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THE FAMILY STEREEACEAE (BASIDIOMYCETES) IN YUGOSLAVIA

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The distribution in Yugoslavia of five genera of the family *Stereaceae*, with 16 species, is presented and shown on the maps. The reactions of hyphae in cresyl blue have also been studied and appear to be characteristic at the generic level.

Introduction

Although the investigations of corticioid fungi in Yugoslavia are far from complete, it is possible to start presenting short surveys of one or several genera or small families, as was done e. g. for the family *Lachnocladiaceae* (Tortić 1983).

Stereaceae Pil. emend. Parm. include six genera (Parmasto 1968) with 19 species known in Europe (Jahn 1971), a few of them being rare or very rare. Five genera with 16 species have been noted in Yugoslavia up to now, and their distribution is presented and discussed.

Materials and Methods

All the involved species have been already published for Yugoslavia, mostly from one or a small number of localities, some only a few years ago. The data about their distribution given here have for the most part been established by quite recent investigations.

The publications are cited for each species except for *Stereum hirsutum* which is mentioned in the majority of papers on Yugoslav fungi. Although for most older and some newer publications no voucher specimens exist, the localities from the literature were taken into account since they are for the most part very probable. In a few instances the identity of a species is doubtful; this is pointed out in the text and

the locality is not included. Available specimens, a number of them not yet published, have been examined. They are preserved at the Department of Botany, Faculty of Science, Zagreb (ZA) and the Museum of Natural History, Beograd (BEO), a few also at the National Museum, Prague (PRM) and the Museum of Natural History, Vienna (W). Common species were often only noted, particularly when the fruitbodies, although recognisable, were in a bad state. Where no collector is mentioned, the specimen was collected or seen by the author, mostly together with her husband, S. Tortić. Descriptions are not given, since they are available in the recent literature (Jahn 1971, Eriksson and Ryvarden 1973—1976, Eriksson et al. 1978—1984, Jülich 1984).

Distribution maps were prepared for all species. The localities are cited (in an abbreviated version) only if there are no more than about twenty known. Hosts and altitude ranges are presented.

Several of the species discussed belong to the most common and wide-spread fungi, and many localities in Yugoslavia are already known, even if there are too few yet to present their probable actual distribution, particularly in regions little explored mycologically. Others, found only a few times, may either belong to really rare species, or may be more frequent in some regions visited only sporadically or not at all.

The reactions of skeletal hyphae and cystidia in cresyl blue have been studied. They appear to be characteristic at the generic level.

The species studied

Amylostereum areolatum (Chail. in Fr.) Boid.

Slovenia: Zelenci near Podkoren, 900 m, 8/83, ZA; Pokljuka near Bled, 1300 m, 5/6/74 leg. Hočevar (material seen); Ljubljana, 300 m, 9/73, leg. Hočevar, det. Pouzar, ZA; Pijava Gorica near Ljubljana, 350 m, 3/72, leg. Hudoklin, ZA; Kočevski rog Mt., Prelesnikova koliševka, cca 500 m (Hočevar et al. 1980a); Oplotnica on Pohorje Mt., 600—700 m, 2/74, leg. Habjanič, ZA; Ilova gora near Grosuplje, 400—600 m, 10/79, ZA; Grčarevec at Krka, near Grosuplje, 300 m, 10/79; vicinity of Novo Mesto on two nearby places, about 200 m, 3/81 and 2/82, leg. Vrščaj (material seen); Globoko near Brežice, 160—180 m, 9/80; Župelovec near Brežice, 160—180 m, 11/70, ZA; Krakovo forest near Kostanjevica, 150 m (Hočevar and Tortić 1975); Nova Vas near Bregana, 200 m, 9/70, ZA.

Croatia: Risnjak Nat. Park, Lazac, 1070 m, 9/68, ZA (Tortić 1973); Sungerski Lug at Mrkopalj, 800 m, 8/72, ZA (Tortić 1973); Plitvička Jezera Nat. Park, collected or noted many times since 1972 in various places, from 700—900 m. Several collections at ZA (Tortić 1985).

Bosna and Hercegovina: Oštrej Mt near Bosanski Petrovac, 1100 m, 9/72, leg. Usčuplić, ZA; Igman Mt. near Sarajevo, 1200 m, 5/74, leg. Rončević, ZA; Trebević Mt. near Sarajevo, 1100 m, 4/71, 7/80, 9/84, one at ZA; Trnovo at the base of Treskavica Mt 850—1000 m, 9/82, ZA; Borijska near Kalinovik (south of Sarajevo), 1100 m, 7/80, ZA.

Macedonia: Adžina Reka in Mavrovo Nat. Park, 1400 m, 9/75, ZA. (Fig. 1)

As seen from the dates, the species has been first collected in Yugoslavia only very recently. The finds are mainly by the present author who has also examined the material by some other collectors. It occurred on dead wood of *Picea abies*, mostly on stumps, occasionally on logs and prostrate branches. The specimen at Igman Mt. was indicated as collected on *Abies alba*, which is a possible although rare host, but there is no trace of wood on it to check.

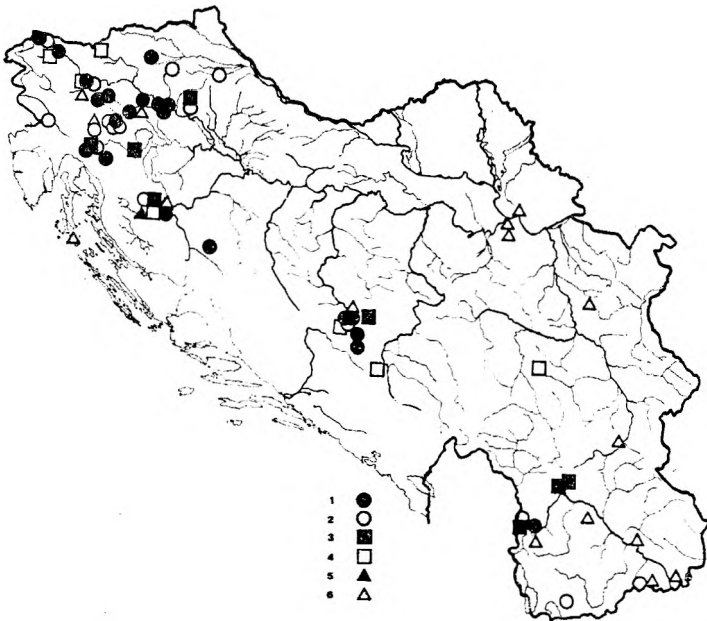


Fig. 1. 1 *Amylostereum areolatum*, 2 *A. chailletii*, 3 *A. laevigatum*, 4 *Columnocystis abietina*, 5 *C. ambigua*, 6 *Lopharia spadicea*

A large part of localities (10) is from lower altitudes, up to 500 m (five only up to 200 m), where the species grew in mixed forests with planted spruce; frequent occurrence in such forests was pointed out by Jahn (1971). In higher altitudes it was collected in natural spruce forests or such where spruce is admixed (e. g. beech and fir forest, pine forest), in five localities between 500 and 1000 m, in seven over 1000 m. It is probably rather well-spread although not very frequent, and will be found in time also in republics from which there exist no data at all for the moment. The cited locality in Macedonia is probably among the southernmost ones of *A. areolatum* in our country, since its main host, spruce, reaches there the southern boundary of its area.

Amylostereum chailletii (Pers. : Fr.) Boid.

Slovenia: Famlje near Divača, 450 m, 6/82, leg. Čebulec, ZA; Martuljek near Kranjska Gora in Triglav Nat. park, 900 m, 8/83, ZA; Strmec Mt. near Kočevje, 700—850 m, 10/76, leg. Hočev ar, ZA; Kočevski Rog Mt. in three places: Stara Žaga, Pečke (both 800—900 m), Prelesnikova Koliševka (500 m), ZA (Hočev ar et al. 1980a); Lavrica near Ljubljana, ca 300 m, leg. Vrščaj, 1/86, ZA.

Croatia: Risnjak Nat. Park, 700 m, 7/80, ZA; Medvednica Mt. near Zagreb, 850 m, 9/66, det. Svrček, ZA; Varaždinske Toplice near Varaždin, 200—250 m, 4/69, ZA; Donji Macelj near Krapina, 300—350 m, 2/77, ZA; Plitvička Jezera Nat. Park several times from 1973 on, 800—900 m, some specimens at ZA (Tortić 1985).

Bosnia and Hercegovina: Igman Mt. near Sarajevo, 1200 m, 9/84, ZA.

Macedonia: Korab Mt. 1400 m (Pilát and Lindtner 1938 as *Stereum chailletii*) PRM (not examined); Pelister Nat. Park, 1400 m, 9/83, ZA; Kožuf Mt., 950 m, 8/84 (Karadelev 1987). (Fig. 1)

This species, in contrast to the preceding, grows mainly on dead wood: branches, stumps, logs, of *Abies alba*, in Macedonia also on *A. borisii regis*. In Kočevski Rog Mt. and Igman Mt. it was collected in addition to fir also on *Picea abies*, at Martuljek in Triglav Nat. Park on *Larix decidua*, and in Pelister Nat. Park both on *Abies* and *Pinus peuce*. According to Boidin & Lanquetin (1984) *A. areolatum* and *A. chailletii* differ mainly macroscopically but also in the shape and size of the spores which in the former are ovoid oblong and in the latter cylindrical and somewhat longer. Since collected specimens were mostly sterile this character could not be used for identification.

Five localities are at altitudes up to 500 m, the lowest among them at Varaždinske Toplice where the species grew in a park on a stump of a planted tree. Most localities (8) are from 500—1000 m altitude in natural, sometimes virgin forests, mainly those of beech and fir. Three localities are over 1000 m, up to 1400 m.

Amylostereum laevigatum (Fr.) Boid.

Croatia: Razloge at the source of the river Kupa, 550 m, on dead branches of *Juniperus communis*, 7/80, ZA; Severin on the Kupa, in an old park, 200 m, on the bark of a trunk of living *Taxus baccata*, 5/77, ZA; Golubovec near Donja Stubica, 200 m, old park, on the bark of living *Taxus baccata*, 4/79, ZA; Plitvička Jezera Nat. Park in three places on dead branches of *Juniperus communis*, 700—850 m, observed many times from 1975 on, several collections in ZA (Tortić 1985).

Bosnia and Hercegovina: Ravna Romanija near Sarajevo, ca 1200 m, on a dead trunk of *Juniperus communis*, 9/84, ZA.

Serbia: Šar Planina Mt., Crni Kamen, 1100 m on *Taxus baccata* (Pilát and Lindtner 1938 as *Peniophora laevigata*) PRM, partly in BEO.

Macedonia: Šar Planina Mt., Ljuboten, 1500 m and over, on *Juniperus nana*; Korab Mt., 1400 m, on *Juniperus nana* (both Pilát and Lindtner 1938 as *Peniophora laevigata*) PRM, partly in BEO. (Fig. 1).

More than 35 years had passed since the publication of this species by Pilát and Lindtner (1938) before it was collected again and there are as yet only few localities known in Yugoslavia. As pointed out by Ryvar den (1971) it grows on the underside of stems and branches, mostly of *Juniperus* spp. and is easily overlooked, particularly because of its resupinate habit.

Most collections are from *Juniperus* spp. and three on *Taxus baccata*. According to Eriksson and Ryvar den (1973) the form on *Taxus* has larger spores than the one on *Juniperus*. For the most part it was not possible to check the spore size as the specimens were mainly sterile.

The altitude range of *A. laevigatum* is considerable since it follows its hosts, irrespectively of the type of forest, from 200 to 1500 m and over. Two localities are at 200 m, two between 500 and 1000 m (Plitvice Nat. Park is counted as one, but the mentioned three places are at least 10 km apart), and four over 1000 m. Owing to the small number of finds it is not possible to make any conclusions about the preference for particular altitudes.

In all three species of *Amylostereum* the thick-walled skeletal hyphae and cystidia turn, in cresyl blue, deep blue with a red overlay. Some hyphae become only violet red; they seem to have thinner walls or have absorbed less dye.

Columnocystis abietina (Pers.: Fr.) Pouz.

Slovenia: Solčava in Kamniške Alpe mountain range, 700 m, 5/81, ZA; Pokljuka near Bled, 1200—1300 m, 5/74, leg. Hočevar, ZA (Tortić 1978); Ljubljana, 300 m, 1928, leg. Lindtner, det. Pilát, PRM, BEO (Tortić 1978).

Croatia: Plitvička Jezera Nat. Park, several times from 1976 on in two places at least 10 km apart, 800—900 m, several collections at ZA (Tortić 1978, 1985).

Bosna and Hercegovina: Igman Mt. near Sarajevo, 1200 m, 9/82 ZA; Perućica in Sutjeska Nat. Park, 1200—1300 m, 9/84, ZA.

Serbia: Kopaonik Mt., about 1300 m, 10/53, leg. Lindtner, BEO (Tortić 1978). (Fig. 1).

C. abietina is bound mostly to the dead wood of *Picea abies*; the finds on *Abies* are very rare (Jahn 1971). In our localities it occurred on dead wood of spruce: logs — preferably on cut surfaces, stumps, fallen branches. The host for the find at Ljubljana is not indicated but is probably also *Picea abies*. As pointed out by Tortić (1978), the specimen published by Voss (1889—92) under the name of *Stereum abietinum*, proved to be *Hymenochaete cf. subfuliginosa*, and the find by Skorić (1928), as *Stereum striatum*, without voucher specimen, is unlikely to represent this species since *Pinus* is given as the substrate.

Except in Ljubljana, at 300 m, where the host was presumably planted, the localities are at altitudes from 700—1300 m in autochthonous forests, either of spruce or where spruce is admixed to beech and fir or to pine. In Plitvička Jezera Nat. Park the species is not particularly rare and is probably spread in other similar forests in Yugoslavia.

Columnocystis ambigua (Peck) Pouz.

Croatia: Plitvička Jezera Nat. Park, in same places as *C. abietina*, 800—900 m, in beech and fir forest and pine forest, on logs and prostrate trunks of *Picea abies*, 7/76, 7 and 10/77 (Tortić 1978, 1985). (Fig. 1).

This species was not collected later anywhere else, nor was even refund in this locality and seems to be really very rare.

Both species of *Columnocystis* react in cresyl blue in the same manner as *Amylostereum* spp.: the skeletal and cystidia turn very deep blue. In both genera the natural brown tint adds probably to the intensity of colour reaction.

Lopharia spadicea (Pers. : Fr.) Boid.

Slovenia: Šiška in Ljubljana, 300 m, on *Quercus robur* (Voss 1889—92); Glazuta near Kočevje, 1100 m, on *Acer* sp., 4/74, leg. Habjanič, ZA; Gorjanci mountain range near Novo Mesto, Nature Reserve of Ravna gora, 850—950 m, on prostrate trunk and branch of *Fagus*, 10/76, leg. Hočevar, ZA.

Croatia: Mali Lošinj on the island of Lošinj, worked wood, 7/86, leg. Forstinger, ZA; Plitvička Jezera Nat. Park, in two places, 600 and 850 m, on prostrate trunks of *Fagus* in beech forest and beech and fir forest, 8/66, 5/76, 10/80. The first collection by Kotlaba is in PRM, others in ZA (Tortić 1979, 1985).

Bosna and Hercegovina: Lukavica near Sarajevo, on a stump of *Quercus* sp., 600 m (Protić 1921—22).

Serbia: Košutnjak at Beograd, 100—200 m, on *Tilia tomentosa*, 7/36, leg. Lindtner, and Pančevo near Beograd, 75 m, 11/35, leg. Lindtner, PRM, BEO (both Pilát 1937 as *Stereum sponheimeri* sp. n.), a specimen in PRM was

revised by J. Eriksson (Göteborg); Avala near Beograd, 300—500 m, branch of a broadleaved tree, 11/34, leg. Lindtner, det. Litschauer as *S. spadiceum*, BEO, W; Južni Kučaj Mt. near Čuprija, 850 m, on *Fagus sylvatica*, 9/47, leg. Lindtner, BEO; Pljačkovica Mt. near Vranje, alt. unknown, on *Robinia pseudacacia*, 3/37, leg. Lindtner, PRM, BEO (Pilát and Lindtner 1938 as *Stereum spadiceum*).

Macedonia: Bistra Mt on *Fagus*, alt. unknown, 9/72, leg. Papazov, ZA; Orlovo brdo near Krivolak, 200 m, on (probably) *Quercus* sp. 3/39, leg. Lindtner, BEO, PRM; Jakupica Mt., 1400 m, prostrate branch of *Fagus sylvatica*, 9/75, ZA; Bogdanci near Gevgelija, 150—250 m, on *Carpinus orientalis*, *Quercus* sp., *Paliurus spina-christi*, *Pyrus amygdaliformis*, 11—12/83, 1/84, leg. Karadelev, ZA (Karadelev 1987); Kožuf Mt. (at the border with Greece) 750 and 1000 m on *Alnus glutinosa*, *Fagus sylvatica*, *Quercus* sp., 9 and 10/83, leg. Karadelev, specimens seen (Karadelev 1987). (Fig. 1).

The data by Voss (1889—92) and Protić (1921—22) could not be checked because of the lack of voucher specimens, but seem to be probable.

Lopharia spadicea was collected on stumps, logs, dead branches of various broadleaved trees: five times each on *Fagus sylvatica* and *Quercus* spp., and once each on *Acer* sp., *Alnus glutinosa*, *Carpinus orientalis*, *Paliurus spina christi*, *Pyrus amygdaliformis*, *Robinia pseudacacia*, *Tilia tomentosa*, in various forest associations; in a few cases the substrate is unknown, once on worked wood (block-board). Seven localities are up to 500 m, five from 500—1000 m and two over 1000 m, one of them even 1400 m. For two the altitude is not known.

According to Kotlaba (1986a) in Europe this species is most frequent in the south, but occurs also in warmer parts of Central, even North Europe where it is rare. It was noted in Czechoslovakia in 88 localities on 37 autochthonous and introduced woody species (including two conifers). In Yugoslavia it should be therefore more frequent and the small number of localities is due simply to inadequate mycological investigations. In this country *L. spadicea* also seems to be more frequent toward the south.

In cresyl blue the hyphae and cystidia are strongly metachromatic, but the red colour has a violet tinge.

Stereum gausapatum (Fr.) Fr.

Slovenia: Meja near Kranj, 380 m, branch of probably *Quercus* sp., 7/72, leg. Hudoklin, ZA; Krakovo forest near Kostanjevica, 150 m, branches of *Quercus robur*, 10/75, ZA (Hočevar et al. 1980).

Croatia: Rovinj in Istria, *Quercus pubescens*, at the sea—coast, 3/24, leg. Baumgartner, det. Litschauer, W. The material was revised by Z. Pouzar, Prague. It is in bad condition and the identity is not certain, although most likely. Ližnjan near Pula, at the sea-coast, *Quercus pubescens*, 8/72 leg. Kotlaba, PRM; Lovran near Rijeka, at the sea-coast, dead standing *Quercus* sp., 2/83, ZA; Košljun island near Punat on Krk, at the sea-level, branch and stumps of *Quercus ilex*, leg. Barčić, ZA (Barčić 1982); Njivice on the island of Krk, sea-coast, *Quercus* sp., 4/86, leg. Vrščaj (material seen); Seline near Starigrad-Paklenica, at the base of Velebit Mt., nearly at sea-level, branch of *Quercus petraea* leg. Kotlaba, rev. Pouzar, 7/68, PRM; Maksimir Park in Zagreb, 130 m, branches, stump and at the base of living *Quercus* sp. 9/76, 10/74, ZA; Prašnik near Okučani, about 100 m, prostrate branches of *Quercus robur*, 9/82, ZA.

Serbia: Topčider at Beograd, on *Quercus* sp., about 100 m, 9/55, leg. Lindtner, BEO.

Macedonia: Debarska Banja near Mavrovo, 600—700 m, on a stump of *Quercus pubescens* and branch of *Ulmus* sp., 9/72, leg. Gudeski, ZA; Mavrovo Nat. Park, Koža, ca 1250 m, stump of *Quercus* sp., 9/83, ZA; Vodno Mt. near

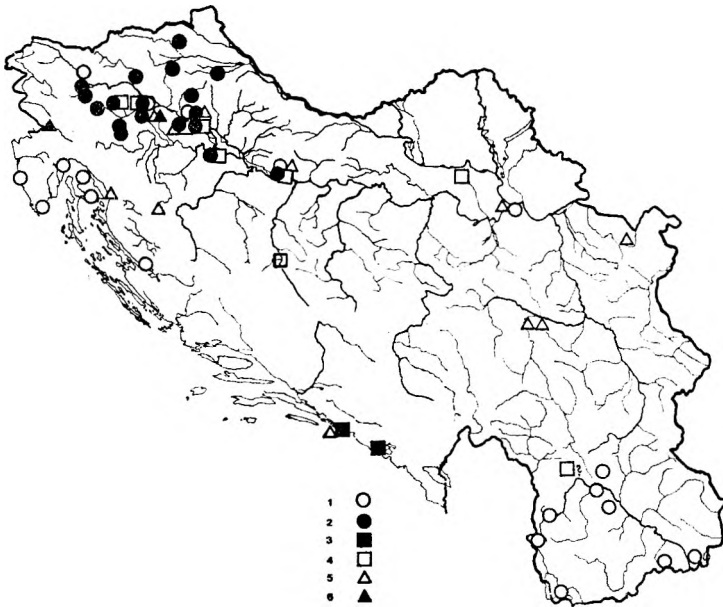


Fig. 2. 1 *Stereum gausapatum*, 2 *S. rameale*, 3 *S. reflexulum*, 4 *S. subtomentosum*, 5 *Xylobolus frustulatus*, 6 *X. subpileatus*

Skopje, 700—800 m, stump of *Quercus pubescens*, 10/78, ZA; Skopska Crna Gora, near Skopje, about 1000 m, stump of *Quercus* sp., 9/83; Jakupica Mt. near Skopje, 1000 m, on stumps of *Quercus* spp. (Tortić and Cekova 1975, Sylejmani 1980); Galičica Mt., 900 m *Quercus frainetto*, 9/86, leg. Karadelev, specimen seen; Bogdanci near Gevgelija, 150—300 m, on *Carpinus orientalis*, *Fraxinus ornus*, *Quercus* sp., 7 and 11/83, leg. Karadelev, ZA (Karadelev 1987); Kožuf Mt., 800 m, *Quercus* sp., 10, 11/83, leg. Karadelev, ZA (Karadelev 1987). (Fig. 2).

The substrate was mostly *Quercus* spp.: *Q. frainetto*, *Q. ilex*, *Q. petraea*, *Q. pubescens*, *Q. robur*, once each also *Carpinus orientalis*, *Fraxinus ornus* and *Ulmus* sp. Since *Quercus* is known as the preferred host for this species, the find published by Škorić (1928) from Gorski kotar at Podstene, on a stump of *Fagus*, without voucher specimen, is unlikely and the find very probably represents *Stereum rugosum*.

Stereum gausapatum was collected in nine localities from sea-level (more or less) to 200 m altitude, on two from 200—400 m, six from 400—1000 m and one at about 1250 m. Most localities are on the Adriatic coast and in Macedonia. It is surely more distributed; for instance, it is unbelievable that there should be only one locality in Serbia.

In Jakupica mountain the carpophores of this species, as well as those of *S. hirsutum*, sometimes develop extremely abundantly in a forest of *Q. cerris* and *Q. pubescens* on oak stumps, separately or both together on one stump. On one occasion when the fruitbodies were quite fresh and air moisture high, the bleeding of *S. gausapatum* was so prominent that the palm of a hand passed quite lightly over them became blood-red.

Stereum hirsutum (Willd.) Pers.

One of the most common lignicolous fungi on broadleaved trees, very rarely conifers, and widely distributed. It was mentioned in the majority of publications on higher fungi in Yugoslavia, including various phytopathological papers, and was without doubt observed in many more localities than published. However, as is usually the case with common species, it was rarely collected and there are not many specimens existing in our herbaria. Therefore, as visible from the map (Fig. 3) in intensively investigated regions many localities were noted, for instance, several in one mountain or in the vicinity of a town, quite near to one another, whilst from parts little explored mycologically, or where investigations have only started, there are few data and a whole mountain is sometimes cited as one locality.

For that reason the number of localities known now can be estimated only approximately at about 150, but this does not give an idea of the frequency of this species in a given locality.

In many cases the altitude was not indicated and it is not possible to give an exact picture of the vertical distribution of *S. hirsutum*. It was found from sea-coast up to over 1500 m (Ljuboten in Šar Planina Mt.). It grew in various forest associations, or outside associations, also on cultivated woody plants, mostly as saprophyte on stumps, prostrate trunks, logs, branches. On freshly felled trunks, e. g. of oaks (easily observable in timberyards) it develops in the narrow zone of sapwood under the bark, forming circles of carpophores on butts, and lines on the bark along the trunks. More rarely it occurs on living trees, usually on still attached dead branches or in injured parts of the trunk. It was found also underground, on mine timber in coal mines (Šarić 1957), and in Postojna cave (Voss 1889—92).

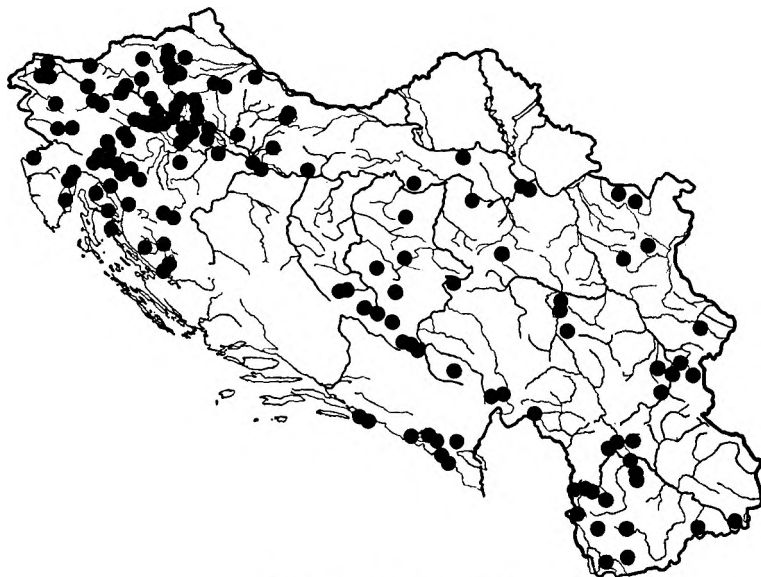


Fig. 3. *Stereum hirsutum*

Oldest published records are those by Schulzer (1866) who studied fungi mostly in the vicinity of Vinkovci and stated that the species occurred on old stumps everywhere, in forests or outside them, and Stoitzner (1869) who mentions the locality »Brsaya«, probably in Papuk Mt.

The hosts noted are numerous, predominantly broadleaved ones: *Acer* sp., *A. obtusatum*, *Aesculus hippocastanum*, *Alnus glutinosa*, *A. incana*, *Betula* sp., *B. verrucosa*, *Carpinus betulus*, *C. orientalis*, *Castanea sativa*, *Cornus mas*, *Corylus avellana*, *Crataegus* sp., *Fagus sylvatica* (incl. *F. moesiaca*), *Fraxinus* sp., *Laurus nobilis*, *Olea europaea*, *Ostrya carpinifolia*, *Paliurus spina christi*, *Pistacia terebinthus*, *Platanus orientalis*, *Populus* sp., *Prunus avium*, *Punica granatum*, *Quercus* sp., *Q. cerris*, *Q. coccifera*, *Q. frainetto*, *Q. ilex*, *Q. petraea*, *Q. robur*, *Rhamnus* sp., *Robinia pseudacacia*, *Rosa* sp., *Salix* sp., *Tilia* sp., *T. tomentosa*, *Vitis vinifera*. Exceptionally it was noted on conifers: *Cupressus sempervirens* (Lokrum Island, VII 67, leg. Kuthan, det. Kotlaba, PRM), *Pinus halepensis* (Rab Island, Jaap 1916), and *P. heldreichii* (Prokletije Mts. Prljinićević and Đorović 1974). The preferred hosts are apparently *Quercus* spp. and *Fagus sylvatica*; it is also frequent on *Carpinus betulus*, *Corylus avellana*, and appears in great quantities particularly in forests of oaks and those of beech.

Stereum insignitum Quél.

Beck and Szyszyłowicz (1888 sub *Stereum rugosum*), Pilát and Lindtner 1938 as *S. hirsutum* f. *fasciatum*) Jelić (1966, 1967), Tortić (1966), Lisiewska and Jelić (1971), Tortić and Lisiewska (1971), Tortić and Jelić (1972), Grujoska

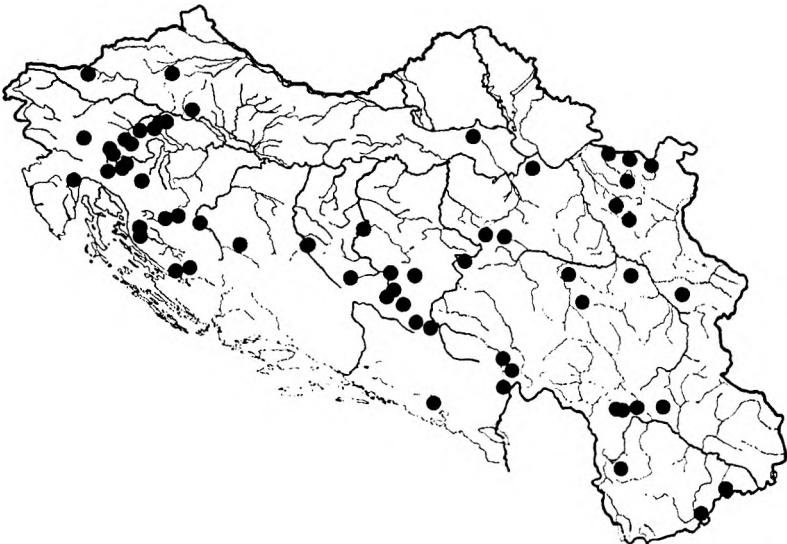


Fig. 4. *Stereum insignitum*

and Prljinićević (1972), Černy (1972), Tortić (1979, 1985), Hočevar et al. (1980b, 1985) Kotlaba (1985), Karadelev (1987).

Localities of this species in Yugoslavia known up to then were published and shown on the map by Tortić and Jelić (1972); in papers published at the same time or later only few new ones were added. However, since then the species has been found in many other places and the number of localities is now over 60, still too few to show the actual distribution of this species. *S. insignitum* is particularly bound to the wood of *Fagus* (in Yugoslavia *F. sylvatica* and its variety *moesiaca*), which tree forms part of the most wide-spread forests in this country. It is often very abundant in particular regions and is, for instance, found regularly in great quantities in the Plitvička Jezera National Park.

Most localities are at altitudes from about 600 to over 1600 m; it was, however, found also in beech forests at a low altitude, the lowest in Đerdap region, 100–180 m (Jelić 1966, Tortić and Jelić 1972).

Exceptionally, it was collected twice on *Ostrya carpinifolia*: Velika Paklenica in Velebit Mt., leg. Kotlaba, PRM, and Plitvička Jezera Nat. Park, leg. Černy, duplicate at ZA, but without substrate. Kotlaba (1985) also cites rare finds in Czechoslovakia and elsewhere from *Acer campestre*, *Carpinus* spp., *Quercus* spp. and *Ulmus*.

The specimens from most localities are at ZA, some at BEO and PRM.

Stereum rameale (Pers.) Fr.

Slovenia: Rožnik at Ljubljana, 300–350 m, branches of *Quercus* sp. (Voss 1889–92 as *S. ochroleucum*); Grčarevec near Grosuplje, 300 m, branch of *Carpinus betulus* 10/79, ZA; Laško near Celje, 230 m, on *Robinia pseudacacia* (Wettstein 1888 as *S. ochroleucum*); Voličina in Slovenske Gorice near Maribor, 300–400 m, *Quercus* branch, 10/73, leg. Habjanič. ZA; Krakovo near Kostanjevica, 150 m, branches of *Quercus robur*, 10/75, ZA, also on *Corylus avellana* (Hočevar and Tortić 1975, Hočevar et al. 1980); Kočevski Rog Mt. near Novo Mesto, Stara Zaga, 900 m, branch of *Fagus*, 10/75, ZA; Kopa in Kočevski Rog Mt., 1000–1060 m, on *Fagus* (Hočevar et al. 1985); Dobrava near Trebnje, 300 m, branches of *Quercus* sp., 10/84, ZA; Ravna gora in Gorjanci Mt., 850–950 m, on *Fagus* (Hočevar et al. 1985); Smrjene near Pijava Gorica at Ljubljana, 350–400 m, branches of *Quercus* sp., 10/86 (seen)

Croatia: Čička Poljana and Peščenica near Zagreb, 100 m, prostrate branches of *Quercus robur* 10/71, 10/77, 11/84, 10/85, 7/86, several at ZA; Zagreb, parks Tuškanac and Maksimir, 130 m, substrate unknown, 11/79, ZA, branch of *Quercus robur* 8/83; Stupnički lug near Zagreb, about 100 m, branches of *Quercus robur* 11/84, 10/85, ZA; Donji Macelj near Krapina, 300–350 m, on *Quercus* sp., 2/77, ZA; Golubovec near Donja Stubica, 200 m, branch of *Sorbus* sp.? 11/76, ZA; Varaždinske toplice near Varaždin, 200–250 m, branches of *Aesculus* sp.? 8/74, ZA; Prašnik near Okučani, 100 m, branches of *Quercus robur*, 10/81, 11/84, ZA; Kotar near Petrinja, 100 m, branches of *Quercus petraea* and *Q. robur*, 9/83, 8/85, ZA. (Fig. 2).

The data by Wettstein (1888) and Voss (1889–92) are taken here into account as probable; there is no herbarium material to check.

S. rameale grows saprophytically mostly on prostrate branches and twigs of *Quercus* spp., but was noted also on *Carpinus betulus*, *Corylus avellana*, *Fagus sylvatica*, and is cited by Wettstein from *Robinia pseudacacia*. In a few cases the host could not be identified with certainty or not at all.

According to Jahn (1971), in Europe this is a submediterranean-subatlantic species which becomes rare towards the north. It was pub-

lished from a single locality in southern Norway (Ryvarden 1971, Jahn 1971), but according to Eriksson et al. (1984:1432) the specimen proved to be an old *S. hirsutum*. Therefore *S. rameale* does not occur in Fennoscandia.

In Yugoslavia the species seems to be particularly abundant in lowland oak forests, at least those investigated, such as Krakovo, Prašnik, Kotar, Stupnički Lug, Peščenica, where it often occurs on prostrate branches of *Quercus robur*, together with *S. hirsutum*. It is interesting to note that in such cases both species are usually well separated, since the former occupies thinner twigs and the latter thicker branches, both in large quantities.

S. rameale was found predominantly at lower altitudes: seven localities up to 200 m, eight from 200—400 m and only three from 850—1000 m; there it grew on the wood of *Fagus*. Although the known localities are only from two republics, it is of course very unlikely that this species should not occur in others.

Stereum reflexulum Reid

Croatia: Island Lokrum near Dubrovnik, at about sea-level, on thin branches of an angiosperm, 5/30, leg. Rechinger, W (Tortić 1975), on *Cupressus sempervirens*, 6/67, leg. Kuthan (Kuthan 1980).

Crna Gora: Igalo near Hercegovci, at the sea-coast, on thin twigs of *Juniperus oxycedrus*, 9/40, leg. Glišić, BEO (Tortić 1975). (Fig. 2).

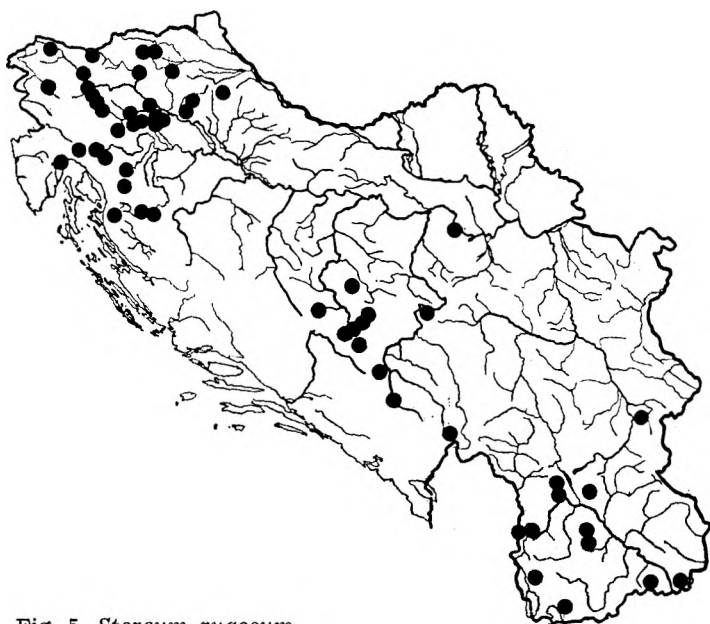
These two localities are still the only ones known in Yugoslavia, although this species is probably more spread along the sea-coast. It is, however, rather inconspicuous, or confused with small *Stereum hirsutum*.

Stereum rugosum (Pers. : Fr.) Fr.

Wettstein (1888), Ranojević (1902), Protić (1901, 1904), Jaap (1908), Bubák (1915), Pilát (1937), Pilát and Lindtner (1938), Tortić (1968, 1973), Tortić and Lisiewska (1971), Grujoska and Prljincević (1972), Hočevar and Tortić (1975), Tortić (1979, 1981, 1985), Hočevar et al. (1980, 1985), Karadelev (1987).

The species is, like *S. gausapatum*, conspicuous by its bleeding reaction to bruising, which, however, may be very slow or absent in old specimens. Its 56 known localities, as visible from the map (Fig. 5) are rather crowded in some parts of the country, whilst other regions are mostly blank. The latter may have been rarely explored mycologically, but it is also probable that this species, like other common fungi, was rarely collected. For instance in BEO, where a lot of *Aphylliphorales* are preserved, collected for the most part by V. Lindtner, I did not find a single specimen from Serbia. It may be presumed that it is rather widely spread, even if less so than e. g. *S. hirsutum*.

S. rugosum grows on hardwoods and is often found on dead as well as on injured parts of living trees. Main host is *Fagus sylvatica* (including *F. moesiaca*), but it was collected also on *Carpinus betulus* (8 ×) and *Corylus avellana* (7 ×). On other hosts it was noted rarely: *Quercus* spp. (4 ×), *Alnus glutinosa* (3 ×), *Populus* sp. (2 ×), *Betula* sp. (1 ×). In some instances the host is unknown. Mostly it was found in beech forests, also in forests of oak and hornbeam, as well as in various mixed stands.

Fig. 5. *Stereum rugosum*

Up to 200 m altitude there is only one locality (at about 60 m), thirteen from 200—500 m, twenty-one from 500—1000 m, and over 1000 to 1600 m or higher twenty-one localities. Only in one instance was it collected at the sea-coast: on the slopes Učka Mt. above Opatija, but at 250 m at least. Apparently it prefers higher altitudes.

Stereum sanguinolentum (Alb. et Schw. : Fr.) Fr.

Stoitzner (1869), Voss (1889—92), Jaap (1916), Protić (1921—22), Škorić (1928, as *S. crispum*), Tortić (1968), Tortić and Lisiewska (1971), Grujoska (1973), Prljinićević (1972), Hočevar and Tortić (1975), Hočevar et al. (1980a, 1985), Tortić and Sylejmani (1982), Tortić (1985).

Only 45 localities were registered, mostly from the better investigated north-west part of the country. As was the case of *S. rugosum*, no specimen of *S. sanguinolentum* from Serbia was found in BEO. It is, however, certainly more spread, although on its known localities not particularly abundant. Like *S. gausapatum* and *S. rugosum*, this species also shows a bleeding reaction, but can be distinguished from them already by hosts, since it is bound to conifers. It was found mostly in natural coniferous forests, but also on wood of planted conifers in broad-leaved forests. In fifteen localities the host was *Abies alba*, in fifteen *Picea abies*. Other hosts, on which it was found from once to four times, were *Larix decidua* and various pines: *Pinus halepensis*, *P. heldreichii*, *P. nigra*, *P. peuce*, *P. strobus*, *P. sylvestris*. It occurs from sea level to more than 1600 m, and was found even underground, in the Postojna Cave (Voss 1889—92). At the sea coast it was noted several times (on *P. halepensis*), but seems to be more frequent inland. The altitude is apparently not very important, since 17 localities are from sea level up to 500 m, 12 from 500—1000 m and 16 from 1000 upwards.

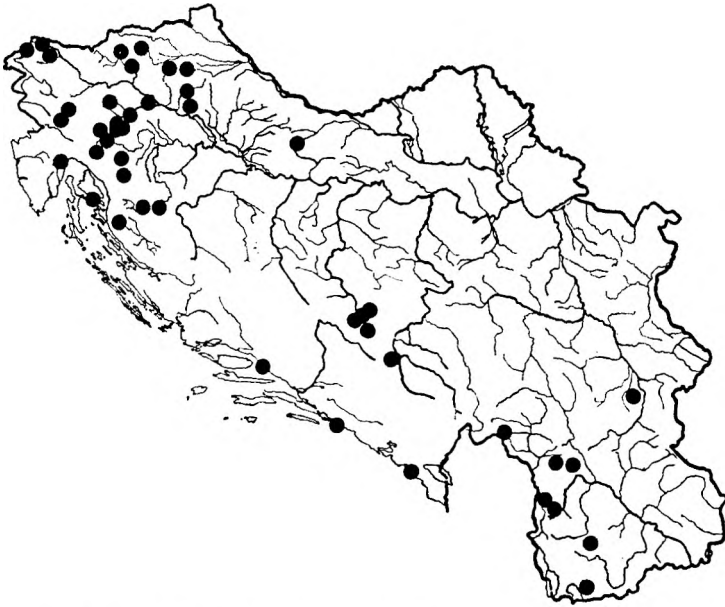


Fig. 6. *Stereum sanguinolentum*

Stereum subtomentosum Pouz.

Slovenia: Krakovo near Kostanjevica, 150 m, lowland oak forest, seen and collected many times from 1973 on, on prostrate branches particularly of *Alnus glutinosa*, but also on *Prunus padus*, *Quercus robur*, *Salix* sp., several collections at ZA (Tortiĉ and Hoĉevar 1976, Hoĉevar et al. 1980); Ojstri Vrh near Trebnje, 400 m, beech forest, wood of *Fagus sylvatica*, 10/84, ZA (rev. Pouzar).

Croatia: Ćiĉka Poljana near Zagreb, 100 m, branches of *Quercus robur*, 6/68, ZA, rev. Pouzar (Tortiĉ and Jeliĉ 1972) and Pešćenica (only a few km apart), branches of *Quercus robur* and *Alnus glutinosa*, 5—7/86, ZA; Stupniĉki lug near Zagreb, 100 m, branches of *Alnus glutinosa* 10/85; Kotar near Petrinja, about 100 m, branch of *Quercus robur*, 9/83, 10/84, ZA; Prašnik near Okuĉani, cca 100 m, branch of *Salix* sp. and *Carpinus betulus*, 11/84, ZA.

Bosnia and Hercegovina: Jaize, Bosnien, 4/1901, 1. (et. d.?) v. Höhnel, ut *S. insignitum*, rev. 1984 F. Kotlaba et Z. Pouzar (FH) (Kotlaba 1987). The find in this locality (correctly: Jajce) was published by Tortiĉ and Jeliĉ (1972) as *S. insignitum*, cited from Pilát (1930) where a stump of *Fagus* was mentioned as substrate. The altitude of this town is 360—380 m.

Serbia: Fruška Gora Mt., 450 m, logs of *Tilia tomentosa* and stumps of *Quercus petraea*, 9/70, 5/76, leg. Jeliĉ, det. Pouzar and Kotlaba, ZA (Tortiĉ and Jeliĉ 1972); Šar Planina Mt., northern side, alt at least 1000 m, in injured parts of standing trees (!) and prostrate dead wood of *Fagus* (Grujoska and Prljiniĉević 1972).

This species occurs mostly in wet forests along rivers, on lake shores etc., on dead wood principally of *Alnus* and *Salix* spp. (Jahn 1971). According to Kotlaba (1987) most collections in Czechoslovakia are from *Fagus sylvatica*, although it is also frequent there on *Alnus glutinosa*.

nosa and *A. incana*. Nearly two thirds of localities in that country are in planar and colline belts up to 500 m, but the highest is at 1240 m. The same author states that *S. subtomentosum* was collected from sea level (Finland) up to 1200—1700 m (Mongolia).

In Yugoslavia the number of known localities of *S. subtomentosum* is still small; for the most part they are in wet lowland oak forests, at altitudes of 100—150 m, where the fungus grows predominantly on *Alnus glutinosa*, less frequently on *Quercus robur* and rarely on *Carpinus betulus*, *Prunus padus* and *Salix* sp. In such forests it is usually abundant.

Only few collections are from higher altitudes and on other hosts. Particularly unexpected were the finds on *Fagus*, since in Yugoslavia *S. insignitum* is characteristic of this host. Two collections are supported by voucher specimens, but the published account from Šar Planina Mt. is rather doubtful. It is not so much because of the altitude which is possible, but because the fungus allegedly grew on injured parts of standing trees which is never the case with *S. subtomentosum*. The authors, Gruj oska and Prlj in č ević (1972) state that they also found *S. insignitum* in the same locality and that both species differed mainly in colour: the first named was brown, the second rusty brown. It is probable that there was only one involved, *S. insignitum*, but since there are no voucher specimens, the locality is cited here and put on the map with a question mark. In any case, it is necessary to look for further finds of *S. subtomentosum* on *Fagus*, although I suppose they will not be numerous.

In all species of the genus *Stereum* the hyphae and all types of cystidia are metachromatic in cresyl blue, sometimes very strongly.

Xylobolus frustulatus (Pers. : Fr.) P. Karst.

Croatia: Senjska Draga near Senj, 400—450 m, on wood of *Quercus* sp. (Šk orić 1928 as *Stereum frustulosum*); Lokrum island near Dubrovnik, sea-coast, on *Quercus frainetto*, 6/67, leg. et det. Kuthan, ZA (Torti ć 1978a); park Tuškanac in Zagreb, ca 130—150 m, stump of *Quercus* sp., leg. Göttl 12/79, ZA; Stojdraga in Žumberačko Gorje mountain range, 500 m, dead part of living tree and a log of *Quercus petraea*, 11/74, 2/76, ZA; Plitvička Jezera National Park, shore of Lake Kozjak, ca 550 m, injured part of living *Quercus petraea*, 6/78, ZA (Torti ć 1985); Stupnički Lug near Zagreb, 100 m, stump of *Quercus robur*, 11/86, ZA; Prašnik near Okučani, prostrate branch of *Quercus robur*, 10/81, ZA, 11/84.

Serbia: Beograd, Botanical garden, in a cellar, 120 m, 1934, leg. Lindtner, BEO; Debeli Lug near Majdanpek, 300 m, logs and wood for fuel, *Quercus* sp. (Petrović 1971); Goč Mt., logs and wood for fuel, *Quercus* sp. (Petrović 1971); Stolovi Mt., *Quercus petraea* (Marinković 1954).

In phytopathological literature this characteristic and easily recognised species is cited as a serious destroyer of wood of *Quercus* spp., on which it grows exclusively, but few localities are named and I could not find more data about its distribution. It was found on logs or dead parts of living trees of *Quercus frainetto*, *Q. robur* and *Q. petraea*, and certainly prefers lower altitudes, since its host does not occur very high up. The altitudes of localities in Mts. Stolovi and Goč could not be estimated.

Xylobolus subpileatus (Berk. et Curt.) Boid.

Slovenia: Famlje near Divača. on wood of *Quercus cerris*, 450 m, 6/82, leg. Čebulec, ZA.

Croatia: Žumberačko gorje mountain range near Zagreb, in three places only a few km apart, ca 350 m, on logs and a stump of *Quercus cerris*, 3/73, 3 and 6/79, 9/85, ZA. In the last find the species of oak is uncertain.

A specimen from Avala Mt. on *Fagus*, published by Pilát (1937) as this species, represents in fact *S. insignitum* (Tortić 1975, Kotlaba 1985).

According to Kotlaba (1985a) *Q. cerris* is the preferred host of this fungus, which was, however, collected in Europe very rarely also on some other species of oaks, and in other continents on several genera of broadleaved trees. Since particularly in the eastern parts of Yugoslavia forests of *Q. cerris* abound, *X. subpileatus* is probably not so very rare there and should be looked for.

Kotlaba (1985a, 1986) is of the opinion that *Xylobolus* should be included in the genus *Stereum*, and accordingly names those species *Stereum frustulatum* and *S. subpileatum*. Other authors, such as Boidin et al. (1979) consider it as a separate genus.

In cresyl blue the hymenium of both *Xylobolus* species turns light red. Lower layers of *X. frustulatus*, consisting of vertical elements with thickened walls, glued together, become violet blue. In *X. subpileatus* the skeletal of the context, parallel to the substrate, turn very dark red (if not well teased apart they become light blue!) and those of the tomentum very dark blue, with occasional dark red ones.,

Note on reactions in cresyl blue

Recently Niemelä (1985) has proposed a simplified way to indicate colour reactions of microscopical structures in fungi, using + = colour change and — = no colour change. However, already in the case of Melzer's reagent (IKI) it was necessary to distinguish two positive colour reactions: amyloid and dextrinoid, which he designates as IKI grey or blue and IKI red (rusty brown would be nearer in my opinion). For cresyl blue he uses + for metachromatism (change to red) and — if the structures become blue, and adds that the reaction is sometimes weak, intermediary or variable.

As I have pointed out (Tortić 1976) the hyphae in cresyl blue turn a wide variety of colours: from deep red through many shades of violet to deep blue, or remain quite or almost colourless. If the section is too thick or the hyphae densely intertwined, the reagent cannot penetrate deeply and the reaction is weak or absent, even contrary (e. g. *X. subpileatus*), but usually thinner parts or loose ends, where it can be observed more or less clearly, can be found. The colour or absence of it appear to be characteristic of a particular species, sometimes of a whole genus. Therefore one ought to take into account intermediary bluish or reddish violet colours as well. All this is complicated by the fact that different brands of cresyl blue give different colour shades. An investigator used to a particular brand may need some time to accustom himself to another one. The product of Dr. G. Grübler et Co. Leipzig, gave the widest range of colours among the several which I had the opportunity to try and I prefer it, but other people may find

another product more satisfactory. For those reasons I am afraid that many people will not consider the reaction in cresyl blue as objective enough, but it works well for, if I may say so, home use. After all, in this manner another character is added to help in the determination of a species.

The same author found that in the laboratory colour change in cresyl blue is regulated by pH, but of course other factors may be involved. The difference in pH might indeed help to explain the above mentioned difference in colour in various parts of fruitbodies in the genus *Xylobolus*, found also in *Scytinostroma* (Tortić 1985), as well as change of colour reaction during the development of *Ischnoderma benzoinum*, where skeletal hyphae of the tube trama become red in young fruitbodies and blue in mature ones (Tortić 1979a).

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SAŽETAK

PORODICA STEREACEAE (BASIDIOMYCETES) U JUGOSLAVIJI

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U Evropi je dosad poznato 6 rodova porodice *Stereaceae* s 19 vrsta, od kojih su neke vrlo rijetke (Jahn 1971). Dosad je u Jugoslaviji ustanovljeno 5 rodova sa 16 vrsta i ovdje se govori o njihovoj raspranjenosti u nas.

Samo je manji broj vrsta, uglavnom čestih, bio objavljen već prije za našu zemlju, i to s jednog ili s nekoliko lokaliteta. Većina ovdje iznesenih podataka rezultat je najnovijih istraživanja. Neke vrste, nađene na malo mjesta, vjerojatno su uistinu rijetke, no broj poznatih lokaliteta čak i onih općenito čestih zapravo je malen, uglavnom stoga što mnogi naši krajevi nisu istraživani s mikološkog gledišta.

Lokaliteti su prikazani na kartama, a pojedinačno navedeni u engleskom tekstu samo ako ih je dvadesetak i manje. Uzeti su u obzir i podaci iz literature, iako bez pristupačnih herbarskih primjeraka, ako su se činili vjerojatnima. U nekim su slučajevima bili sumnjivi, što je istaknuto. Označeni su domaćini, nadmorske visine, po mogućnosti i tipovi šuma. Istraživana je i reakcija hifa s odeblijalim zidovima u krezilnom plavilu.

Od roda *Amylostereum* ustanovljeni su *A. areolatum*, koji se uglavnom razvija na smrekovu drvu, na 22 lokaliteta, *A. chailletii*, najčešće na jelovu drvu, na 17, te *A. laevigatum*, karakterističan za drvo raznih vrsta borovica i tise, na 8, sva tri od nizine do oko 1400 m. Hife u krezilnom pravilu postaju vrlo tamno modre s crvenim preljevom.

Columnocystis abietina i *C. ambigua* rastu na smrekovu drvu. Od prve je poznato 7 lokaliteta, no vjerojatno je broj lokaliteta veći, a druga je nađena samo na jednom mjestu i općenito je vrlo rijetka. U krezilnom pravilu hife im reagiraju kao u predašnjem rodu.

Lopharia spadicea raširena je u Evropi najviše u južnim dijelovima. Nalazi se, iako rijetko, i u srednjoj pa i sjevernoj Evropi na toplijim mjestima (Kotlaba 1986a). U nas je nađena na 14 lokaliteta, no sigurno je mnogo češća, jer je spomenuti autor navodi u Čehoslovačkoj, gdje se smatra rijetkom, na 88 nalazišta. Raste na mrtvom drvu različitog listopadnog drveća, većinom u nižim predjelima pa do 1000 m, izuzetno i na višim lokalitetima. U krezilnom plavilu postaju hife i cistide intenzivno crvene (metahromatične) s ljubičastim tonom.

Od roda *Stereum* raste u Jugoslaviji 8 vrsta. Među njima *S. hirsutum* pripada najčešćim i najobičnijim lignikolnim gljivama, a ustanovljen je na 27 rodova listača i 3 vrste četinjača. Osobito se često nalazi na bukvi i hrastu, zatim na lijeski, grabu i dr. Zasad je poznato oko 150 lokaliteta, od morske obale do 1500 m visine, ali za mnoga područja gdje je sigurno prisutan nije zabilježen. Na pojedinim se nalazištima razvija u velikom mnoštvu na ležećim granama, trupcima i dr.

S. insignitum u nas je raširen uglavnom na bukovu drvu, samo je dvaput nađen na crnom grabu. Poznat je na preko 60 lokaliteta, većinom na višim nadmorskim visinama, od 600 do 1600 m; izuzetno se javlja u nižim dijelovima, gdje su razvijene bukove šume, kao u Đerdapu na 100—180 m.

S. gausapatum karakterističan je za hrast (nađen na 5 vrsta hrastova), ali dolazi i na nekim drugim lišćarima. Utvrđeno je ukupno 19 nalazišta, najviše s jadranskog primorja i iz Makedonije, i to većinom u nižim položajima. Himenij mu na pritisak pocrveni. Istu takovu reakciju pokazuju *S. rugosum* i *S. sanguinolentum*. Prvi je nađen na 56 lokaliteta na lišćarima, najviše na bukvi, pa na grabu, lijeski, pojedinačno i na nekim drugim rodovima; nerijetko raste na mrtvim ili oštećenim dijelovima živog drveća. Manji je broj lokaliteta na visinama do 500 m, većina je od 500—1600 m. *S. sanguinolentum* javlja se samo na drvu četinjača, a poznato je 45 lokaliteta, od morske obale do oko 1600 m. Najčešće je nađen na jeli i smreki, rjeđe na različitim borovima i arišu.

S. rameale dosad je poznat samo iz Slovenije i Hrvatske s ukupno 18 lokaliteta, no sigurno dolazi i u drugim krajevima. Zajedno sa *S. hirsutum*, kojemu je veoma sličan, često raste u nizinskim šumama na istim ležećim granama hrasta, samo na tankim ograncima. Većinom je nađen na drvu hrasta, na nižim nadmorskim visinama, jedino je na tri mjesta rastao i na bukovu drvetu u visinama između 850 i 1000 m.

S. reflexulum poznat je samo s dva lokaliteta na čempresu, šmriki i neodređenoj listači (Tortić 1975, Kuthan 1980). To je izrazito mediteranska vrsta koja je na našem primorju vjerojatno raširenija.

S. subtomentosum u nas je zabilježen tek u novije doba na 8 lokaliteta. Raširen je osobito u nizinskim šumama, na visinama 100—150 m. gdje je može razviti vrlo obilno na ležećem drvu johe, zatim hrasta lužnjaka, ponekad i drugog drveća. Nađen je rjeđe i na visinama 400—450 m na lipi, hrastu i bukvi. Nalaz na ozlijeđenim dijelovima stojećih stabala bukve na visini od najmanje 1000 m (Grujoska i Prljinićević 1972) nije pouzdan, jer je ta gljiva saprofit. Navod se međutim ne može provjeriti bez dokaznog materijala pa je lokalitet označen upitnikom.

U svim vrstama roda *Stereum* hife i cistide postaju u krezilnu plavilu crvene.

Xylobolus frustulatus u našoj se fitopatološkoj literaturi navodi kao opasan razarač hrastova drveta na kojem se isključivo razvija. Zasad je pronađen samo na 11 lokaliteta. U vezi sa svojim domaćinima dolazi pretežno na nižim nadmorskim visinama.

X. subpileatus dosad je ustanovljen na po jednom nalazištu u Sloveniji i Hrvatskoj, oba puta na drvu cera, za koji se smatra da mu je najvažniji domaćin.

U krezilnu plavilu himenij vrsta *Xylobolus* postaje svijetlocrven, niži slojevi plodišta *X. frustulatus* plavoljubičasti, dok kod *X. subpileatus* skeletne hife postaju vrlo tamnocrvene, a hife tomentuma tamnoplave.

Na kraju se govori o nekim iskustvima pri istraživanju reakcija hifa u krezilnu plavilu.

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