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NOTES ON POLISH POLYPORES. 3. FOUR RARE SPECIES OF OLD-GROWTH FORESTS

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Abstract: Four rare Polish polypores that appear mostly in old-growth forests, *Antrodia malicola* (Berk. & M. A. Curtis) Donk, *Diplomitoporus lindbladii* (Berk.) Gilb. & Ryvarden, *Pycnoporellus alboluteus* (Ellis & Everh.) Kotl. & Pouzar and *Pycnoporellus fulgens* (Fr.) Donk, are described, illustrated and discussed, to supplement information in the second fascicle of the *Atlas of the geographical distribution of fungi in Poland*.

Key words: *Antrodia*, *Diplomitoporus*, *Pycnoporellus*, polypores, ecology, indicator fungi

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Work on the second fascicle of *Atlas of the geographical distribution of fungi in Poland* (Piątek 2002a–e) provided observations on the ecology, site conditions, basidiome morphology and taxonomy of five polypores rare in Poland. The paper supplies observations concerning four of them; the morphology and ecology of another one were earlier presented by Piątek and Cabała (2002). This is the third part of papers intended to describe, illustrate and map all polypores occurring in Poland.

Instead of complete lists of studied material, only a few representative specimens are listed under each species, including those used for descriptions and/or illustrations of basidiome morphology, or otherwise referred to in the text. Full reference material is published in the *Atlas of the geographical distribution of fungi in Poland.* In addition, foreign materials from the Stanisław Domański herbarium in KRAM and other Polish herbaria are published, cited in the 'additional specimens seen' sections. Preparation of the diagrams of phenology employed all single samples for which the month of collection/observation of basidiomes was known, with the exception of evident duplicates.

Antrodia malicola (Berk. & M. A. Curtis) Donk (Fig. 1)

Persoonia **4**: 340. 1966.

Trametes malicola Berk. & M. A. Curtis, Acad. Nat. Sci. Philadelphia J. **2**(3): 209. 1856. – *Coriolellus malicola* (Berk. & M. A. Curtis) Murrill, Mycologia **12**: 20. 1920.

Trametes kuzyana Pilát, Atl. champignons de l'Europe: 285. 1939. – *Trametes kuzyana* Pilát *ex* Pilát, Sborn. Nár. Muz. v Praze, Ser. B **9**(2): 104. 1953. – *Funalia kuzyana* (Pilát) Bondartsev, Trut. Griby: 532. 1953.

Basidiomes annual to biennial; consistency tough and corky in fresh specimens, hard when dry; sometimes resupinate but often effused-reflexed with nodulose pilei, and even sessile with ± abundant imbricate pilei; upper surface pale cinnamon to woody brown, sometimes with grayish tint, especially in old specimens, at first tomentose then glabrous; margin rounded with sterile zone next to hymenophore, up to 1 mm wide; pore surface pale woody brown, paler than upper surface; pores circular, angular to sinuous in various parts of hymenophore, usually 2–3(–4) per mm. Context fibrous, pale woody brown, up to 3 mm thick; tubes slightly paler than context, up to 5 mm long. Hyphal system dimitic; generative hyphae

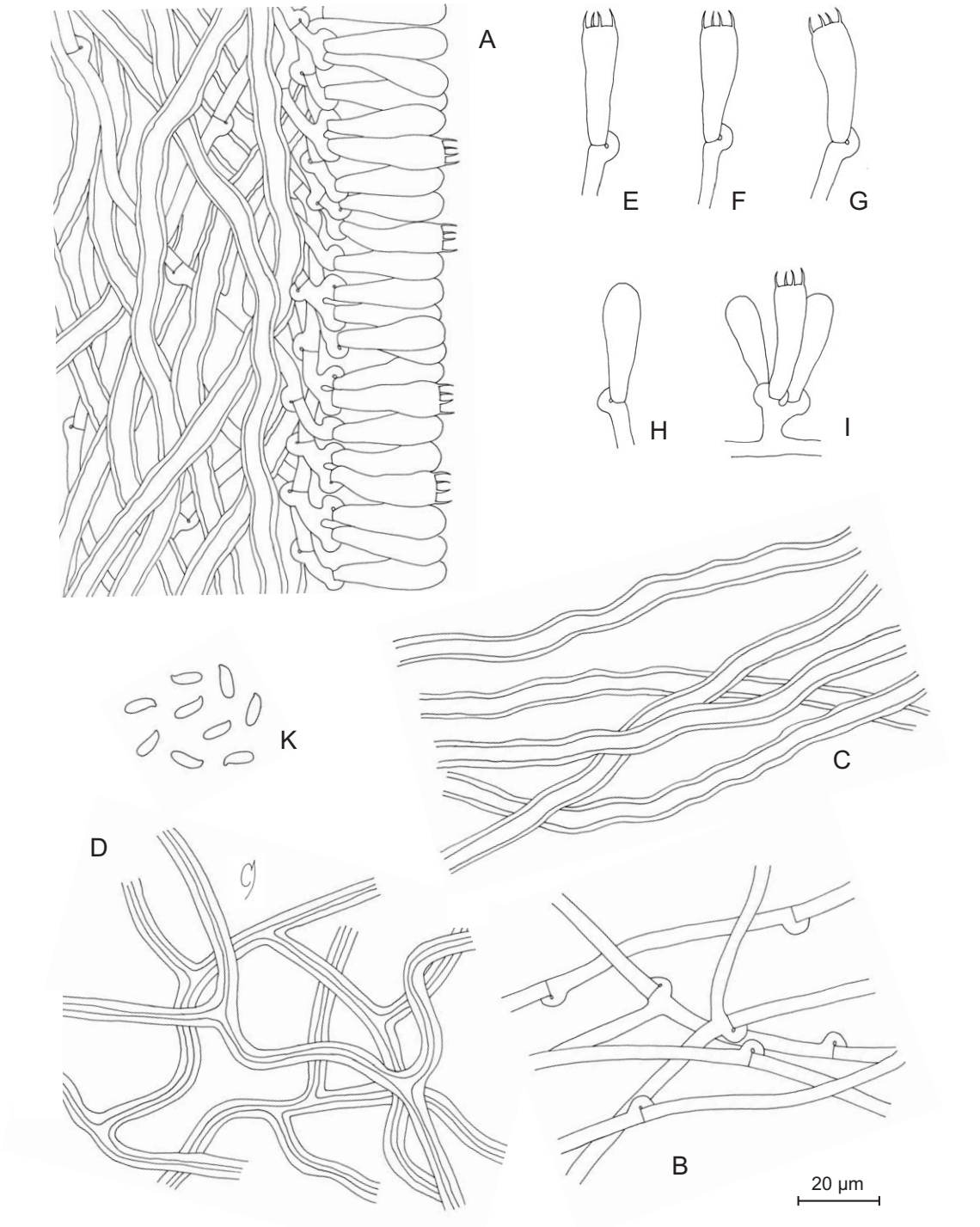

Fig. 1. *Antrodia malicola* (Berk. & M. A. Curtis) Donk: A – hymenium, B – generative hyphae, C – skeletal hyphae, D – branched binding hyphae, E–I – basidia, K – basidiospores (from KRAM-Domański 5053; drawn by J. Cabała).

hyaline, branched, thin-walled, with clamps, 2–4 μm; skeletal hyphae dominate in hymenium and context, subparallel and strongly intermixed, pale brownish, semisolid to thick-walled, unbranched, non-septate, flexuose, 2–4 μm, at the end sometimes claviform thickened; narrow binding hyphae present in the context, richly, shortly branched, solid, non-septate, 2–3 μm. Cystidia or other similar sterile hymenial elements absent; basidia clavate, hyaline, with a basal clamp, 4-sterigmate, 20–30 × 7–10 μm; basidiospores oblong ellipsoid to cylindric, arcuate close to the distinct apiculus at the adaxial side, hyaline, thin-walled, smooth, non amyloid, 7.0–9.0 × 2.5–4.0 μm.

SPECIMENS EXAMINED. POLAND. KOTLINA SANDOMIERSKA BASIN. Płaskowyż Tarnowski plateau: Tarnów, Debrza Reserve (at Wiśniowa Street), *Tilio cordatae-Carpinetum betuli*, on branch of *Carpinus betulus*, 28 July 1998, *leg. M. Piątek* (KRAM F-51233); Pradolina Podkarpacka spillway: Rzeszów, at J. Słowackiego Street, on trunk of living *Prunus domestica*, 17 July 1966, *leg. S. Domański & A. Orlicz* (KRAM-Domański 5053); WESTERN CARPATHIANS. Pogórze Rożnowskie foothills: Szczepanowice, alt. *ca* 300 m, herb-rich forest with *Fraxinus excelsior*, on trunk of *Carpinus betulus*, 25 March 1995, *leg. M. Piątek* (KRAM F-51339).

ADDITIONAL SPECIMENS SEEN. AUSTRIA. Near Grünau, on *Fagus sylvatica*, 2 Sept. 1973, *leg. M. Ławrynowicz* (WA 021969). UNITED STATES. OHIO: Cincinnati Nature Center, Clermont Co., on *Ulmus americana*, 30 Sept. 1967, *leg. W. B. & V. G. Cooke 3891* (KRAM-Domański); Scioto State Park, Ross Co., on rotting wood, 31 Aug. 1968, *leg. W. B. & V. G. Cooke 39733* (KRAM-Domański); Mt. Airy Forest Park, Cincinnati, Hamilton Co., on rotten hardwood, 10 July 1973, *leg. W. B. & V. G. Cooke 48870* (KRAM-Domański); Fort Ancient State Memorial, Warren Co., on rotting hardwood log (? elm), 22 Nov. 1973, *leg. W. B. & V. G. Cooke 49157* (KRAM-Domański); Lake Hope State Park, Hinton Co., on hardwood, 30 Sept. 1978, *leg. W. B. & V. G. Cooke 56009* (KRAM-Domański).

NOTE. From the Stanisław Domański herbarium only foreign specimens not published by Domański (1966) in his work on *Antrodia malicola* in Eurasia are cited. The remaining specimens are not repeated here although they are present in the herbarium and were seen during this work.

TAXONOMY AND IDENTIFICATION. The genus *Antrodia* P. Karst. is one of the largest genera of polypores, represented by 27 species in Europe. To the 25 taxa given by Ryvarden and Gilbertson (1993), two more were added later: *Antrodia pseudosinuosa* A. Henrici & Ryvarden (Henrici & Ryvarden 1997) and *Antrodia sandaliae* Bernicchia & Ryvarden (Bernicchia & Ryvarden 2001). Within the genus, *Antrodia malicola* is distinguished by pale brown reflexed-effused basidiomes sometimes producing numerous imbricate pilei, and by the shape and size of the basidiospores. Such imbricate pilei, depicted for instance by Domański (1966: 603), Jahn (1983: 221) and Lohmeyer (2000: 34), have been observed in the collection from Szczepanowice reported here (KRAM F-51339); they were even more abundant than is visible in the cited photographs.

Antrodia malicola may be confused with the morphologically similar *Trametes cervina* (Schwein.) Bres., but the latter has smaller basidiospores, cystidioles in the hymenium, and larger pores which are usually clearly dedaleoid or irpicoid-hydnoid. Also, in contrast to *A. malicola*, *T. cervina* causes white rot in wood, but this feature is not always accessible. In the past there was another taxon similar to *Antrodia malicola*, namely *Trametes kuzyana* Pilát *ex* Pilát described originally by Pilát (1953) from slopes of Menčul Mt. between the Kuzy and Bredecel rivers in the Eastern Carpathians, now in the Ukraine (Holec 2002). However, on the basis of careful examination of numerous specimens identified as *Trametes kuzyana* and *Coriolellus malicola* (Berk. & M. A. Curtis) Murrill (= *A. malicola*) and culture characters, Domański (1966) concluded that these two names refer to the same species and that the latter has priority over the former. This statement was later confirmed by Kotlaba and Pouzar (1991).

ECOLOGY. Most localities of *Antrodia malicola* are situated in mesic or herb-rich deciduous forests, primarily of natural origin, with a high degree of continuity in the supply of substrate. Localities in synanthropic habitats are quite rare; in Poland, a station in Rzeszów on a trunk of living *Prunus domestica* L. is of such character

(Domański 1966). *Antrodia malicola* generally occurs on various deciduous trees (Gilbertson & Ryvarden 1986; Ryvarden & Gilbertson 1993) and exceptionally on conifers, being present *inter alia* on *Pinus halepensis* Mill. in France (David & Dequatre 1984) and on introduced *Pinus patula* Schltdl. & Cham. in Zimbabwe (Masuka & Ryvarden 1992). In Poland it is noted from seven stations where it was found: twice each on *Carpinus betulus* L. and *Fagus sylvatica* L., and once each on *Prunus domestica*, *Salix alba* L., and *Salix fragilis* L. The polypore causes brown rot of dead hardwood but it is not sufficiently known at which stage of decay it appears on wood. *Antrodia malicola* has been observed on living trees as a very rare parasite of *Malus* (Kreisel 1961), *Prunus* cf. *serratula* Lindl. (Jahn 1983) or coppice stumps of *Eucalyptus grandis* W. Hill *ex* Maiden (Masuka & Ryvarden 1992).

In the literature concerning Polish localities, as a rule there is no more detailed information on ecology and site conditions of *Antrodia malicola*. A handful of such observations were noted in the locality in Szczepanowice in the Western Carpathians. *Antrodia malicola* emerged there on a fallen, partly decorticated trunk of *Carpinus betulus*. About 20 specimens grew mainly on wood and rarely on the outer and inner part of bark which lagged from the wood owing to fructification of the fungus. The trunk was lying on the border between a poor beech forest and an herb-rich moist tree stand with scarce young *Fraxinus excelsior* L., making this site rather open and sunny. The basidiomes of *Antrodia malicola* grew only on the part of the trunk lying in this open site, surrounded solely by vascular plants typical of moist habitats: *Asarum europaeum* L., *Carex pendula* Huds., *Dryopteris filix-mas* (L.) Schott, *Equisetum sylvaticum* L., *Eupatorium cannabinum* L., *Geranium robertianum* L., *Impatiens noli-tangere* L., *Petasites albus* (L.) Gaertn., *Salvia glutinosa* L., *Stachys sylvatica* L. and *Urtica dioica* L.

The first Polish collection of *Antrodia malicola* was made in the last days of March, but the basidiomes were obviously from the previous year. The main findings originate from July and August (Fig. 2). More general conclusions about the phenology of *A. malicola* cannot be drawn because of the paucity of collections and the rarity of the species.

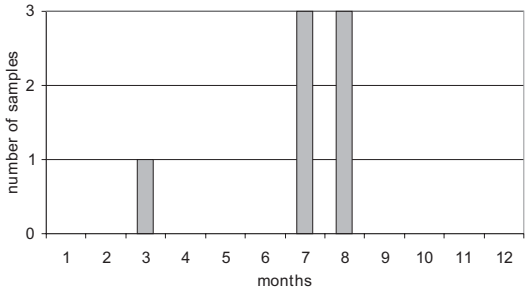

Fig. 2. Phenology of *Antrodia malicola* (Berk. & M. A. Curtis) Donk in Poland.

DISTRIBUTION. Widely distributed throughout the Northern and rarely the Southern Hemisphere, but everywhere it is not a common species, in Poland it is reported from eight localities (for details see Piątek 2002a).

Diplomitoporus lindbladii (Berk.) Gilb. & Ryvarden (Fig. 3)

Mycotaxon **22**: 364. 1985.

Polyporus lindbladii Berk., Grevillea **1**: 54. 1872. – *Poria lindbladii* (Berk.) Cooke, Grevillea **14**: 111. 1886. – *Antrodia lindbladii* (Berk.) Ryvarden, The Polyp. Of North Europe **1**: 82. 1976. – *Cinereomyces lindbladii* (Berk.) Jülich, Biblioth. Mycol. **85**: 400. 1981.

Polyporus cinerascens Bres., Verh. Zool.-Bot. Geselsch. **50**: 361. 1900, *nom. illeg*. – *Poria cinerascens* (Bres.) Sacc., Syll. Fung. **16**: 161. 1902. – *Tyromyces cinerascens* (Bres.) Bondartsev & Singer, Ann. Mycol. **39**: 52. 1941.

Basidiomes annual but often overwintering and persisting to the next spring, and in such cases the new basidiomes emerge on the previous ones; consistency soft to tough and corky when fresh, hard in dry specimens, slightly brittle in longer-preserved materials; always resupinate, at first circular, then becoming widely effused on the substrate; margin white, distinctly delimited towards the substratum, with narrow to wide sterile zone, characteristically fimbriate, at least in young specimens; pore surface at first white, soon becoming

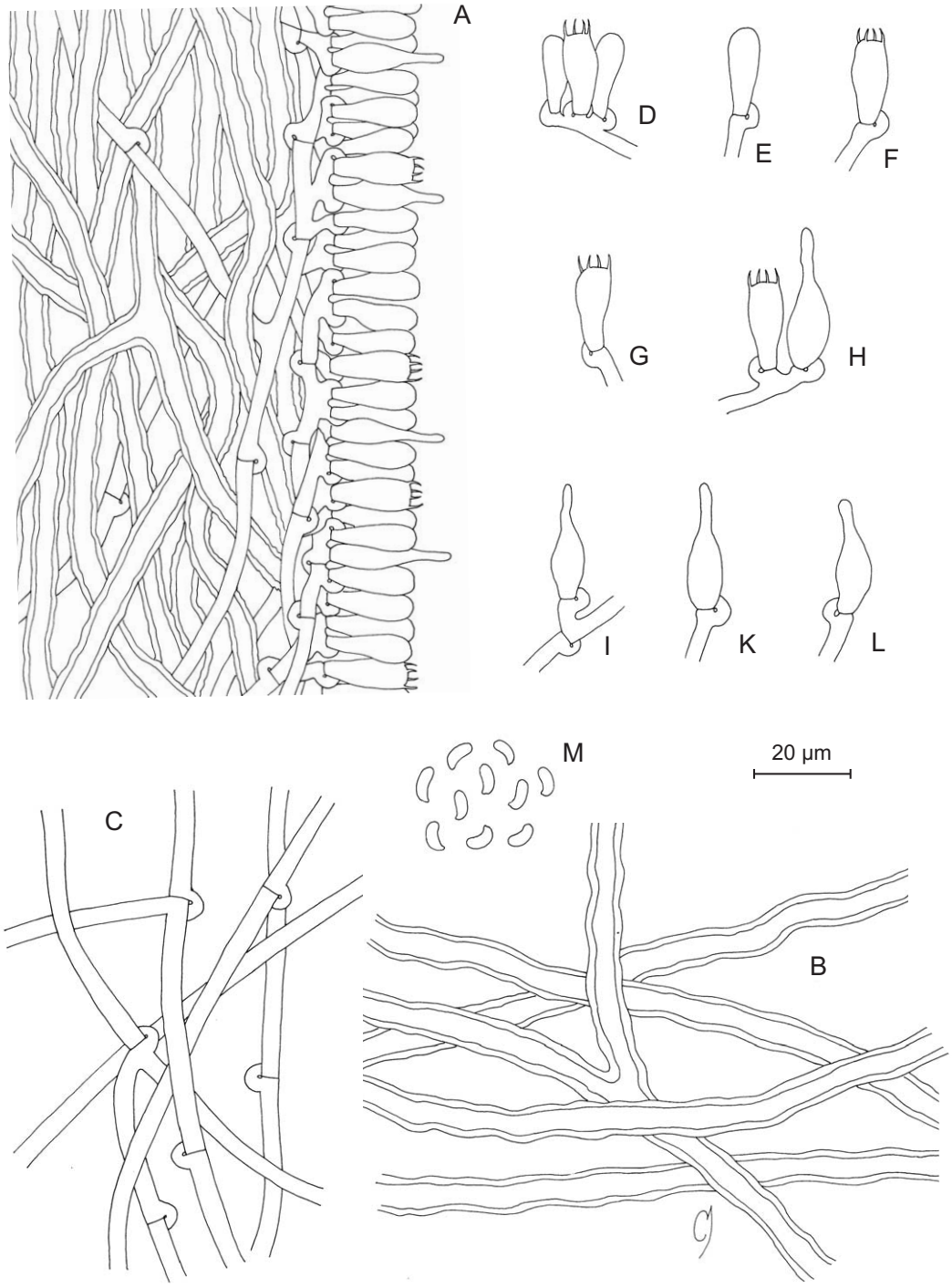

Fig. 3. *Diplomitoporus lindbladii* (Berk.) Gilb. & Ryvarden: A – hymenium, B – skeletal hyphae, C – generative hyphae, D–G – basidia, H – basidium + cystidium, I–L – cystidia, M – basidiospores (from KRAM-Domański 3431; drawn by J. Cabała).

distinctly greyish over most of the basidiome, remaining white only close to outer part; pores circular or sometimes angular, 3–5 per mm. Context white and cottony, up to 4 mm thick, tubes whitish near context, greyish towards surface of pores, up to 6 mm long. Hyphal system dimitic; generative hyphae hyaline, moderately branched, thin-walled, with clamps, 3–5 μm; skeletal hyphae predominant, subparallel and strongly intermixed, hyaline, sparsely branched, straight to flexuose, solid or thick-walled, non-septate, 3–8 μm, strongly gelatinized and partly dissolving in KOH. Cystidioles fusoid to lageniform, slightly projecting over the hymenium, thin-walled, hyaline, with a basal clamp; basidia clavate, hyaline, with a basal clamp, 4-sterigmate, 15–20 × 4–6 μm; basidiospores allantoid to cylindrical, hyaline, thin-walled, smooth, non-amyloid, (4.2–)5.2–6.2 × 1.7–2.1 μm.

SPECIMENS EXAMINED. POLAND. WYSOCZYZNY PODLASKO-BIAŁORUSKIE HIGH PLAINS. Równina Bielska plain: Białowieża Primeval Forest, mixed forest, on fallen trunk of *Picea abies*, 20 Oct. 1963, *leg S. Domański* (KRAM-Domański 3431); WESTERN CARPATHIANS. Pogórze Ciężkowickie foothills: Podlesie-Zalasowa, alt. *ca* 300 m, forest with *Abies alba* and *Fagus sylvatica*, on fallen trunk of *Cerasus avium,* 4 July 1998, *leg M. Piątek* (KRAM F-52189); Western Tatra Mts: Sarnia Skała Massif, Grześkówki Ridge, alt. *ca* 980 m, *Dentario glandulosae-Fagetum*, on fallen trunk of *Abies alba*, 5 Sept. 2001, *leg A. Miśkiewicz & M. Piątek* (KRAM F-52587, F-52591).

ADDITIONAL SPECIMENS SEEN. CANADA. Kananaskis Expt. Sta., Alta., on *Picea engelmannii*, 8 July 1962, *leg. R. L. Gilbertson* (KRAM-Domański). GERMANY. Hintersee bei Parchim (Mecklemburg), on *Picea abies*, Feb. 1967, *leg. R. Doll* (KRAM-Domański 005429); Crwik bei Weberin, on *Betula*, 24 Aug. 1970, *leg. R. Doll* (KRAM-Domański).

TAXONOMY AND IDENTIFICATION. *Diplomitoporus* Domański was created by Domański (1970) as a genus of its own for two species, *D. flavescens* (Bres.) Domański and *D. crustulinus* (Bres.) Domański, and at present in Europe it is represented by four species. *D. lindbladii* was combined into the genus later (Gilbertson & Ryvarden 1985; Ryvarden & Gilbertson 1993) and *D. meridionalis* Pieri & Rivoire was described quite recently (Pieri & Rivoire 1998). Of these, *Diplomitoporus lindbladii* is readily distinguishable by its weak amyloid reaction in the skeletal hyphae, which gelatinize and partly dissolve in KOH. *D. meridionalis* has similar hyphae but is characterized by the presence of leptocystidia and cartilagineous hymenophore. The greyish color of the hymenophore surface is also an important guideline for identifying *D. lindbladii*. However, sometimes the hymenophore is white or even snowy white, especially in young specimens, and becomes greyish with age. The appearance of the sterile margin is another useful feature during determination of *D. lindbladii*; the margin is distinctively fimbriate, lagging from the substrate. All these characters are so unusual in the genus *Diplomitoporus* that Jülich (1981) described the separate genus *Cinereomyces* Jülich to accommodate this taxon, but most mycologists have not accepted his proposal. Ryvarden and Gilbertson (1993) stated their opinion clearly: 'since the type of rot, the hyphal system and the spores are of the same length and type [as in *Diplomitoporus* – note by MP], we feel the deviating characters [...] do not justify a separate genus.' The above-mentioned characters are untypical in the genus *Antrodia* as well; the latter shares the same microstructure as *Diplomitoporus* and is separated from it only by the type of rot (brown rot in *Antrodia* and white rot in *Diplomitoporus*; compare the European species in the key of Bernicchia & Ryvarden 2001).

ECOLOGY. *Diplomitoporus lindbladii* occurs mostly in extensive managed forests, often in old growth and in virgin forest. In Poland, for example, this polypore is very common in the Białowieża Primeval Forest, and almost all other localities are in highly natural forests or protected areas. In most cases it is restricted to coniferous trees of the genera *Abies*, *Larix*, *Picea*, *Pinus*, *Pseudotsuga*, *Sequoia*, *Thuja* and *Tsuga*, but is recorded from a number of deciduous trees as well (Ryvarden & Gilbertson 1993; Gilbertson & Ryvarden 1986). In Poland it was recorded mostly on *Picea abies* (L.) H. Karst. and *Pinus sylvestris* L.,

but also on *Abies alba* Mill., *Betula pendula* Roth, *Cerasus avium* (L.) Moench and on wood of an unidentified deciduous tree.

Diplomitoporus lindbladii causes white rot of dead wood. Ryvarden and Gilbertson (1993) noted the frequent occurrence of its basidiomes on or close to *Trichaptum* Murrill on coniferous hosts, which may suggest that it is a successor species and appears at later stages of wood decomposition. Niemelä *et al.* (1995) do not mention this polypore in their survey of successors. Of the 47 specimens examined during the present studies I found only two specimens of *D. lindbladii* that emerged on the previous year's basidiomes of *Trichaptum abietinum* (Dicks.: Fr.) Ryvarden, so this phenomenon must be very rare in Polish populations of the polypore. Perhaps the former should be considered a facultative successor, defined as a successor not strictly associated with predecessors (Piątek 2001), but this problem requires further observations. Remnants of this species must be carefully studied because *D. lindbladii* often emerges on its own hymenophore of the previous year and sometimes can be mistaken for an old hymenophore of *Trichaptum*.

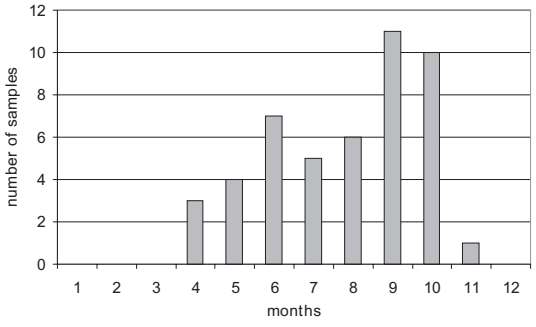

Fig. 4. Phenology of *Diplomitoporus lindbladii* (Berk.) Gilb. & Ryvarden in Poland.

In Poland *Diplomitoporus lindbladii* begins to form basidiomes in April and ends in November. Its main period of fructification is in September and October, but June, July and August also offer favourable conditions for the formation of basidiomes of this polypore (Fig. 4).

DISTRIBUTION. *Diplomitoporus lindbladii* is widely distributed but scattered in the Northern Hemisphere, and also present but rare in the Southern Hemisphere. From Poland it has been recorded from thirteen stations located in twelve grid squares (for details see Piątek 2002b).

Pycnoporellus alboluteus (Ellis & Everh.) Kotl. & Pouzar (Fig. 5)

Česká Mykol. **17**: 174. 1963.

Fomes alboluteus Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia **1895**: 413. 1895. – *Phaeolus alboluteus* (Ellis & Everh.) Pilat, Atl. champignons de l'Europe: 144. 1937. – *Hapalopilus alboluteus* (Ellis & Everh.) Bondartsev & Singer, Ann. Mycol. **39**: 52. 1941.

Basidiomes annual but sometimes overwintering and persisting to the next spring; consistency elastic and soft in fresh specimens and brittle and hard when dry, yellowish-orange, bright orange, salmon to apricot; basidiomes usually resupinate or slightly reflexed, pulvinate, often widely effused on lower side of fallen trunks, up to 1 m long or more, not attached to the ground; margin without sterile zone; pore surface orange, salmon to apricot; pores angular, variable in size and shape but usually larger than 1 mm in diameter, sometimes splitting and forming a hydnaceous hymenophore. Context soft, pale orange, thin, up to 2 mm thick; tubes concolorous with context, up to 2 cm long, sometimes forming nodular false pilei; all parts of basidiomes turning purple or cherry red in aqueous solution of KOH. Hyphal system monomitic; hyphae bright reddish, yellowish or hyaline in KOH, old hyphae covered by crystals dissolving in KOH and making the hyphae rough; tramal hyphae interwoven or subparallel, simple-septate, flexuose, sparsely or moderately branched, thin- or thick-walled, variable in size, 2–8 μm in diameter; contextual hyphae sparsely branched or almost unbranched, strongly intermixed, thin- and thick-walled, variable in size, 2–10 μm in diameter. Cystidia frequent and strongly projecting over hymenium, cylindric, thin-walled, hyaline, 60–120 × 5–10 μm; basidia clavate, hyaline, without basal clamp, 4-sterigmate, 20–30 × 5–6 μm; basidiospores narrowly ellipsoid to cy-

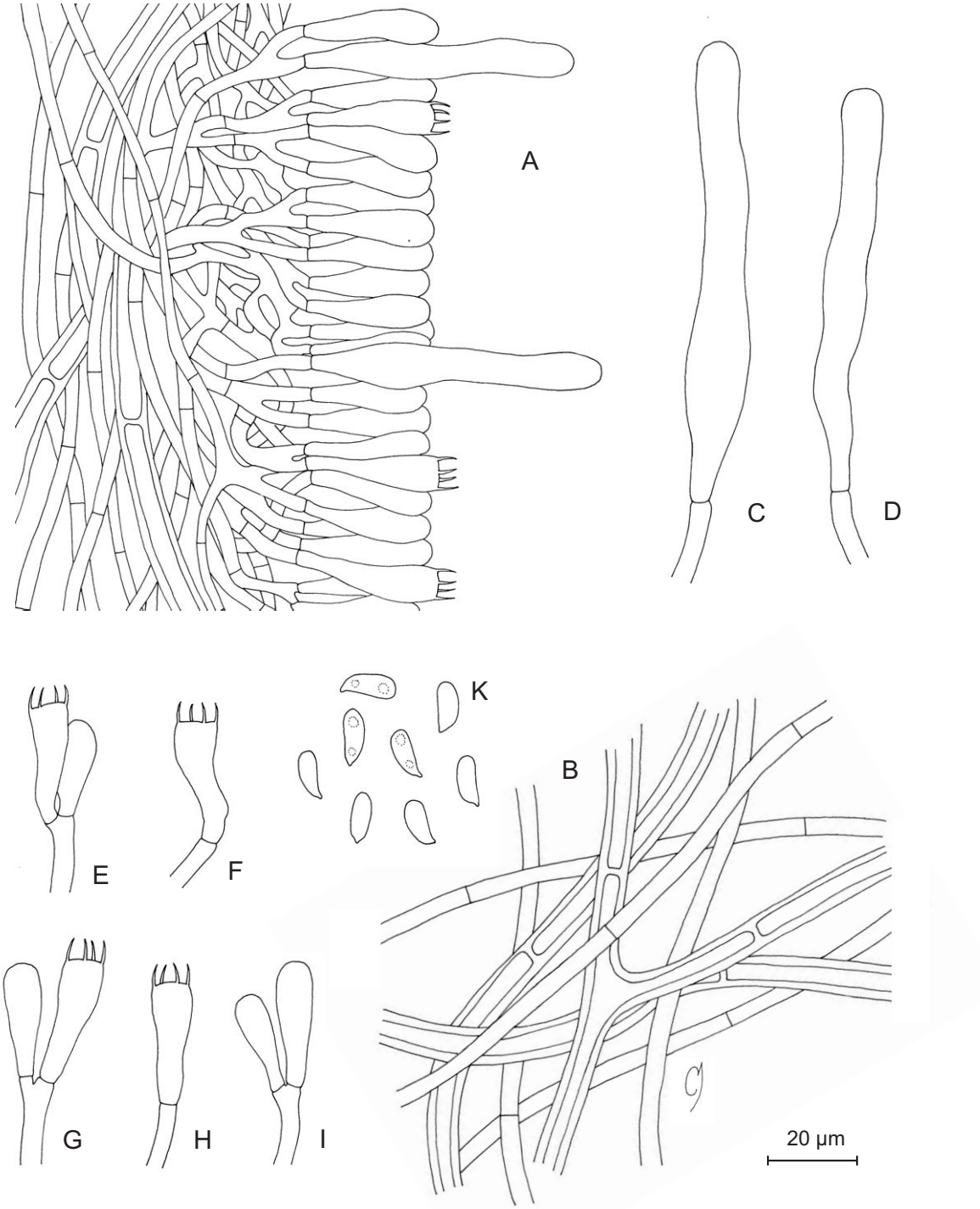

Fig. 5. *Pycnoporellus alboluteus* (Ellis & Everh.) Kotl. & Pouzar: A – hymenium, B – hyphae, C–D – cystidia, E–I – basidia, K – basidiospores (from KRAM-Domański 3019; drawn by J. Cabała).

lindric, hyaline, thin-walled, smooth, slightly tapering at adaxial side and ending with distinct apiculus, non-amyloid, 9.0–10.0 × 3.0–3.5 μm.

SPECIMENS EXAMINED. POLAND. WYSOCZYZNY PODLASKO-BIAŁORUSKIE HIGH PLAINS. Równina Bielska plain: Białowieża Primeval Forest, mixed forest, on fallen trunks of *Picea abies*, 11 May 1963, *leg. S. Domański* (KRAM-Domański 2580), 16 Sept. 1960, *leg S. Domański* (KRAM-Domański 944, 944 *duplicatum*, 3017, 3018, 3019); Białowieża Primeval Forest, forest division 398, mixed forest ('*Querco-Carpinetum*'), on fallen trunk of *Picea abies*, 24 Aug. 1973, *leg. W. Wojewoda* (KRAM F-14394).

ADDITIONAL SPECIMENS SEEN. UNITED STATES. COLORADO: Roosevelt Natl Forest, Cameron Pass, on conifer, 25 Aug. 1955, *leg. J. L. Lowe & R. L. Gilbertson* (KRAM-Domański).

TAXONOMY AND IDENTIFICATION. *Pycnoporellus* Murrill is a small genus with only two species worldwide, easily distinguished from each other. *Pycnoporellus alboluteus* forms resupinate basidiomes, whereas *P. fulgens* (Fr.) Donk has pileate fruitbodies. Microscopically the former has cystidia and basidiospores larger than *P. fulgens*. Thanks to tubes forming false nodular pilei and large pores, *Pycnoporellus alboluteus* cannot be confused with any other resupinate polypores with orange basidiomes.

The genus *Pycnoporellus* shares the same microstructure as *Phaeolus* (Pat.) Pat., in which it was included in the past. The only feature discriminating the two genera morphologically is the coloration of mature basidiomes, yellow to rusty brown in *Phaeolus* and orange in *Pycnoporellus* (Ryvarden & Gilbertson 1994). However, the two genera are distinct biochemically: *Phaeolus*, with the only species *Phaeolus schweinitzii* (Fr.) Pat., causes a special type of rot, called 'imperfect brown rot' by Fiasson and Niemelä (1984); some test reactions characterize the species as true brown rot fungus but it has the triterpene content of white-rot fungus.

ECOLOGY. Niemelä (1980) detailed the ecology of *Pycnoporellus alboluteus* in Scandinavia and the world, so only brief information on its ecological preferences is given here. This polypore is restricted exclusively to boreal or mountainous virgin forests, where it occurs on fallen trunks of coniferous trees: *Abies*, *Larix*, *Picea*, *Pinus*, *Pseudotsuga* and *Tsuga*, and very rarely on deciduous trees like *Alnus* and *Populus* (Overholts 1953; Niemelä 1980; Gilbertson & Ryvarden 1987; Ryvarden & Gilbertson 1994). All Polish collections derive from fallen trunks of *Picea abies*. *P. alboluteus* causes brown rot in dead wood, and its basidiomes occur on the lower side of fallen trunks but not close to ground level: in such conditions it was observed for instance in the Białowieża Primeval Forest (Domański 1959). In North America this fungus is one of the most important decomposers of conifer wood in subalpine forests from the Rocky Mountains westward, and in many places it extends up to the timberline (Overholts 1953; Gilbertson & Ryvarden 1987).

The phenology of *Pycnoporellus alboluteus* differs in various regions of its geographical range. In North America the basidiomes of this polypore grow under snow in winter and early spring and persist until midsummer (Gilbertson & Ryvarden 1987), but in Europe the typical season for its fructification is late summer and autumn. One Polish collection is from May (KRAM-Domański 2580), and the specimens seem to be fresh, not from previous years. However, the main period of fructification of *P. alboluteus* in Poland begins in August and ends in October (Fig. 6).

DISTRIBUTION. A rare fungus worldwide, distributed in the boreal zone and mountain regions

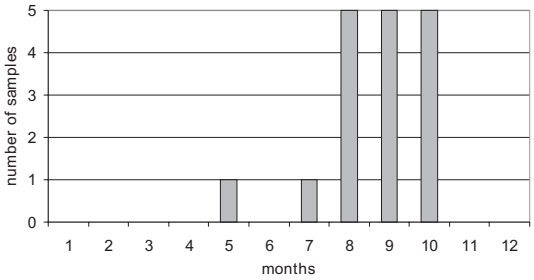

Fig. 6. Phenology of *Pycnoporellus alboluteus* (Ellis & Everh.) Kotl. & Pouzar in Poland.

of the Northern Hemisphere. In Poland *Pycnoporellus alboluteus* is present only in the Białowieża Primeval Forest in one grid square, but in this forest it is a common fungus (for details see Piątek 2002c).

Pycnoporellus fulgens (Fr.) Donk (Fig. 7)

Persoonia **6**: 216. 1971.

Hydnum fulgens Fr., Öfvers. Kongl. Vetenskaps-Akad. Förhandl. **9**: 130. 1852.

Polyporus fibrillosus P. Karst., Sydvestra Finlands polyporeer: **30**. 1859.– *Pycnoporellus fibrillosus* (P. Karst.) Murrill, Bull. Torrey Bot. Club **32**: 489. 1905. – *Phaeolus fibrillosus* (P. Karst.) Bourdot & Galzin, Hymen. France: 558. 1928.

Basidiomes annual, growing solitary or sometimes in imbricate groups; consistency soft, fibrous, spongy when fresh, brittle and light-weight in dry specimens, orange, reddish orange or rust-colored in old specimens, paler in dry conditions; pilei sessile or effused-reflexed, semicircular, mostly narrowly attached, up to 10 cm long, 5 cm wide and 3 cm thick; margin thin and sharp, sometimes slightly lacerate; upper surface tomentose in young basidiomes, then hispid and radially fibrillose, often with slight zonation; pore surface pale orange, rough; pores roundish or angular, lacerate and irpicoid in old specimens, (1–)2–3 per mm. Context light orange, homogeneous or sometimes duplex, lower layer firm and corky, upper layer soft and fibrous, 2–4 mm thick and up to 15 mm thick at the base attached to substrate; tubes concolorous with context, up to 7 mm thick; all tissues of the basidiomes turning cherry red in aqueous solution of KOH. Hyphal system monomitic; hyphae in KOH hyaline or pinkish in trama and pale reddish in context; old hyphae covered by crystals dissolving in KOH and making the hyphae surface rough; tramal hyphae subparallel, strongly intermixed, simple-septate, flexuose, moderately branched, thin- to thick-walled, variable in size, 2–8 μm wide; contextual hyphae loosely arranged, sparsely branched, simple-septate, 3–10 μm in diameter, thin- but usually thick-walled with narrow lumen. Cystidia rather frequent, projecting over hymenium, cylindric, thin-walled, hyaline, 40–60 × 4–5 μm; basidia clavate, hyaline, without basal clamp, mostly 4-sterigmate, 20–30 × 4–5 μm; basidiospores narrowly ellipsoid to cylindric, hyaline, thin-walled, smooth, slightly tapering at adaxial side and ending with distinct apiculus, non-amyloid, 7.3–8.3 × 3.5–4.0 μm.

SPECIMENS EXAMINED. POLAND. POJEZIERZA WSCHODNIOBAŁTYCKIE LAKELANDS. Równina Augustowska plain: Starożyn Reserve, on trunk of *Picea abies*, 6 June 1966 (KRAM-Domański 4972); WYSOCZYZNY PODLASKO-BIAŁORUSKIE HIGH PLAINS. Równina Bielska plain: Białowieża Primeval Forest, mixed forest, on wood of *Picea abies*, July 1958, *leg. S. Domański* (KRAM-Domański 2610); Białowieża Primeval Forest, forest division 256, *Peucedano-Pinetum*, 15 June 1988, *leg. H. Komorowska* (KRAM F-39582); forest division 224, spruce forest, on dead standing trunk of *Picea abies*, 22 Sept. 1987, *leg. H. Komorowska* (KRAM F-29765); forest division 369B, mixed forest, fallen trunk of *Picea abies*, 2 Sept. 2000, *leg. A. Miśkiewicz* (KRAM F-50360); forest division 285, *Circaeo-Alnetum*, on fallen trunk of *Picea abies*, 24 Aug. 1973, *leg. W. Wojewoda* (KRAM F-32352); WYŻYNA MAŁOPOLSKA UPLAND. Góry Świętokrzyskie Mts: Łysogóra Mt., near Słupia Nowa, on decayed trunk of *Abies alba*, 29 Oct. 1963, *leg S. Domański* (KRAM-Domański 3510); WESTERN CARPATHIANS. Pogórze Ciężkowickie foothills: Ryglice, near Pod Lasem farmstead in valley of unnamed stream on NW slopes of Góra Liwecka Mt., alt. *ca* 360 m, forest with *Fagus sylvatica* and *Abies alba*, 8 Aug. 2000, *leg M. Piątek* (KRAM F-52155).

ADDITIONAL SPECIMENS SEEN. UNITED STATES. NEW YORK: Wanakena, on spruce, 21 July 1958, *leg. J. L. Lowe* (KRAM-Domański).

TAXONOMY AND IDENTIFICATION. Orange, pileate basidiomes reddening in KOH make *Pycnoporellus fulgens* rather easy to identify. In Europe there are only a few other pileate species with orange color of basidiomes, for example *Hapalopilus croceus* (Pers.: Fr.) Bondartsev & Singer, *Hapalopilus nidulans* (Fr.) P. Karst., *Bondarcevomyces taxi* (Bondartsev) Parmasto and *Pycnoporus cinnabarinus* (Jacq.: Fr.) P. Karst. These four species are immediately ruled out by microscopic examination because unlike *P. fulgens* they have clamps on generative hyphae. A number of other

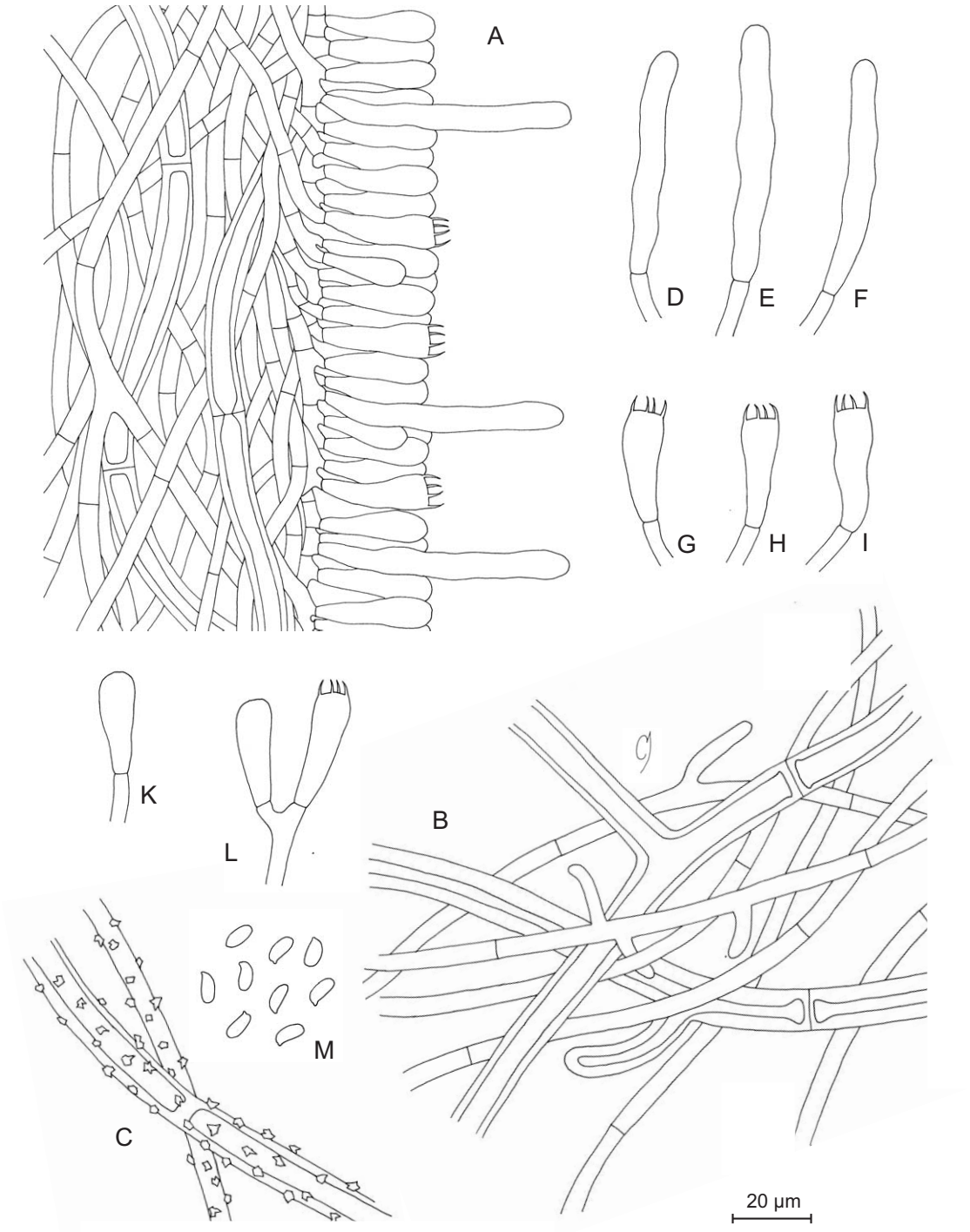

Fig. 7. *Pycnoporellus fulgens* (Fr.) Donk: A – hymenium, B – hyphae visible in 5% aqueous solution of KOH, C – encrusted hyphae visible in water, D–F – cystidia, G–L – basidia, M –basidiospores (from KRAM-Domański 2610; drawn by J. Cabała).

characters differentiate these fungi. *Hapalopilus croceus* is restricted to oak and chestnut, has broadly ellipsoid basidiospores, and becomes darker and shrinks during drying, *Hapalopilus nidulans* is observed on numerous hardwoods and has small ellipsoid basidiospores. Both *Hapalopilus* P. Karst. species redden in KOH (Ryvarden & Gilbertson 1993), like *P. fulgens*, but in *H. croceus* the shade is rather red to carmine, in *H. nidulans* vivid violet, and in *P. fulgens* cherry red. *Bondarcevomyces taxi* becomes grey in KOH, has small cylindric to oblong basidiospores; it is very rare in Europe, known only from the Black Sea coast in the Caucasus, and also reported from the Russian Far East and China (Dai & Niemelä 1995; Parmasto & Parmasto 1999). *Pycnoporus cinnabarinus* has a corky consistency and the shape of the basidiomes is characteristic for fungi of the genus *Trametes* Fr.; it has regular pores and become yellowish in KOH (Ryvarden & Gilbertson 1994), and it occurs mostly on deciduous trees.

ECOLOGY. *Pycnoporellus fulgens* occurs in old-growth and virgin forests, mostly coniferous or mixed, but also in typical deciduous plant communities such as *Stellario-Alnetum*, *Luzulo pilosae-Fagetum* or *Tilio cordatae-Carpinetum betuli.* In the locality in the Pogórze Ciężkowickie foothills (KRAM F-52155) the fungus occurred in old forest with *Abies alba* and *Fagus sylvatica* in the vicinity of a small mountain stream in a deep valley, so this site had high moisture. In places with such high-moisture conditions *P. fulgens* occurs in Fennoscandia (Niemelä 1980). Probably it grows in similar microclimatic conditions in at least a few other Polish localities.

In general, *Pycnoporellus fulgens* is restricted to coniferous trees, and is present on *Abies*, *Larix*, *Pinus*, *Picea*, *Pseudotsuga*, *Thuja* and *Tsuga*, but it also occurs on deciduous trees, *inter alia* on *Acer*, *Betula*, *Fagus*, *Populus*, *Quercus* and *Tilia* (Niemelä 1980; Gilbertson & Ryvarden 1987; Ryvarden & Gilbertson 1994). Most Polish collections were made from fallen trunks of *Picea abies*, more rarely from *Abies alba*, *Betula*, *Pinus*, *Populus tremula* L., *Quercus*, and from unidentified coniferous and deciduous woods. *Pycnoporellus fulgens* causes brown rot in wood. Niemelä (1980) found that it is often associated with wood previously decayed by *Fomitopsis pinicola* (Swartz: Fr.) P. Karst. At present this association is considered constant and the polypore is treated as a successor species (Niemelä *et al.* 1995), most probably as an obligatory successor (Piątek 2001). In Poland the occurrence of basidiomes of *P. fulgens* near basidiomes of *F. pinicola* was reported only by Niemelä (1980); Polish authors have not recorded such an association, evidently because no special attention has been paid to this phenomenon. In field studies I found only one locality of *P. fulgens*, and there basidiomes of the successor also emerged close to basidiomes of *F. pinicola*, suggesting that this phenomenon must be constant in Poland.

In Poland, fresh specimens were collected from April to November, the number of collected basidiomes increasing until August, the month of maximum occurrence, and then decreasing to November (Fig. 8). In Fennoscandia as well, the occurrence of *Pycnoporellus fulgens* has its distinct maximum in the second half of August and the first half of September (Niemelä 1980).

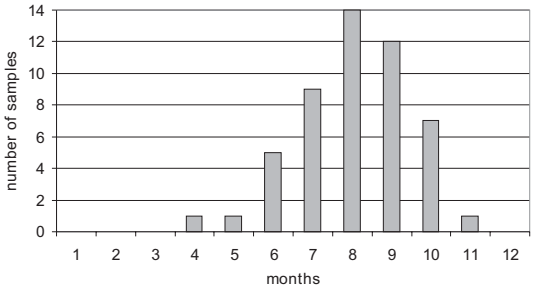

Fig. 8. Phenology of *Pycnoporellus fulgens* (Fr.) Donk in Poland.

DISTRIBUTION. *Pycnoporellus fulgens* is a circumpolar species widely distributed but rare in the Northern Hemisphere. From Poland it was reported from 21 sites located in the eastern part of the country (for details see Piątek 2002d).

CONCLUSION

The four polypores discussed here are clearly restricted to old-growth forests, that is, forests without intensive forest management, characterized by high continuity in the supply of substrate, and may be treated as indicator fungi for such forests. *Diplomitoporus lindbladii*, *Pycnoporellus alboluteus* and *P. fulgens* occur most abundantly in the Białowieża Primeval Forest, an area of pristine nature, and Domański (1967) already recognized it as a representative of fungi growing in virgin forests. *Pycnoporellus fulgens* is treated as an indicator fungus of old beech and fir forests in former Yugoslavia by Tortić (1998), and similarly in Finland by Kotiranta and Niemelä (1993) and in Estonia by Parmasto and Parmasto (1997). The latter authors introduced the term 'old forest indicator fungi' for species distributed mainly or exclusively in old forests minimally affected by forest management. In Poland a list of old forest indicator fungi is to be compiled.

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