowice n. Brzeziny, *Qrp*, 09.72: MŁ, LOD 20047; – DD 96 Res. Molenda, *Qrp Pa*, 08.74: MŁ, LOD 20013, 20121 & 20619; – DD 99 f.r. Kruszewiec, *Cb*, 05.74: MŁ, LOD 20044, 20058 & 20136; – DE 19 Lubiaszów – Markowice Mokre, *Ch PaQ*, 08.72: RO, LOD 20348, – f.r. Lubiaszów, *Ps Qrp TC*, 05.80: RO & G. Drzeń, LOD 20041 & 20515; – DE 28 f.r. Kaleń n. Łęczno, *Qrp*, 10.72: MŁ, LOD 20048, 20163, 20335 & 20434; – DE 38 f.r. Lubień, *Ps*, 09.72: MŁ, LOD 20430; – ED 54 Skuły Wschód, *Cb Ag*, 09.81: RO, LOD 20510 & 20597; – ED 62 Res. Babsk, *Cb Qrp*, 07 & 08.79, 04-09.80: KM, LOD 20005, 20016-17, 20022, 20078-79, 20109-10, 20112, 20517 & 20598-607; – ED 74 Res. Trębaczew, *Qrp Cb Ldp Ps PaQ*, 08.68, 04-08.69, 08 & 11.70, 04.72 & 06.79: MŁ & KM, LOD 20009, 20019, 20044, 20056, 20120, 20122, 20124-26, 20128-29, 20131-32, 20435 & 20608-13; – ED 81 Wielka Wola FI Spała, *Qrp Bpp Ps*, 08.81: RO, LOD 20620 & 20622; – ED 91 Res. Spała, *Qrp Fs Ps Bpp Pt*, 10.68, 08 & 11-12.69, 04.76: MŁ & RO, LOD 20053, 20133-35 & 20338, – f.r. Spała *Cb Bpp Qrp Ps*, 11.73, 05.77 & 10.81: MŁ, RO, MK & J. Guzewski, LOD

20055 & 20614-16, – Res. Konewka n. Spała, *Qrp Ps*, 05.74 & 08.82: MŁ & RO, LOD 20130, 20337 & 20617-18; – EE 00 Borki n. Spała, *Cb Ps*, 11.73 & 06.74: MŁ, LOD 20046 & 20115. Przedgórze Sudeckie – BE 98 Res. Muszkowicki Las Bukowy, *Fs*, 06.82: RO, LOD 20922-23. Sudety Zachodnie – BE 61 Sokole Mtns n. Trzcińsko, ca 500 m alt., *Pa*, 06.62: WW, KRAM 15816. Sudety Środkowe – BE 73 Szczawno Zdrój, *Cb Qrp Fs*, 04.82: KM, LOD 20658-59; – BE 95 Sowie Mtns, 08.24: M; – BE 96 Bielawa, *Qrp Tc Aps*, 08.81: KM, LOD 20334. Wyżyna Woźnicko-Wieluńska – DE 40 Mierzyce, *Ps Qrp Pa*, 06.79, 05 & 07-08.82: RO & MK, LOD 20003, 20437 & 20639-41; – DE 50 Res. Stawiska n. Parzymiechy, *Qrp*, 07.72: J. Hereźniak, LOD 20050, – Res. Bukowa Góra, *Fs*, 04.74: MŁ, LOD 20331; – f.r. Niżankowice, *Ps Qrp*, 09.79: MŁ & KM, LOD 20024. Wyżyna Krakowsko-Częstochowska – DE 74 Jaskrów, *Qrp Fs Bpp*, 10.79: MŁ, LOD 20095; – DE 84 Mirów – Hektary, *Qrp Pt Fs*, 08.81: RO, LOD 20326, – Res. Zielona Góra, *Fs Ps*, 08.81: MŁ, LOD 20333; – DE 94 Res. Sokole Góry n. Olsztyn, *Fs*, 06.78: MŁ, LOD 20088; – DE 95 Potok Złoty, *Fs*, 09.82: MŁ, MK, W. Maliński, LOD 20643-46; – DE 06 Kroczyce Rocks (Skałki Kroczyckie), *Fs*, 09.82: MŁ, MK & KM, LOD 20647-48; – DF 08 Ołudza Fl Szczekociny, *Qrp Ps*, 09.82: MŁ, MK & KM, LOD 20652. Wyżyna Przedborska – DE 19 Res. Gaik, *Qrp*, 04.78: MŁ & RO: LOD 20086 & 20171; – DE 39 Diabla Góra n. Opoczno, *Qrp Ps*, 10.73: MŁ & RO, LOD 20065, 20170 & 20623; – DE 48 Res. Bąkowa Góra, *Qrp Fs*, 10.79: RO & MŁ, LOD 20098 & 20426; – DE 56 Res. Jasień, *Ps Pa Bpp*, 06.75 & 05.83: MŁ, LOD 20107; – DE 57 Kajetanów Fl Kobiele Wielkie, *Qrp Ps Bpp Aa*, 09.78: RO, LOD 20007 & 20432; – DE 58 Res. Góra Chełmo, *Qrp Cb Ps*, 08.78: MŁ, LOD 20010, 20020, 20156 & 20341; – DE 59 Res. Bukowa Góra, *Fs*, 10.73: MŁ, LOD 20118, – Stara Wieś, *Qrp Ps*, 11.73: MŁ, LOD 20057; – DE 68 Res. Dębowiec, *Qrp Cb Bpp*, 06.79: MŁ & KM, LOD 20001 & 20018; – DE 75 Skrzydlów, *Qrp Bpp Qru*, 06.79: MŁ, LOD 20014 & 20092; – DE 76 Antoniów Fl Dąbrowa Zielona, *Qrp*, 08.78: MŁ & RO, LOD 20511; – DE 86 f.r. Wielki Las n. Święta Anna, *Cb Fs Bpp*, 05.73 & 10.79: MŁ & RO, LOD 20008 & 20329, – f.r. Knieja, *Ag*, 10.79: MŁ, LOD 20077; – DE 87 Res. Borek, *Qrp*, 04.75: MŁ, LOD 20066 & 20091; – DE 97 f.r. Wygiełzów n. Lelów, *Fs*, 09.82: MŁ, LOD 20653, – Zagórze n. Sokolniki, *Fs*, 09.82: RO, LOD 20654; – DF 08 f.r. Gąszcze Fl Szczekociny, *Cb Pt Bpp Qrp*, 09.82: KM, MŁ & Z. Wnuk, LOD 20649-51; – EE 00 Sługocice Fl Smardzewice, *Cb Qrp Aa Ps*, 05.74: MŁ & RO, LOD 20064, 20117, 20327, 20340, 20346 & 20633; – EE 11 Prymusowa Wola, *Qrp Ps Pa*, 08.73: MŁ, LOD 20104 & 20621, – Januszewice, *PaQ*, 08.74: RO, LOD 20113; – EE 41 Lipa n. Cieklińsko, *Fs Aa*, 04.74: MŁ, LOD 20169; – EE 60 Res. Zabrody n. Olesno, *Pa*, 11.73: MŁ, LOD 20063. Wyżyna Kielecko-Sandomierska – EE 24 Przysucha, *Qrp Fs*, 05.74: RO, LOD 20161-62; – EE 45 Res. Skarżysko, *Fs Fe Ag*, 06.79: MŁ, LOD 20342; – EE 48 Zębiec n. Iłża, *Ps Qrp Cb*, 06.79 MŁ & KM, LOD 20071; – EE 55 Res. Świnia Góra, *Aa Qrp*, 06.79: MŁ, LOD 20045 & 20431; – EE 78 Res. Góra Chełmowa, 04.10: M. Raciborski, KRAM 885, – *Fs*, 07.75: MŁ, LOD 20140; – EE 97 Raków – Jamno, *Qrp*, 07.77: MŁ, LOD 20073, – Raków – Hańcza, *Qrp Ps Pa*, 07.77: MŁ, LOD 20074, 20323 & 20663; – EF 08 env. of Staszów, *Qrp Ps*, 06.77: MŁ, LOD 20165. Wyżyna Lubelska – FE 37 Zemborzyce n. Lublin, *Qrp Cb*, 08.67: BS, LBL; – FE 63 Stary Rachów, *Qrp*, 09 & 10.65: BS, LBL, – Grabówka n. Annopol, *Qrp*, 10.65: BS, LBL. Roztocze – GE 91 Res. Bukowa Góra n. Zwierzyniec, *Fs Ag*, 10.66, 08.67 & 08.68: BS, LBL. Pogórze Zachodniobeskidzkie – EF 81 Czasław n. Dobczyce, *Ps Bpp*, 09.10 & 04.11: K. Rouppert, KRAM 884 & 12882. Beskidy Zachodnie – EG 37 Tylicz – Krynica, *Aa*, 10.62: BG, KRA. Tatry – DG 49 Mt. Gubałówka, *Pa*, 08.80: AS, LOD 20665; – DG 59 Dale of Biały (Dolina Białego), *Pa Aa Fs*, 10.79: MŁ, LOD 20021. Bieszczady Zachodnie – FG 68 Wetlina, *Fs*, 09.58: BG, KRA; – FG 69 Caryńska Mt. Pasture (Połonina C.), *Fs*, 05.76: MŁ, LOD 20660; – CG 60 Szeroki Peak (S. Wierch), *Fs Pa*, 08.76: MŁ, LOD 20661-62. Pojezierze Litewskie – FA 99 Rybalnia, *Qrp Pa Bpp*, 08.79: RO, LOD 20080 & 20154; –

GB 22 env. of Rygol, *Ps Bpp*, 08.79: RO, LOD 20002; – GB 30 Czarny Bród Fl Płaska, *Ps Bpp*, 06.72: MŁ, LOD 20067; – GB 31 Res. Starożyn, *Cb Qrp TC*, 08.79: RO, LOD 20076. Nizina Północnopodlaska – GC 55 BiNP, *Cb Tc*, 05 & 10.81: KM & MŁ, LOD 20512 & 20667-69. Polesie Wołyńskie – GE 13 Res. Bachus n. Chełm, *PaQ*, 08.72: BS, LBL.

5.4. *Elaphomyces papillatus* Vitt.

Distribution in Europe (Fig. 7). On the basis of herbarium material, only two localities are definitely confirmed: one in Poland and the other in Hungary (Libickozma Komitat Somogy). Further localities have been quoted by Szemere (1965). In the Paris herbarium (PC), there are two samples without indicated localities, but annotated "Ex Musteri Vittadini celebrissimis Tul. dedit". Probably they originated from N Italy since the region is

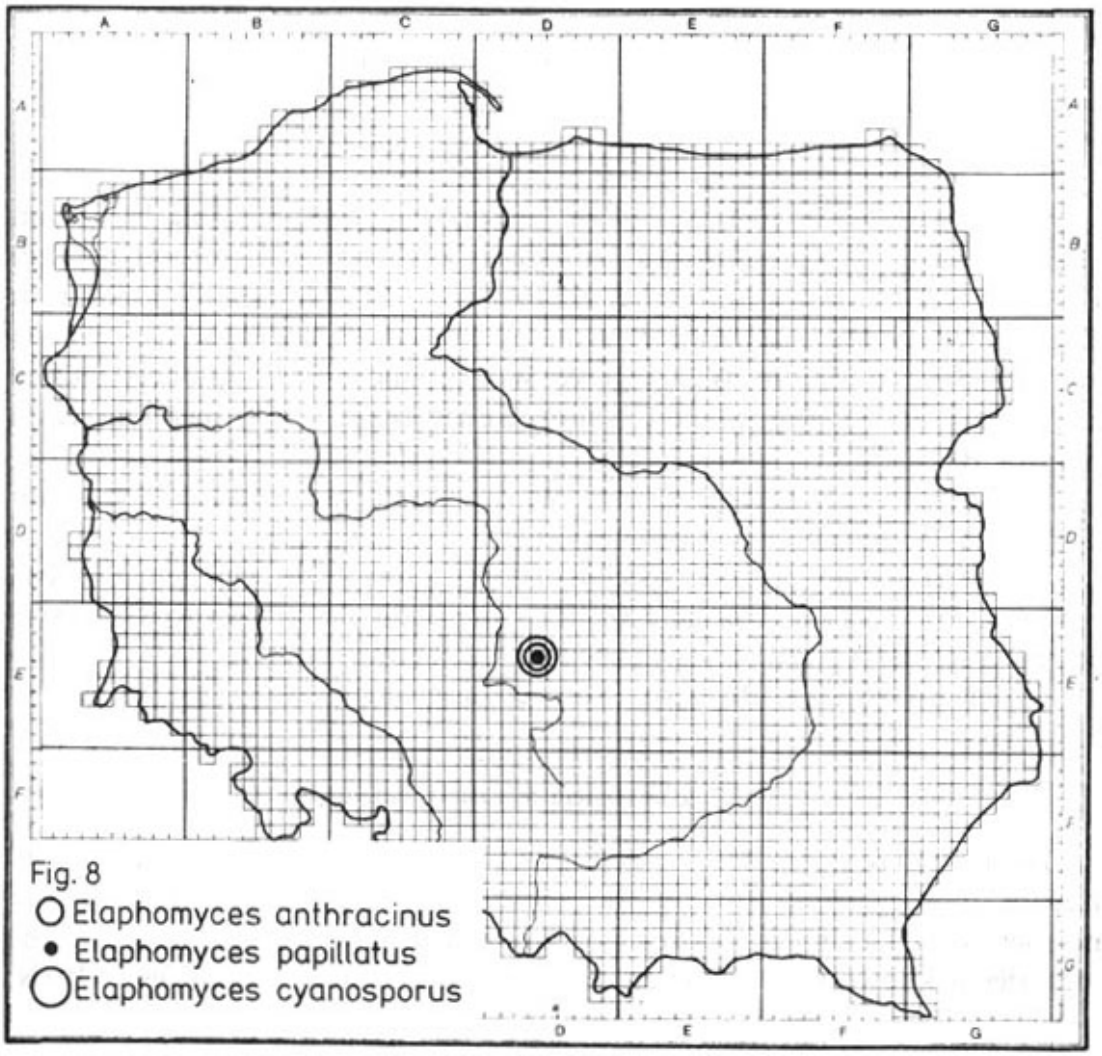


quoted in Vittadini (1831), whilst in Tulasne & Tulasne (1851) one read: "Vidimus siccum e Lombardia benevole ab ill. Vittadinio nobisc. comm." According to this work the species occurs in oak and chestnut forests nearby Milan and Ticino. Hesse (1894) cites it from Kirchditmol (n. Kassel, prov. Hessen-Nassau). The Polish locality is the most northerly in Europe.

Hypothetical distribution. Probably quite widely distributed in the mild climatic zone of C and S Europe, but rare everywhere.

Habitat. In deciduous forests, under *Quercus robur*, *Q. cerris*, *Castanea sativa*, *Betula pendula*, *Carpinus betulus*, and *Fagus sylvatica*, in soil with a light litter cover. Until now, found only in localities containing other hypogeous species, possibly implying the need for optimal hypogeous conditions. Fruitbodies few in number when found.

Distribution in Poland. (Fig. 8). Appearing in the richest habitat,



with respect to other hypogeous fungi: together with 11 other species of hypogeous *Ascomycetes*.

Localities in Poland. Nizina Południowowielkopolska – DE 34 f.r. Wola Wydrzyna n. Szczerców, *Bpp Cb Qrp*, 09.79: RO, LOD 21107.

5.5. *Elaphomyces atropurpureus* Vitt.

Distribution in Europe. The species not yet carted because of the lack of data on its localities in the herbarium materials. In the Paris herbarium (PC) there are some specimens from the Tulasne collection but without data. Probably the specimens came from Italy since in Tulasne & Tulasne (1851), p. 102, one read: "In nemoribus prope Roncaro agri Mediolanensis ed Torre d'Isola Ticinensis", and then: "Vidimus specim. exsiccata". Ceruti (1960), citing Quélet, reports this species also from the French Jura.

Habitat. Oak and chestnut forests; also pine forests on the lime subsoil.

Distribution in Poland. Not yet discovered.

5.6. *Elaphomyces leucosporus* Vitt.

Distribution in Europe (Fig. 7). Following the accessible herbarium documentation the appearance stated only in environs of Milan (Italy) and in France along the lower Loire river. Hawker (1954) quotes the species from England citing the original collection of Broome (Chudleigh, Devonshire) and her own collection: Westridge & Wotton-under-Edge (Gloucestershire) and Cleeve & Wraxall (Somersetshire); Schwärzel (1958) mentions environs of Basle (Switzerland).

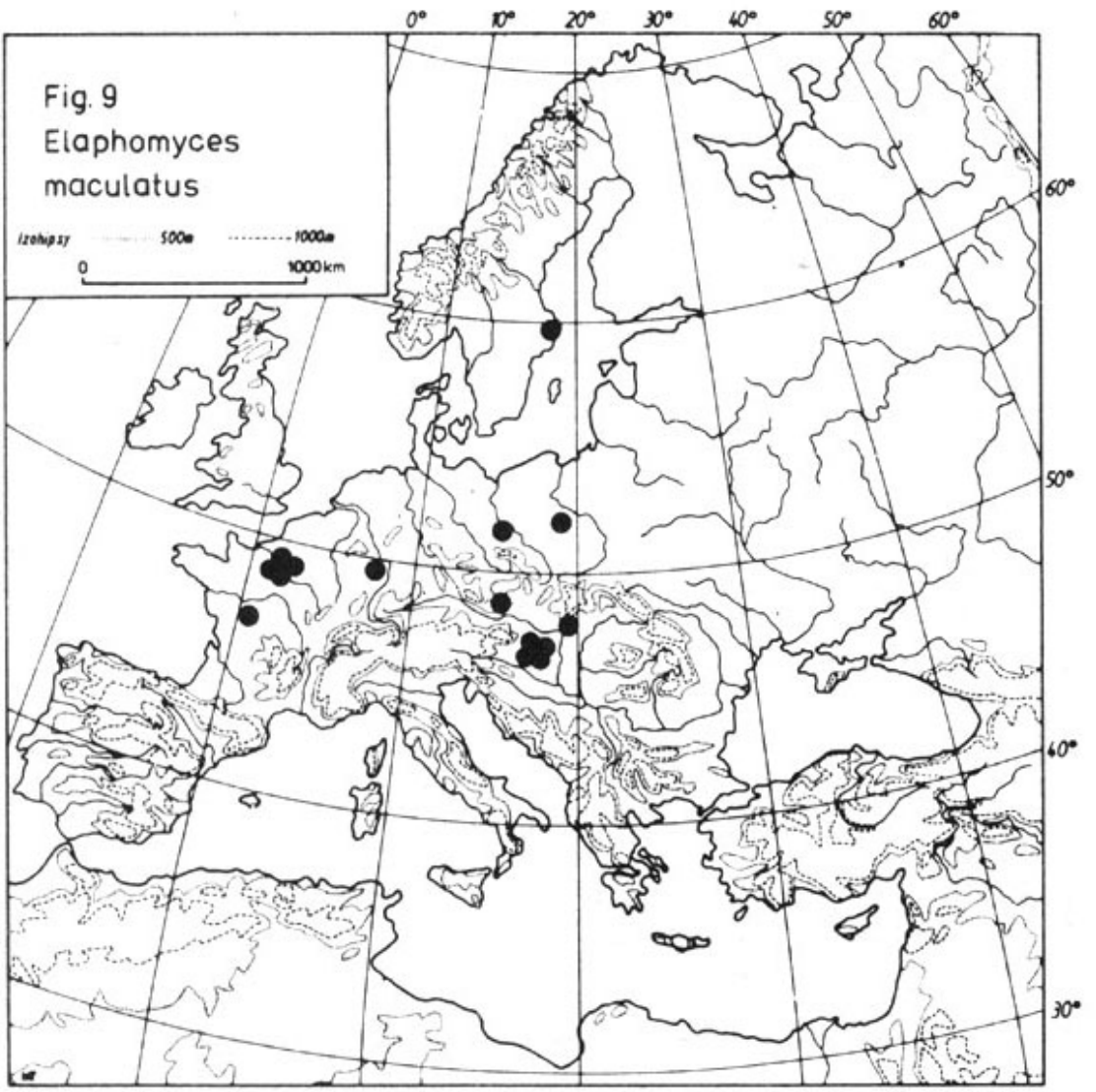
Hypothetical distribution. Warmer and wet zone of temperate climate in W Europe and northern Italy.

Habitat. Under various species of forest trees: *Castanea sativa*, *Fagus sylvatica*, *Fraxinus excelsior*, and *Quercus*; originally described species collected under *Q. ilex*. Fruitbodies formed in the humus layer.

Distribution in Poland. Not yet discovered.

5.7. *Elaphomyces maculatus* Vitt.

Distribution in Europe (Fig. 9). Appearing not too often in C Europe, not crossing Alps in the south. Very rare in Scandinavia; the northernmost locality in environs of Uppsala (Sweden). A larger density of localities is known in the Balaton region (Hungary) and in environs of Paris.

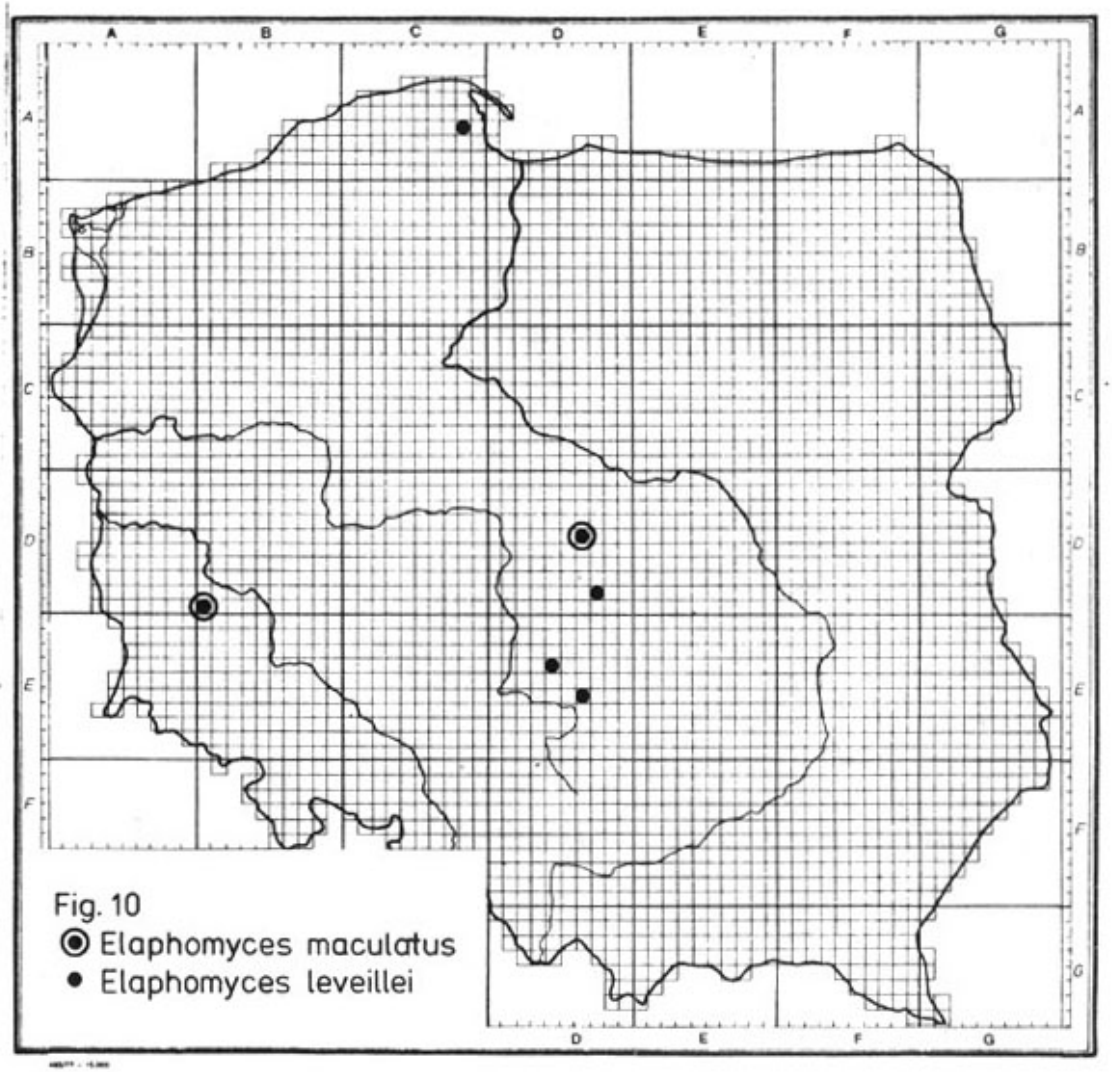


The locality in Poland is one of the three easternmost localities. A typical lowland species, no locality exceeds 500 m alt.

Hypothetical distribution. The lowland part of C, W & SE Europe and S Scandinavia, in the deciduous forest zone.

Habitat. Under *Quercus*, *Fagus sylvatica*, *Carpinus betulus*, *Alnus glutinosa* and *Corylus avellana*, usually quite deep under the soil surface, in humus of the mull-type.

Distribution in Poland (Fig. 10). Niziny Sasko-Łużyckie – BD 90 Piotrowice n. Przemków, 07.1988: Herb. Schroet. WRSL (sub nom. *E. anthracinus*). Nizina Środkowomazowiecka – DD 46 f.r. Bielawy – Mroga n. Głowno, *Cb Qrp*, 10.78: MŁ, LOD 21106.

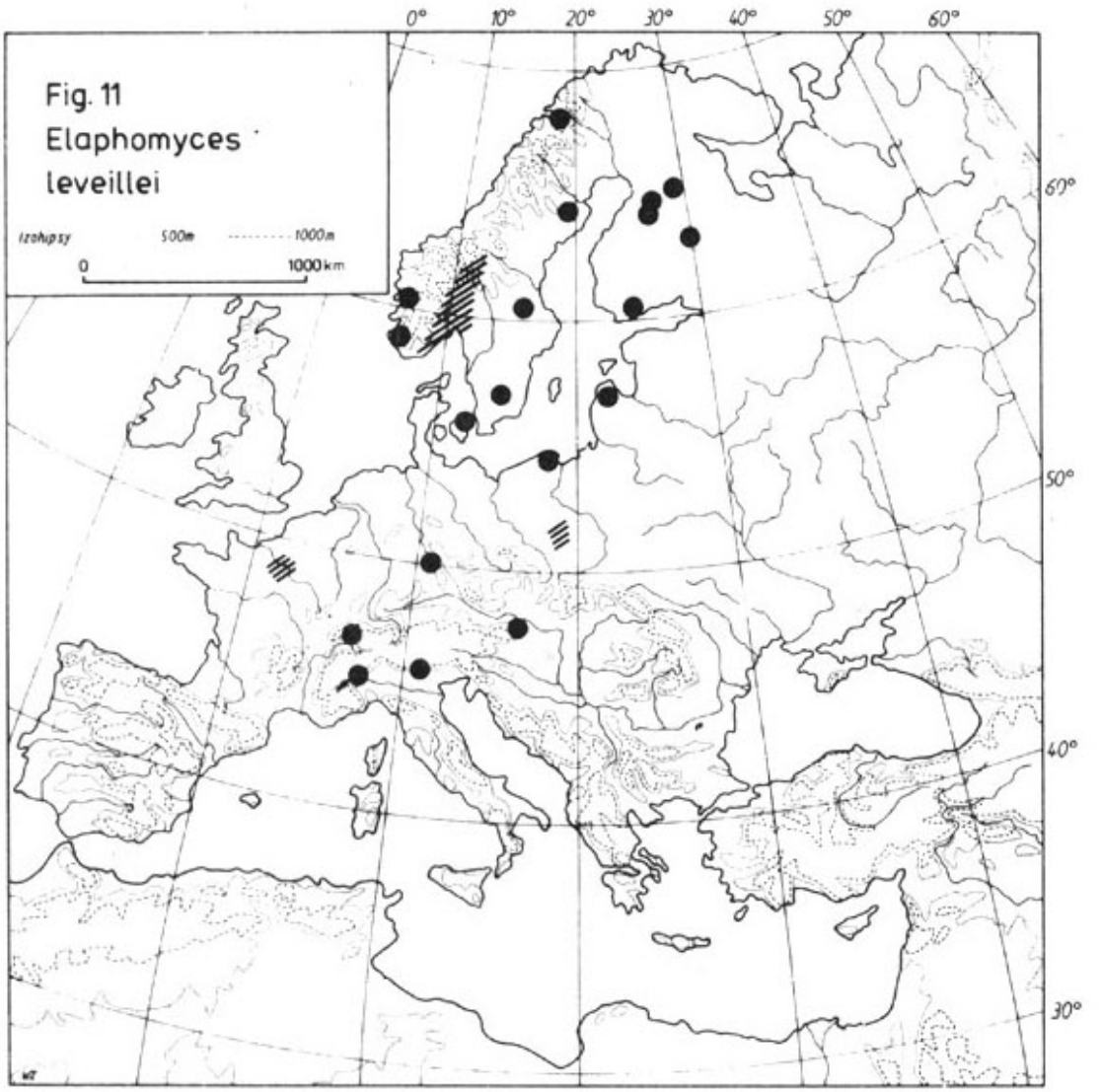


5.8. *Elaphomyces leveillei* Tul.

Distribution in Europe (Fig. 11). Often in N Europe, rare and scattered in C & W Europe. Appearing in lowlands and low mountain sites. In the north it considerably exceeds the arctic circle; collected nearby Narvik (Norway) and Gällivare (Sweden). When in continental climate, the range is more restricted to the south. The southernmost localities occur in northern Italy and S slopes of the Alps.

Hypothetical distribution. Entire Europe excluding the S and SE parts, mainly in the boreal zone of deciduous forests.

Habitat. Under *Fagus sylvatica*, *Picea abies*, *Abies alba*, and *Pinus sylvestris*, in acidic, penetrable soils, often in mixed woods including *Quercus*, *Betula*, and *Castanea sativa*. Fruitbodies formed not deep under mossy and lichen-grown soil surfaces. The habitats of the specimens collected by the

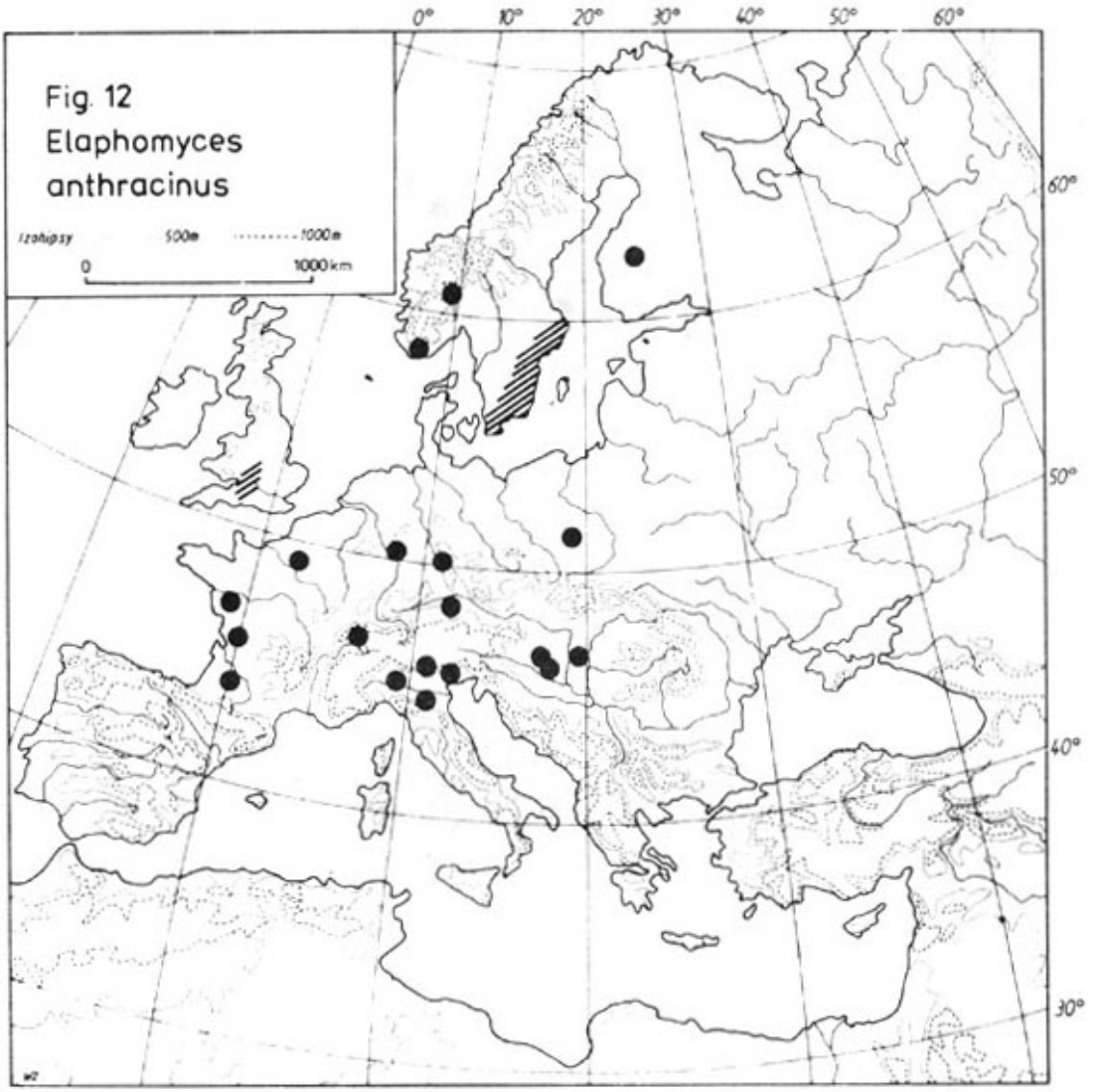


author in Poland and at Gällivare in the far north were quite similar: the undergrowth included the species of *Ericaceae*: *Calluna vulgaris*, *Vaccinium myrtillus* and *V. vitis-idaea*; in Sweden also *Erica* sp. and *Linnea borealis*.

Distribution in Poland (Fig. 10). Pojezierze Wschodniopomorskie – CA 68 Puszcza Darżlubska n. Reda, *Fs*, 09.69: MŁ, LOD 21105. Nizina Południowowielkopolska – DE 34 f.r. Wola Wydrzyna n. Szczerców, *Bpp Qrp Ps*, 10.79: KM, LOD 21102. Wzniesienia Południowomazowieckie – DD 87 Justynów n. Łódź, *Aa Pa*, 10.79: MŁ, LOD 21101. Wyżyna Przedborska – DE 56 Res. Jasień, *Ps Pa Bpp*, 05 & 07.75: MŁ, LOD 21103-04.

5.9. *Elaphomyces anthracinus* Vitt.

Distribution in Europe (Fig. 12). Not too often in C & W Europe, Scandinavia and S from the Alps and Carpathians. Occurring in lowlands



and low tectonic forelands. A considerable density of localities in southern Sweden; in the north not exceeding the arctic circle: the extreme stand at Konnovesi (Finland).

Hypothetical distribution. Entire Europe except for the Mediterranean & cold zones and high mountains.

Habitat. Mycorrhiza formed with several deciduous tree species: *Quercus*, *Castanea sativa*, *Corylus avellana*, *Fagus sylvatica*, and coniferous tree species: *Abies* and *Pinus*. Fruitbodies formed in the humus layer. In Poland gathered under *Carpinus betulus* in a site poor in herbaceous plants.

Distribution in Poland (Fig. 8). Nizina Południowowielkopolska DE 34 f.r. Wola Wydrzyna n. Szczerców, *Cb TC*, 08.80: RO, LOD 21116.

5.10. *Elaphomyces septatus* Vitt.

Distribution in Europe. Not recorded in available herbarium material. Originally described from Italy in Vittadini (1831), p. 68: "In quercetis mediolanensibus secus flumen Lambro". Also reported from Hungary (Szemere 1965) and Denmark (Lange 1956). Hesse (1894) states its absence in Germany.

Habitat. Gathered under oaks, beeches, and hornbeams.

5.11. *Elaphomyces virgatosporus* Holl.

Distribution in Europe (Fig. 7). On the basis of herbarium material, the occurrence ascertained at Szekszard (Komitat Tolna, Hungary), from where the species had been described by Hollós (1908). It was there collected also in environs of Basle (Switzerland) by Knapp in 1921 (M).

Hypothetical distribution. Europe, temperate climate zone of deciduous forests.

Habitat. Fruitbodies gathered under *Fagus sylvatica* and *Carpinus betulus*.

Distribution in Poland. Not yet discovered.

5.12. *Elaphomyces morettii* Vitt.

Distribution in Europe (Fig. 7). Only one locality nearby Turin (northern Italy) is recorded in available herbarium metarial. In the original description of the species by Vittadini (1831), p. 71, one read: "In sylva quercina mediolanensi secus flumen Lambro".

Hypothetical distribution. Southern Europe.

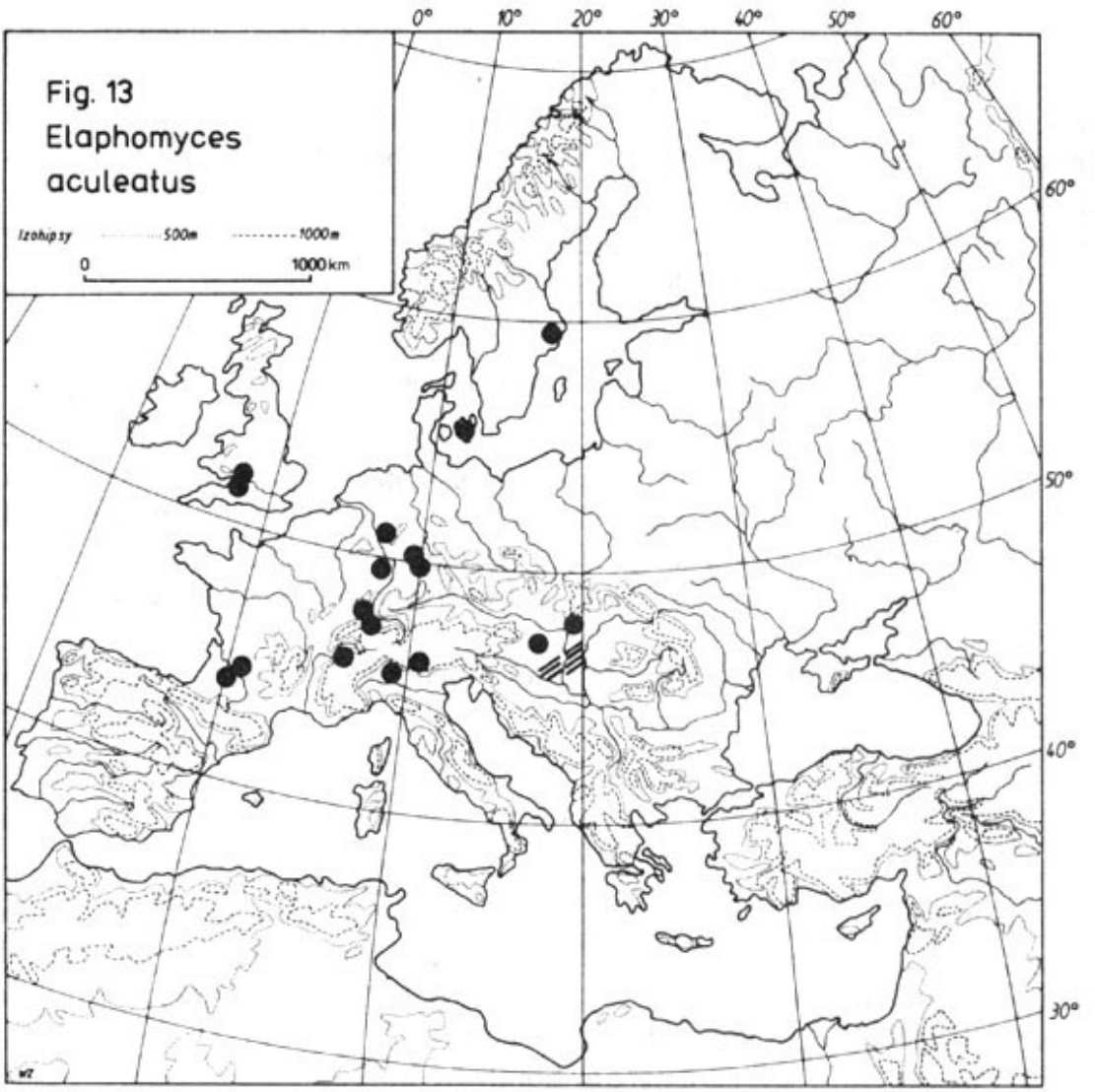
Habitat. Oak and chestnut forests.

Distribution in Poland. Not discovered.

5.13. *Elaphomyces aculeatus* Vitt.

Distribution in Europe (Fig. 13). Widely distributed. The material from Denmark, FRG, France, Hungary, and Italy has been analysed. Also recorded by Hawker (1954) from England. The most northerly finding was in the vicinity of Stockholm by Kers (1979), the most southerly ones nearby Milan and in the Adige valley in the Alps. Numerous localities are in the southern part of Hungary.

Hypothetical distribution. Not too often, but probably in a wider range than indicated by the currently known localities. Associated with the deciduous forest zone. Throughout Europe, within the temperate climate



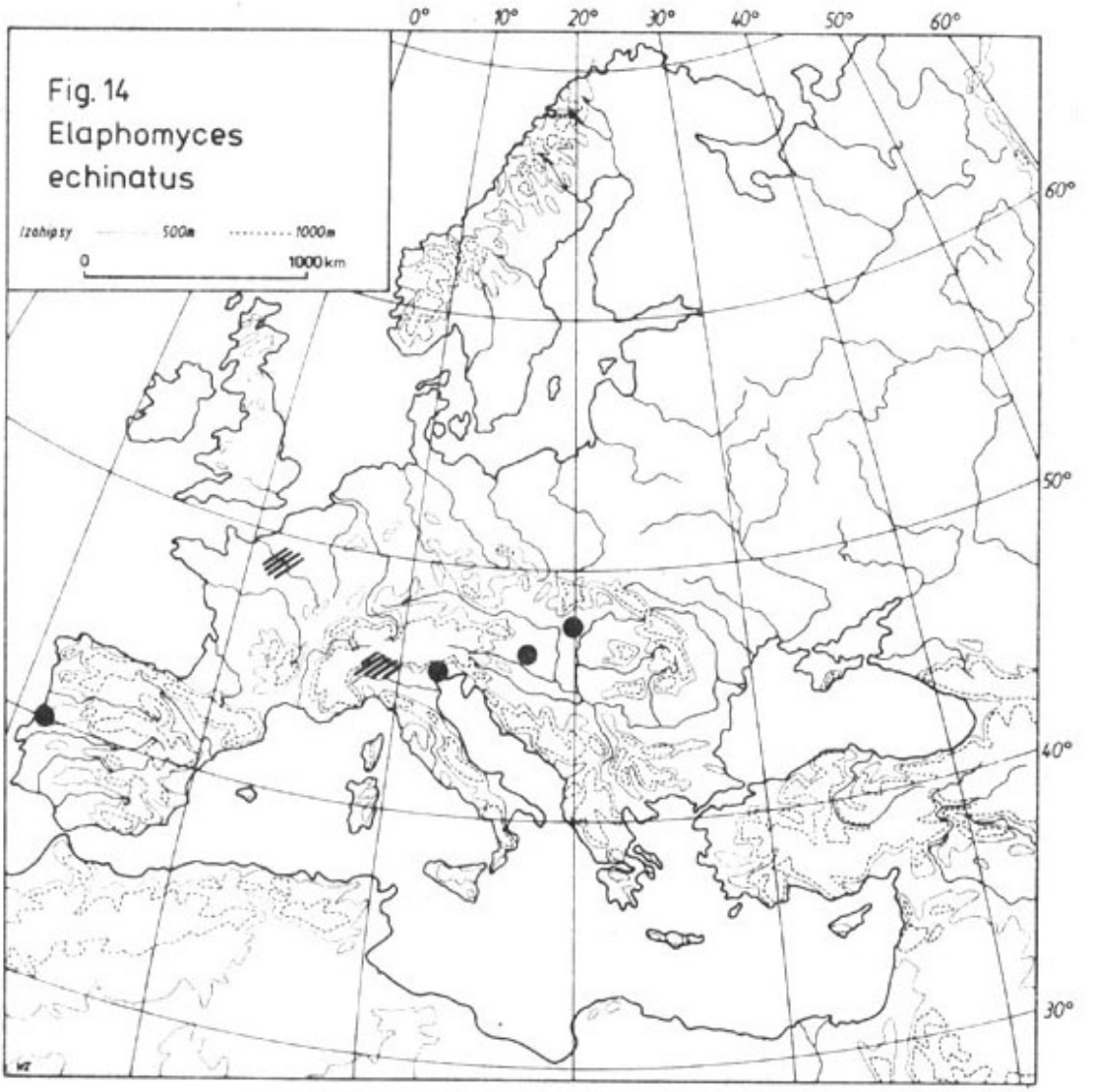
range, especially in its warmer zone, as well as within the zones of maritime and submaritime climate.

Habitat. Under *Quercus*, *Fagus*, *Fraxinus*, and *Corylus*, often in the lime subsoil. Fruitbodies formed ca 10 cm under the soil surface, between branched tree rootlets.

Distribution in Poland. Not yet discovered, but the occurrence quite possible.

5.14. *Elaphomyces echinatus* Vitt.

Distribution in Europe (Fig. 14). Rare. The examined herbarium material provide some localities in northern Italy and in environs of Paris as



well as single stands in the Iberian Peninsula and south from the Carpathian Mtns.

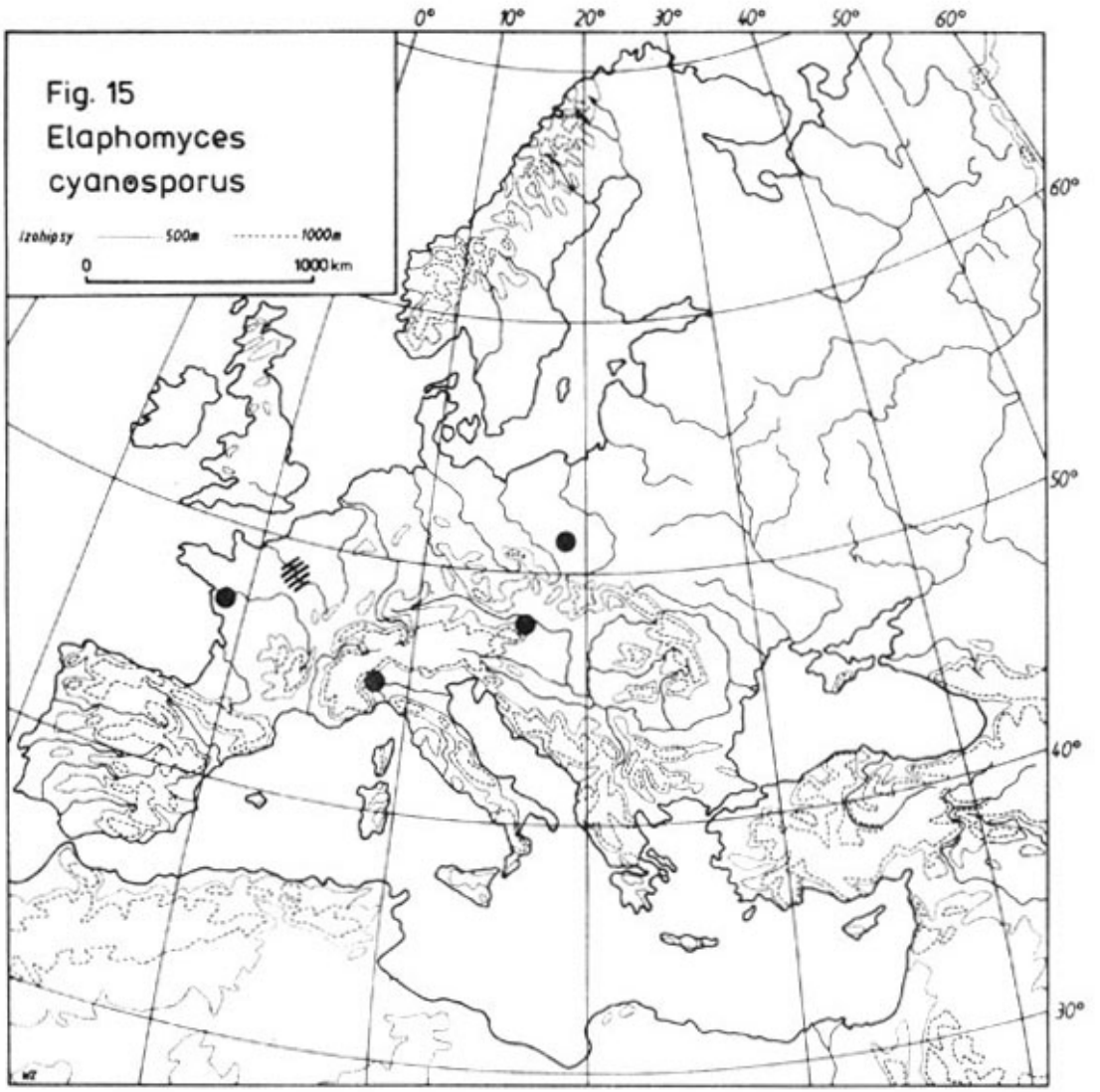
Hypothetical distribution. Wooded hills of S and W Europe in the warmer zone of temperate and submediterranean climate.

Habitat. Under different species of deciduous trees.

Distribution in Poland. Not yet discovered.

5.15. *Elaphomyces cyanosporus* Tul.

Distribution in Europe (Fig. 15). Small, scattered localities: in the vicinity of Paris, along the lower Loire river, in northern Italy, in environs of Vienna, and in Central Poland.



Hypothetical distribution. Lowlands of C and W Europe; temperate, maritime and submaritime climate zones of deciduous forests.

Habitat. Under *Quercus*, *Castanea*, and *Carpinus betulus* in recent fertile humus, in strongly shaded sites with little plant cover and small moss turfs.

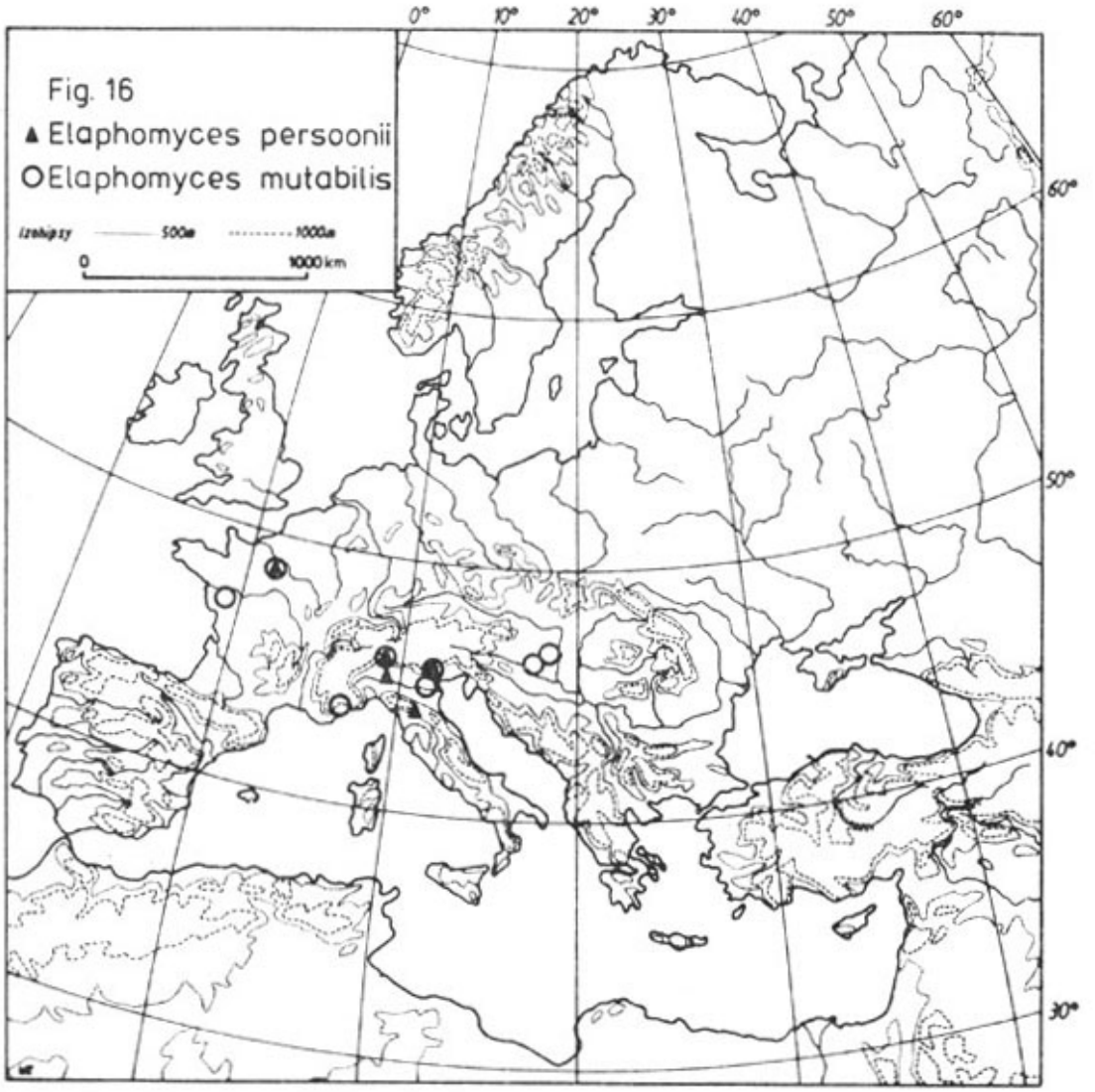
Distribution in Poland (Fig. 8). Nizina Południowowielkopolska – DE 34 f.r. Wola Wydrzyna n. Szczerców, *Cb TC*, 08.80: RO, LOD 21117.

5.16. *Elaphomyces foetidus* Vitt.

The herbarium material very scant, without indicating localities. Ceruti (1960) reports the species from oak forests in Italy.

5.17. *Elaphomyces persoonii* Vitt.

Distribution in Europe (Fig. 16). Rare; few localities known south from the Alps, in Appenines, and nearby Paris. In Tulasne & Tulasne (1851) one read that the species had been reported by Fries from Scania, but this is least probable and not confirmed.



Hypothetical distribution. S and W Europe in the warm zone of temperate and submediterranean climate, in lowlands and low mountain sites.

Habitat. Oak forests, in soils rich in humus.

Distribution in Poland. Not occurring.

5.18. *Elaphomyces mutabilis* Vitt.

Distribution in Europe (Fig. 16). On the basis of herbarium material, some localities ascertained in France, Hungary, and northern Italy. Appearing rarely. The data from Germany (Hesse 1894) require to be confirmed by herbarium material.

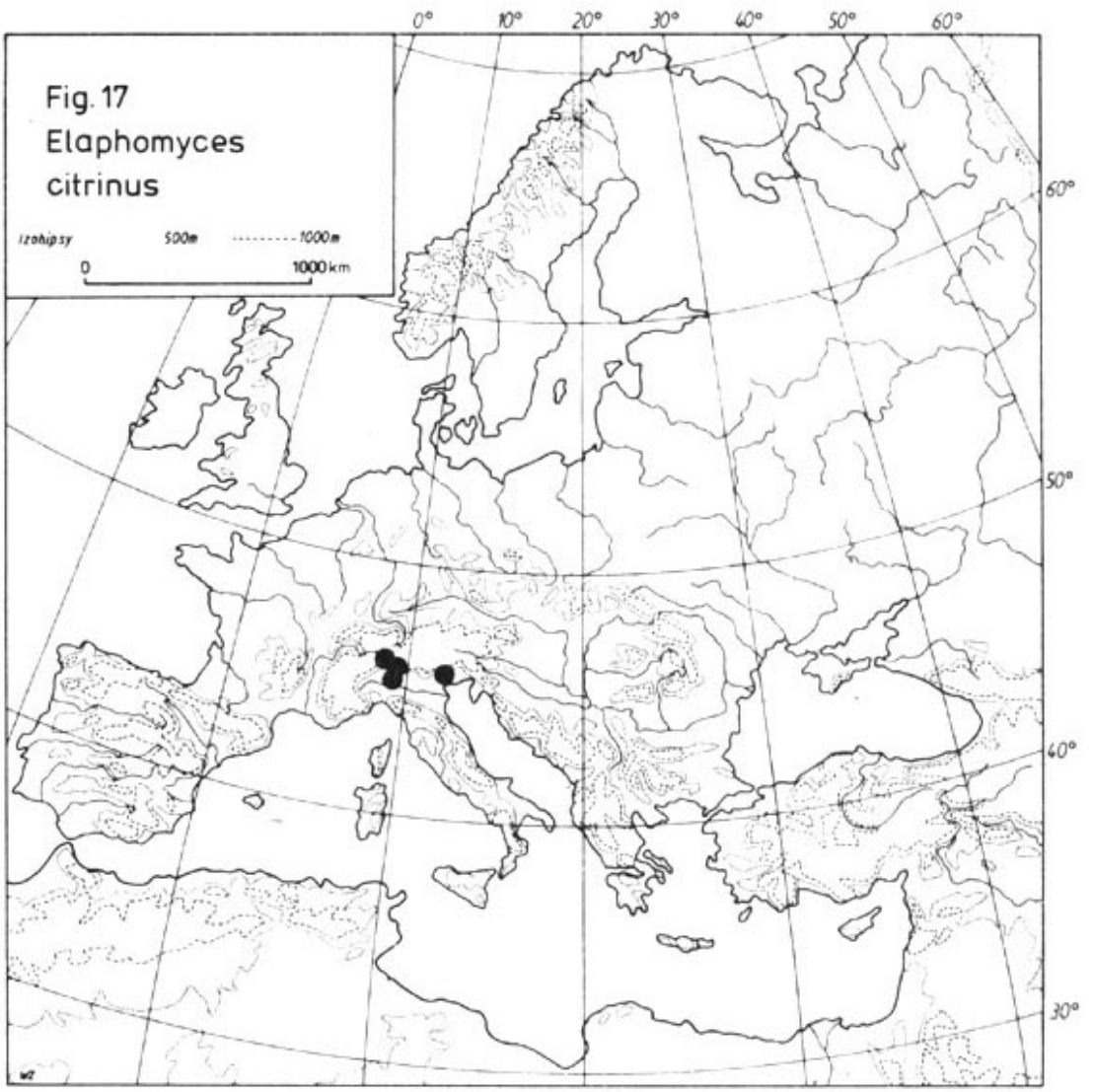
Hypothetical distribution. Southern, stenothermal species; probably distributed as *E. echinatus*.

Habitat. Under oaks, chestnuts, birches, and pines.

Distribution in Poland. Not yet discovered.

5.19. *Elaphomyces citrinus* Vitt.

Distribution in Europe (Fig. 17). On the basis of herbarium material, some localities ascertained in northern Italy and southern Switzerland.



Hypothetical distribution. Southern and, probably, Western Europe in the submediterranean climate zone and the warmer zone of temperate climate.

Habitat. Oak forests.

Distribution in Poland. Not yet discovered.

5.20. *Elaphomyces striatosporus* Kers

Distribution in Europe. Known from only one locality in Norway: Aker n. Gaustad in the vicinity of Oslo, and one locality in Sweden; originally described by Kers (1980).

Habitat. Under *Corylus avellana.*

Distribution in Poland. Not yet discovered.

6. CHOROLOGY OF *CENOCOCCUM GEOPHILUM* FR. (*DEUTEROMYCETES*)

Distribution in Europe. Herbarium material in the form of sclerotia is scant and comes from a few localities. This does not mean that the species is rare or of limited range. According to the author's investigations their sclerotia can often be found within a quite wide changeability range of habitat conditions (Ławrynowicz 1983).

Hypothetical distribution. Probably entire Europe; the range is as large as that of *Elaphomyces muricatus.*

Habitat. Woods, peatbogs, moors: in the fresh humus layer; sometimes also cultivated areas.

Distribution in Poland (Fig. 18). Common throughout the whole country in lowlands, uplands and mountains. Most often in recent coniferous forests.

Localities in Poland. Pobrzeże Bałtyckie – AB 23 WoNP Wisełka, *Fs Qrp Cb*, 06.77: MŁ, LOD 21088-90; – AB 93 Puszcza Bukowa Res. Bukowe Zdroje, *Fs*, 06.74: MŁ, LOD 21091-92. Pojezierze Południowopomorskie – CB 44 Bory Tucholskie Konigort, *Qrp Cb Tc*, 08.74: MŁ, LOD 21087; – CB 55 Żukowo, *Ps*, 07.73: MŁ, LOD 21124. Pojezierze Chełmińsko-Dobrzyńskie – DE 95 Ciche n. Zbiczno, *Ps*, 07.82: RO, LOD 20920. Pradolina Toruńsko-Eberswaldzka – DC 96 Lucień n. Gostynin, *Ps*, 07.79: RO, LOD 21068; – DC 97 Łąck, *Ps Pa Qrc TC*, 07.79: RO, LOD 21040. Pojezierze Wielkopolskie – DD 02 f.r. Rogoźno, *Qrp Cb Pt Ca*, 09.79: RO, LOD 21131. Nizina Południowowielkopolska – CD 79 Sokołów n. Koźminek, *Aps Rp Qrp Fs*, 10.78: RO & MŁ, LOD 21065 & 21085, – Goszczanów, *Qrp*, 10.78: MŁ, LOD 21024; – CD 99 Jasionna n. Błaszki, *Qrp Ps Cb*: KM, LOD 20796; – CE 09 Kliczków Forests (Lasy Kliczkowskie) n. Jarozłaj & Sundały, *Ps Qrp*, 08.79: KM, LOD 21032; – CE 28 Res. Ryś n. Lututów, *Fs Cb Aa Pa*, 07 i 10.79: MŁ LOD 21022-23; – CE 36 Biadaszki n. Opatów, *Qrp Fs*, 01.80: RO, 21064; – DD 14 f.r. Ostrowy n. Kutno, *Qrp Cb*, 06.79: MŁ, LOD 20806 & 21067; – DD 53 Gostków n. Poddębice, *Ps Qrp Pa*, 04.75: MŁ, LOD 21016; – DD 60 Linne n. Dobra, *Ps Qrp Pa*, 04.75: MŁ, LOD 21125; – DD 62 Zakrzew n. Poddębice, *Qrp Pt*, 05.80: KM, LOD 21018; – DD 75 Łódź Park Ludowy, *Qrp Bpp Cb*, 10.78 & 06.82: MŁ, KM & MK, LOD 20792-93 & 21002; – DD 82 f.r.

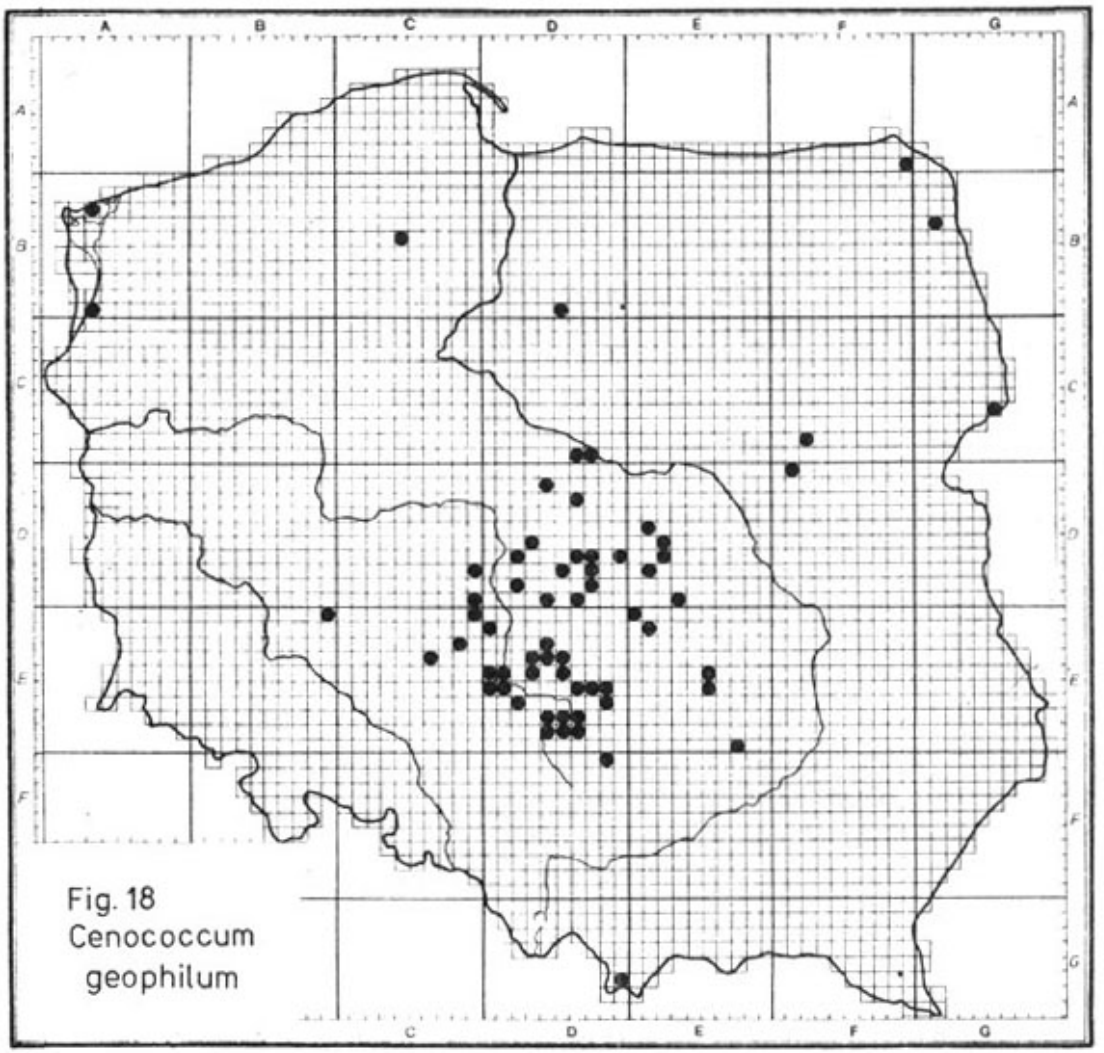


Fig. 18
Cenococcum geophilum

Wojsławice n. Szadek, *Aa*, 10.81: MK & KM, LOD 21025; – DD 94 f.r. Ostrów n. Łask, *Ps*, 06.79: RO, LOD 21017; – DE 10 Res. Nowa Wieś, *Fs*, 10.80: MŁ, LOD 21026; – DE 24 Kluki, *Ps*, 08.78: RO, LOD 21044; – DE 33 f.r. Stróża n. Szczerców, *Ps Bpp Pa*, 08.78: MŁ, LOD 21047-49; – DE 34 f.r. Wola Wydrzyna, *Cb Qrp Bpp Ps*, 09 & 10.79, 08.80: MŁ, KM & RO, LOD 20802, 21027-28 & 21037; – DE 35 Huba Ruszczyńska n. Szczerców, *Qrp Ps* cl., 08.78: MŁ & RO, LOD 21050-51. Obniżenie Milicko-Głogowskie – BE 09 Niezgoda n. Żmigród, *Qrp*, 06.82, E. Wiącek, LOD 20822. Nizina Środkowomazowiecka – DD 26 f.r. Mnich n. Oporów, *Cb Ps*, 05.79: RO, LOD 21069; – ED 41 Puszcza Bolimowska f.r. Bolimów, *Qrp Ps Bpp*, 05.82: MK & KM, LOD 20807-12; – ED 52 f.r. Puszcza Mariańska, *Qrp Ps*, 09.79, 05 & 06.82: MŁ, KM & MK, LOD 20813-21 & 21059-61; – FC 82 Zgrzebichy n. Stoczek Węgrowski, *Cb*, 10.79: MŁ, 21084; – FD 01 Kąty Borucze n. Mińsk Mazowiecki, *Ps Bpp*, 10.79: MŁ, LOD 21066. Wzniesienia Południowomazowieckie – DD 66 Łódź Las Łagiewniki, *Pa*, 05.80: KM, LOD 21003; – DD 67 f.r. Janinów n. Brzeziny, *Qrp Fs*, 10.78: MŁ, LOD 21012-13; – DD 69 Res. Zimna Woda n. Rogów, *Qrp Ps Cb*, 05.74: RO, LOD 21015; – DD 79 f.r. Wiączyń n. Nowosolna, *Fs*, 08.75: KM, LOD 20795; – DD 87 Justynów n. Łódź, *Qrp Fs Bpp Ps*, 10.79: MŁ, LOD 21004-05, – Janówka n. Justynów, *Fs Qrp*, 08.82:

L. Samosiej, LOD 21006; – DD 96 Res. Wolbórka n. Łódź, *Ps*, 09.76: MŁ, LOD 21007, – Tuszyn, *Ps*, 05.77: M. Borowska, LOD 21008, – Res. Molenda, *Qrp Ps*, 08.74 & 10.79: MŁ, LOD 21009-11, – Modlica, *Cb, Ps, Pa, Qrp*, 03.80: MŁ, LOD 21127, – Szczukwin, *Ps*, 09.82: W. Maliński, LOD 21014; – ED 62 Res. Babsk, *Qrp Cb*, 07 & 08.79, 04, 05 & 09.80, 08.81: KM, LOD 20804-05 & 21054-58; – ED 71 Podlas n. Rawa Mazowiecka, *Bpp*, 08.81: RO, LOD 21062; – ED 93 Żardki n. Odrzywół, *Qrp*, 08.79: KM, LOD 21045; – EE 00 Borki n. Spała, *Cb*, 06.74: MŁ, LOD 21039. Wyżyna Woźnicko-Wieluńska – DE 40 f.r. Mierzyce, *Ps Qrp Pa*, 06.79 & 08.82: RO & MK, LOD 20797-800 & 21030-31; – DE 41 f.r. Niżankowice, *Qrp Ps*, 05 & 08.82: MK, LOD 20801 & 21029; – DE 43 Res. Murowaniec n. Pajęczno, *Aa*, 04.79: RO, LOD 21052; – DE 50 Załęcze Małe, *Aa Ps Qrp Pa*, 07 & 08.79: MŁ & RO, LOD 20803 & 21019-21, – Springs of Revelation (Źródła Objawienia) FI Cisowa, *Pa*, 07.79: RO, LOD 21053; – DE 51 Giętkowizna n. Parzymiechy, *Pa*, 04.75: MŁ, LOD 21033; – DE 62 Miedzno n. Kłobuck, *Qrp Ps*, 09.79: MŁ, LOD 21086. Wyżyna Krakowsko-Częstochowska – DE 74 Jaskrów, *Qrp Fs Bpp*, 10.79: MŁ, LOD 21077; – DE 84 Mirów – Hektary, *Qrp Ps*, 08.81: RO, LOD 21082; – DE 85 Śmiertny Dąb FI Potok Złoty, *Ps*, 04.75: MŁ, LOD 21128, – Lipnik n. Żuraw, *Ps Pa Pt*, 10.78: MŁ, LOD 21070; – DF 08 Ołudza FI Szczekociny, *Qrp Ps*, 09.82: MK, LOD 21075; – DE 45 Hulanka n. Dobryszyce, *Qrp Pa*, 09.78: RO, LOD 21083. Wyżyna Przedborska – DE 56 Res. Jasień, *Ps Pa Bpp*, 06 & 07.75: MŁ, 20794 & 21041; – DE 57 f.r. Modrzewszczyzna n. Kobiele Wielkie, *Ps Qrp Pa*, 09.78: RO, LOD 21038; – DE 58 Mt. Chełmo, *Qrp Cb Pt Pa*, 08.79: MŁ, LOD 21080-81; – DE 68 Res. Dębowiec, *TC Qrp Cb Tc*, 06.79: MŁ, LOD 21042; – DE 75 Skrzydlów, *Qrp Ps Cb Bpp Fs*, 06 & 07.79, 04.80: MŁ, LOD 21034-36; – DE 76 f.r. Lipie n. Święta Anna, *Ps Bpp*, 08.78: MŁ, LOD 21046; – DE 86 f.r. Wielki Las n. Święta Anna, *TC Cb Qrp Bpp*, 10.79: MŁ, LOD 21078; – f.r. Knieja, *Ps Bpp*, 10.79: MŁ, LOD 21079; – DF 08 f.r. Gąszcze FI Szczekociny, *Ps*, 09.82: MŁ & MK, LOD 21074; – EE 11 Januszewice, *PaQ*, 08.74: RO, LOD 21063, – Prymusowa Wola, *Pa Qrp*, 08.73: MŁ, LOD 21129. Wyżyna Kielecko-Sandomierska – EE 45 Res. Cisowy Majdów, *Ps Pa Aa Bpp*, 06.79: MŁ, LOD 21073; – EE 55 Res. Świnia Góra, *Qrp*, 06.74: MŁ, LOD 21076; – EE 97 Raków – Hańcza, *Qrp Ps Pa*, 07.77: MŁ, LOD 21071-72. Beskidy Zachodnie – DG 19 Rabka Hill (Wzgórze) Bania, *Pa*, 11.79: MŁ, LOD 21130. Tatry – DG 59 Kościeliska Dale (Dolina K.) mouth of the Smytna Dale, *Pa*, 10.79: MŁ, LOD 21097. Pojezierze Litewskie – FA 99 Rybalnia, *Pa Ps*, 08.79: RO, LOD 21096; – GB 31 Res. Starożyn, *TC Qrp Pa*, 08.79: RO, LOD 21094, – Res. Mały Borek, *Ps Pa*, 08.79: RO, LOD 21095. Nizina Północnopodlaska – GC 55 BiNP, *TC*, 05.78: MŁ, LOD 21126; – GC 65 Czerlonka, *Qrp*, 05.80: RO, LOD 21093.

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