CZECH MYCOL. 57(3–4): 279–297, 2005

Bankeraceae in Central Europe. 2.

PETR HROUDA

Department of Botany, Faculty of Science, Masaryk University
Kotlářská 2, CZ-61137 Brno, Czech Republic
svata@sci.muni.cz

Hrouda P. (2005): *Bankeraceae* in Central Europe. 2. – Czech. Mycol. 57(3–4): 279–297.

The paper presents the second part of a study of the genera *Bankera*, *Phellodon*, *Hydnellum*, *Sarcodon* and *Boletopsis* in selected herbaria of Central Europe (Poland and northern Germany in this part). For each species, its occurrence and distribution is described. Historical changes of the occurrence of hydnaceous fungi in the Central European area are discussed at the end of the study.

Key words: *Bankeraceae*, distribution, Central Europe.

Hrouda P. (2005): *Bankeraceae* ve střední Evropě. 2. – Czech. Mycol. 57(3–4): 279–297.

Práce představuje druhou část výsledků studia rodů *Bankera*, *Phellodon*, *Hydnellum*, *Sarcodon* a *Boletopsis* ve vybraných herbářích střední Evropy (tato část je zaměřena na Polsko a severní Německo). U jednotlivých druhů je popsán výskyt a rozšíření a závěrem jsou pak diskutovány historické změny ve výskytu lošáků v prostoru střední Evropy.

INTRODUCTION

The presented study follows the previous article summarising the knowledge of the genera *Bankera*, *Phellodon*, *Hydnellum*, *Sarcodon* and *Boletopsis* in the southern part of Central Europe (Hrouda 2005). This article represents the second part of the study, which describes the ecology, occurrence and distribution of *Bankeraceae* in Poland and northern and central Germany (all lands except Bavaria and Baden-Württemberg), and is completed with a summary of the historical and recent occurrence of this group in Central Europe.

Some general information, presented in the previous part, is not repeated here.

MATERIAL AND METHODS

The core of the work represents a revision of herbarium material deposited in selected Polish and German herbaria (KRAM, WA, LOD, WRSL, GLM, DR, LZ, JE, B, HBG, BREM and MSTR, and some material from the studied area deposited in

Czech, Austrian and south-German herbaria). Specimens of critical species (not safely distinguished by macroscopical characters) were studied microscopically, as well as unidentified or doubtfully identified specimens of other species; the studied specimens were provided with revision cards.

Where useful, some data from literature were added either to complete information or for a comparison with facts based on herbarium material. The following journals have been excerpted: Acta Mycologica, Polish Botanical Journal, Fragmenta Floristica et Geobotanica, Zeitschrift für Mykologie (formerly Zeitschrift für Pilzkunde), Boletus, Mykologisches Mitteilungsblatt, and Westfälische Pilzbriefe; besides many individual records, principal sources of literature data were Verbreitungsatlas der Großpilze Deutschlands (Krieglsteiner 1991), Die Großpilze Niedersachsens und Bremens (Wöldecke 1998) and articles by Otto (1989, 1992, 1997).

Similarly to the previous part, general information about the occurrence and distribution in particular countries and partial regions is presented for each species. In the case of very rare species, data of individual finds and collections and/or literature records are presented. Neither presents this article a complete survey of the occurrence of *Bankeraceae* in the region. As it is based on the study of material from selected herbaria, some other material certainly remains omitted, but the selection contains the largest herbarium collections and this should provide a general view of the situation in the whole region.

Short notes on the occurrence in countries surrounding northern Germany and Poland (Benelux, Denmark, Belarus, Ukraine, sometimes completed with information from other countries in northern Europe; the southern half of Europe being commented in the previous part) are only informative, based on literature (Arnolds 2003, Hansen and Knudsen 1997, Kotlaba 1984, Maas Geesteranus 1975, Otto 1992, Pegler et al. 1997; the different sources are usually not cited under every species, except in the case of rare species) and records from the Central European herbaria (see abbreviations, except specimens from Sweden and Finland, which are present in many herbaria). Herbarium collections from the other countries (except Central Europe) have not been revised. The word Fennoscandia means all three countries: Norway, Sweden, and Finland.

RESULTS

Bankera fuligineo-alba (J. C. Schmidt: Fr.) Coker et Beers ex Pouzar

Rare species occurring in *Pinus* forests. It is recently known from Rheinland-Pfalz (Kaiserslautern, 1988, KR), Niedersachsen (Scheuen, 1967, in Wöldecke 1998), Lusatia (Klitten, 2001, GLM; Cottbus, 2001, LZ; several finds in the 1990s),

Brandenburg (Otto 1992), Mecklenburg (Wesenberg, 1976, GLM), northern Poland (Bory Tucholskie, 2000, LOD), northeastern Poland (Zabludow, 1977, KRAM; reserve „Perkuć", 1977, in Lisiewska 1992) and southeastern Poland (Roztocze near Zamość, 1988, KRAM).

In the surrounding countries and northern Europe the species is recently documented from Sweden, Finland, Russia (W) and Estonia (STU), and it is also known from Great Britain, Belgium, the Netherlands, Denmark and Norway.

Bankera violascens (Alb. et Schw.: Fr.) Pouzar

Due to the dominance of lowlands in Poland and northern Germany, this species (associated with *Picea* especially in mountainous areas) is rarer than *Bankera fuligineo-alba* in this area. It is known from Westfalen (Krieglsteiner 1991), Niedersachsen (Benkert et al. 1992), Thüringen (Friedebach, 1989, LZ; Schleusingen, 1981, JE and B), southwestern Sachsen (Otto 1992) and from the Carpathian Mts. (Muszyna in Beskid Sądecki, 1964, in Gumińska 1966).

The species is recently documented from Sweden and Finland, and it is also known from Great Britain, Belgium, Denmark, Norway, Estonia and Russia.

Phellodon niger (Fr.: Fr.) P. Karst.

A somewhat less common species than in the southern part of Central Europe (Hrouda 2005), known from Rheinland-Pfalz, Niedersachsen, Thüringen, Sachsen, Silesia, the Carpathians, and several localities in the northern regions of Poland and Germany, in *Pinus*, *Picea*, and *Fagus* forests.

Phellodon niger is recently documented from Denmark, Fennoscandia and Estonia (LZ), formerly from Great Britain (WU); it is also known from Belgium, the Netherlands and Russia.

Phellodon confluens (Pers.) Pouzar

This formerly rare species (associated with *Quercus* or *Fagus* in this area) has recently been recorded in some regions of Poland: Rychwald near Tarnow (1994, KRAM); Łódź, „Las Łagiewnicki" forest (1974, LOD). In Germany there are recent finds from Sachsen (Bernsdorf, 2000; Mönau, 1999, both GLM), Brandenburg (Bad Liebenweda, 1993, LZ), Mecklenburg-Vorpommern (Parkentin, 2001, GLM; surroundings of Schwerin in the 1990s), and Westfalen (Tatenhausen, 1987, MSTR); the species is reported from Thüringen, Sachsen-Anhalt, Niedersachsen and Schleswig-Holstein (Benkert et al. 1992).

Phellodon confluens is documented from the Netherlands (M, GZU) and Sweden, it is also reported from Great Britain, Belgium, Denmark, Norway and Finland.

Phellodon connatus (Schultz: Fr.) P. Karst.

As mentioned in the previous article (Hrouda 2005), this species is probably rather overlooked than really rare – recently it has been often recorded from Sachsen, but in most of the other regions there are only scattered localities. *Phellodon connatus* is accompanied by *Pinus* and *Picea*, occasionally it occurs also in deciduous forests.

In the surrounding countries, the species is documented from Denmark (M) and Russia (W), it is also known from Great Britain, Belgium, the Netherlands and Fennoscandia.

Phellodon tomentosus (L.: Fr.) Banker

Rather common species in some regions – eastern Poland, the Carpathian Mts., Sachsen, and northern Germany (up to Rügen); scattered localities in most of the other regions. *Pinus* and *Picea* are common accompanying trees.

In the other countries, *Phellodon tomentosus* has recently been documented from Norway (GLM), Sweden, Finland and Russia (W), older specimens are from Estonia (LZ), Latvia (B, JE) and Belarus (KRAM). The species is also known from Great Britain, Belgium, the Netherlands and Denmark.

Hydnellum suaveolens (Scop.: Fr.) P. Karst.

Although there are several old records (before World War II) from some other regions (Silesia, Sachsen, Thüringen, Brandenburg, Niedersachsen, Schleswig-Holstein), the recent distribution range of *Hydnellum suaveolens* is probably limited only to the Carpathian Mts. and near surroundings (mostly in *Picea* forests) – it occurs in the Tatra Mts. and the Gorce Mts., individual records are known from the Pieniny Mts. (Gumińska 1972) and Roztocze near Zamość (*Vaccinio-Pinetum*, 1973, WA).

Hydnellum suaveolens is known from Great Britain, Belgium, Denmark, Norway (JE, GZU), Sweden, Finland, Estonia, Latvia (JE, B, W), Russia and the Ukrainian Carpathians (KRAM).

Hydnellum caeruleum (Hornem.) P. Karst.

Species similarly rare as the previous one in the northern part of Central Europe, formerly occurring at scattered localities in central and eastern Germany and southern Poland, mostly in *Pinus* or *Pinus*-containing forests. Its occurrence is recently confirmed in Niedersachsen (Marwede, 1988; Scheuen, 1967, both in Wöldecke 1998), Thüringen (Nordhausen, 1999, LZ). Somewhat older records are

known from Sachsen (Deschka, 1975, GLM), Schleswig (Kropp, 1966, M), Brandenburg and Rheinland-Pfalz (Benkert et al. 1992), eastern Poland (Zwierzyniec near Zamość, 1966, WA) and the Carpathian Mts. (Kowaniec near Nowy Targ, 1961, WA).

The species is recently documented from Sweden, Finland and Estonia (LZ), formerly from Russia (W), Latvia (W) and Belarus (KRAM). Besides, it is reported from Great Britain, Belgium, the Netherlands, Denmark and Norway.

Hydnellum floriforme (Schaeff.) Banker

A rare species, documented from Puszcza Augustowska in northeastern Poland (reserves „Starożyn", 1977, and „Perkuć", 1974, KRAM) and from the Carpathian region (Zarębek Średni, 1963, KRAM, cit. in Wojewoda 1964; Kowaniec, 1961, Zakopane, 1963, both WA), formerly occurring also in Silesia, Sachsen, Thüringen (see also note to *H. aurantiacum*), Sachsen-Anhalt, Brandenburg, and reported from Niedersachsen (Benkert et al. 1992), Schleswig-Holstein, Hessen and Saarland (Krieglsteiner 1991).

Hydnellum floriforme is recently documented from Denmark (STU), Fennoscandia and Russia (W), and reported also from Great Britain, Belgium, the Netherlands and Estonia.

Hydnellum aurantiacum (Batsch: Fr.) P. Karst. em. Otto 1997

Very rare species, which is recently known from Thüringen (in *Fagus* forests: Bleiderode, 2002, LZ; Bleicherode, 2002, LZ, and 1993, GLM), Sachsen-Anhalt (Allstedt, 1979, GLM), and Niedersachsen (Osterwald, Königskanzel, 1993 and 1996, in Wöldecke 1998). Some specimens from the Thuringian localities represent typical *Hydnellum aurantiacum*, whereas paler ones look somewhat like *H. floriforme* – obviously, presence of both species in the region cannot be excluded. I do not accept the opinion that *H. floriforme* is conspecific with *H. aurantiacum*. Subtle dark specimens namely from mountain areas are considerably different from more massive light specimens for example from southern Bohemia. Benkert et al. (1992) report the species also from other regions: Sachsen-Anhalt, Schleswig-Holstein, Rheinland-Pfalz and Saarland. Occurrence of this species in Poland has not been confirmed, although it is quite probable (according to its occurrence on the Slovak side of the Carpathian Mts.).

Hansen and Knudsen (1997) reported this species as *Hydnellum auratile* from Sweden and Finland.

Hydnellum peckii Banker

Hydnellum peckii is a rare species in the northern part of Central Europe, occurring in coniferous, especially *Picea* and *Pinus* forests. It is recently recorded from Thüringen (vicinity of Stadtilm, 2002, LZ, and 1997, GLM), and Puszcza Augustowska (reserve „Perkuć", 1974, KRAM); older records are known from scattered localities in central Poland and northeastern Germany (East German regions and Niedersachsen, with *Picea* as the most frequent accompanying tree).

Hydnellum peckii is recently documented from Belgium, Sweden, Finland and Russia (LZ); it is also reported from Great Britain, the Netherlands, Denmark, Norway and Estonia.

Hydnellum compactum (Pers.: Fr.) P. Karst.

A very rare species. Recently it is known from Westfalen („Paulinen-Allee" near Tatenhausen, under *Quercus*, 1987, MSTR) in Germany and from central Poland („Las Łagiewnicki" forest near Łódź, under *Quercus*, 1974, LOD). In the 1930s the species occurred also in Mecklenburg-Vorpommern, and the specimen collected in this region (Neumühler See) by Westphal in 1994 (deposited in LZ, formerly identified as *Hydnellum spongiosipes* and revised as *H.* cf. *scrobiculatum*) appears to represent an untypical basidiome of this species as well. Benkert et al. (1992) report it also from Rheinland-Pfalz and Saarland.

Hydnellum compactum is known from Belgium, the Netherlands, Fennoscandia and Estonia.

Hydnellum spongiosipes (Peck) Pouzar

A very rare species, occurring at isolated localities in Germany, associated with *Quercus* or *Fagus*: Niedersachsen („Gut Sunder" near Winsen/Aller, 2001, LZ; Forellenbachtal, 1993; Düngel, 1987, last two in Wöldecke 1998), Westfalen („Paulinen-Allee" near Tatenhausen, 1987, MSTR), Sachsen-Anhalt („Burghof" in protected area „Kyffhäuser", 1987, LZ; „Ferchauer Forst" near Salzwedel, 1981, JE), Brandenburg („Gubelpfuhe" near Buckow, 1979, JE) and rarely in Mecklenburg (Otto 1992), Thüringen and Rheinland-Pfalz (Benkert et al. 1992); also the species reported by Nespiak (1968) from *Fagus* forests in Wesergebirge as *Calodon velutinus* probably represents *Hydnellum spongiosipes*.

In surrounding countries, *Hydnellum spongiosipes* is documented from the Netherlands (M, GZU), and reported from Belgium and Great Britain.

Hydnellum ferrugineum (Fr.: Fr.) P. Karst.

A relatively rare species with scattered localities in various regions of Germany (recently in Rheinland-Pfalz, Leistadt, 2002, KR, and Sachsen, Bergen, 1996, GLM) and Poland (documented also from the northernmost part of the country: Gdańsk, Wrzeszcz, 1958, WA), mainly in *Pinus*, less in *Picea* forests.

The species is often documented from Fennoscandia, Estonia (LZ), Latvia (B, DR), Russia (W) and Belarus (KRAM); it is also reported from Great Britain, Belgium, the Netherlands and Denmark.

Hydnellum scrobiculatum (Fr.) P. Karst.

Surprisingly rare species, recently recorded in Sachsen (latest find: Kreba, under *Quercus*, 1999, GLM), at the end of the 1960s also in Niedersachsen (Dannenberg, under *Fagus*, 1968, M) and Westfalen (Kleinenbremen, under *Fagus*, 1968, M). The species is reported also from the rest of East Germany and Rheinland-Pfalz (Benkert et al. 1992), and is probably extinct from Poland (Wojewoda and Ławrynowicz 1992). Some specimens documented as *Hydnellum scrobiculatum* have been revised as *H. concrescens*.

Hydnellum scrobiculatum is documented from Great Britain (W), Sweden and Finland; it is also known from Belgium and Denmark.

Hydnellum concrescens (Pers.) Banker

Rather common species in both deciduous and coniferous forests especially in eastern Germany (almost the entire territory of the former GDR), with several recent records also in Rheinland-Pfalz, Hessen, Nordrhein-Westfalen, Niedersachsen, central Poland and the Carpathian Mts.

The species is recently documented from Great Britain, the Netherlands, Sweden and Finland; it is reported also from Belgium, Denmark, Norway, Estonia and Russia.

Hydnellum geogenium (Fr.) Banker

As predictable, the mountainous species *Hydnellum geogenium* occurs rarely only in the Carpathian region; its latest find is from Poland: Mała Roztoka in the Beskid Sądecki Mts. (Gumińska 1962, as *Calodon sulphureum*). The reported occurrence in Nordrhein-Westfalen (Benkert et al. 1992) is probably based on a wrongly identified specimen of *Hydnellum compactum* (see under that species, the specimen from Tatenhausen was originally identified as *H. geogenium*).

In the year 2005, the species was twice collected in Slovakia (supplement to Hrouda 2005, new records after 16 years!): Oravice (northern Slovakia), site

„Šatanová", 850 m, young *Picea* forest (CB), and Nízke Tatry Mts, valley of the Ľupčianka river 10 km south of Partizánska Ľupča, 800 m (BRNM).

Hydnellum geogenium is also known from Norway, Sweden and Finland (Hansen and Knudsen 1997).

Sarcodon imbricatus (L.: Fr.) P. Karst.

Although *Sarcodon imbricatus* is not such a common species in Poland and northern Germany as in the southern part of Central Europe, it occurs in forests with *Picea* in various regions. The species has recently been recorded in Thüringen and Hessen in Germany, and in the Carpathian region (common occurrence until now) in southern Poland, but it certainly occurs in other regions, too.

The species is recently documented from Sweden, Finland and formerly from Ukraine (Eastern Carpathians, B). Besides, it is known from Great Britain, the Netherlands, Denmark, Norway, Estonia and Russia.

Sarcodon squamosus (Schaeff.) Quél.

A rather common species whose occurrence corresponds with the distribution of *Pinus* forests in the studied area. The recent distribution range of *Sarcodon squamosus* covers almost the entire lowland area of Poland and eastern Germany (most of the localities mapped by Otto 1992 under *S. imbricatus* certainly belong to *S. squamosus*, except Thüringen); its occurrence has recently not been confirmed in northwestern Germany.

Sarcodon squamosus is known in Great Britain, Belgium, the Netherlands, Denmark, Fennoscandia and Latvia (W).

Sarcodon leucopus (Pers.) Maas Geest. et Nannf.

An extremely rare species recently occurring only in Sachsen (Oberlichtenau near Kamenz, 1985, GLM), with few old records from eastern Germany (according to the map in Otto 1992; Benkert et al. 1992 report it from Brandenburg, Sachsen, Sachsen-Anhalt and Thüringen).

The species is documented from Sweden; it is also reported from Iceland, Great Britain, Belgium, the Netherlands, Norway, Finland and Russia.

Sarcodon versipellis (Fr.) Quél.

S. versipellis is reported only from Thüringen (Otto 1992) and Sachsen-Anhalt (Benkert et al. 1992), and is probably missing from rest of the studied area.

The species is documented from Sweden and reported from Belgium, Norway and Finland.

Sarcodon scabrosus (Fr.) P. Karst.

A less common species recently occurring in both deciduous and coniferous forests in Rheinland-Pfalz, Niedersachsen, Mecklenburg, Brandenburg, Thüringen, Sachsen (according to Benkert et al. 1992 and Otto 1992 also in Hessen and Sachsen-Anhalt) and Poland.

Sarcodon scabrosus is documented from Great Britain (GZU), the Netherlands (M) and Sweden; it is also reported from Belgium, Denmark, Norway, Finland, Estonia and Russia.

Sarcodon glaucopus Maas Geest. et Nannf.

Very rare species, formerly known from Sachsen and Thüringen, recently occurring in Brandenburg (under *Pinus*, Krugau, 2000, LZ).

Besides Central Europe, the species is documented (and also reported in literature) only from Sweden (LZ) and Finland (KRAM).

Sarcodon lepidus Maas Geest.

Very rare species with few recent localities. Poland: Lódź, „Las Łagiewnicki" forest (under *Quercus*, 1974, LOD, originally identified as *S. laevigatus* = *S. imbricatus*). Germany: Sachsen, Mönau near Hoyerswerda, „Mönauer Teiche" (under *Quercus*, 1999 and 2001, LZ), and Thüringen, Krimderode near Nordhausen, „Gipshügel" (under *Quercus* + *Betula*, 1985, JE). Possible another German locality is Schönberg near Freiburg in Baden (during the last 15 years, not. G. Saar in letter to P. Otto – according to his information the recorded species should also be *S. lepidus*).

Besides Germany and Poland, the species is known only from Belgium, the Netherlands and Italy (Arnolds 2003, Otto 1992).

Sarcodon martioflavus (Snell) Maas Geest.

Benkert et al. (1992) report the species from Sachsen; unfortunately I have not seen the material.

Hansen and Knudsen (1997) report *S. martioflavus* from Fennoscandia.

Sarcodon joeides (Pass.) Bataille

S. joeides is also a very rare species with only several recent localities in Germany: Niederlausitz, Schlaubetal near Guben, bank of „Schulzenwasser" (mixed deciduous forest, 1987, LZ); Mecklenburg, Neumühler See and Pinnower See (both in sandy *Fagus* forest, 1994, LZ); Niedersachsen, Düngel (1987, in Wöldecke 1998); Westfalen, „Paulinen-Allee" near Tatenhausen (under *Quercus*, 1987, MSTR); Pfalzer Wald, Birkweiler near Landau (under *Castanea*, 1980, M). Otto (1992) reports the species also from central Brandenburg (Drewitz/Potsdam), Benkert et al. (1992) from Saarland and Rheinland-Pfalz.

In the surrounding countries, *Sarcodon joeides* is reported from Belgium and the Netherlands (Arnolds 2003).

Sarcodon fuligineo-violaceus (Kalchbr.) Pat.

In the year 2005, the species was found in the Strážovské vrchy Mts.: Podskalie, under the Podskalský Roháč Mt., slope of a small stream valley, *Pinus sylvestris* and *Picea abies*, on calcareous background, 500 m a.s.l. (6. X. 2005, leg. J. Lederer, det. J. Holec et al.; PRM) – it is the first record from Slovakia since Kalchbrenner's find (locus classicus) in 1870 (supplement to Hrouda 2005)!

Besides Slovakia, the recent occurrence of *S. fuligineo-violaceus* in Central Europe is very probably limited to Austria and southern Germany (see Hrouda 2005); only old localities are known from the rest of the German territory – Hessen (Darmstadt, 1936, M), Niedersachsen, Thüringen and Sachsen (Benkert et al. 1992; Otto 1992 reports the latest find in 1955).

Besides Central Europe, the species is known from Fennoscandia (Hansen and Knudsen 1997).

Boletopsis leucomelaena (Pers.) Fayod

Very rare species in non-mountainous regions, recently occurring in *Picea* forests (or forests with *Picea*) at several localities in the area of interest. Germany: Rheinland-Pfalz, Vulkaneifel near Gerolstein, near „Mürlenbach" in Remmelbachtal (1987, W); Nordrhein-Westfalen, Bielefeld, „Eckendorfer Wald" (1991, MSTR); Thüringen, Stadtilm (1987, JE and GLM); Sachsen, Görlitz-Südstadt (1980, GLM); Benkert et al. (1992) report it also from Hessen, Niedersachsen and Sachsen-Anhalt (this might be doubtful due to the common confusion of *Boletopsis* species in German herbaria). Poland: Harklowa near Nowy Targ, „Bór Harklowski" forest (1970, KRAM), and Zakopane (1963, WA).

Boletopsis leucomelaena is documented from Sweden, Finland and Russia (W); the species is also reported from Denmark and Norway.

Boletopsis grisea (Peck) Bondartsev et Singer

Boletopsis grisea has often been identified as *B. leucomelaena* (*leucomelas*) or *B. subsquamosa*; as in the previous article (Hrouda 2005), only finds identified or revised as *B. grisea* with certainty are considered. Compared to the area of *Pinus* forests in Poland and northern Germany, the species appears to be surprisingly rare. The only recorded recent localities are in northern Poland (Chojnik in „Bory Tucholskie", 1993, WA) and Sachsen (Rietschen, 1977, GLM, and Treuenbrietzen, 1974, JE), formerly (also in Benkert et al. 1992) the species was found in Brandenburg and Mecklenburg-Vorpommern. Records from Westfalen, Niedersachsen and Brandenburg (Jahn 1963, cited as *B. subsquamosa* = *B. leucomelas*) might represent *B. grisea*, but it is not certain.

Boletopsis grisea is documented from Finland; it is also known from the Netherlands, Denmark, Fennoscandia and Russia.

Besides species reported in this article, some other Central European species have been documented from northern Europe: *Hydnellum mirabile*, *Sarcodon lundellii* and *S. fennicus* from Sweden, the latter one also from Finland and Karelia in northern Russia. Hansen and Knudsen (1997) report *Hydnellum mirabile*, *Sarcodon fennicus* and *S. lundellii* from Fennoscandia and *Hydnellum cumulatum* from Denmark.

At the end of the results chapter, the summarising table shows the altitudinal range of the particular species in the whole of Central Europe (Tab. 1). It is based on complete records from the Czech Republic and Slovakia (the altitude was found for all localities) and selected records from other countries (only the localities where the altitude was mentioned). In my opinion, such records can be taken as a representative sample – the relief of the Czech Republic (mostly lowlands or hills) is comparable to Poland and northern Germany, whereas the relief of Slovakia with dominating mountains is similar to the Alpine regions, so that the sample should show the real distribution in Central Europe. (If only localities with exactly recorded altitude are taken for all countries, the total number of records would be rather low – therefore at least the Czech and Slovak localities have been included completely.)

Table 1 shows that species which are distinctly bound to low or high altitudes are not so common. It is more prominent in mountainous species (the very rare and endangered *Boletopsis leucomelaena*, *Hydnellum geogenium* and *Sarcodon versipellis*), but also distinct lowland species (*Phellodon confluens*, *Hydnellum spongiosipes*) belong to the rare ones.

Tab. 1. Numbers of recorded finds according to altitude.
Last column („char" = characteristics) shows affinity of the particular species to low or high altitudes: M = mountainous species, (M) = weakly mountainous species, 0 = species without distinct affinity to low or high altitudes, (L) = weak lowland species, L = lowland species, L+ = strong lowland species; – shows that the species has not been characterised due to low numbers of records (<5).

	number of records						% of records						char
Altitude (m)	**0–200**	**201–500**	**501–800**	**801–1100**	**1101 –**	**total**	**0–200**	**201–500**	**501–800**	**801–1100**	**1101 –**	**total**	
Bankera fuligineo-alba	1	23	10	1		35	3	66	29	3	0	100	L
Bankera violascens	1	15	25	13	5	59	2	25	42	22	8	100	(M)
Phellodon niger	1	44	53	21	1	120	1	37	44	18	1	100	0
Phellodon confluens	4	12	1			17	24	71	6	0	0	100	L+
Phellodon connatus	2	43	55	11	2	113	2	38	49	10	2	100	0
Phellodon tomentosus	4	46	62	24	4	140	3	33	44	17	3	100	0
Hydnellum suaveolens		24	40	19	5	88	0	27	45	22	6	100	(M)
Hydnellum caeruleum		46	34	21	2	103	0	45	33	20	2	100	0
Hydnellum floriforme	2	17	21	23	3	66	3	26	32	35	5	100	(M)
Hydnellum aurantiacum		3	3	3		9	0	33	33	33	0	100	(M)
Hydnellum peckii	1	21	26	15	1	64	2	33	41	23	2	100	0
Hydnellum mirabile		1		1		2	0	50	0	50	0	100	–
Hydnellum compactum		4		1		5	0	80	0	20	0	100	L
Hydnellum spongiosipes	1	6	1			8	12	75	12	0	0	100	L+
Hydnellum ferrugineum	1	43	46	6		96	1	45	48	6	0	100	(L)
Hydnellum tardum		1	4			5	0	20	80	0	0	100	0
Hydnellum scrobiculatum		24	9	7	2	42	0	57	21	17	5	100	(L)
Hydnellum concrescens	5	51	32	18	1	107	5	48	30	17	1	100	(L)
Hydnellum geogenium		2	13	8	1	24	0	8	54	33	4	100	M
Sarcodon imbricatus	2	50	55	41	13	161	1	31	34	25	8	100	(M)
Sarcodon squamosus	6	17	9	2		34	18	50	26	6	0	100	L
Sarcodon leucopus	2	4	7	2	1	16	12	25	44	12	6	100	0
Sarcodon versipellis		3	13	3	1	20	0	15	65	15	5	100	M
Sarcodon scabrosus		27	24	5		56	0	48	43	9	0	100	(L)
Sarcodon glaucopus		3	7	3		13	0	23	54	23	0	100	(M)
Sarcodon fennicus		4	2	1		7	0	57	29	14	0	100	(L)
Sarcodon regalis			1			1	0	0	100	0	0	100	–
Sarcodon lepidus	1					1	100	0	0	0	0	100	–
Sarcodon martioflavus		1				1	0	100	0	0	0	100	–
Sarcodon joeides		3				3	0	100	0	0	0	100	–
Sarcodon fuligineo-violaceus			2	1		3	0	0	67	33	0	100	–
Boletopsis leucomelaena		2	11	8	2	23	0	9	48	35	9	100	M
Boletopsis grisea	1	19	14	1	1	36	3	53	39	3	3	100	L
Total	**35**	**559**	**580**	**259**	**45**	**1478**	**2**	**38**	**39**	**18**	**3**	**100**	

Occurrence of *Bankeraceae* – historical overview

Compared to the southern part of Central Europe, lowlands and hills are dominating landscape types in Poland and northern Germany (except for the mountains on the Slovak and Czech borders). Also the share of deciduous and pine forests is higher than in the mountain areas. Therefore the occurrence of some species is quite different from that described in the previous article (Hrouda 2005) and also the total occurrence of *Bankeraceae* is influenced by the different conditions in the mentioned countries.

Tab. 2. Numbers of recorded finds in particular countries, completed with total numbers for the entire area of Central Europe (including the countries presented in the previous article, Hrouda 2005).

Country	–1915	1916–45	1946–60	1961–75	1976–90	1991–2005
Poland	37	19	20	91	25	14
Northern Germany	126	103	30	74	126	110
Central Europe – total	**484**	**590**	**525**	**776**	**592**	**553**

A low number of records in Germany in the post-war period (the same situation is visible in Poland) is followed by increasing numbers in next periods. However, the surprisingly high numbers of records in the last decades are certainly connected with the work of P. Otto since the 1980s (similar to the significant peak appearing in Czechia in the 1950s in connection with the work of Z. Pouzar). This is why especially eastern Germany is currently the best investigated area (concerning *Bankeraceae*), but it is hard to draw a conclusion about changes in occurrence at the end of the 20th century (compared to the previous era).

The situation in Poland is similar to the situation in Hungary (see Hrouda 2005) – also here a prominent peak is visible in the 1960s, followed by a rapid decrease in the next decades. There are two explanations for such rapid decrease – either a really decreasing occurrence of the fungi or lower mycological activity in later decades. To answer the question what is the right explanation, I utilise my data on the occurrence of the genera *Hydnum* and *Auriscalpium* in Poland and compare them with the data on *Bankeraceae*. As visible from Table 3, the truth is probably somewhere inbetween.

Tab. 3. Numbers of records of *Bankeraceae* compared with genera *Hydnum* and *Auriscalpium* (the occurrence of these genera is not elaborated elsewhere in the presented study) in Poland during the second half of the 20th century.

Period	1951–1960	1961–1970	1971–1980	1981–1990	1991–2000
Bankeraceae	19	62	37	17	11
Hydnum	15	32	32	7	13
Auriscalpium	14	34	46	17	24

Tab. 4. Numbers of recorded finds in particular countries.
Periods: **–15** = up to 1915, **–45** = 1916–1945, **–60** = 1946–1960, **–75** = 1961–1975, **–90** = 1976–1990, **–05** = 1991–2005. The last 6 columns (Central Europe – total) represent the total sums for the whole of Central Europe, together with the counts from table 2 in the previous article (Hrouda 2005).

Country	**Northern Germany**						**Poland**						**Central Europe – total**					
Period	**–15**	**–45**	**–60**	**–75**	**–90**	**–05**	**–15**	**–45**	**–60**	**–75**	**–90**	**–05**	**–15**	**–45**	**–60**	**–75**	**–90**	**–05**
Bankera fuligineo-alba	9	5	2	8	6	11	3	1		7	3	1	21	24	15	29	15	18
Bankera violascens					6		1	1		1			5	26	16	27	30	27
Phellodon niger	5	12	1	6	9	14	2	1	2	4			36	45	54	70	56	53
Phellodon confluens	3	2			7	8				2		1	7	8	4	22	10	16
Phellodon connatus	13	7		12	18	11	5		1	1	1		36	45	45	46	37	36
Phellodon tomentosus	29	13		12	11	4	4	1	2	9	3	2	70	64	43	91	46	49
Hydnellum suaveolens	7	16	21	6		1	4	5	2	15			56	53	54	57	15	12
Hydnellum caeruleum	5	12		4		2	1	2	1	2			41	61	51	46	24	17
Hydnellum ferrugipes																1		
Hydnellum floriforme	3	3			1	2	5		2	5	1		32	32	20	36	31	26
Hydnellum aurantiacum				1	1	2							3	3		6	7	4
Hydnellum peckii	7	2				4	1			1			18	23	20	34	23	33
Hydnellum mirabile														2			1	
Hydnellum compactum		2			1	1				1			1	4		2	2	4
Hydnellum spongiosipes	2	3		1	5	1							3	4	3	12	12	2
Hydnellum ferrugineum	4	3		1	3	2	3	1	1	1			17	25	41	26	37	31
Hydnellum tardum														1		6	4	1
Hydnellum scrobiculatum	2	2	2	5	2	1	1			2	2	1	10	21	19	19	15	12
Hydnellum concrescens	18	8	3	4	29	20	2			5	1		45	38	51	60	57	41
Hydnellum cumulatum															1			
Hydnellum geogenium								2		1			2	7	9	17	7	5
Sarcodon imbricatus	7	2	1	2	5	1	3	5	7	22	4	1	40	44	30	60	57	67
Sarcodon squamosus	11	5		9	11	12	1		2	9	10	7	15	9	9	22	31	39
Sarcodon leucopus													7	11	7	7	3	2
Sarcodon versipellis													6	9		17	5	6
Sarcodon scabrosus				1	3	4							1	11	20	21	17	15
Sarcodon glaucopus		2				1							1	2	7	4	8	7
Sarcodon fennicus													2	5	4	7	2	1
Sarcodon regalis						1												1
Sarcodon lepidus					1	2				1						1	1	2
Sarcodon lundellii																		1
Sarcodon martioflavus																1	1	
Sarcodon joeides					3	4										1	5	4
Sarcodon fuligineo-violaceus		1					1						2	1		4	2	
Boletopsis leucomelaena	1				3	1				2			3	3		19	25	14
Boletopsis grisea		3		2	1							1	4	9	1	5	6	7
Total	126	103	30	74	126	110	37	19	20	91	25	14	484	590	525	776	592	553

In comparison with the common saprotrophic *Auriscalpium vulgare* (which can be regarded a species with rather constant occurrence), all species show a lower number of records since 1980, but species of the common mycorrhizal genus *Hydnum* show an almost similarly rapid decrease as *Bankeraceae* (although the decrease of *Bankeraceae* is more gradual and we can expect that not all finds of *Hydnum* have been documented). Another possible factor which might have influence on the number of finds is the way of investigating – according to herbarium and literature sources, a long-term systematic investigation of some localities has taken place (which can lead to very interesting results, e.g. many finds of rare species in „Las Łagiewnicki" forest), whereas the total number of investigated localities (per area unit) is probably lower than in Czechia or eastern Germany and therefore also the chance to find rare species is lower.

Tab. 4 shows a total summary of the records of the studied species during history and changes in their occurrence (mostly a decrease in the cases of some prominent changes) in the study area. Besides current finds of *Sarcodon joeides* and *S. lepidus*, which might be ascribed to intensive investigation in Germany since the 1980s, *Phellodon confluens* does not seem to be so endangered as in the southern regions. A similar case is *Bankera fuligineo-alba*. In general, the species are not so rare and the possible decrease in occurrence is not so striking in large areas with their natural habitats (deciduous or pine forests, as mentioned above). Another situation is represented by mountainous species (or species currently occurring mostly in mountain areas), which are really endangered or almost extinct from most of the area – *Hydnellum geogenium*, *H. caeruleum* and *H. suaveolens*.

Endangered species in national Red Data Lists

Finally, a short report about the endangered species. Tab. 5 shows a survey of the Central European species and their position in national Red Data Lists of the particular countries (Beran and Holec in prep., Lizoň 2001, Wojewoda and Ławrynowicz 1992, Benkert et al. 1992, Krisai-Greilhuber 1999, Siller and Vasas 1995).

As visible, Czech and German lists are the most complete ones and the classification of particular species generally corresponds with my investigation. In the German list, category „R" for *Sarcodon lepidus* may be explained by some expected data deficiency; the list should be completed with two species recorded already by Maas Geesteranus (1975): *Hydnellum tardum* and *Sarcodon regalis*.

The Polish list should be completed with the very rare *Bankera violascens*, *Boletopsis grisea*, *Hydnellum compactum*, *H. peckii*, *Phellodon confluens*, *P. connatus* and newly discovered *Sarcodon lepidus*.

Tab. 5. Species included in the Red Data Lists of particular countries.
Abbreviations of the IUCN categories: EX: extinct, CR: critically endangered, EN: endangered, VU: vulnerable, NT: near threatened, LC: least concern, DD: data deficient, NE: not evaluated.

Country	Czech Rep.	Slovakia	Poland	Germany	Austria	Hungary
Bankera fuligineo-alba	CR		E (EN)	1 (CR)		
Bankera violascens	EN			1 (CR)		
Phellodon niger	NT+LC		V (VU)	2 (EN)		
Phellodon confluens	EN	LR: LC		2 (EN)		
Phellodon connatus	NT+LC			2 (EN)		
Phellodon tomentosus	NT+LC		V (VU)	2 (EN)		
Hydnellum suaveolens	CR		V (VU)	2 (EN)		
Hydnellum caeruleum	EN		E (EN)	2 (EN)	3 (VU)	
Hydnellum ferrugipes						
Hydnellum floriforme	EN		V (VU)*	1 (CR)	3 (VU)*	
Hydnellum aurantiacum	CR		*	2 (EN)	*	
Hydnellum peckii	EN	EN		2 (EN)	3 (VU)	
Hydnellum mirabile	?EX					
Hydnellum compactum				2 (EN)		
Hydnellum spongiosipes	CR			3 (VU)		
Hydnellum ferrugineum	NT+LC		E (EN)	2 (EN)		
Hydnellum tardum	CR					
Hydnellum scrobiculatum	VU		Ex (EX)	3 (VU)		
Hydnellum concrescens	NT+LC	EN	E (EN)	3 (VU)	3 (VU)	
Hydnellum cumulatum	?EX					
Hydnellum geogenium	CR	EN	E (EN)	1 (CR)		
Sarcodon imbricatus	NT+LC		V (VU)	3 (VU)	3 (VU)	EN
Sarcodon squamosus **	VU					
Sarcodon leucopus	CR			1 (CR)		
Sarcodon versipellis	?EX			2 (EN)	3 (VU)	
Sarcodon scabrosus	EN			2 (EN)	0 (EX)	EN
Sarcodon glaucopus	EN	DD	Ex (EX)	1 (CR)	3 (VU)	
Sarcodon fennicus	CR					
Sarcodon regalis						
Sarcodon lepidus				R (NT)		
Sarcodon lundellii						
Sarcodon martioflavus				1 (CR)		
Sarcodon joeides				2 (EN)	4 (NT)	
Sarcodon fuligineo-violaceus		LR: LC		1 (CR)		EN
Boletopsis leucomelaena	CR	DD	E (EN)	2 (EN)	3 (VU)	
Boletopsis grisea ***	VU	VU				

Other categories in particular countries:
– Czech Republic: ?EX= probably extinct (extinction is not 100% certain in macromycetes)
– Slovakia: LR = low risk (NT and LC fused in one category)

– Poland: Ex, E and V are compatible with EX, EN and VU
– Germany: 1 = critically endangered, 2 = strongly endangered, 3 = endangered, R = rare (possibly compatible with CR, EN, VU and NT)
– Austria: 0 = extinct or missing, 1 = endangered by extinction, 2 = strongly endangered, 3 = endangered, R = potentially endangered, very rare (possibly compatible with EX, CR, EN, VU and NT)
– Hungary: EN = species endangered by extinction, vulnerable and rare species (fused category)

Notes:
* *Hydnellum aurantiacum* cited in the list, it probably means *H. floriforme* or confused species.
** *Sarcodon squamosus* was not distinguished until 1999 – in all lists except the Czech one it has been confused with *S. imbricatus*.
*** *Boletopsis grisea* (as *B. subsquamosa* in the Slovak list) has not been usually distinguished from *B. leucomelaena* especially in Austria and Germany.

Austria has a similar number of listed species, but there the occurrence of many species is really higher (this is possibly the reason why they are not included in the Red Data List; also most of the species in Austria are listed in the low category „3"). The Austrian list should be completed with the extremely rare *Hydnellum mirabile*, *H. spongiosipes*, *H. compactum*, *Phellodon confluens*, *Sarcodon fennicus*, *S. leucopus*, *S. versipellis* and the newly discovered *Sarcodon lundellii* and *Hydnellum tardum*, whereas *Sarcodon scabrosus* is certainly not extinct from Austria (current finds after 2000).

The Slovak and Hungarian lists are rather incomplete as for *Bankeraceae* and many lacking species can be considered to be threatened (at various levels) in these countries. Except this, category „LR" in Slovakia appears to be underestimated for the very rare *Phellodon confluens* and especially for *Sarcodon fuligineo-violaceus*, recorded in Slovakia after 135 years (the occurrence of this species in Hungary has not been confirmed in this study).

CONCLUSION

In two parts, the occurrence and distribution of 36 species of the family *Bankeraceae* in Central Europe is presented. Based on the total sums in Tab. 2, a simple conclusion might be that the occurrence of the whole group in the entire area is almost constant (with an inconspicuous peak in the period 1961–75). The result is that local fluctuations are overall almost completely equalised.

In my opinion, such simple conclusion would not be correct. Mycological activity appeared to be higher in the second half of the 20th century (which can be supported with the discovery of several new species in the Central European area during this period). In the sums, the decline of some hydnaceous fungi in the lowlands during the last decades is compensated by increasing mycological activity in mountainous regions (where the occurrence of most of the species appears to be almost constant). Changes in mycological activity in particular regions must be re-

spected (see the above mentioned „booms" in the investigation of hydnaceous fungi in Czechia and Germany) and therefore partial conclusions – as commented in Historical overview – have a higher value than a too general conclusion.

Some species, especially those associated with certain habitats, show a different pattern. In various forest types, altitudes, etc. (typical of each species) changes in occurrence are well visible and it is possible to compare the changes of various species occurring in the same or similar habitats. As is visible from Tab. 4, really endangered species are *Hydnellum suaveolens* and *Hydnellum caeruleum*, which show a strong decline in almost the whole of Central Europe, especially in the lowlands, but also in mountainous regions. Other species which show a great decline are *Hydnellum geogenium* and *Sarcodon versipellis*, recently absent in non-mountainous regions but very rare also in the mountains – it seems that strictly mountainous species are strongly limited by their altitudinal optimum. Also some other *Sarcodon* species have become very rare – *S. leucopus*, *S. fennicus* and especially *S. fuligineo-violaceus*, which was recently recorded in Central Europe for the first time since the end of the 1970s.

ACKNOWLEDGEMENTS

I wish to thank the curators and employees of all visited herbaria for their service and help (and enabling me to work at night in some cases, as well as in Austria and southern Germany). Special thanks to Dr. Peter Otto (Leipzig) for his consultancy and providing the data from former East Germany, and to Daniel Dvořák for providing the Red Data Lists and excerpted data from the Central European countries.

The work was supported by the Grant Agency of the Czech Republic (project no. 206/02/D052).

REFERENCES

ARNOLDS E. (2003): De Stekelzwammen en Pruikzwammen van Nederland en België. – Coolia 46(3), 2003 supplement: 1–96.

BENKERT D., DÖRFELT H., HARDTKE H.-J., HIRSCH G., KREISEL H., KRIEGLSTEINER G. J., LÜDERITZ M., RUNGE A., SCHMID H., SCHMITT J. A., WINTERHOFF W., WÖLDECKE K. and ZEHFUß H.-D. (1992): Rote Liste der gefährdeten Großpilze in Deutschland. – 144 p. Eching.

BERAN M. and HOLEC J. (eds.): Červený seznam makromycetů České republiky. – (in prep.).

GUMIŃSKA B. (1962): Grzyby Roztoki Małej w Beskidzie Sądeckim. – Fragm. Florist. Geobot. 8(2): 205–213.

GUMIŃSKA B. (1966): Mikoflora łasów jodłowych okolic Muszyny. – Acta Mycol. 2: 107–149.

GUMIŃSKA B. (1972): Mikoflora Pienińskiego Parku narodowego (Cześć II). – Acta Mycol. 8(2): 149–174.

HANSEN L. and KNUDSEN H. (eds.) (1997): Nordic Mycromycetes, vol. 3. – 444 p. Copenhagen.

HROUDA P. (2005): *Bankeraceae* in Central Europe. 1. – Czech Mycol. 57: 57–78.

JAHN H. (1963): Mitteleuropäische Porlinge (*Polyporaceae* s. lato) und ihr Vorkommen in Westfalen. – Westfäl. Pilzbriefe 4: 1–143.

KOTLABA F. (1984): Zeměpisné rozšíření a ekologie chorošů (*Polyporales* s. l.) v Československu. – 194 p. + 123 maps, Praha.

KRIEGLSTEINER G. J. (1991): Verbreitungsatlas der Großpilze Deutschlands (West), Band 1 Ständerpilze, Teil A, Nichtblätterpilze. – 1600 maps, Stuttgart.

KRISAI-GREILHUBER I. (ed.) (1999): Rote Liste Gefährdeter Großpilze Österreichs. 2. Fassung. – In: Niklfeld H. (red.), Rote Listen gefährdeter Pflanzen Österreichs, 2. Aufl., p. 229–266, Graz.

LISIEWSKA M. (1992): Flora Macromycetes Rezerwatu „Perkuć" u Puszczy Augustowskiej. – Acta Mycol. 27(2): 175–187.

LIZOŇ P. (ed.) (2001): Red List of Slovak fungi. – http://www.wsl.ch/eccf/Slovakia.pdf.

MAAS GEESTERANUS R. A. (1975): Die Terrestrischen Stachelpilze Europas. – 127 p. + 40 tab. Amsterdam and London.

NESPIAK A. (1968): Grzyby wyzsze lasów bukowych wzgórz nad Wezera w Niemieckiej Republike Federalnej. – Acta Mycol. 4(1): 93-130.

OTTO P. (1989): Seltene Stachelpilze aus Thüringen und Untersuchungen zur Mykorrhiza. – Boletus 13(2): 33–40.

OTTO P. (1992): Verbreitung und Rückgang der terrestrischen Stachelpilze Ostdeutschlands. – Gleditschia 20(1): 153–202.

OTTO P. (1997): Kommentierter Bestimmungsschlüssel der terrestrischer Stachelpilze Deutschlands mit taxonomischen und nomenklatorischen Anmerkungen. – Boletus 21(1): 1–21.

PEGLER D. N., ROBERTS P. J. and SPOONER B. M. (1997): British chanterelles and tooth fungi. – 114 p. + 79 figs, Kew.

SILLER I. and VASAS G. (1995): Red List of macrofungi in Hungary (revised edition). – Studia Bot. Hung. 26: 7–14.

WOJEWODA W. (1964): Wstępne uwagi o grzybach Gorców. – Fragm. Florist. Geobot. 10(2): 275–282.

WOJEWODA W. and ŁAWRYNOWICZ M. (1992): Czerwona lista grzybów wielkoowocnikowych zagrożonych w Polsce. – In: Zarzycki K., Wojewoda W. and Heinrich Z. (eds.), Lista roślin zagrożonych w Polsce, p. 27–56, Kraków.

WÖLDECKE K. (1998): Die Großpilze Niedersachsens und Bremens. – Naturschutz und Landschaftspflege in Niedersachsen 39: 1–536.