

## Hydnaceous fungi of the Czech Republic and Slovakia

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The paper presents a survey of the results of a study of four hydnaceous genera – *Bankera*, *Phellodon*, *Hydnellum* and *Sarcodon* – in the Czech Republic and Slovakia. It is based on material deposited in Czech and Slovak herbaria as well as on literature records of finds of the included species from the studied territory. For each species a short description is provided, highlighting characters distinguishing it from related species. Short notes about its ecology, occurrence and distribution are added. In the latter the actual state is compared with historic and literature data. The study is supplemented with distribution maps of individual species.

**Key words:** Hydnaceous fungi, occurrence, accompanying trees, distribution, Czech Republic, Slovakia.

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Práce představuje souhrnný přehled výsledků studia čtyř rodů lošákovitých hub – *Bankera*, *Phellodon*, *Hydnellum* a *Sarcodon* – na území ČR a SR. Je založena na studiu materiálu uloženého v českých a slovenských herbářích a na literárních záznamech nálezů daných druhů ze studovaného území. U každého druhu je vyhotoven stručný popis, zdůrazněny rozlišovací znaky od podobných druhů a stručně komentována ekologie, výskyt a rozšíření. Současný stav je porovnán s historickými a literárními údaji. Studie je doplněna mapami rozšíření jednotlivých druhů.

### INTRODUCTION

#### Systematic classification of studied genera

The studied genera belong to Holobasidiomycetes, order Thelephorales (according to Pegler et al. 1997), family *Bankeraceae* Donk (genera *Bankera* Coker et Beers ex Pouz., *Phellodon* P. Karst.) and *Thelephoraceae* Chev. (genera *Hydnellum* P. Karst. and *Sarcodon* P. Karst.). The paper includes neither the less relative genera *Hydnum* L.: Fr. and *Auriscalpium* S. F. Gray nor other genera with a hydroid (spiny) hymenophore (resupinate and gelatinous types).

#### Ecology and phenology

Species of the genera *Bankera*, *Phellodon*, *Sarcodon*, *Hydnellum* (also *Hydnum*) are living in ectomycorrhiza with trees. This hypothesis is according to Arnolds (1989) based on circumstantial evidences from field observations.

The occurrence of basidiomes is limited to the direct neighbourhood of living trees (also in areas with dispersed growth). Most other known saprophyte basidiomycetes are not limited to the neighbourhood of trees.

Most of the species have a certain degree of host specificity.

Hydnaceous fungi are never found close to trees which usually do not form ectomycorrhiza in Europe (for example *Acer*, *Aesculus*, *Ulmus*, *Fraxinus*), although these trees can grow on otherwise suitable habitats.

Many species prefer soils with only a very thin layer of litter and humus. No intensified decomposition of litter (decomposition of lignine) was observed near the basidiomes. In the habitats in the Czech Republic visited in 1991, the thickness of the surface humus layer ranged from 1 to 7 cm, on average between 2 and 5 cm.

The studied species grow mostly on acid, sandy soils (Pegler et al. 1997) – see also the following table describing chemical properties of soils in habitats visited in 1991:

	humus layer (3–5 cm from surface)			sandy or loamy soil (deeper than 3–5 cm)		
	min.	average	max.	min.	average	max.
	pH <sub>H<sub>2</sub>O</sub>	3.1	3.65	3.95	3.75	4
pH <sub>KCl</sub>	2.2	2.57	2.9	2.75	3.2	3.75
Ca (mg/100 g)	24.74	63.05	152.97	11.71	13.37	20.4
K (mg/100 g)	9.41	35.11	82.29	3.8	6.79	11.29
Na (mg/100 g)	3.68	9.59	13.95	3.68	5.91	8.41
Mg (mg/100 g)	1.45	7.2	15.5	0.55	1.18	3.58
N (%)	0.39	0.92	1.3	0.09	0.13	0.85
C (%)	25.28	57.71	92.88	0.77	9.29	27.61

The degree of host specificity is different in various species. A small number of the studied species occurs with only one tree species (the species of the genus *Bankera*), some are associated with deciduous trees (*Phellodon confluens*, *Hydnellum spongiosipes*, *Sarcodon joeides*), most of them are commonly associated with coniferous trees and there is also quite a number of indifferent species.

The ectomycorrhizal relationship was proved in *Bankera fuligineo-alba*, which was synthetised in pure culture with *Pinus banksiana* (Danielson 1984). The same author performed unsuccessful experiments with growing *Hydnellum peckii*, *Phellodon melaleucus* and *Sarcodon imbricatus* in pure culture. Other species have not been tested so far.

Hydnaceous fungi are autumn fungi occurring most frequently from August to October. Under extremely favourable conditions (warm spring, sufficient rainfall) these species can be found earlier (in June, the earliest occurrence recorded 12.

VI.), but the number of such records is minimal; also small is the number of later (winter) records (in this case represented by mostly dry, "dead" basidiomes).

#### MATERIAL AND METHODS

The core of the work represents a revision of material deposited in Czech and Slovak herbaria (BRA, BRNM, BRNU, CB, MJ, OLP, OP, PL, PRC, PRM – abbreviations according to Hradilek et al. 1992). Special thanks belong to J. Herink, who kindly offered not only material from his private herbarium, but also records of more finds not deposited in his herbarium. All unidentified and uncertainly identified specimens and all specimens identified with a forgotten name just as specimens of critical species (not safely to be distinguished by macroscopical characters) were studied microscopically and consulted with Z. Pouzar. The basic characters by which such critical species were distinguished, were spore morphology, presence or absence of clamp-connections on hyphae and colour reaction of the flesh in KOH.

The studied species are treated as follows. The introduction of the special part is formed by the key to the families and genera and by an integral key to all stipitate *Hydnium*s with emphasis on characters for practical identification in field conditions. This key contains stipitate genera including the genera *Auriscalpium* and *Hydnium* (otherwise not included in this study), but excludes resupinate genera or genera with fruticulose basidiomes (*Hericium* type).

In species descriptions practically useful and diagnostic characters were emphasised. Expulsion of liquid mentioned for living basidiomes means guttation, in case of exsiccates it means an expulsion of crystals of unknown composition (Maas Geesteranus 1975). Data from descriptions in literature (Maas Geesteranus 1956, 1957, 1958, 1960, 1975, Nikolaeva 1961, Pegler et al. 1997) were taken over for species which were not even seen as exsiccates; partially the same was done in cases where the number of studied specimens was not regarded sufficiently representative. Spore sizes are given according to Maas Geesteranus (1975).

Changes in the occurrence of each species is commented for the 20th century. A common trend in most species is a strong increase in the number of collections after the Second World War (either caused by a higher number and increased activity of mycologists or by worse documentation of pre-war finds), followed by a smaller or larger decrease in occurrence approximately after the year 1970. The sketched trend can be generalised only for the Czech Republic, where finds have been documented more or less continuously. The situation in Slovakia is different: the finds of Kalchbrenner, Kmet' and Truchlý from the 19th century are followed by a half-century interval of low activity (only 2 records of all studied species are from the years 1901–1950). Later an invasion of mycologists into Slovak forests is noticeable after 1970, manifested by an increased number of collections. This

increase can even prevail over the decrease in the number of finds in the Czech Republic and create an erroneous impression of increasing occurrence of certain species at the level of both countries together.

Comments on accompanying trees compare a literature source (Maas Geesteranus 1975) with data from Czechoslovak records. I have also tried to record changes in the representation of accompanying trees for individual species through time. Most of the species do not show any conspicuous change; if some species show a certain shift in the spectrum of accompanying trees, the usual trend is that: the spectrum narrows, i. e. the fungi are more found with one tree.

The distribution maps given for each species are not wholly authoritative, because they illustrate activity of collectors rather than occurrence of individual species; this study is not an exception. The most investigated regions in the Czech Republic are central Bohemia, southern Bohemia, Bohemian-Moravian Highland and the surroundings of Brno, in Slovakia the northern part from Kysuca to Spiš. Greater value can be attributed to a division of records into several time periods showing the disappearing of species from regions where they formerly occurred, respectively new finds in other regions. The records from the periods before 1945, 1945-1970 and after 1970 are differentiated in the distribution maps. The reason for just this differentiation (the years 1945 and 1970 as turning-points) is given above. For all species point mapping was used by reason of the relatively small number of localities. In case of broadly defined localities the centre of each symbol was situated in the centre of the given site (mostly a larger town).

The distribution maps were produced with DMAP for Windows 6.1 (© Alan Morton 1993-97). The following symbols were used:

Accurately defined localities:

documented data:

- - locality where the species was found before 1945
- - locality where the species was found between 1945 and 1970
- - locality where the species was found after 1970

data from literature:

- - locality where the species was recorded before 1945
- - locality where the species was recorded between 1945 and 1970
- - locality where the species was recorded after 1970

Broadly defined or inaccurately indicated localities:

documented data:

- × - sites, where the species was found before 1945
  - \* - sites, where the species was found between 1945 and 1970
- (No such data after 1970.)

data from literature:

+ - sites, where the species was recorded before 1945

(No such data after 1945.)

If more records were recorded from one locality in different periods, the last collection is always decisive.

In the lists of recorded localities (for rare species only) the localities are arranged according to the phytogeographic divisions of the Czech Republic and Slovakia (Skalický 1988, Futák 1984).

### SPECIAL PART

Key to the families and genera of Czecho-Slovak stipitate Hydnums

- 1) Amyloid spores; basidiome tiny cochleariform with mostly excentric stipe  
     ... *Auriscalpium*, family Auriscalpiaceae
- 1') Spores non-amyloid; basidiomes of various sizes, minute to relatively large, with  $\pm$  central stipe
  - 2) Spores perfectly smooth, white to ochraceous in mass; basidiome fleshy  
     ... *Hydnum*, family Hydnaceae
  - 2') Spores verrucose or spiny; basidiome fleshy or tough
    - 3) Spores short ellipsoid to oval, spinulose with hyaline wall, white in mass; basidiomes with smell of fenugreek especially after drying  
 ... family Bankeraceae
    - 4) Basidiome fleshy, never overgrowing branchlets or grass  
 ... *Bankera*
    - 4') Basidiome tough, often overgrowing branchlets, grass or other objects  
 ... *Phellodon*
  - 3') Spores regular, moderately to roughly verrucose or spiny with coloured wall, brown or brown-ferruginous in mass; basidiomes without a smell of fenugreek  
 ... genera of family Thelephoraceae
- 5) Basidiome fleshy, never overgrowing branchlets or grass  
     ... *Sarcodon*
- 5') Basidiome tough, often overgrowing branchlets, grass or other objects  
     ... *Hydnellum*

In the following table the main characters of the four studied genera are shown.

Genus	Basidiome	Spores	Colour in mass	Smell
<i>Bankera</i>	fleshy, terminated growth	oval, spinulose, wall hyaline	white	fenugreek
<i>Phellodon</i>	tough, indefinite growth	irregular, roughly verrucose, wall brownish	brown	different in various species – aromatic, farinaceous, graveolent or without smell
<i>Hydnellum</i>				
<i>Sarcodon</i>	fleshy, terminated growth			

The key to the genera and the keys to the species of each genus are either based on obvious characters or on characters invisible at first sight, like characters on spores, reaction with KOH etc., which should provide a reliable and precise determination. But as one does not always have a microscope or chemical reagents at one's disposal, one more key based on visual macro-characters only (quite often on colours) is given; this is a complete key for the whole studied group. Herewith, cases can be excluded in which a wrong genus determination automatically leads to an incorrect species determination. This key is only for orientation and sometimes leads to a group of species or to a probable species.

- 1) Basidiome tiny cochleariform with predominantly lateral stipe  
... *Auriscalpium vulgare*
- 1') Basidiomes of different sizes and shapes with central stipe (distinct or covered by spines running down to its base)
  - 2) Basidiome fleshy, never overgrowing branchlets or grass
    - 3) Pileus light orange to orange, with concolorous stipe, spines whitish  
... species of genus *Hydnum*
    - 3') Pileus with various brown tints
    - 4) Context pink or violet  
... see *Sarcodon*: *S. fuligineo-violaceus*, *S. joeides*
    - 4') Context whitish to brown
      - 5) Base of stipe grey-green (or black-green)  
... see *Sarcodon*: *S. fennicus*, *S. glaucopus*, *S. scabrosus*
      - 5') Base of stipe differently coloured
      - 6) Surface of pileus breaking up into conspicuous, especially in the centre erect scales at maturity
      - 7) Pileus brown to dark brown; basidiomes lacking smell or aromatic, but never with a smell of fenugreek  
... *Sarcodon imbricatus*

- 7') Pileus light brown; basidiomes, especially when dried, with a smell of fenugreek  
 ... *Bankera violascens*
- 6') Surface of pileus always lacking conspicuous scales or cracked at the centre into areoles, at most breaking up into appressed squamules with raised tips which may continue towards the margin
- 8) Context whitish (or chrome yellow where the pileus passes into the stipe – not conspicuous in exsiccatos); pileus light to orange-brown with appressed squamules  
 ... *Sarcodon versipellis*
- 8') Context whitish to brown, without yellow colour; pileus light-brown
- 9) Basidiome, especially when dried, with a smell of fenugreek
- 10) Surface of pileus covered with putrefying plant remains  
 ... *Bankera fuligineo-alba*
- 10') Surface of pileus without any putrefying remains  
 ... *Bankera violascens*
- 9') Basidiome lacking the smell of fenugreek, smell unpleasant  
 ... *Sarcodon leucopus*
- 2') Tough basidiome, often overgrowing branchlets, grass or other objects
- 11) Surface of pileus with more or less conspicuous concentric zones
- 12) Context bright to dark orange  
 ... *Hydnellum auratile*
- 12') Context whitish to brown
- 13) Spines light, more or less beige  
 ... *Phellodon tomentosus*
- 13') Spines brown to dark brown  
 ... *Hydnellum conrescens*
- 11') Surface of pileus without concentric zones
- 14) Cross-section of the basidiome showing blue colours (often in zones)  
 ... see *Hydnellum*: *H. caeruleum*, *H. suaveolens*
- 14') Cross-section of the basidiome not showing any blue colours
- 15) Young basidiomes sulphur yellowish, older ones olive-green

turning black on pressing, mostly more basidiomes grown together; context concolorous

... *Hydnellum geogenium*

15') Basidiomes coloured otherwise

16) Spines grey, grey-brown, grey-beige or dirty white; context black, grey or grey-brown; basidiome, especially when dried, with a smell of fenugreek

... see *Phellodon*: *P. confluens*, *P. melaleucus*, *P. niger*

16') Spines whitish, pink, purple-brown, brown to dark brown; context light-brown, brown to ferruginous or (at *H. aurantiacum*) whitish and orange in the base of the stipe; basidiome lacking smell of fenugreek

... see *Hydnellum*: *H. aurantiacum*, *H. conrescens*,  
*H. cumulatum*, *H. ferrugineum*, *H. peckii*,  
*H. scrobiculatum*, *H. spongiosipes*

## Bankeraceae Donk

### *Bankera* Coker et Beers ex Pouzar

Basidiomes stipitate, pileate. Surface of the pileus at first tomentose, later smooth or broken up into scales, mostly light-brown; stipe concolorous. Spines light-brown to greyish. Context fleshy to tough, non-zoned, white or light coloured, monomitic. Hyphae inflating towards the centre of the pileus, thin-walled, gradually turning to slightly thick-walled and very close together, without clamp-connections. Basidia clavate, 4-spored, without basal clamp-connections. Spores semiglobose to oval, slightly verrucose, colourless. Cystidia absent.

#### Key to the species:

1) Surface of mature pileus rarely broken into scales, but covered by a thin layer of tomentum, often with remains of overgrown putrefying plant matter; growing under *Pinus*

... *Bankera fuligineo-alba*

1') Surface of mature pileus often broken into scales, not covered with a distinct tomentum and lacking remains of overgrown putrefying plant matter; growing under *Picea*

... *Bankera violascens*

### *Bankera fuligineo-alba* (J. C. Schmidt: Fr.) Pouzar

Pileus about 80 mm in width, velutinous, rarely with appressed squamules, pale, whitish, yellow-brown, flesh-brown, brown, the surface tomentum overgrowing

remains of putrefying plant matter. Stipe brown, only pale under the spines. Spines pale brown, greyish, with pink hue in young stages. Context whitish, with age and towards the stipe turning brown, not changing colour in KOH. Expulsion of liquid not observed. Clamp-connections absent. Spores oval with small acute warts,  $4.7-5.4 \times 2.7-3.6 \mu\text{m}$ .

Related species. *B. violascens* is often scaly when old and – most of all – never has any putrefying matter on the surface of its pileus, its context turns olive-green in KOH, it grows under *Picea*. The species of the genus *Sarcodon* have no smell of fenugreek and possess roughly verrucose coloured spores of a rather irregular shape.

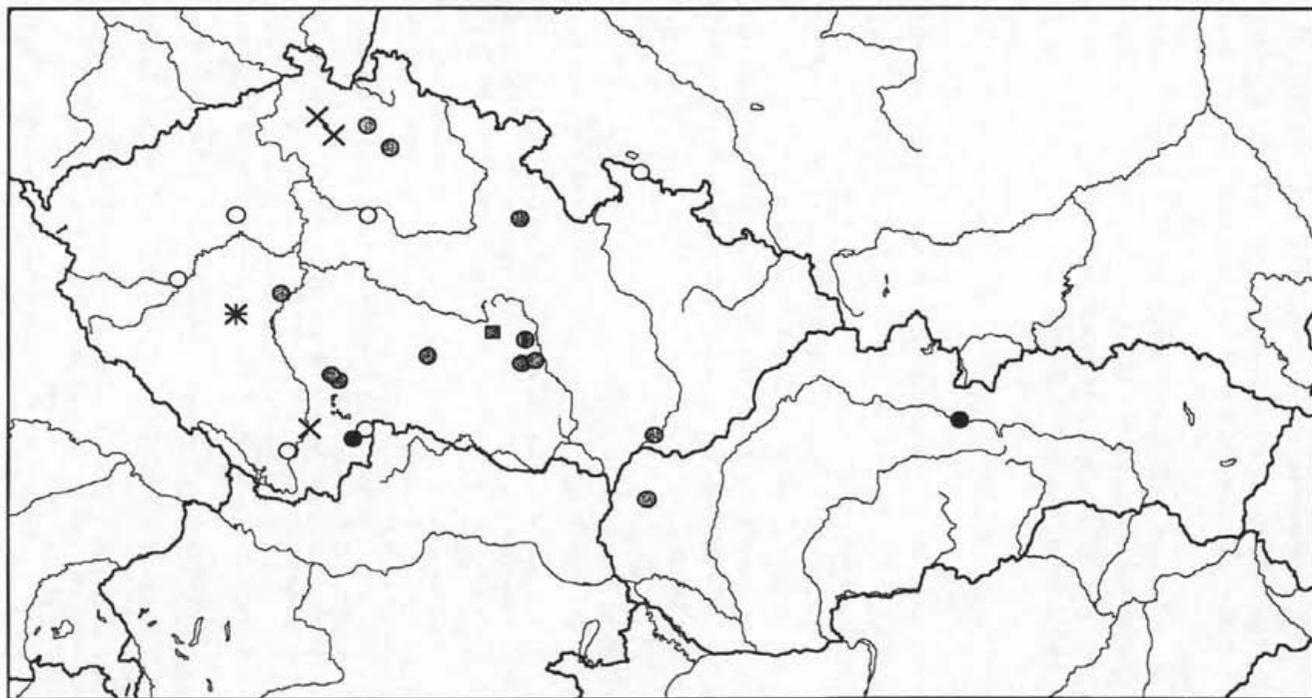
Occurrence. Less abundant species with a strongly declined occurrence during the last 20 years.

Accompanying trees. Literature sources associate *Bankera fuligineo-alba* with *Pinus*; also in our country *Pinus* occurs in all localities where accompanying trees were recorded, at least as an admixture.

Distribution (Map 1). Formerly less abundant over the whole territory of Bohemia and Moravia, recently rare and confined to isolated localities. The last record from northern Bohemia dates from 1966, in Moravia it was last seen in 1969. The low number of records from Slovakia does not allow to draw conclusions on the distribution of this species.

#### List of recorded localities – Czech Republic:

- Sadská, sandy *Pinus* wood, IX. 1932, leg. O. Zvěřinová, det. A. Pilát ut *Sarcodon fuligineo-albus* (PRM)
- Strážnice, Přívoz, sandy *Pinus* wood, 9. X. 1955, leg. et det. F. Šmarda (BRNM)
- Ruda near Nové Strašecí, "Leontýnino poleší" SW of Ruda, between the site "V chaloupkách" and První luh valley, *Picea* wood with *Pinus*, 17. X. 1937, leg. J. Herink sen., det. J. Herink ut *Calodon laevigatus*, rev. Z. Pouzar (PRM)
- Plzeň-Bolevec, *Pinus* wood, 10. X. 1906, leg. et det. F. Maloch ut *Hydnum fuligineo-album* (PL)
- Blanský les Mts., SE slope of Mt. Klet, *Pinus* wood, 26. VIII. 1934, leg. Josef et Jan Herink, det. A. Pilát ut *Calodon laevigatus*, rev. Z. Pouzar (PRM)
- Cep near Suchdol nad Lužnicí, margin of lake Cepský nový, sandy *Pinus* wood with *Vaccinium*, 30. IX. 1978, leg. J. Kubička, det. Z. Pouzar (PRM)
- Chlum u Třeboně, near lake Vydymač, *Pinus* wood with *Vaccinium*, 30. VIII. 1935, leg. et det. K. Kavina ut *Sarcodon fuligineo-albus*, rev. Z. Pouzar (PRM)
- Soběslav, *Pinus* wood, 20. IX. 1946, leg. R. Veselý, det. Z. Pouzar (PRM)
- Soběslav, Karvánky, *Pinus* wood, VII. 1932, leg. et det. A. Pilát ut *Sarcodon fuligineo-albus* (PRM)
- Vlastiboř, Jezárka forest, *Pinus* wood with *Vaccinium* and *Calluna*, 2. X. 1954, leg. F. Kotlaba, det. Z. Pouzar (PRM)
- Vlastiboř, Padělky forest, *Pinus* wood with *Vaccinium* and *Calluna*, 24. X. 1954, leg. F. Kotlaba, det. Z. Pouzar (PRM)
- Žebrák, *Pinus* wood, 26. IX. 1954, leg. B. Hřebíková, det. Z. Pouzar (PRM)
- Vrčky, west of the village, planted *Pinus* wood, 4. IX. 1965, leg. et det. J. Herink, 2. X. 1966, leg. J. Herink, det. Z. Pouzar (both Herb. Herink)
- Podkost, Žehrovský forest, near the road Dobšice - Kamenice, *Pinus nigra* wood with *Vaccinium* and *Calluna*, 330 m, 24. IX. 1952, leg. et det. J. Herink (Herb. Herink)
- Kostelec nad Orlicí, coniferous wood, IX. 1950, leg. M. Svrček, det. Z. Pouzar ut *Sarcodon fuligineo-albus* (PRM)

Map No. 1 - *Bankera fuligineo-alba*

- Documented data:
- - locality where the species was found before 1945
  - ◐ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded between 1945 and 1970

- Broadly defined localities:
- ✕ - locality where the species was found before 1945
  - ✱ - locality where the species was found between 1945 and 1970

- Cejle, Mt. Čefínek, mixed wood (*Picea abies*, *Pinus silvestris*, *Fagus sylvatica*), 700 m, 11. IX. 1966, Jihlava mushroom exhibition (BRNM)  
 Ostrov nad Oslavou, 13. IX. 1960, leg. et det. F. Šmarda (Kříž, Svrček et Šmarda 1961)  
 Vlkov, forest between Vlkov and Katov, *Pinus* wood, 1. IX. 1957, 16. IX. 1962, leg. et det. F. Valkoun (BRNM)  
 Věžná, Teplá forest, *Pinus* wood, 500 m, 27. IX. 1946, leg. et det. F. Šmarda (BRNM)  
 Věžná, forest between Věžná and Střítež, 450 m, 27. IX. 1946, leg. F. Šmarda, det. Z. Pouzar (BRNM)  
 Dolní Loučky, Falcův mlýn, *Picea* wood with admixed *Pinus*, 17. VII. 1969, leg. B. Kasala, det. K. Kříž (BRNM)  
 Vidnava, Kohoutí hill, X. 1911, leg. J. Hruby, det. Z. Pouzar (BRNM)

Broadly defined localities:

- Near České Budějovice, planted *Pinus* wood, leg.?, det. J. Herink (Herb. Herink)  
 Doksy, *Pinus* wood, 1936, leg. G. Japp, det. A. Pilát ut *Sarcodon fuligineo-albus* (PRM)  
 Česká Lípa, 1935, leg. G. Japp, det. Z. Pouzar ut *Sarcodon fuligineo-albus* (PRM)  
 Rožmitál pod Třemšínem, 10. VIII. 1952, leg. et det. A. Pilát ut *Sarcodon fuligineo-albus* (PRM)

Slovakia:

- Bílkove Humence, 15. IX. 1970, leg. Z. Novák, det. I. Fábry (BRA)  
 Kráľova Lehota, between K. L. and Svarín, calcareous soil, *Pinus* wood, 500 m, 13. VIII. 1982, leg. et det. J. Kuthan (BRA)

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

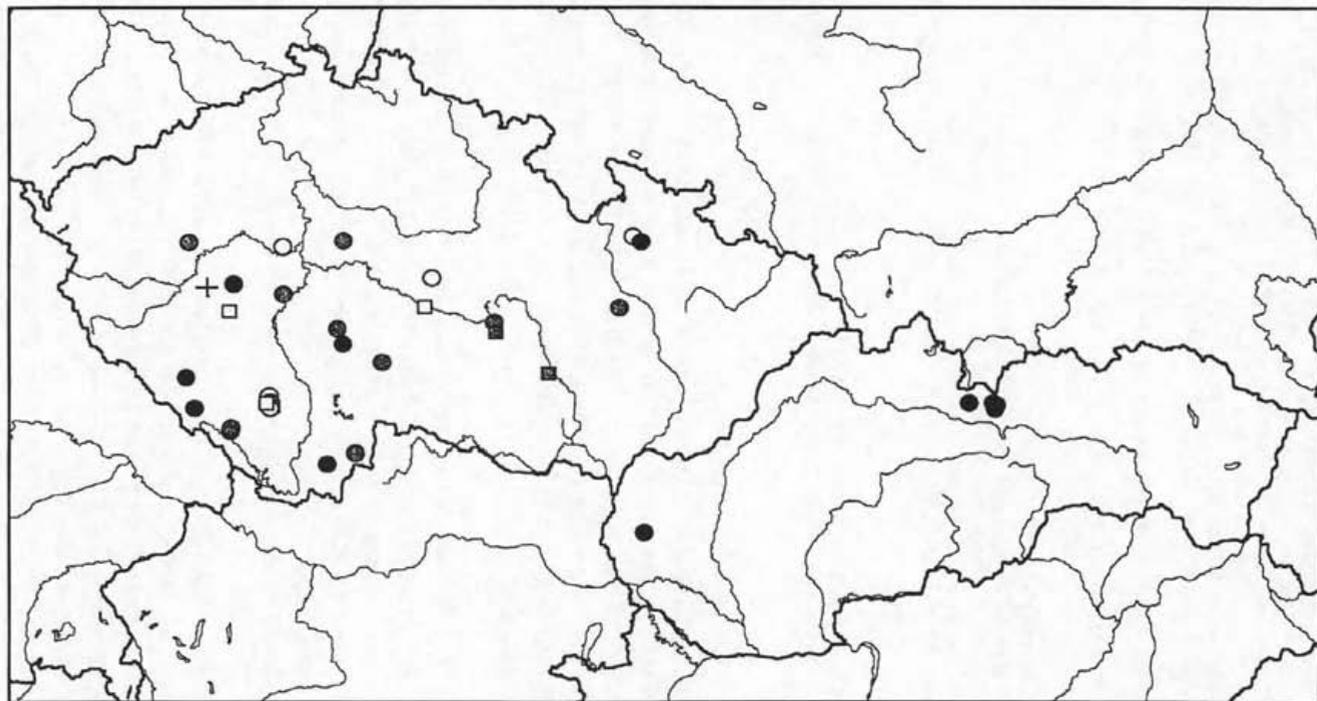
Pileus about 80 mm in width, surface smooth or broken into concentrically arranged scales, whitish, yellow-, grey- or flesh-brown, never covered with putrefying plant rests. Stipe brown, without a whitish zone under the spines. Spines pale brown, greyish, pinkish, white or bluish in young stages. Context whitish, brown to grey-brown, turning olive-green in KOH when cut. Expulsion of liquid not observed. Clamp-connections absent. Spores oval with small acute warts, 4.5–5.4 × 4.3–4.5 μm.

Related species. *B. fuligineo-alba* never has a pileus broken into erect scales and – most of all – the surface of its pileus is covered with putrefying plant matter, its context does not change colour in KOH, it grows under *Pinus*. The species of the genus *Sarcodon* have no smell of fenugreek and possess roughly verrucose coloured spores of rather irregular shape.

Occurrence. Species of moderate abundance, not showing a very conspicuous decline.

Accompanying trees. According to the literature *Bankera violascens* is associated with *Picea*. This is confirmed by our records with only one exception (Křepice near Vodňany, forest SE of road to Libějovické Svobodné Hory, 500 m a. s. l., planted *Pinus* wood, 29. VIII. 1934, leg. et det. J. Herink ut *Sarcodon infundibulum* – but in this locality also *Picea* occurs).

Distribution (Map 2). Formerly not very abundant species in the Czech Republic, recently rare in isolated localities. From Slovakia only a few collections from recent years (Tatra Mts.) exist, so it is impossible to draw any conclusions.

Map No. 2 - *Bankera violascens*

- Documented data:
- - locality where the species was found before 1945
  - - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945
  - - locality where the species was recorded between 1945 and 1970

- Broadly defined localities:
- + - locality where the species was recorded before 1945

**Phellodon** P. Karst.

Basidiome pileate, stipitate; stipe sometimes shortened because of the spines running down to the base. Predominating colours of the basidiome grey or brown. Surface of the pileus tomentose at first, then fibrillose, ridged, slightly scrobiculate, variously coloured. Stipe concolorous with pileus or darker. Spines variously coloured in different species. Context fibrillose, soft or tough to woody, zoned, monomitic, pale or coloured. Hyphae cylindrical (not inflating), always thin-walled, without clamp-connections in the European species. Hyphae in spines similar, somewhat narrower, also without clamp-connections. Basidia clavate, 4-spored, without basal clamp-connections. Spores semiglobose to oval, slightly verrucose, hyaline. Cystidia absent.

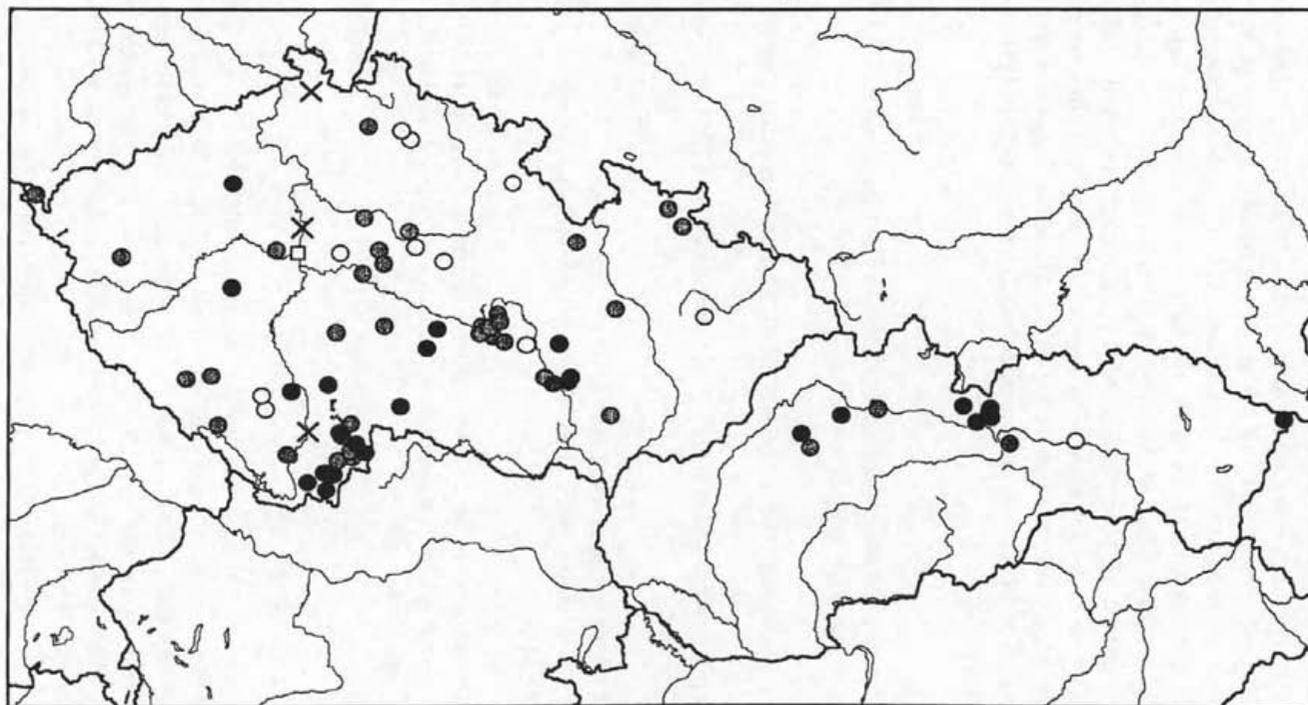
Key to the species:

- 1) Basidiome with conspicuously black context also in the pileus, with violet hue when young, grey-black to grey at maturity  
... *P. niger*
- 1') Context of the pileus not conspicuously black (but ochraceous, greyish or white)
  - 2) Surface of pileus with darker brown concentric zones on a light-ochraceous to brown ground  
... *P. tomentosus*
  - 2') Surface of pileus without conspicuous concentric zones
    - 3) Small basidiomes with dark pileus, light spines and dark, thin, smooth stipe  
... *P. melaleucus*
    - 3') Basidiomes with beige to brown pileus, concolorous or darker spines, often decurrent to the tomentose base of the stipe; associated with deciduous trees  
... *P. confluens*

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

Pileus about 40 mm in width, young velutinous, older smooth to rough, light-grey or violet in young stages, turning dark to black with age. Stipe tomentose (especially when young), dark. Spines white to blue-grey, grey when old. Context black (dark slate grey after drying), turning blue-green in KOH when cut. Expulsion of liquid not observed. Clamp-connections absent. Spores oval with small acute warts,  $3.6-4.5 \times 2.7-3.5 \mu\text{m}$ .

Related species. The context of *P. confluens* does not turn blue-green in KOH; this species grows in deciduous woods only. *P. melaleucus* is smaller, has conspicuously light spines contrasting to the dark stipe and does not have a

Map No. 3 - *Phellodon niger*

- Documented data:
- - locality where the species was found before 1945
  - ⊙ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945

- Broadly defined localities:
- × - locality where the species was found before 1945

velutinous pileus. Principal difference: none of the related species have such a black context.

Occurrence. Although showing decline, this species is still relatively abundant.

Accompanying trees. Literature sources mention its occurrence in deciduous, coniferous and mixed woods, under *Fagus*, *Quercus*, *Picea* and *Pinus*; a small number of our collections come from deciduous woods, a large majority comes from coniferous and mixed woods. *Picea* occurs in 66 %, *Pinus* in 43 % of localities, but this rate has changed during the last 20 years (*Pinus* present in 62 %, *Picea* in 58 % of localities).

Distribution (Map 3). Relatively most finds are concentrated in southern Bohemia, in the area between Žďár n. Sáz. and Brno in Moravia and in the Tatra-Fatra region in Slovakia. But relatively recent collections from northern and western Bohemia testify that the main reason of the large number of collections in the first mentioned areas is their high rate of investigation.

***Phellodon melaleucus* (Sw. in Fr.: Fr.) P. Karst.**

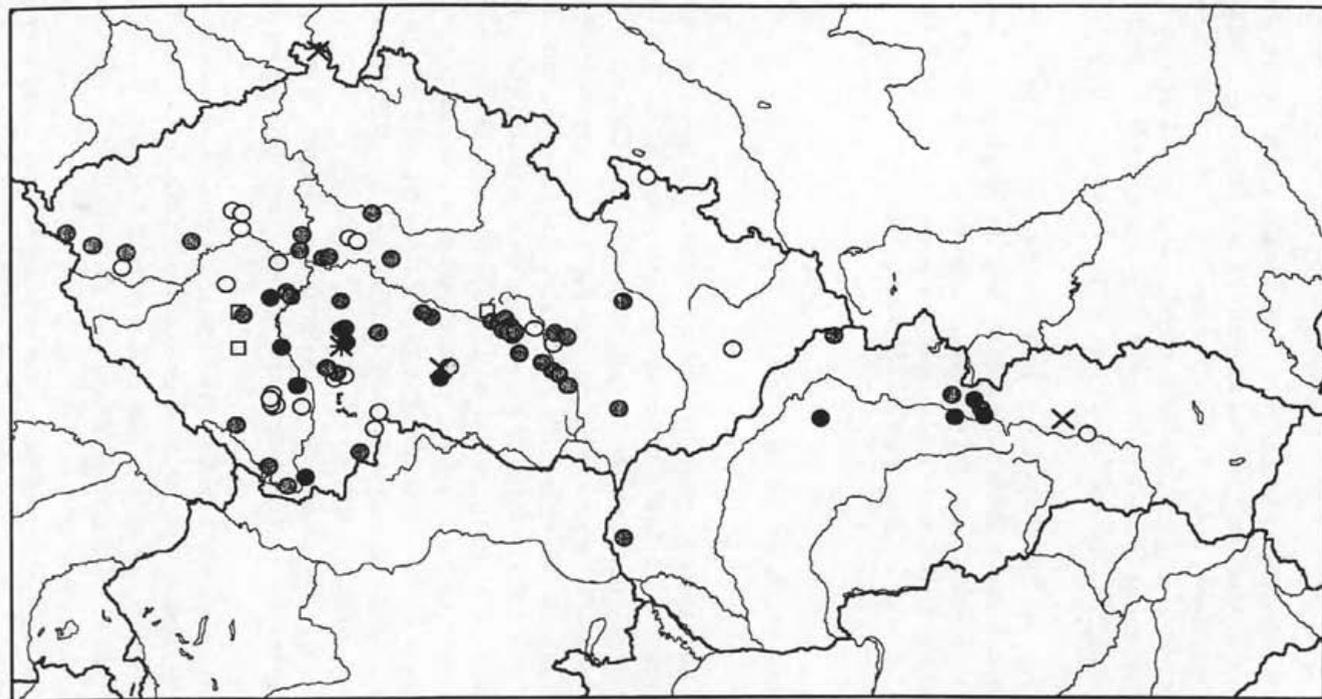
Pileus about 25 mm in width, rough to wrinkled particularly in old specimens, whitish, ash-grey, grey to blackish or with brown hue. Stipe smooth, thin (1–5 mm), dark brown, grey, black. Spines whitish to pale grey or brown. Context grey to brown, turning green in KOH when cut. Expulsion of liquid not observed. Clamp-connections absent. Spores oval with small acute warts, 3.6–4.5 × 3–4 μm.

Related species. *P. confluens* does not have a stipe with colours different from the spines, its context does not turn green in KOH and grows under deciduous trees only. *P. niger* has a clearly black context. Both these species lack such a subtle stipe as *P. melaleucus* has. *P. tomentosus* is brown coloured with conspicuous concentric zones (*P. melaleucus* has such zones too, but less conspicuous) and its context does not turn green in KOH.

Occurrence. This species showed a large decline during the last 20 years, but was found in two places in the Czech Republic in 1991. (Has this fungus been overlooked?)

Accompanying trees. In the literature its occurrence in both deciduous and coniferous woods is mentioned; a small number of our collections came from deciduous woods, a large majority from coniferous and mixed woods. *Picea* occurs in 74 %, during the last 30 years in 86 % of localities. The past 10 years this species was not found under any other tree.

Distribution (Map 4). Formerly in the whole of Bohemia and Moravia except for the northern parts; during the last 20 years found almost only in southern Bohemia. In Slovakia most collections are from the Tatra Mts.

Map No. 4 - *Phellodon melaleucus*

- Documented data:
- - locality where the species was found before 1945
  - ◐ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945

- Broadly defined localities:
- × - locality where the species was found before 1945
  - \* - locality where the species was found between 1945 and 1970

**Phellodon tomentosus** (L.: Fr.) Banker

Pileus about 35 mm in width, velutinous, concentrically wrinkled, brown, ochraceous, yellow-brown or grey-brown, mostly with conspicuous darker concentric zones. Stipe smooth, more or less concolorous with the pileus. Spines white, then pale ochre-greyish, sometimes pinkish in young stages. Context pale, ochraceous, brown in the stipe, not changing colour in KOH. Expulsion of liquid not observed. Spores oval with small acute warts,  $3.1-3.6 \times 2.7-3 \mu\text{m}$ .

Related species. *P. melaleucus* does not have a velutinous pileus with such conspicuous concentric zones and its context turns green in KOH. *Hydnellum concrescens* is sienna to umbra brown with dark brown spines and has a context concolorous with the surface of the basidiome. All species of the genus *Hydnellum* have more roughly verrucose spores lack the smell of fenugreek after drying.

Occurrence. Abundant species with a relatively constant occurrence.

Accompanying trees. In the literature its occurrence in coniferous and mixed woods is mentioned; data from the Czech Republic confirm this with a few exceptions. *Pinus* occurs in 61 % of localities, *Picea* on 48 %. The rate of collections under *Picea* grew during the last 20 years (*Picea* being present in 64 % and *Pinus* in 46 % of localities).

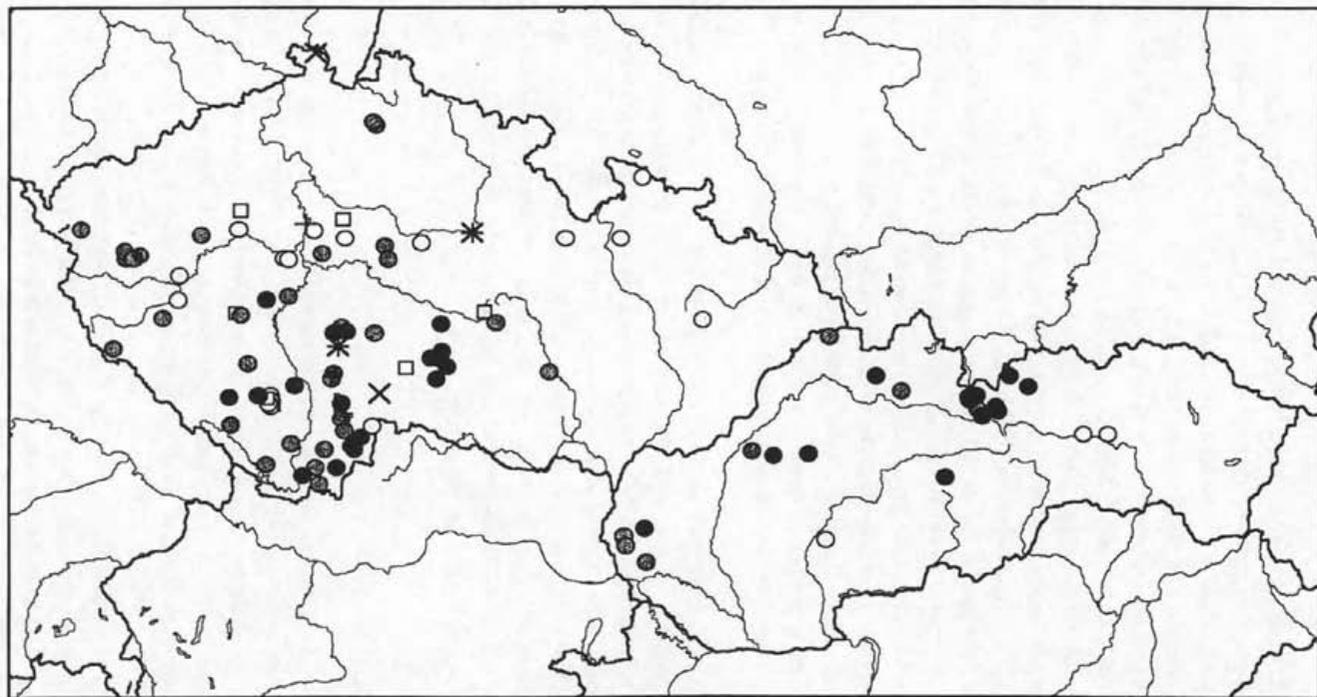
Distribution (Map 5). The species occurs in a great part of the Czech Republic and Slovakia, the highest density of collections is found in the zone western Bohemia – southern Bohemia – Bohemian-Moravian Highland. Remarkable is the absence of collections from such a well-investigated area as the surroundings of Brno is. It is possible that this species was so abundant there that it was not collected and documented (like for example *Sarcodon imbricatus*, which has a small number of records from the surroundings of Brno, too). Just as likely is that the species really does not grow in this area.

**Phellodon confluens** (Pers.) Pouzar

Pileus about 40 mm in width, surface at first tomentose, then rough to broken, whitish, greyish, yellow-brown. Stipe tomentose at base, more or less concolorous with the pileus. Spines pale to grey, in fresh young specimens light-blue. Context pale to grey-brown in the stipe, not changing colour in KOH. Expulsion of liquid not observed. Clamp-connections absent. Spores oval with small acute warts,  $3.5-4.5 \times 3-4 \mu\text{m}$ .

Related species. *P. niger* has a clearly black context turning blue-green in KOH. *P. melaleucus* is more subtle, has a thin, dark, smooth stipe (conspicuously differing from the spines) and its context turns green in KOH.

Occurrence. Relatively rare species, showing a strong decline during the last 20 years.

Map No. 5 - *Phellodon tomentosus*

- Documented data:
- - locality where the species was found before 1945
  - - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945

- Broadly defined localities:
- × - locality where the species was found before 1945
  - \* - locality where the species was found between 1945 and 1970
  - + - locality where the species was recorded before 1945

Accompanying trees. Literature sources mention its occurrence under *Fagaceae* (*Fagus*, *Castanea*, mostly *Quercus*), more rarely in mixed woods with *Picea* and *Pinus*; records from the Czech Republic and Slovakia confirm this.

Distribution (Map 6). Rare occurrence, mostly in warm regions; the distribution of this species is limited by the distribution of its accompanying trees, but it was never found in deciduous woods of higher altitudes.

List of recorded localities - Czech Republic:

- Praha-Vokovice, valley of Šárecký stream, foot of the slope on the right bank of the stream between Džbán and Dívčí skok, mixed wood (*Pinus sylvestris*, *Quercus* sp., *Robinia pseudo-acacia*) with grassy undergrowth, 17. VIII. 1939, leg. J. Herink, det. Z. Pouzar (PRM)
- Pofíčany, Kersko, *Quercus* wood, IX. 1936, leg. J. Sýkora, det. A. Pilát (PRM), X. 1937, leg. J. Sýkora, det. Z. Pouzar (PRC), 11. X. 1955, leg. et det. Z. Pouzar, 22. VIII. 1965, leg. et det. E. Wichanský (both PRM), 8. X. 1967, leg. et det. Z. Pouzar (Kotlaba 1968); mixed wood, 30. IV. 1944, leg. M. V. Svrček, det. Z. Pouzar, 22. VIII. 1965, leg. E. Wichanský, det. Z. Pouzar (both PRM)
- Chudoplesy near Bakov nad Jizerou, western margin of Baba hill, deciduous wood (*Quercus petraea*, *Carpinus betulus*, *Tilia cordata*, *Betula* sp., *Populus tremula*, *Crataegus* sp.), 10. IX. 1966, leg. et det. J. Herink (Herb. Herink)
- Obora near Obrubce, Obrubce forest, deciduous wood (*Quercus petraea*, *Betula* sp., *Tilia cordata*, *Frangula alnus*, *Carpinus betulus*, *Populus tremula*, *Crataegus* sp., *Molinia caerulea*), 240 m, 6. VIII. 1955, 16. VIII. 1958, 16. VIII. 1966, 5. IX. 1970, 5. X. 1974, all leg. et det. J. Herink (Herb. Herink)
- Sukorady near Hořice, deciduous wood, 2. VIII. 1965, 25. VII. 1966, both leg. L. Rychtera, det. Z. Pouzar (PRM)
- Frahelž, dam of lake Naděje, amongst grass, mosses and fallen leaves of *Quercus* sp., *Populus tremula* and *Salix* sp., 415 m, 20. VIII. 1988, 19. IX. 1988, both leg. T. Papoušek, det. F. Tondl (CB)

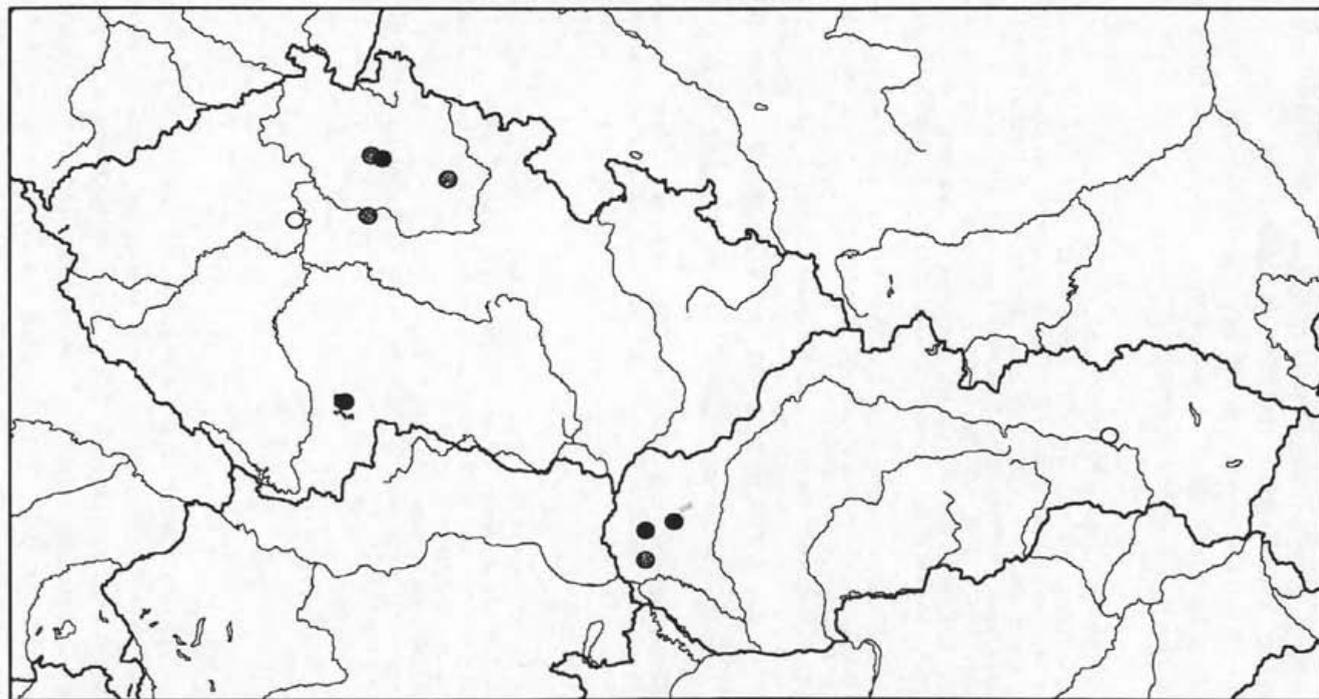
Slovakia:

- Svätý Jur, *Fagus* wood, 21. IX. 1965, 7. IX. 1966, both leg. et det. I. Fábry ut *P. amicus*, 22. IX. 1966, leg. et det. I. Fábry ut *Hydnellum zonatum*, rev. Z. Pouzar (all BRA)
- Malé Karpaty Mts., Kuchyňa, Vývrať, *Quercus-Fagus-Carpinus* wood, 8. VIII. 1972, leg. A. Dermek, det. Z. Pouzar (BRA, Dermek 1973)
- Horné Orešany, 30. VII. 1972, leg. B. Matoušek, det. P. Hrouda (BRA)
- Kluknava, Predná dolina, mossy *Pinus* wood, X. 1862, leg. et det. K. Kalchbrenner ut *Hydnum hepaticum*, rev. Z. Pouzar (BRA)

Thelephoraceae Chev.

*Hydnellum* P. Karst.

Basidiomes pileate, stipitate; stipe sometimes shortened, because of the spines running down to the base. Surface of the pileus tomentose, fibrillose, ridged, rough or scrobiculate, variously coloured. Stipe tough, concolorous with pileus or not. Spines brown at maturity in most of the species. Context fibrillose, soft or tough to woody, zoned, variously coloured, monomitic. Hyphae rarely inflating, thin-walled to thick-walled, with or without clamp-connections. Hyphae in spines similar, but remaining thin-walled; the presence or absence of clamp-connections

Map No. 6 - *Phellodon confluens*

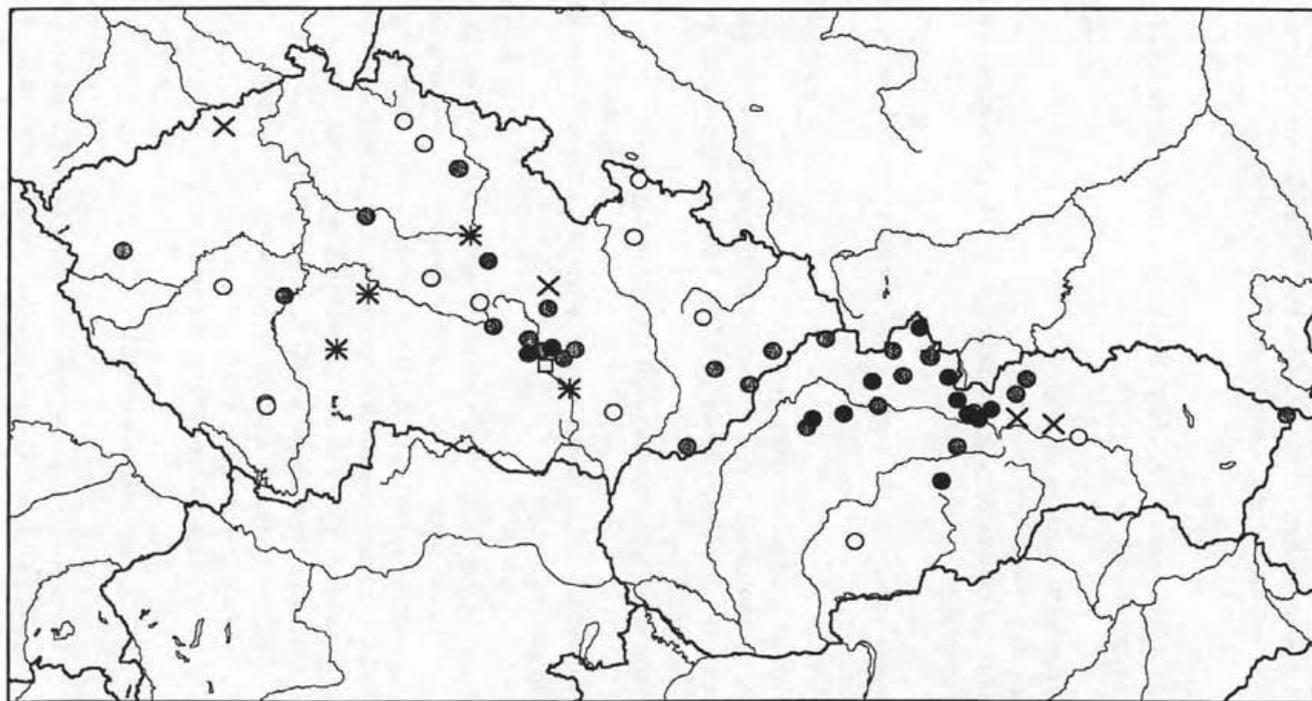
Documented data:

- - locality where the species was found before 1945
- ◐ - locality where the species was found between 1945 and 1970
- - locality where the species was found after 1970

on these hyphae and at the base of the clavate 4-spored basidia is connected with their presence or absence in the hyphae of the whole basidiome. Spores of irregular shape, verrucose, tuberculiform or spiny, brownish. Cystidia absent.

Key to the species:

- 1) Young basidiome sulphurous yellow, older olive-green, turning black on pressing, the context concolorous  
... *H. geogenium*
- 1') Basidiome differently coloured, never yellow
  - 2) Context showing blue colours when cut
    - 3) Base of the stipe conspicuously orange (on the surface and especially in the context)  
... *H. caeruleum*
    - 3') No orange colour in the base of the stipe nor elsewhere on the basidiome  
... *H. suaveolens*
  - 2') Context without blue colour when cut
    - 4) Surface of basidiome and also context orange or pale with orange hue; context not turning violet in KOH; base of stipe orange as in *H. caeruleum*
    - 5) Context pale, surface of pileus pale or orange  
... *H. aurantiacum*
    - 5') Context orange to orange-brown, more or less concolorous with the pileus  
... *H. auratile*
  - 4') Basidiome (respectively pileus) pale, ferruginous or brown, context brown to ferruginous; context quickly turning violet (sometimes changing to olive-green) in KOH; if not turning violet, taste pungent
    - 6) Surface of pileus brown, non-tomentose, rough, wrinkled, zoned or covered with irregular outgrowths already when young
    - 7) Pileus rather thin, wrinkled and concentrically zoned; sometimes covered with irregular outgrowths; spores with acute or truncate, angular warts
    - 8) Spores with truncate, angular warts  
... *H. conrescens*
    - 8') Spores with acute warts  
... *H. cumulatum*
    - 7') Pileus rather massive, nearly always covered with irregular outgrowths (but the previous two species may look similar); spores with rounded warts  
... *H. scrobiculatum*

Map No. 7 - *Hydnellum suaveolens*

- Documented data:
- - locality where the species was found before 1945
  - ⊙ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945

- Broadly defined localities:
- × - locality where the species was found before 1945
  - \* - locality where the species was found between 1945 and 1970

- 6') Surface of pileus pale and tomentose when young, later changing to ferrugineous and the tomentum falling off  
9) Growing in deciduous woods; tomentum of the stipe smooth  
... *H. spongiosipes*
- 9') Growing in coniferous woods; tomentum on the stipe rough  
10) Taste pungent; context not turning violet in KOH; hyphae with clamp-connections  
... *H. peckii*
- 10') Taste mild; context immediately turning violet (sometimes changing to olive-green) in KOH; hyphae without clamp-connections  
... *H. ferrugineum*

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

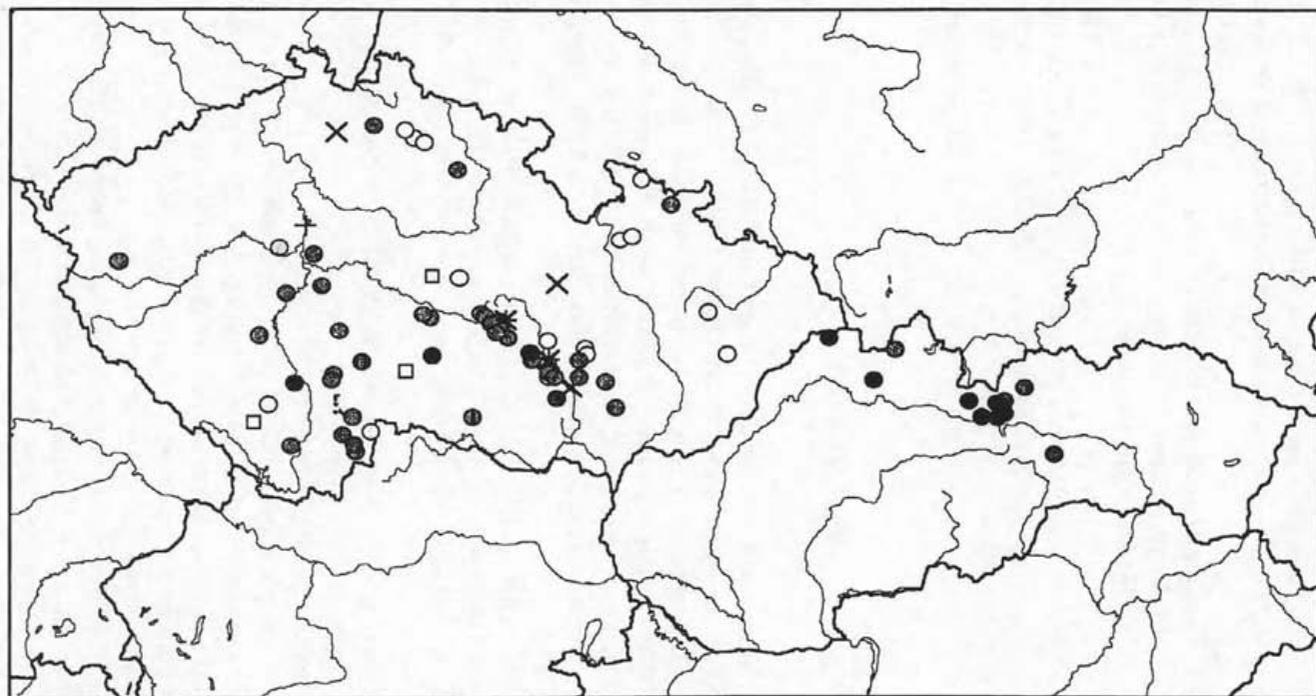
Pileus about 75 mm in width, velutinous in young stages, rough, wrinkled when old, whitish, with bluish hue when young, turning yellow to brown with age. Stipe whitish, sometimes with translucent blue tones. Spines whitish to lightly bluish when young, soon turning pink to brown. Context whitish, brightly blue zoned when cut, a thin cut turning blue-green in KOH. Expulsion of liquid not observed. Clamp-connections present. Spores irregularly tuberculiform, not verrucose, 4-5 × 3-3.6 μm.

Related species. No other species than *H. caeruleum* has the blue colouring of the context, but that species has a brightly orange stipe base. The odour of *H. suaveolens* is strong like aniseed (even after 40 years in herbarium - according to J. Herink).

Occurrence. Formerly abundant species which has recently become rare; not found in the Czech Republic during the last 10 years.

Accompanying trees. The literature mentions coniferous trees (*Picea* woods, more rarely other or mixed woods); this is fully confirmed by the Czech and Slovak collections. *Picea* occurs in 84 % of localities, but the rate of localities with occurrence of other trees is neither negligible. Also the collection from Kersko between Praha and Poděbrady is probably connected with *Pinus*. During the last 25 years the species was found only in localities with *Picea*.

Distribution (Map 7). More abundant occurrence in the Bohemian Massif (area of the Czech Republic without the Carpathian Mountains) between Žďár n. Sáz. and Brno, anywhere else rare in isolated localities. In the Carpathians since the 1970s abundant, collected here almost exclusively at mountain and sub-mountain elevations.

Map No. 8 - *Hydnellum caeruleum*

- Documented data:
- - locality where the species was found before 1945
  - (with a dot) - locality where the species was found between 1945 and 1970
  - (solid black) - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945

- Broadly defined localities:
- × - locality where the species was found before 1945
  - \* - locality where the species was found between 1945 and 1970
  - + - locality where the species was recorded before 1945

**Hydnellum caeruleum** (Hornem.) P. Karst.

Pileus about 60 mm in width, without corrugate formations, young specimens softly velutinous, sometimes with light-blue hue, white, turning light-orange to brown when old. Stipe pale, turning dark when old like the pileus. Spines whitish, old brownish. Context pale, blue coloured in the pileus, brightly orange to ferruginous in the base of the stipe, a thin cut turning (blue-)green in KOH. Context sometimes with zonations of blue lines when cut, blue colours may also be seen on the surface of the basidiome where damaged. Expulsion of liquid not observed. Clamp-connections present, scattered on old hyphae. Spores with conspicuous angular warts,  $5.4-6(-6.3) \times 3.4-4.3 \mu\text{m}$ .

Related species. The similar *H. aurantiacum* has no blue colours in cross-section. *H. suaveolens* has no orange or ferruginous colours in its context (which is characteristic for the stipe base of *H. caeruleum*).

Occurrence. Formerly an abundant species, but rapidly declining since the 1970s.

Accompanying trees. The literature mentions mostly coniferous trees, more rarely deciduous woods (*Fagus*); in our country the species is known almost exclusively from coniferous woods. *Picea* occurs in 68 %, *Pinus* in 44 % of localities.

Distribution (Map 8). The species was abundant in southern Bohemia, south of Prague, in the Bohemian-Moravian Highland and in southern Moravia (from Žďárské vrchy to Ždánický les) until the 1950s, the last record from the surroundings of Brno dates from 1975, in northern and eastern Bohemia it was last seen in 1963, in northern Bohemia in 1951. In Slovakia the species has been found in the region of the Tatras, where it does not show any sign of decline.

**Hydnellum aurantiacum** (Batsch: Fr.) P. Karst.

Pileus about 50 mm in width, at first pale beige to white, turning bright to dark orange. Stipe orange to orange-brown. Spines whitish when young, brown at maturity. Context pale in the pileus, orange in the stipe (especially its base), a thin cut turning olive-green in KOH. Expulsion of liquid not observed. Clamp-connections absent. Spores with conspicuous angular warts,  $(5.8-)6-6.7 \times (4-)4.3-4.9 \mu\text{m}$ .

Related species. *H. auratile* has a dark orange context concolorous with the pileus surface (the context of *H. aurantiacum* is pale). *H. caeruleum* shows (conspicuous) blue zones in cross-section.

Occurrence. Moderately abundant species, in the Czech Republic rare in the last decades.

Accompanying trees. The literature mentions different trees, both coniferous and deciduous. Our collections from all localities where the accompanying trees were written down, are associated with coniferous trees. *Picea* occurs in 66 %, *Fagus* in 33 %, *Pinus* in 17 %.

*Pinus* in 43 % of localities. In collections of the last 20 years *Picea* dominated (73 %).

Distribution (Map 9). Formerly an abundant species in southern Bohemia and the region of the river Sázava, scatteredly growing elsewhere in Bohemia. During the last 30 years it was found only three times in Bohemia. The last record from Moravia dates from 1960. In Slovakia it is relatively abundant at higher altitudes, not showing any signs of decline.

### **Hydnellum auratile** (Britzelm.) Maas G.

Pileus about 25 mm in width, rough, wrinkled to concentrically ridged, orange to light orange-brown, sometimes with concentric, not clearly delimited zones of appressed squamules of a bright orange (to red) colour on a darker (brownier) ground; basidiomes subtle. Stipe concolorous with the pileus. Spines mostly brown. Context more or less concolorous with pileus, a thin cut turning olive-green in KOH. Expulsion of liquid not observed. Clamp-connections absent. Spores with conspicuous angular warts,  $4.9-5.8 \times 3.6-4.5 \mu\text{m}$ .

Related species. *H. aurantiacum* has the context paler than the surface (except for young specimens) and lacks the mentioned squamules on the pileus surface. The shape is similar to *H. conrescens*, but this species is brown on the surface and also inside, without any orange hue.

Occurrence. Very rare species.

Accompanying woods. The literature mentions both coniferous and deciduous trees (*Picea*, *Fagus*); our collections are mostly from *Picea* woods.

Distribution (Map 10). Rare occurrence in isolated localities.

#### List of recorded localities – Czech Republic:

- Vlastibůf, forest part of V Horkách, sandy *Pinus* wood with *Calluna* and *Vaccinium*, 430 m, 20. IX. 1991, leg. P. Hrouda, det. Z. Pouzar (PRM)  
 Mnichovice, VII. 1936, leg. J. Velenovský, det. P. Hrouda (PRC)  
 Partutovice, coniferous wood, IX. 1936, leg. et det. F. Petrak ut *H. aurantiacum*, rev. R. A. Maas Geesteranus (Maas Geesteranus 1964, Kubička 1965), rev. P. Hrouda (PRM)

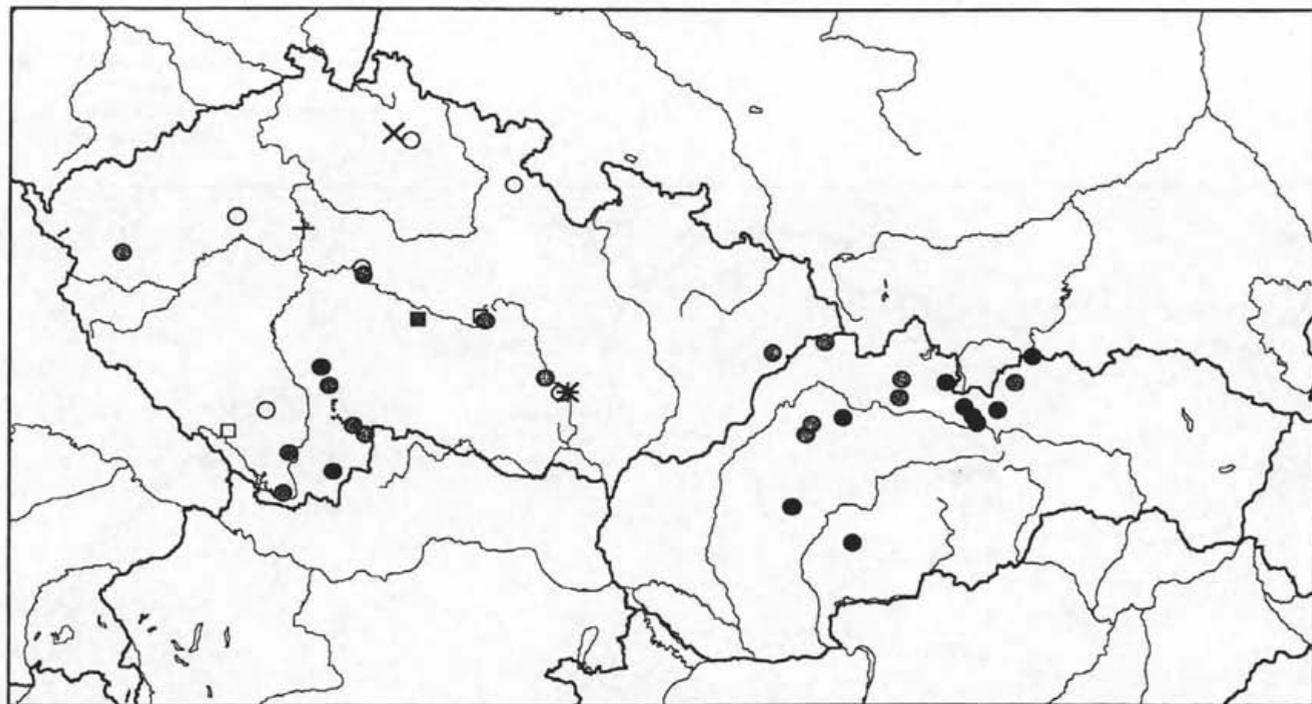
#### Slovakia:

- Vážec, Vážecká poľana (Slamená), mixed *Picea* wood, 1000 m, 12. IX. 1988, leg. F. Kotlaba, det. F. Kotlaba et J. Lazebník ut *H. aurantiacum*, rev. P. Hrouda (PRM)  
 Vavrišovo near Liptovský Hrádok, *Picea* wood, 15. VIII. 1974, leg. A. Dermek, det. Z. Pouzar (PRM, BRA)

### **Hydnellum peckii** Banker in Peck

Pileus about 50 mm in width, at first whitish and velutinous, later turning dark, ferruginous to brown and soon becoming roughly fibrillose. Stipe concolorous. Spines whitish when young, turning brown with age. Context pale to brown,

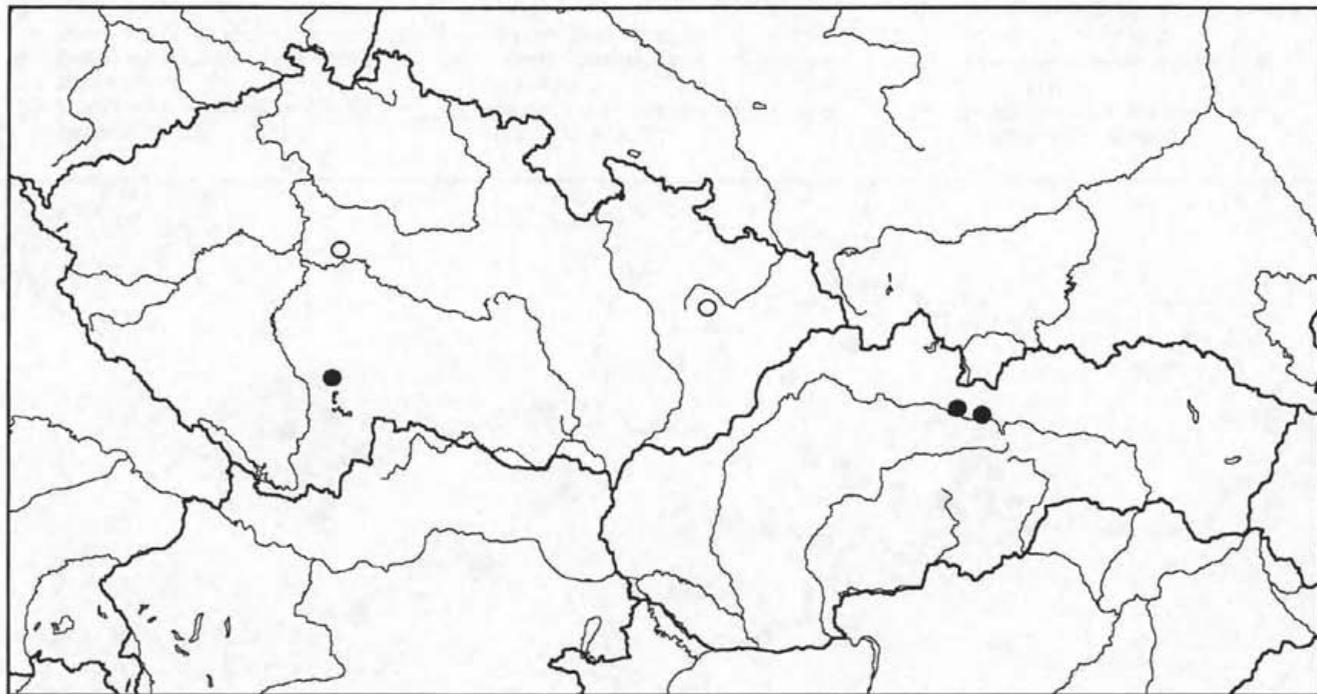
Map No. 9 - *Hydnellum aurantiacum*



- Documented data:
- - locality where the species was found before 1945
  - - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945
  - - locality where the species was recorded between 1945 and 1970

- Broadly defined localities:
- × - locality where the species was found before 1945
  - \* - locality where the species was found between 1945 and 1970
  - + - locality where the species was recorded before 1945

Map No. 10 - *Hydnellum auratile*

Documented data:

- - locality where the species was found before 1945
- - locality where the species was found after 1970

darker in the stipe, not changing colour in KOH. Red drops of expelled liquid may appear on the surface of the young pileus. Clamp-connections present. Spores with conspicuous angular warts,  $4.9-5.4 \times 3.8-4 \mu\text{m}$ .

Related species. *H. ferrugineum* has a mild taste (*H. peckii* is sharp even as an exsiccate), its context turns violet in KOH and it lacks clamp-connections. This also counts for *H. spongiosipes*, which in addition grows only in deciduous woods. *H. conrescens* and related species have their pileus, stipe, spines and context approximately equally brown, darker than the pileus of *H. peckii*, and they also lack clamp-connections.

Occurrence. Moderately abundant species, showing gradual decline.

Accompanying trees. The literature mentions coniferous trees (*Picea*, *Pinus*); Czech and Slovak records confirm this, coniferous trees are present in all localities. *Pinus* occurs in 67 %, *Picea* in 55 % of localities.

Distribution (Map 11). The species has two centres in the former Czechoslovakia – southern Bohemia and the central part of the Slovak Carpathians – where it still occurs. The last record from Moravia dates from 1974, in northern Bohemia it was last found in 1966.

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

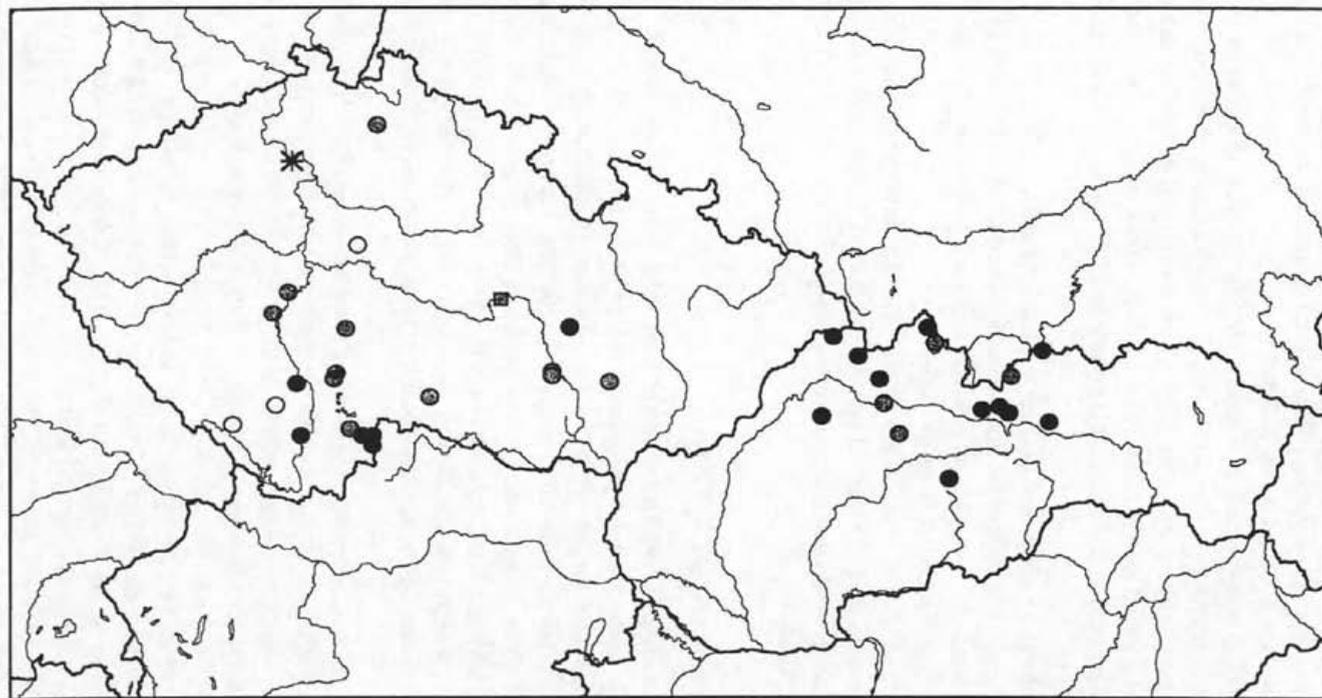
Pileus about 60 mm in width, whitish and velutinous when young, less velutinous to rough and turning ferruginous to brown with age. Stipe at its base, particularly in young stages, white to ferruginous, velutinous, more or less concolorous with the pileus (but not always so), surface tomentose and rather scrobiculate. Spines light brown-violet when young, turning brown with age to dark brown when old. Context ferruginous brown, a thin cut turning dark carmine in KOH. Red drops of expelled liquid may appear on the surface of young pilei. Clamp-connections absent. Spores with conspicuous angular warts,  $(5.4-5.8-6.3 \times 3.6-4.5 \mu\text{m})$ .

Related species. The context of *H. peckii* is pungent even after drying, does not turn violet in KOH, and has clamp-connections. *H. spongiosipes* has a homogeneous tomentum on the stipe, nearly spiny spores (the warts on the spores of *H. ferrugineum* have truncate apices) and grows in deciduous woods.

Occurrence. Still relatively abundant.

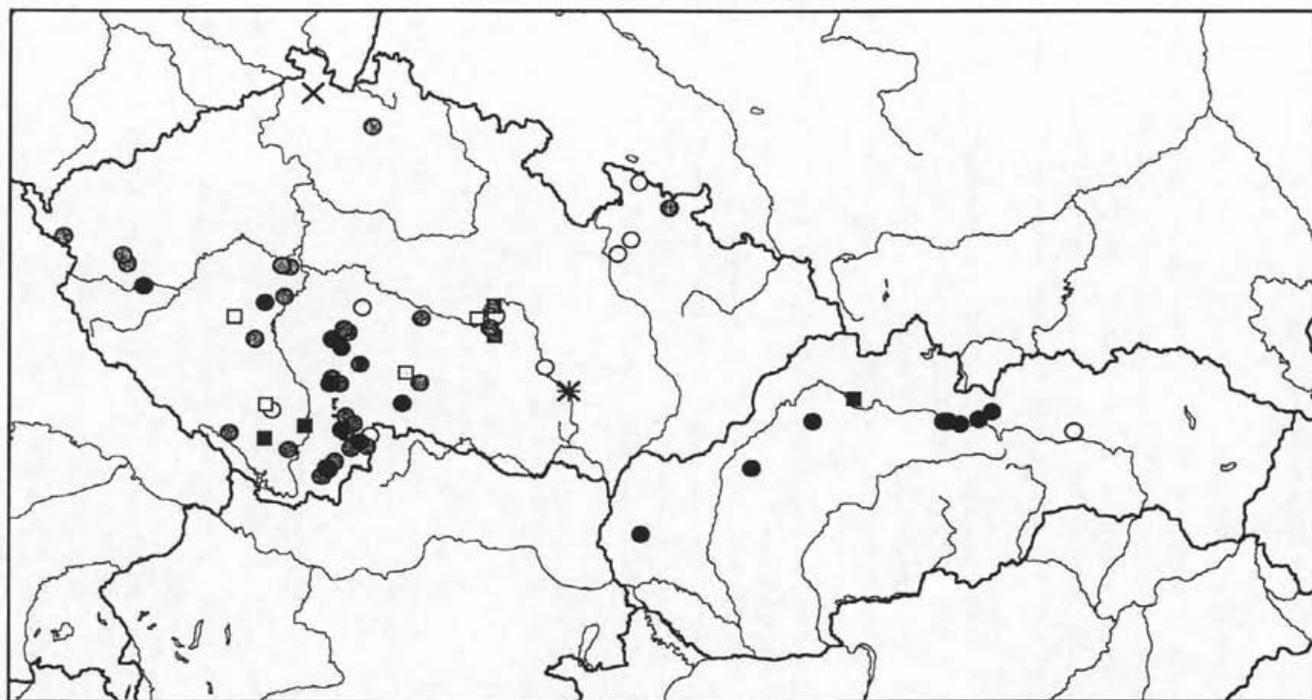
Accompanying trees. The literature mentions coniferous trees (*Picea*, *Pinus*, *Abies*), rarely mixed and deciduous woods; our collections confirm this. *Pinus* occurs in 66 %, *Picea* in 38 % of localities; the rate of localities where *Pinus* occurs grew to 79 % during the last 30 years.

Distribution (Map 12). The centre of its distribution is situated in southern Bohemia; the last record from central Bohemia is from 1957, from northern Bohemia 1966, and from Moravia 1960 (near Žďár n. Sáz.). In Slovakia this species

Map No. 11 - *Hydnellum peckii*

- Documented data:
- - locality where the species was found before 1945
  - ◐ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970
- Data from literature:
- - locality where the species was recorded between 1945 and 1970
- Broadly defined localities:
- \* - locality where the species was found between 1945 and 1970

Map No. 12 - *Hydnellum ferrugineum*



- Documented data:
- - locality where the species was found before 1945
  - ◐ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945
  - ◑ - locality where the species was recorded between 1945 and 1970
  - - locality where the species was recorded after 1970

- Broadly defined localities:
- × - locality where the species was found before 1945
  - \* - locality where the species was found between 1945 and 1970

is not very abundant, it was particularly found below the Tatra Mountains, but it is evident that higher altitudes are not typical of it.

### *Hydnellum spongiosipes* (Peck) Pouzar

Pileus about 50 mm in width, velutinous, at first whitish, then fleshy, turning brown with age, often cinnamomeous. Stipe velutinous, concolorous with the pileus or darker, its surface evenly tomentose. Spines at first whitish, then turning brown. Context concolorous with pileus surface, a thin cut turning dark carmine in KOH. Expulsion of liquid not observed. Spores with very conspicuous acute warts, (5.4-) 6.3-7.2 × 4.4-5.4 μm.

Related species. *H. ferrugineum* and *H. peckii* are species of coniferous woods, their spores have truncate warts and an expulsion of red drops may appear in young specimens of these species. Other characters of *H. peckii* are its pungent taste, the presence of clamp-connections and the context not changing colour in KOH.

Occurrence. Rare species, recently found in Slovakia, but not found in the Czech Republic during the last 20 years.

Accompanying trees. The literature mentions *Fagaceae*, most often *Quercus*. Indeed, *Quercus* is present in all Czech and Slovak localities, where the accompanying trees were recorded, in the remaining cases its presence is possible.

Distribution (Map 13). Rare occurrence in isolated localities.

#### List of recorded localities - Czech Republic:

- Poříčany, Kersko, *Quercus* wood, 30. VII. 1944, leg. V. Vacek, det. R. A. Maas Geesteranus, 11. X. 1955, leg. et det. Z. Pouzar (both PRM, Pouzar 1956), 31. VIII. 1960, leg. et det. Z. Pouzar (BRNM), 8. X. 1967, leg. et det. Z. Pouzar (Kotlaba 1968), 7. IX. 1969, leg. P. Krampera, det. K. Kunc ut *H. velutinum* = *spongiosum* (Krampera 1970); mixed wood, 22. VIII. 1965, leg. et det. E. Wichanský ut *H. velutinum* (PRM)  
 Obora, Obrubce forest, deciduous wood (*Quercus petraea*, *Betula* sp., *Tilia cordata*, *Frangula alnus*, *Molinia caerulea*), 250 m, 5. IX. 1970, leg. et det. J. Herink (Herb. Herink)

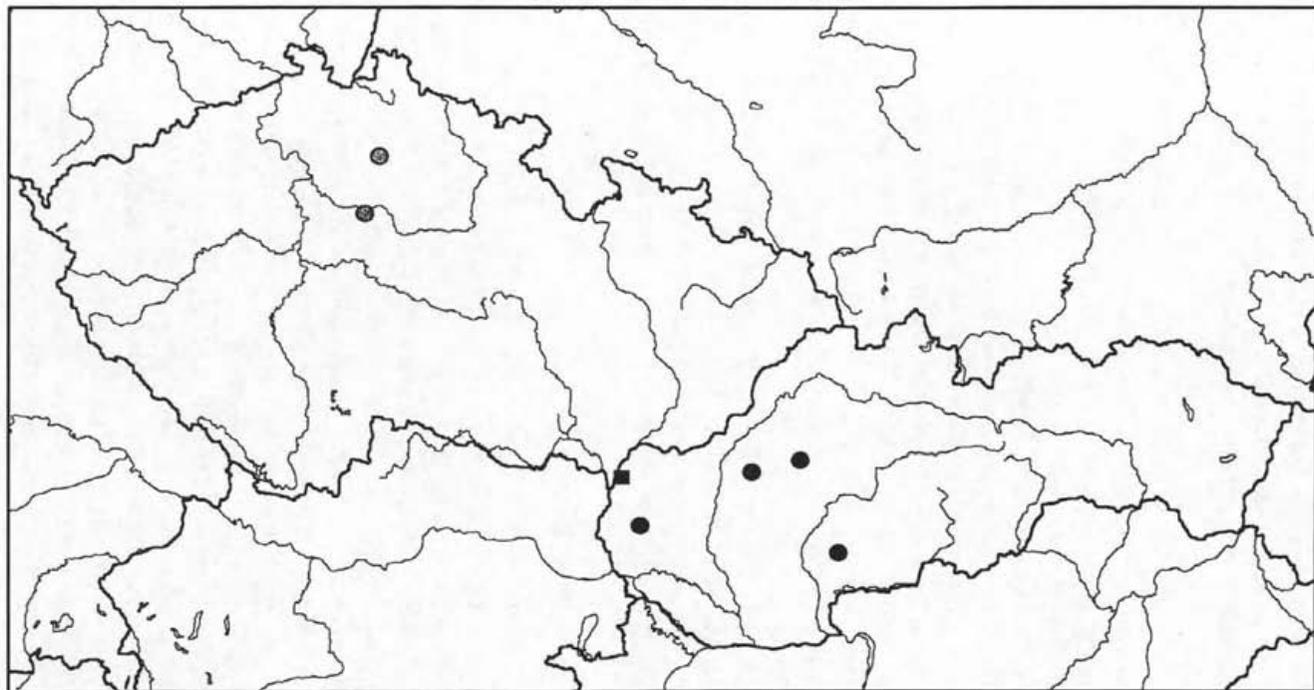
#### Slovakia:

- Žembovce, slope of Husárka hill, *Quercus* wood, 400 m, 23. IX. 1987, leg. et det. J. Kuthan (BRA)  
 Gbely, Dúbravka, *Quercus* wood, 17. IX. 1972, 7. VIII. 1974, both leg. et det. A. Dermek (Dermek 1978)  
 Kuchyňa, Vývrať, 3. VIII. 1972, leg. et det. I. Fábry ut *H. scrobiculatum*, rev. Z. Pouzar, 20. VIII. 1972, leg. A. Horváthová, det. Z. Pouzar (both BRA)  
 Zlatníky, *Quercus* wood, 400 m, 11. VII. 1971, leg. et det. J. Kuthan (BRA)  
 Mačov near Diviaky nad Nitricou, deciduous to mixed wood (*Quercus*, *Pinus*), 420 m, 14. IX. 1980, leg. et det. J. Kuthan (BRA)

### *Hydnellum scrobiculatum* (Fr.) P. Karst.

Pileus about 40 mm in width, rough, wrinkled, mostly covered with many irregular outgrowths or little secondary pileoli; conrescence of basidiomes frequent.

Map No. 13 - *Hydnellum spongiosipes*



- Documented data:
- ⊗ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

Entire basidiome – both pileus and stipe – brown, margin of the pileus sometimes a little lighter. Spines concolorous, context too, a thin cut turning dark carmine in KOH. Yellowish drops of expelled liquid may appear on the surface of the pileus. Clamp-connections absent. Spores with conspicuous rounded warts,  $5.6-7 \times 4.5-4.9 \mu\text{m}$ .

Related species. The species is macroscopically not reliably distinguishable from *H. conrescens* and *H. cumulatum*. Under the microscope the spores of *H. scrobiculatum* are found to have rounded warts, *H. conrescens* has spores with truncate and *H. cumulatum* with acute warts.

Occurrence. Less abundant species, showing a growing decline.

Accompanying trees. The literature mentions coniferous trees (mostly *Pinus*), but also mixed woods (with representatives of the family *Fagaceae*); Czech and Slovak collections come from coniferous (the majority), mixed and deciduous woods. *Pinus* occurs in 54 %, *Quercus* in 29 % of localities. There is a shift from deciduous woods (most collections in the 1930s and 1940s) to coniferous woods (most collections in the 1950s); the species was not found under deciduous tree during the last decade.

Distribution (Map 14). Formerly locally abundant species in the whole of Bohemia, recently limited to a few localities in the area between Prague and České Budějovice. The last record from the northern part of Bohemia is from 1946, in Moravia it was last seen in 1970. In Slovakia it occurs rarely in isolated localities.

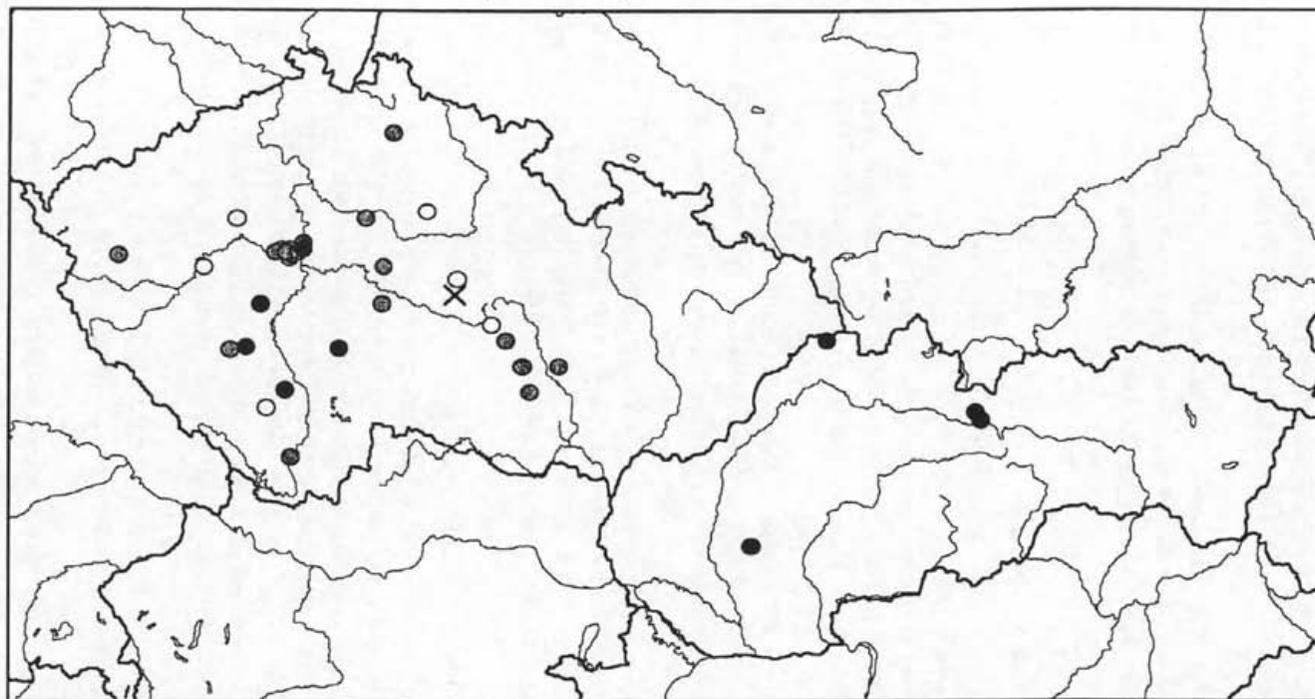
### **Hydnellum conrescens (Pers.) Banker**

Pileus about 40 mm in width, brown, wrinkled, with concentric zones, if not destroyed by irregular outgrowths on the surface of the pileus. Stipe concolorous with the pileus. Spines sometimes paler than pileus in young stages, turning dark brown at maturity. Context brown, concolorous with the surface of the basidiome, a thin cut turning dark carmine in KOH. Yellowish drops of expelled liquid may appear on the surface of the pileus. Clamp-connections absent. Spores with conspicuous angular warts,  $5.4-6.1 \times (3.6-4-4.5 \mu\text{m})$ .

Related species. *H. scrobiculatum* and *H. cumulatum* are macroscopically indistinguishable from this species; basidiomes of *Hydnellum* with a conspicuously concentrically zoned pileus and without surface outgrowths, very probably concern *H. conrescens*, but a microscope is needed to check this: the spores of *H. cumulatum* have acute warts, those of *H. scrobiculatum* rounded warts; the spores of *H. conrescens* have warts with truncate apices (like molar teeth). It can also be confused with *H. auratile* with an orange context and *Phellodon tomentosus* with light, beige to ochraceous spines, oval spores with small apices and a smell of fenugreek when dried.

Occurrence. Formerly abundant, showing strong decline.

Map No. 14 - *Hydnellum scrobiculatum*



Documented data:

- - locality where the species was found before 1945
- (with dot) - locality where the species was found between 1945 and 1970
- (solid) - locality where the species was found after 1970

Broadly defined localities:

- × - locality where the species was found before 1945

Accompanying trees. According to the literature this species grows under both coniferous and deciduous trees, which is confirmed in our country. The spectrum of accompanying trees is very wide. The most frequent are *Picea* (52 %) and *Quercus* (35 % of localities).

Distribution (Map 15). The species occurs almost in the whole area of the former Czechoslovakia. It does not have distinct distribution centres. It is currently not abundant in Slovakia and rare in the Czech Republic, but is still found in isolated localities.

#### **Hydnellum cumulatum** K. Harrison

Pileus about 25 mm in width, scrobiculate, sulcate to radially ridged, brown, often more basidiomes grown together. Stipe concolorous with the pileus, spines more or less so. Colour of the context similar to the surface of the pileus, a thin cut turning dark carmine in KOH. Yellowish drops of expelled liquid may appear on the surface of the basidiome. Clamp-connections absent. Spores with conspicuous acute warts,  $4.3-5.6 \times 3.6-4.3 \mu\text{m}$ .

Related species. *H. cumulatum* is macroscopically indistinguishable from *H. conrescens* and *H. scrobiculatum*. It differs from these species by its acutely spiny spores; *H. conrescens* has spores with truncate, angular warts, *H. scrobiculatum* with rounded warts.

Accompanying trees. The literature mentions coniferous trees (*Picea*, *Pinus*).

Czech find of *Hydnellum cumulatum* (Map 16): Šalmanovice (southern Bohemia), *Pinus sylvestris*, 2. IX. 1960, leg. C. Bas, det. R. A. Maas Geesteranus (preserved in L; Maas Geesteranus 1975, Kubička 1981).

#### **Hydnellum geogenium** (Fr.) Banker

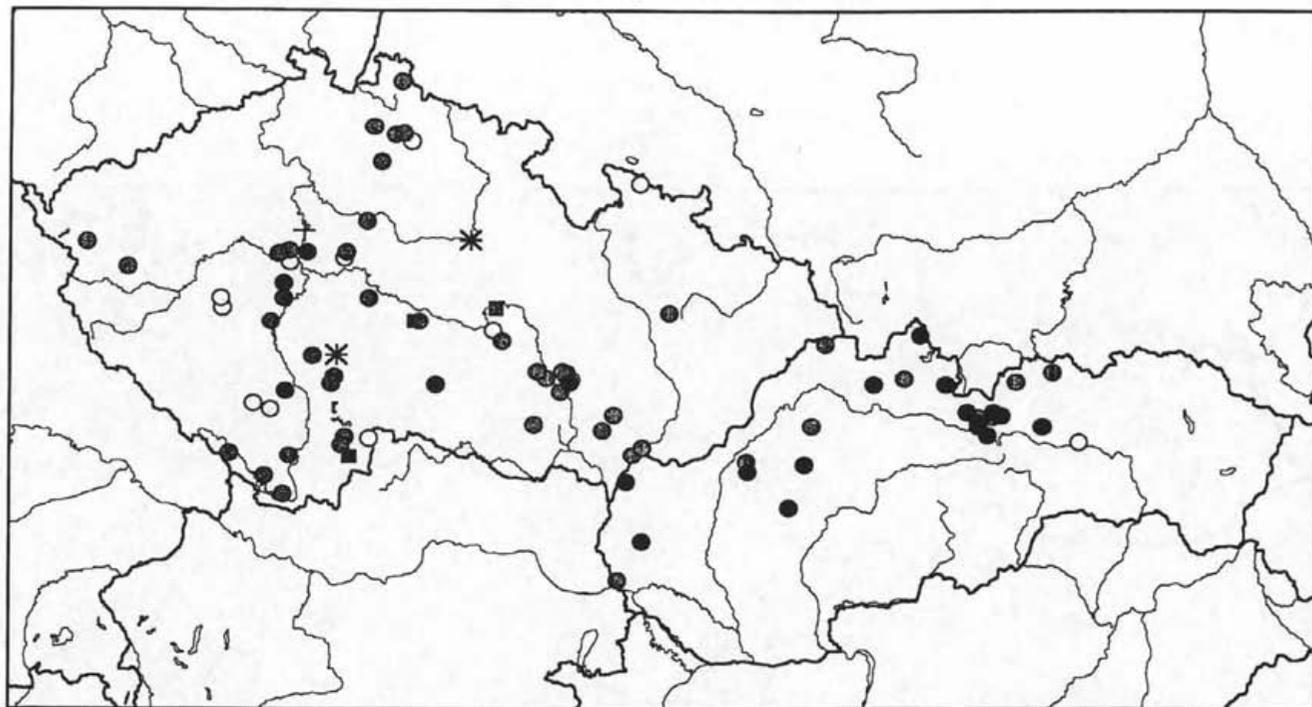
Pileus about 25 mm in width, at first sulphurous yellow, with age and by pressing turning olive-green to black, with irregular surface, wrinkled, with outgrowths or secondary pileoli, basidiomes often grown together. Stipe (often indistinguishable when basidiomes are grown together) concolorous. Spines sulphurous yellow when young, then turning brown. Context yellow when young, gradually turning to olive-green, a thin cut turning olive in KOH. Expulsion of liquid not observed. Clamp-connections present. Spores with not very conspicuous angular warts,  $4.5-5.2 \times 3.1-3.6 \mu\text{m}$ .

Related species. Not to be confused with any other species.

Occurrence. Rare species, still found in Slovakia, almost disappeared from the Czech Republic.

Accompanying trees. Literature sources mention coniferous trees. This species seems to be associated with *Picea*, which occurs (with one exception – a collection from the 19th century) in all localities where the trees were recorded.

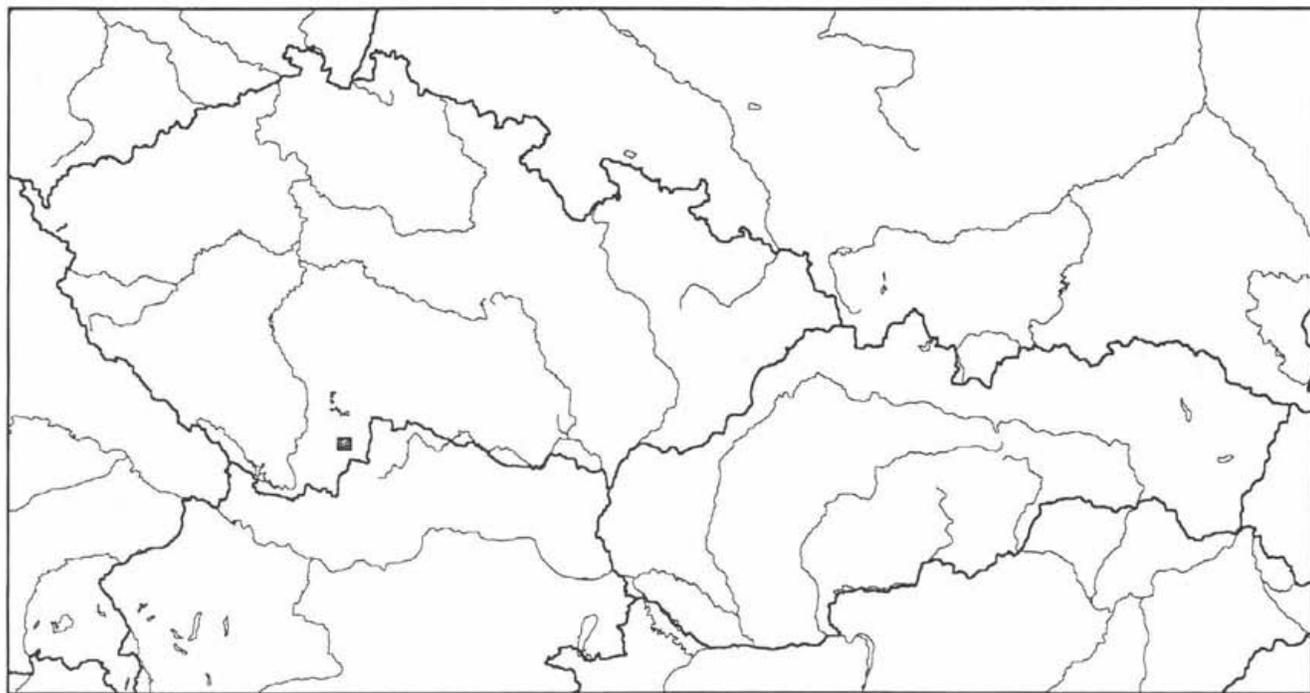
Map No. 15 - *Hydnellum concrescens*



- Documented data:
- - locality where the species was found before 1945
  - - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded between 1945 and 1970
  - - locality where the species was recorded after 1970

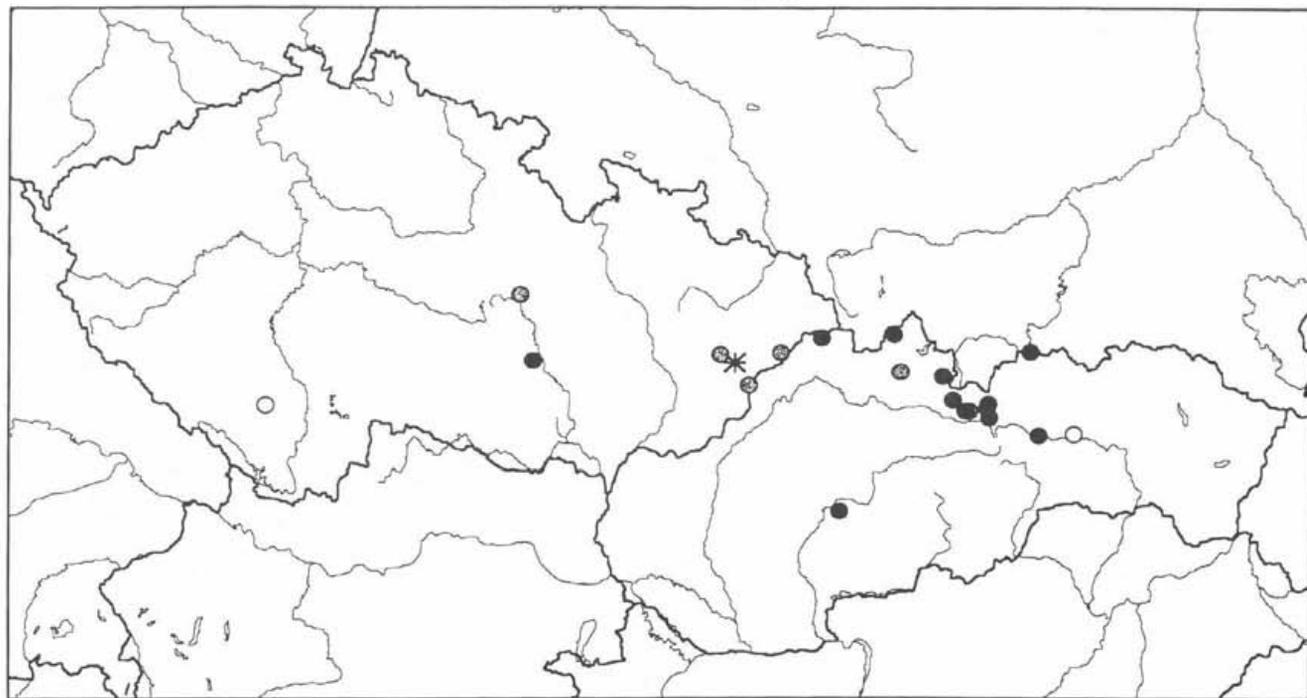
- Broadly defined localities:
- \* - locality where the species was found between 1945 and 1970
  - + - locality where the species was recorded before 1945

Map No. 16 - *Hydnellum cumulatum*

Data from literature:

- - locality where the species was recorded  
between 1945 and 1970

Map No. 17 - *Hydnellum geogenium*



- Documented data:
- - locality where the species was found before 1945
  - ⊙ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Broadly defined localities:
- \* - locality where the species was found between 1945 and 1970

Distribution (Map 17). Isolated occurrence in the Bohemian Massif, somewhat more abundant in the Carpathians (the belt Beskydy - Kysuca - Orava - Tatry - Spiš); prefers higher altitudes.

List of recorded localities - Czech Republic:

- Libějovické Svobodné Hory, forest on Holička hill, planted *Picea* wood, 550 m, VII. 1936, leg. et det. J. Herink (PRM)  
 Sádek, *Picea* wood, 17. IX. 1950, leg. E. Horníček, det. J. Herink (Herb. Herink)  
 Kuřimské Jestřábí, Falcův mlýn, *Picea* wood with admixed *Pinus*, 11. IX. 1974, leg. B. Kasala, det. K. Kříž (BRNM)  
 Kateřinice, central-western part of Mt. Dubcová mountain, planted *Picea* wood, 480 m, 31. VII. 1944, leg. V. Pospíšil, det. F. Šmarda (BRNM), 2. IX. 1948, leg. et det. V. Pospíšil (PRM)  
 Pošle, Poschla forest, *Piceetum nudum*, 3. IX. 1948, 13. VII. and 26. VII. 1953, all leg. V. Pospíšil, det. F. Šmarda, rev. F. Kotlaba (BRNM)  
 Velké Karlovice, Babské valley, *Picea-Fagus* wood, 4. IX. 1948, leg. V. Pospíšil, det. F. Šmarda (BRNM)

Broadly defined locality:

- Vsetín, 15. IX. 1946, leg. V. Pospíšil, det. F. Šmarda (BRNM)

Slovakia:

- Sklené Teplice near Banské Štiavnica, *Picea* wood, 600 m, 28. VIII. 1974, leg. et det. J. Kuthan (BRA)  
 Spišské Vlchy, *Pinus* wood, IX. 1859, leg. et det. K. Kalchbrenner ut *Hydnum sulphureum* (BRA)  
 Čingov, Hradisko hill (3 km west of Spišská Nová Ves), *Picea* wood, 560 m, 17. IX. 1985, leg. et det. J. Kuthan (BRA)  
 Nižná Suňava, *Picea* wood, 850 m, 16. VII. 1977, leg. et det. J. Kuthan (BRA)  
 Mt. Osobitá, slope, *Picea* wood, 1200 m, 7. VIII. 1977, leg. et det. J. Kuthan (BRA)  
 Štrbské Pleso, Uhlíčata, slope of Spálený vrch, *Picea* wood, 1000 m, 14. IX. 1989, leg. et det. J. Kuthan (BRA)  
 Červený Kláštor, *Picea* wood (with *Abies*), 550 m, 10. VII. 1971, leg. et det. J. Kuthan (BRA)  
 Račková valley, right bank of Račková stream, 3 km north of Pribylina, *Picea* wood, 850 m, 17. VIII. 1974, leg. A. Dermek, det. P. Hrouda (BRA)  
 Východná, Krátke forest, *Picea* wood, 950 m, 2. IX. 1978, leg. J. Kuthan, Jos. Herink et Jan Herink, det. Jos. Herink (Herb. Herink)  
 Važecké louky, north of the road Východná - Važec, *Picea* wood, 850 m, 23. VIII. 1970, leg. et det. J. Kuthan (BRA)  
 Tatranská Štrba, *Picea* wood, 900 m, 20. IX. 1977, leg. et det. J. Kuthan (BRA)  
 Raková, Korcháň valley, *Picea* wood, 550 m, 22. IX. 1974; 650 m, 5. X. 1974, both leg. et det. J. Kuthan (BRA)  
 Oravský Podzámok, forest in the direction of Hruštín, old *Picea* wood, 550 m, 12. VIII. 1959, 23. VIII. 1960, both leg. et det. I. Fábry (BRA)  
 Mútne, *Picea* wood, 650 m, 3. VIII. 1973, leg. et det. J. Kuthan (BRA)

*Sarcodon* P. Karst.

Basidiomes pileate, stipitate. Surface of pileus at first tomentose, then glabrescent, with cuticle sooner or later breaking up into areoles or scales, mostly brown, sometimes with yellow hue; stipe similarly coloured. Spines brown. Context fleshy to tough, non-zoned, most often whitish to brown (different colours are

characteristic of some species or groups of species), monomitic. Hyphae in context broadening towards the centre of pileus, thin-walled to slightly thick-walled, with or without clamp-connections. Hyphae in spines similar. Basidia with or without basal clamp-connections, corresponding to their presence or absence in the context, clavate, 4-spored. Spores of irregular shape, tuberculiform, verrucose, brownish. Cystidia absent.

Key to the species:

- 1) Context pink or violet; hyphae without clamp-connections
  - 2) Pileus turning dark (to black) with age; species of coniferous woods  
 ... *S. fuligineo-violaceus*
  - 2') Pileus brown, rather with a red or pink hue; species of deciduous woods  
 ... *S. joeides*
- 1') Context not pink or violet
  - 3) Base of the stipe grey- (to black-) green; hyphae without clamp-connections
    - 4) Pileus brown, cinnamomeous or purple-brown, sometimes broken up into dark brown scales on a somewhat lighter brown ground, stipe concolorous with pileus; context turning blue-green in KOH; spores rough with angular warts  
 ... *S. scabrosus*
    - 4') Pileus yellow-brown to ochraceous, sometimes broken up into scales, which may be come dark-brown, although the ground remains yellow-brown; stipe yellow-brown, ochraceous to ferruginous; spores with small rounded warts
    - 5) Both pileus and stipe more or less equally ochraceous, pileus sometimes broken up into a slightly darker scales on a lighter ground; context not changing colour in KOH  
 ... *S. fennicus*
    - 5') Pileus and stipe differently coloured, cuticle of the pileus breaking up into brown areoles in the centre and scales at the margin (darker towards the centre) on a yellowish ground; stipe dirty pale to purple-brown; context turning blue-green in KOH  
 ... *S. glaucopus*
  - 3') Base of the stipe not differently coloured; hyphae with clamp-connections
    - 6) Context whitish, chrome-yellow where the pileus passes into stipe (not clear in exsiccates); spores without distinct warts, mnot larger than  $5.5 \times 4.5 \mu\text{m}$   
 ... *S. versipellis*
    - 6') Context whitish to brown, without yellow colours; spores with mangular warts, not smaller than  $7 \times 4.5 \mu\text{m}$

- 7) Pileus fleshy to dark brown, breaking up into large scales, erect in the centre of pileus and adjacent on its margin, and deep fissures  
 ... *S. imbricatus*
- 7') Pileus pale, yellow- to light-brown, breaking up in the centre into arcoles or scales with slightly raised tips  
 ... *S. leucopus*

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

Pileus about 100 mm in width, fleshy brown, red-brown to dark brown, with age breaking up into conspicuous scales, erect in the centre of the pileus, appressed towards its margin, on a lighter ground. Stipe lighter, turning brown towards the pileus. Spines pale to purple-brown. Context whitish in the pileus, brown in the base of the stipe, not changing colour in KOH. Expulsion of liquid not observed. Clamp-connections present. Spores with conspicuous angular warts,  $7.2-8.2 \times 4.9-5.4 \mu\text{m}$ .

Related species. The pileus of *S. leucopus* is areolate or possesses only appressed squamules. *S. scabrosus* has a grey-green stipe base and a conspicuously bitter taste (the taste of *S. imbricatus* is neutral or only slightly bitterish). The context of *S. joeides* and *S. fuligineo-violaceus* is pink or violet.

Occurrence. Formerly abundant species showing a relatively conspicuous decline.

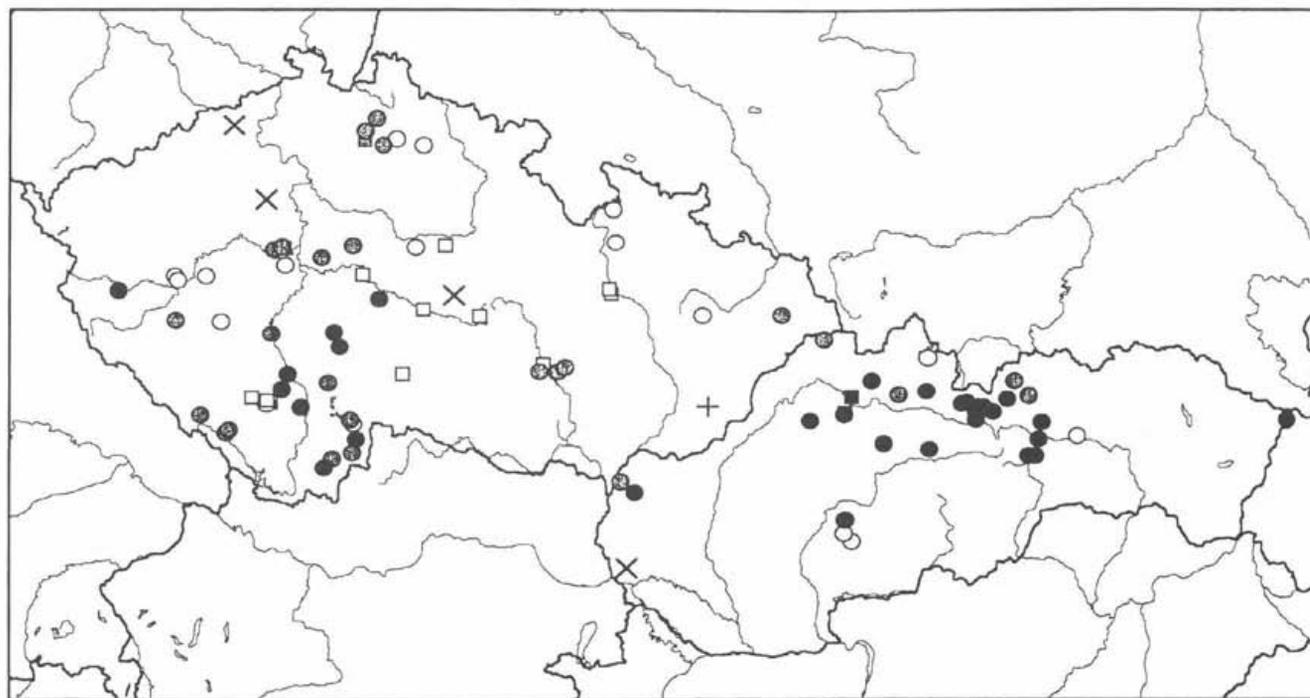
Accompanying trees. The literature mentions coniferous trees, which is confirmed in our countries with a few exceptions. The most frequent accompanying tree is *Picea*, which occurs in 79 % of localities.

Distribution (Map 18). According to J. Herink *S. imbricatus* was so abundant in the past that it was not documented, so its earlier occurrence was probably denser than the map shows. The last record from northern Bohemia dates from the year 1965, from the surroundings of Prague 1968, in Moravia it was last seen in 1957. The only part of Bohemia where it is still commonly collected is southern Bohemia. In Slovakia this species is still abundant, especially at higher altitudes.

**Sarcodon leucopus** (Pers.) Maas G. et Nannf.

Pileus about 100 mm in width, light- to dark brown, at first tomentose, later radially fibrillose towards the margin and areolate or with appressed squamules in the centre; the scales are darker on a lighter (to yellow-brown) ground. Stipe concolorous, mainly in the lower part paler, appressed squamulose with age. Spines at first whitish, later purple-brown. Context whitish with a brown or violet, after some time sometimes also light-green hue, not changing colour in

Map No. 18 - *Sarcodon imbricatus*



- Documented data:
- - locality where the species was found before 1945
  - ⊙ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945
  - ▣ - locality where the species was recorded between 1945 and 1970
  - - locality where the species was recorded after 1970

- Broadly defined localities:
- × - locality where the species was found before 1945
  - +

KOH. Expulsions of liquid not observed. Clamp-connections present. Spores with conspicuous angular warts, (6.7-)7.2-7.6(-9)  $\times$  4.5-5.6  $\mu$ m.

Related species. *S. imbricatus* has pronounced scales with raised tips or completely erect at least in the centre of the pileus and does not have such an unpleasant smell as *S. leucopus*. Fresh basidiomes of *S. versipellis* are brightly orange and the spores of this species have broad rounded warts. *S. glaucopus* has a similarly light and areolate pileus, but the base of its stipe is grey-green.

Occurrence. Rare species, which has not been found in Slovakia during the last 10 years and in the Czech Republic during the last 30 years.

Accompanying trees. The literature mentions coniferous trees. In the former Czechoslovakia *S. leucopus* was found also in deciduous woods. The most frequent accompanying tree is *Picea*, which occurs in 64 % of localities.

Distribution (Map 19). Rare occurrence in isolated localities. The last record from Bohemia dates from 1955, in Moravia it was last seen in 1960.

#### List of recorded localities - Czech Republic:

- Floodplain of the Vltava river between Zvíkov and Červená - valley of Kučerský stream, *Picea* wood, 17. VIII. 1955, leg. et det. M. Svrček ut *S. laevigatus* (PRM)  
 Svojanov, *Picea-Abies-Betula* wood, 21. VI. 1949, leg. J. Kubička det. Z. Pouzar ut *S. laevigatus* (PRM)  
 Veverská Bitýška, Hranečník forest along the road to Lažánky, *Picea* wood with *Abies* undergrowth, 17. X. 1960, leg. et det. F. Šmarda ut *S. laevigatus* (BRNM)  
 Semetín near Vsetín, 20. VII. 1953, leg. F. Šmarda, det. Z. Pouzar ut *S. laevigatus* (BRNM)  
 Javorníky Mts., Nový Hrozenkov, cirque, *Picea-Abies* wood, 600 m, 23. VII. 1953, leg. F. Šmarda, det. Z. Pouzar ut *S. laevigatus* (BRNM)

#### Slovakia:

- Brodské, *Pinus-Quercus* wood, 9. IX. 1973, leg. et det. A. Dermek ut *Hydnum leucopus* (BRA)  
 Svätý Jur, *Fagus* wood, 21. IX. 1965, leg. et det. I. Fábry ut *S. laevigatus* (BRA)  
 Kuchyňa, Vývrať, *Quercus-Fagus-Carpinus* wood, 8. VIII. 1972, leg. A. Dermek (Dermek 1973. ut *Hydnum laevigatum*), 20. IX. 1980, leg. R. Režďovič, det. A. Dermek ut *S. laevigatus* (BRA)  
 Važecké lúky, north of the road Východná - Važec, *Picea* wood, 950 m, 14. IX. 1970, leg. J. Kuthan, det. Z. Pouzar ut *S. laevigatus* (PRM, BRA)  
 Raková, Korcháň valley, *Picea* wood, 19. VII. 1964, leg. et det. J. Veselský ut *S. laevigatus* (BRNM)  
 Oravská priehrada, Ústie, Jedličník hill, west of Ústie, 750m, 25. VII. 1894, leg. et det. S. Truchlý ut *Hydnum laevigatum* (BRA)  
 Lendak, *Picea* wood, 800 m, 11. VIII. 1957, leg. et det. B. Ježek, J. Kubička et K. Kříž ut *S. laevigatus* (BRNM)

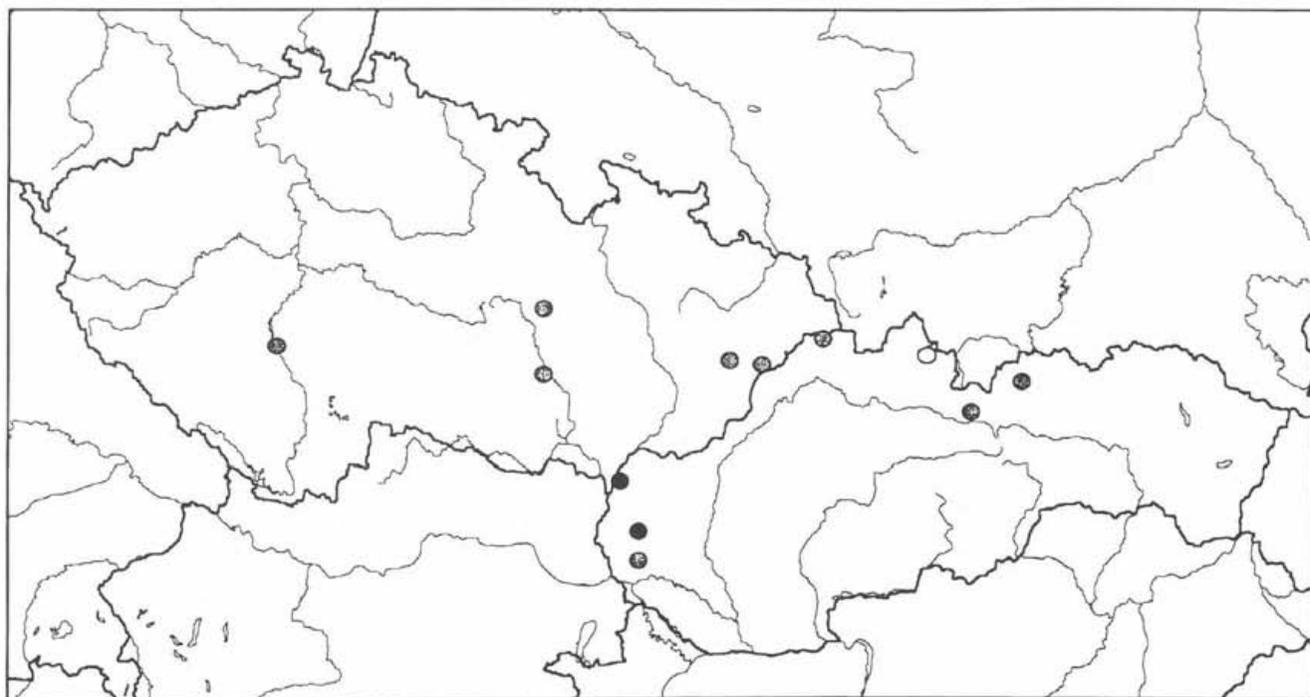
#### Not localised site:

- Nitov, Pýšna hill, 1018 m, 2. IX. 1892, leg. et det. S. Truchlý ut *Hydnum laevigatum* (BRA)

#### *Sarcodon versipellis* (Fr.) Quél.

Pileus about 80 mm in width, orange-brown, lighter towards the margin, dried brownish (or yellowish to greyish) coloured, appressed squamulose to fibrillose towards the margin, the squamules and fibrils being darker brown. Stipe concolorous

Map No. 19 - *Sarcodon leucopus*



- Documented data:
- - locality where the species was found before 1945
  - ⊙ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

or lighter. Spines whitish to purple-brown. Context white, greyish only in the base of the stipe and where the pileus passes into the stipe; not changing colour in KOH. Expulsion of liquid not observed. Clamp-connections present. Spores irregularly tuberculiform,  $4.5\text{--}5.5 \times 3.5\text{--}4.5 \mu\text{m}$ .

Related species. *S. fennicus* is similarly orange-ochraceous, but does not have scales on its pileus, the base of the stipe is grey-green and it does not have clamp-connections. A grey-green stipe base and the absence of clamp-connections is characteristic of *S. glaucopus*, too. The fresh pileus of *S. leucopus* is brown (not brightly orange as the pileus of *S. versipellis*) and its at least  $7 \times 4.5 \mu\text{m}$  large spores have conspicuous angular warts.

Occurrence. Rare species, not found in the Czech Republic for almost 50 years.

Accompanying trees. The literature mentions its occurrence in coniferous (*Picea*) and mixed (*Abies*, *Fagus*) woods; it was always found under coniferous trees in Czechoslovakia, *Picea* occurs everywhere with one exception (*Abies*).

Distribution (Map 20). Collected (except for one collection from southwest Bohemia) in a few isolated localities in submountainous areas of the Carpathians. J. Kuthan's note on the label of the collection documented in PRM as *Hydnum balsamiolens* from Fačkov (north-western Slovakia), 2. VIII. 1970, adds: "It is interesting that it occurs on basic substrate, although in Raková (other locality, also north-western Slovakia) are zones with calcareous breccia. May be it is a calciphilous species."

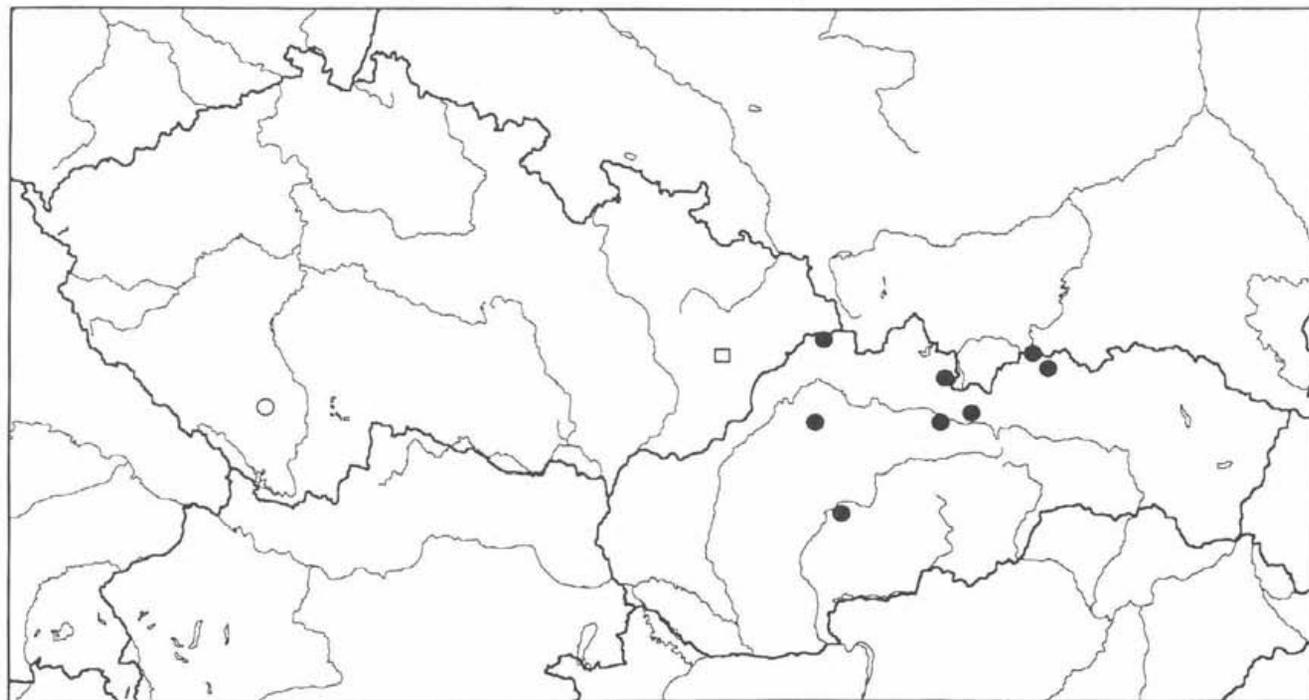
#### List of recorded localities – Czech Republic:

Libějovické Svobodné Hory, forest on Holička hill, *Picea* wood, 550 m, VII. 1936, leg. J. Herink, det. Z. Pouzar (PRM)  
Kateřinice near Vsetín, Dubcové kopce, 31. VII. 1944, leg. V. Pospíšil (Kubička 1971)

#### Slovakia:

Fačkov, valley of Rybná stream under Čierna skala, *Picea-Juniperus* wood, 2. VIII. 1970, leg. J. Kuthan, det. J. Kuthan et Z. Pouzar ut *Hydnum balsamiolens* (PRM); *Pinus-Picea* wood, 500 m, 16. VIII. 1973, leg. et det. J. Kuthan ut *Hydnum balsamiodorum* (BRA)  
Sklenné Teplice, *Picea-Pinus-Abies* wood, 500 m, 15. VII. 1971, leg. et det. J. Kuthan ut *Hydnum balsamiodorum* (BRA)  
Liptovský Ján, Jánska valley, under *Picea* in *Pinus-Picea* wood, 700 m, 14. VII. 1985, leg. et det. J. Kuthan (BRA)  
Mt. Osobitá, slope, *Abies* wood, 1200 m, 6. VIII. 1977, leg. et det. J. Kuthan (BRA)  
Červený Kláštor, *Picea-Abies* wood, 550 m, 17. VII. 1971, leg. et det. J. Kuthan ut *Hydnum balsamiodorum* (BRA)  
Važecké lúky, north of the road Východná - Važec, *Pinus-Picea* wood, 850 m, 20. IX. 1970, leg. et det. J. Kuthan ut *Hydnum balsamiodorum*; 700 m, 17. IX. 1972, leg. et det. J. Kuthan (both BRA)  
Raková, Korchán valley, *Picea-Pinus-Abies* wood, 650 m, 15. VII. 1967, leg. J. Kuthan, det. Z. Pouzar ut *Hydnum balsamiolens* (PRM), 28. VII. 1974, leg. et det. J. Kuthan ut *Hydnum balsamiodorum*; *Picea* wood, 650 m, 14. VII. 1968, leg. et det. J. Kuthan ut *Hydnum balsamiodorum* (both BRA); *Picea-Abies-Fagus* wood, leg. J. Kuthan, det. Z. Pouzar ut *Hydnum balsamiodorum* (PRM)  
Vyšné Ružbachy, *Picea-Pinus-Larix* wood, 650 m, 17. VII. 1971, leg. et det. J. Kuthan ut *Hydnum balsamiodorum* (BRA)

Map No. 20 - *Sarcodon versipellis*



- Documented data:
- - locality where the species was found before 1945
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945

**Sarcodon scabrosus** (Fr.) P. Karst.

Pileus about 75 mm in width, soon breaking up into scales appressed on the margin, erect in the centre, red-brown, brown to black-brown, contrasting with the pale ground. Stipe fleshy-brown or concolorous with the scales of the pileus, turning to grey-, blue- or black-green, covered by whitish mycelium towards its base. Spines pale, slowly turning brown. Context whitish, grey-green in the base of the stipe, turning blue-green in KOH. Expulsion of liquid not observed. Clamp-connections absent. Spores with conspicuous prolonged angular warts, (5.4-)6.3-7.3 × (3.6-)4-5 μm.

Related species. The scales of *S. glaucopus* are appressed also in the centre of the pileus (erect in *S. scabrosus*) and its spores have round warts. The stipe of *S. imbricatus* lacks the grey-green base and has a brown context; the taste of *S. imbricatus* is at most slightly bitterish (clearly acrid-bitter in *S. scabrosus*). The context of *S. joeides* and *S. fulgineo-violaceus* is pink or violet.

Occurrence. Relatively abundant species, showing a slight decline during the last decades.

Accompanying trees. The literature mentions both coniferous (mostly *Pinus*) and deciduous (*Fagaceae* - *Quercus*, *Castanea*) trees. There are collections from deciduous woods in our country too, but collections from coniferous woods dominate. The most frequent accompanying tree is *Pinus*, which occurs in 70 % of localities.

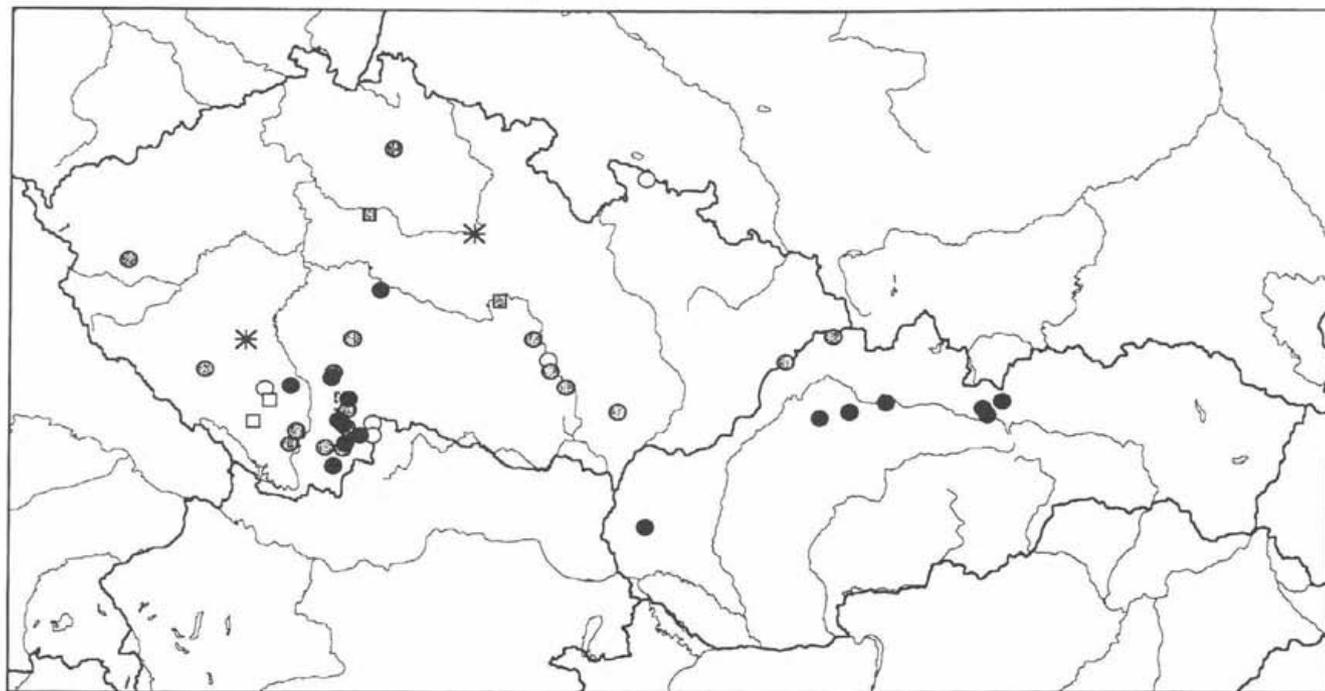
Distribution (Map 21). Abundant occurrence in southern Bohemia, where the species is still collected relatively often, in other regions are only isolated localities or groups of localities. The last record from western Bohemia is from 1966, from northern Bohemia 1952, and in Moravia it was recorded until 1970.

**Sarcodon glaucopus** Maas G. et Nannf.

Pileus about 50 mm in width, pale, yellowish to brown, here and there with greyish hue, areolate in the centre, scaly towards the margin (brown scales on a lighter ground), darker in the centre. Stipe brown in the upper part, grey-green in the lower part, base whitish. Spines whitish, later purple-brown. Context whitish, grey-green in the base of the stipe, turning blue-green in KOH. Yellowish dots of expelled substance may appear on the pileus surface after drying. Clamp-connections absent. Spores with not very conspicuous rounded warts, (5-)5.4-5.8 (-6.3) × (3.6-)4-4.5 μm.

Related species. *S. scabrosus* has a grey-green stipe base too, but the surface of its pileus is darker brown (light brown in *S. glaucopus*) with conspicuously ascendent or erect scales in its centre. The only other species with a grey-green stipe base and whitish context is *S. fennicus*, but this has an ochraceous pileus without scales and its context does not change colour in KOH. The similarly

Map No. 21 - *Sarcodon scabrosus*



- Documented data:
- - locality where the species was found before 1945
  - ⊗ - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945
  - - locality where the species was recorded between 1945 and 1970

- Broadly defined localities:
- \* - locality where the species was found between 1945 and 1970

light coloured *S. leucopus* does not have a grey-green stipe base. The spores of *S. scabrosus* and *S. leucopus* have angular warts.

Occurrence. Rare species, not found in the Czech Republic for more than 20 years.

Accompanying trees. The literature mentions coniferous trees which is confirmed by our records. The number of records is, however, too small to make any detailed conclusions.

Distribution (Map 22). Rare occurrence in isolated localities.

#### List of recorded localities – Czech Republic:

Žebrák, *Pinus* wood, 16. VIII. 1953, leg. B. et F. Hřebíkovi, det. Z. Pouzar ut *S. fennicus*, rev. Z. Pouzar (PRM)

Čechtice, Dvorce forest, *Picea* wood, 15. IX. 1968, leg. V. Brambora, det. Z. Pouzar (PRM)  
 Veverská Bítýška, Hranečník forest along the road to Lažánky, *Picea* wood with *Abies* undergrowth, 2. IX. 1951, leg. K. Kříž, 28. IX. 1960, leg. F. Šmarda, both det. F. Šmarda ut *S. amarescens* (BRNM)

Zdravá Voda near Žarošice, *Pinus-Picea* wood, 27. VIII. 1949, leg. et det. V. Vacek (PRM)  
 Velká Losenice, 1912 (Holub 1926, ut *Hydnum amarescens*)

#### Slovakia:

Štrbské Pleso, Uhliščata, slope of Spálený vrch, *Picea* wood, 1000 m, 14. IX. 1989, leg. et det. J. Kuthan (BRA)

Raková, Korcháň valley, *Pinus-Picea-Abies* wood, 11. VIII. and 8. IX. 1968, leg. J. Kuthan, det. Z. Pouzar ut *S. amarescens*; *Picea* wood, 11. X. 1970, leg. et det. J. Kuthan ut *S. amarescens* (all BRA)

#### *Sarcodon fennicus* (P. Karst.) P. Karst.

Pileus about 50 mm in width, ochraceous, yellow-brown, without scales, fibrillose, or with darker scales on a pale ground. Stipe concolorous in upper part, grey-green in below, with whitish mycelium on its base. Spines whitish to purple-brown. Context whitish, grey-green in the base of the stipe, not changing colour in KOH. Expulsion of liquid not observed. Clamp-connections absent. Spores with not very conspicuous rounded warts,  $6.3-7.6 \times 4.5-5.2 \mu\text{m}$ .

Related species. *S. versipellis* is similarly orange-brown and almost scaleless, but this species does not have a grey-green stipe base. The grey-green stipe base is also characteristic of *S. glaucopus*, but its pileus is almost always areolate or (at least appressed) squamulose and its context turns green to blue-green in KOH.

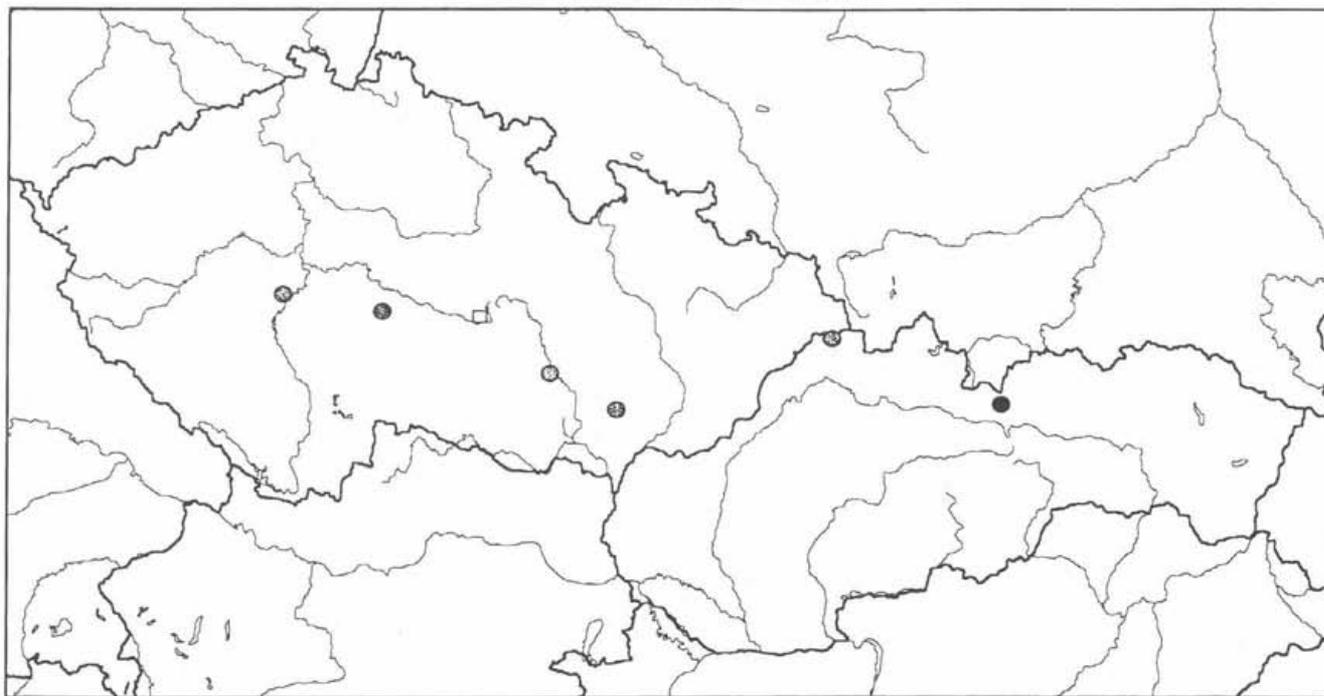
Occurrence. Very rare species.

Accompanying trees. The literature mentions coniferous trees, which is confirmed in the former Czechoslovakia.

Distribution (Map 23). Rare occurrence in isolated localities; the species is not known from Moravia and Slovakia.

#### List of recorded localities – Czech Republic:

Map No. 22 - *Sarcodon glaucopus*

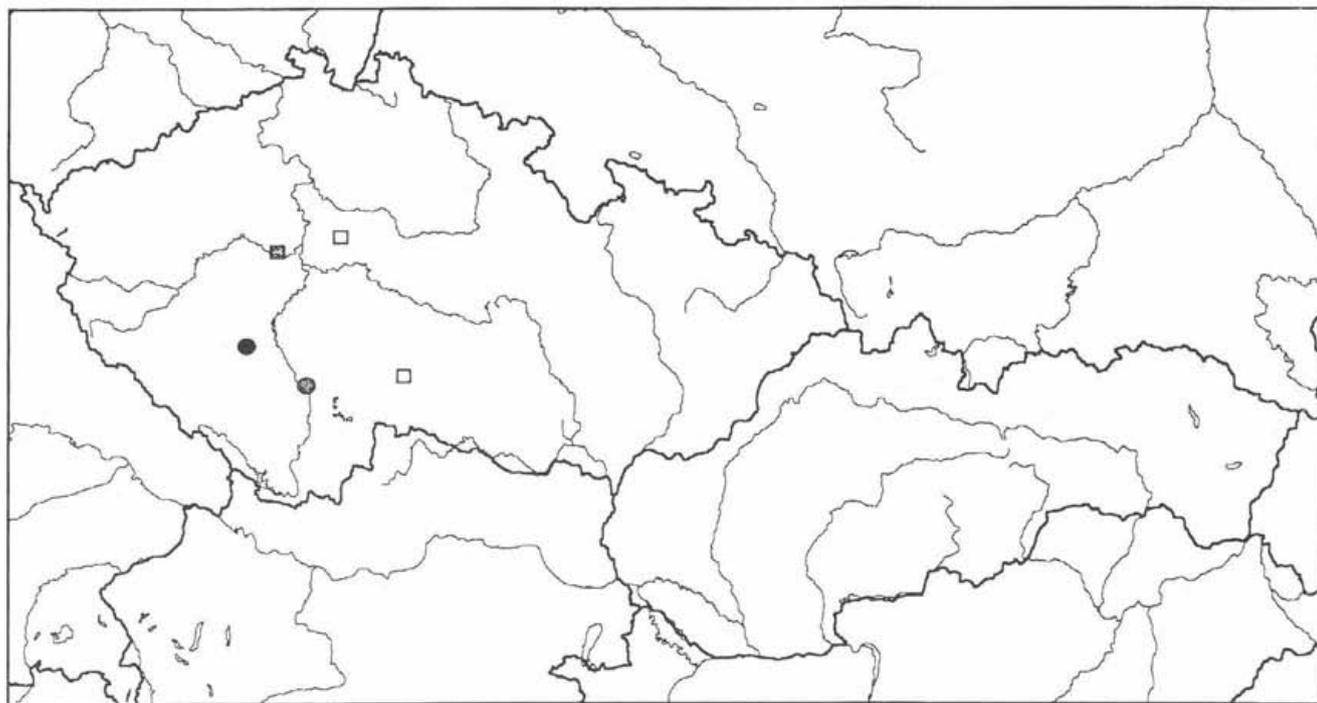


Documented data:

- ⑤ - locality where the species was found between 1945 and 1970
- - locality where the species was found after 1970

Data from literature:

- - locality where the species was recorded before 1945

Map No. 23 - *Sarcodon fennicus*

- Documented data:
- - locality where the species was found between 1945 and 1970
  - - locality where the species was found after 1970

- Data from literature:
- - locality where the species was recorded before 1945
  - - locality where the species was recorded between 1945 and 1970

- Karlštejn, forest in the direction of Mořina, occurrence in the 1950s (verbal report of Z. Pouzar)  
 Buzice, hamlet Buzičky, Buziček forest, *Picea* wood, 450 m, 5. VIII. 1974, leg. J. Herink, det. Z. Pouzar (Herb. Herink)  
 Týn nad Vltavou, Bedrník forest, *Picea* wood, 4. VII. 1965, leg. B. Karlasová, det. M. Svrček (PRM)  
 Babice, old *Pinus* wood, VIII. 1919, leg. O. Zvěřinová (Velenovský 1922)  
 Počátky, Válcha, 1929 (Sak 1930)

**Sarcodon joeides** (Pass.) Bataille

Pileus about 60 mm in width, sinuous, areolate or appressed scaly, pale brown to fleshy brown, more ochre after drying. Stipe concolorous with the pileus, sometimes grey-green at its base. Spines at first pale, then brown. Context at first pink, later violet in the pileus above the spines and in the stipe, grey in the base of the stipe, turning blue-green in KOH. Yellowish dots of expelled substance may appear on the pileus surface after drying. Clamp-connections absent. Spores with conspicuous angular warts,  $5.4-5.8 \times 3.6-4.2 \mu\text{m}$ .

Related species. *S. joeides* is distinguished from all other species except *S. fuligineo-violaceus* by the pink or violet context, but the latter grows only in coniferous woods.

Accompanying trees. According to the literature deciduous trees, mostly *Quercus*, but also *Castanea* and *Fagus*.

Slovak find of *Sarcodon joeides* (Map 24): Malé Karpaty (western Slovakia), Vývrať near Kuchyňa, *Quercus-Fagus-Carpinus* wood, 8. VIII. 1972, leg. et det. A. Dermek ut *Hydnum commutatum* (Dermek 1973).

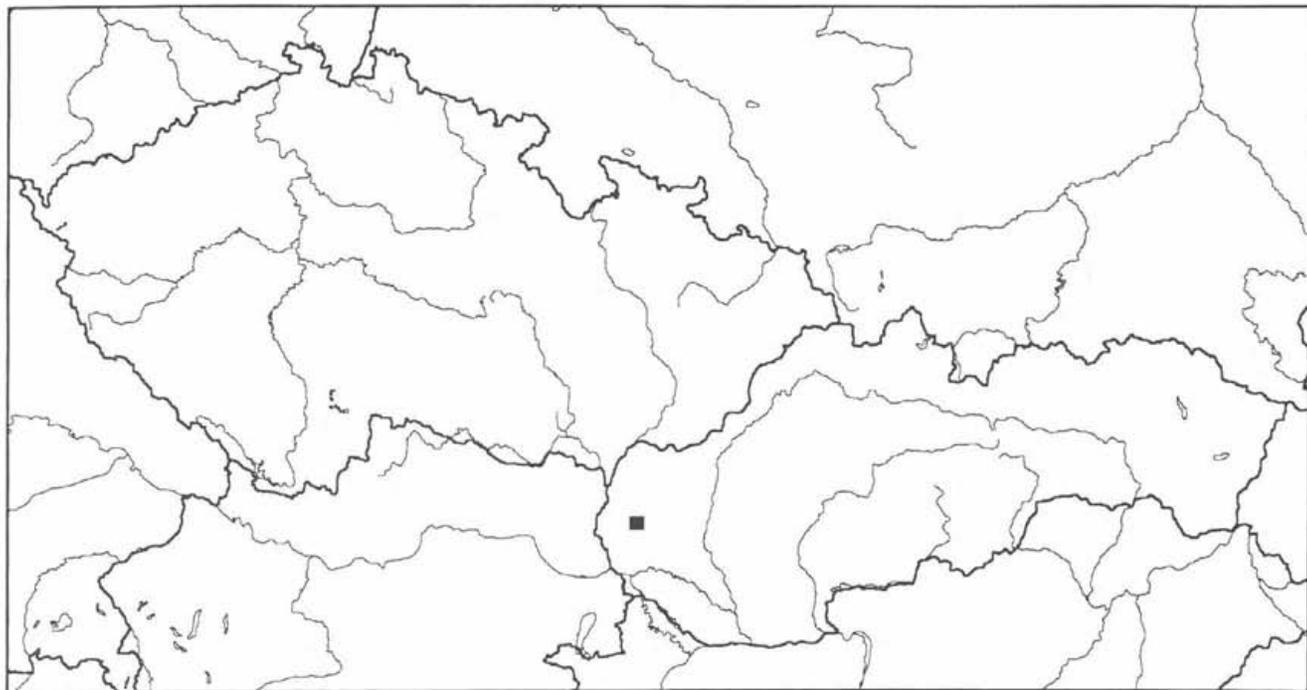
**Sarcodon fuligineo-violaceus** (Kalchbr. in Fr.) Pat.

Pileus about 70 mm in width, red-brown to dark brown, sometimes with blackish hue, innately squamulose. Stipe concolorous with the pileus, paler when young. Spines brown. Context at first pink, later blue-grey-violet in the pileus, with red hue in the stipe and grey-green in its base, turning blue-green in KOH. Yellowish dots of expelled substance may appear on the surface of the pileus after drying. Clamp-connections absent. Spores with more or less conspicuous acute warts,  $5.4-6.5 \times 4-4.7(-5.4) \mu\text{m}$ .

Related species. The pink or violet context distinguishes *S. fuligineo-violaceus* from all other species except *S. joeides*, which grows only in deciduous woods.

Accompanying trees. The literature mentions coniferous trees (*Abies*, *Picea*, *Pinus*).

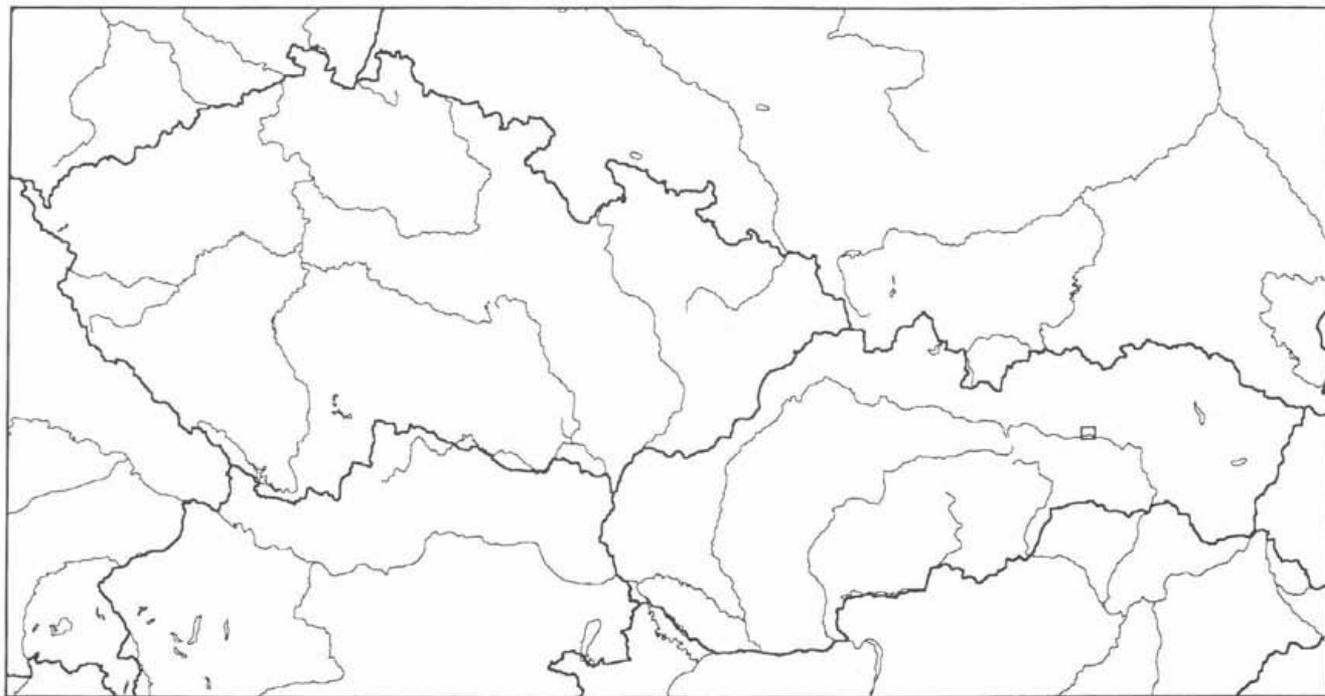
Slovak find of *Sarcodon fuligineo-violaceus* (type locality, Map 25): Near Spišské Vlachy (eastern Slovakia), *Pinus sylvestris* [in pinetis Carpatorum ad Olaszi], IX. 1870, leg. et det. K. Kalchbrenner ut *Hydnum fuligineo-violaceum* (preserved in UPS; Maas Geesteranus 1960, 1975).

Map No. 24 - *Sarcodon joecides*

Data from literature:

- - locality where the species was recorded after 1970

Map No. 25 - *Sarcodon fuligineo-violaceus*



Data from literature:

- - locality where the species was recorded  
before 1945

## CONCLUSION

Twenty-five species of hydnaceous fungi were recorded from the area of the Czech Republic and Slovakia. Their occurrence, ecology and distribution is commented and documented with distribution maps. A considerable decline in occurrence during the last decades was found for almost all species. Quantification of this decline is possible only in the Czech Republic, where a sufficient number of records from a longer period is available.

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