Fragm. Flor. Geobot. 45(1–2): 501–507, 2000

Punctularia strigosozonata (Fungi, Corticiaceae) in Poland and North Korea

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WOJEWODA, W. 2000. *Punctularia strigosozonata* (Fungi, Corticiaceae) in Poland and North Korea. *Fragmenta Floristica et Geobotanica* 45(1–2): 501–507. Kraków. ISSN 0015–931x.

ABSTRACT: The article deals with the taxonomy, ecology, general distribution and threatened status of *Punctularia strigosozonata* (Schw.) Talbot. In Europe it is known only from Estonia, Poland, Ukraine and Russia. In Poland it was found in three NE localities; one is new. In 1983–1986 the author found this species in 5 localities in seminatural forests of North Korea, in various mountains and in the Central Botanical Garden in Pyongyang. The systematic positions of the genus *Punctularia* Pat. & Lagerh. and of *P. strigosozonata* are discussed, and numerous synonyms of this fungus and important references are cited.

KEY WORDS: Fungi, Basidiomycetes, Stereales, Corticiaceae, *Punctularia strigosozonata*, distribution, ecology, taxonomy, threat, Europe, Poland, Asia, North America, North Korea

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Different authors have placed the genus *Punctularia* Pat. & Lagerh., Bull. Herb. Boiss. 3: 57. 1895, in various taxa such as these: Thelephoraceae, subfamily Merulioideae (Talbot 1958); Thelephoraceae, subfamily Corticioideae, tribe Stereae (Cunningham 1963); Aphyllophorales Rea 1922 and Punctulariaceae Donk (Donk 1964; Domański 1978); Aleurodiscales Jülich 1981 and Punctulariaceae (Jülich 1981); Aphyllophorales and Meruliaceae Rea 1922 (Imazeki & Hongo 1975; Anon. 1983); Basidiomycota, Corticiomycetes, Corticiomycetidae, and Corticiaceae (Parmasto 1986); and Poriales Locquin 1957 and Corticiaceae Herter 1910 (Michael *et al*. 1988). In recent years *Punctularia* has been placed in Basidiomycota, Basidiomycetes, Holobasidiomycetidae, Stereales Ferro 1907, Corticiaceae Herter 1910 (Hawskworth *et al.* 1995) or in Vuilleminiales Boidin *et al*., and Punctulariaceae (Boidin *et al*. 1998).

Three species of the genus *Punctularia* have been described so far (Hawksworth *et al*. 1995): *P. strigosozonata*, *P. atropurpurascens* (Berk. & Br.) Petch = *P. tuberculosa* (Pat.) Pat., known from South Africa, Brazil, Ecuador and Florida (Talbot 1958); *P. subhepatica* (Berk.) Hjortst., known from Peru and the Balearic Islands (Hjortstam 1995; Tellería 1997); and one species "ad interim": *P. ethiopica* Boid. (Boidin *et al*. 1998).

Punctularia strigosozonata (Schw.) Talbot

Bothalia 7(1): 143. 1958.

Selected synonyms – (in chronological order; for further synonyms see Cooke 1956):

Merulius strigosozonatus Schw., Trans. Am. Phil. Soc. n.s. 4: 160. 1834 (basionym).

Exidia tenuis Lév., Ann. Sci. Nat. Bot. III, 2: 214. 1844.

Phlebia rubiginosa Berk. & Rav. *in* Ravenel, Fungi Car. 3: 22. 1855 (nom. nud.).

Corticium hepaticum Berk. & Curt., Grevillea 1: 180. 1873.

Hirneola tenuis (Lév.) Sacc., Syll. Fung. 6: 769. 1888.

Thelephora stereoides Cooke & Massee, Grevillea 18: 6. 1889.

Phlebia strigosozonata (Schw.) Lloyd, Myc. Writ. 4: Letter 46: 6. 1913.

Auricularia strigosozonata (Schw.) Bres., Ann. Mycol. 18: 70. 1920.

Phaeophlebia strigosozonata (Schw.) W. B. Cooke, Mycologia 48: 401. 1956.

Stereum strigosozonatum (Schw.) Cunn., Trans. R. Soc. N. Z. 84: 213. 1956.

Iconography – Chamuris (1988: 172, *f. 62*, as *Punctularia*); Cunningham (1963: 28–29, *pl. III f. 2*; 216, *text f. 128*, as *Stereum*); Davydkina (1980: 109, *pl. VII f. 38*, as *Punctularia*); Eriksson *et al.* (1981: 1229, *f. 629–630*, as *Punctularia*); Imazeki & Hongo (1975, 2: 124–125, *pl. 40, f. 242*, as *Phlebia*); Talbot (1958: 215, *pl. III f. 2*; *text f. 128*).

Systematic position – This species has been placed by various authors in 10 genera: *Auricularia*, *Corticium*, *Exidia*, *Hirneola*, *Merulius*, *Phaeophlebia*, *Phlebia*, *Punctularia*, *Stereum* and *Thelephora* (Cooke 1956; Talbot 1958). It has holobasidia and belongs in the subclass Holobasidiomycetidae.

General distribution – *P. strigosozonata* is distributed mainly in tropical and subtropical areas. In Europe it is known only from the eastern part of the continent: Estonia, Poland, Ukraine (western Dniestr area), European part of Russia (Dvina area, Volga-Don area, Volga-Kama area, and Ural Mts). In Asia it is known from China, Taiwan, Japan, Korea, Malaya and the Asiatic part of Russia (Western and Eastern Siberia and the Far East). It is known in South America (Brazil, Chile, Venezuela), North America (Mexico, United States, Canada), South Africa and the South Pacific (Australia, Tasmania, New Zealand) (Cooke 1956; Talbot 1958; Cunningham 1963; Imazeki & Hongo 1975; Davydkina 1980; Järva & Parmasto 1980; Anon. 1983; Domański 1991a; Wojewoda *et al*. 1993; Maekawa & Zang 1995).

Ecology – *P. strigosozonata* grows on decayed wood of various deciduous trees and very rarely on coniferous ones. In Europe it is recorded on *Alnus incana* (L.) Moench, *Populus tremula* L. and *Salix caprea* L. (Bresadola 1903; Eriksson *et al*. 1981; Jülich 1984); in Australia and New Zealand on *Banksia* Domb. *ex* DC., *Eucalyptus* L'Herit and *Nothofagus* Blume (Cunningham 1963); in North America on *Acer* L., *Betula* L., *Carya* Nutt., *Castanea* Tourn. *ex* L., *Corylus* L., *Fagus* L., *Fraxinus* L., *Malus* Mill., *Picea* Link, *Populus* L. (e.g. *P. tremuloides* Michx.), *Prunus* L., *Quercus* L., *Salix* L., ?*Tilia* L. and *Ulmus* L. (Cooke 1956; Ginns & Lefebvre 1993; Martin & Gilbertson 1980; Chamuris 1988); in Asia and the tropics on *Dracontomalum*? [probably *Dracontomelon* Blume], *Persica* Mill., *Psidium* L., *Shorea* Roxb., *Strombosia* Blume and *Zisaphus*? [probably *Zizyphus* Mill.] (Cooke 1956); and in Korea on *Fraxinus rhynchophylla* Hance.

P. strigosozonata is a saprobic fungus associated with a white rot (Ginns & Levebre 1993).

The temperature optimum for mycelium of this fungus is 32°C, and the maximum is 40°C (Davydkina 1980).

Antibiotics – Highly antibacterial metabolites have been isolated from basidiomes of *P. strigosozonata*: phlebiakauranol and phlebianorkauranol (Lisy *et al*. 1975; Smerdžieva & Veselský 1986).

Punctularia strigosozonata in Poland

Description, based on Polish collections. Macroscopic features – Individual basidiocarps 1.4–5.0 × 1.1–3.0 cm, stereoid, effuso-reflexed, dimidiate or rarely corticioid, resupinate, coriaceous-ceraceous, sessile, when confluent up to 10–12.5 × 6–8 cm. Upper surface velutinous, coarsely tomentose, tomentum at first chestnut, soon concentrically sulcate and zones with bands of different colors, in old specimens bases grey with margin chestnut, finally becoming grey or dingy brown zonate, black brown. Context gelatinous. Hymenophore phlebioid, subgelatinous in living state, drying hard, at first smooth, then with elongate, radial ridges or irregular knobs, dark brown-violaceous.

Microscopic features – Hyphal system monomitic. Hyphae up to 5–(6) μm wide, with clamps at all septa, hyaline, slightly yellowish, yellow or brown, smooth. Basal hyphae thick-walled, hymenial ones thin-walled, smooth. Cystidia and gloecystidia absent. Dendrohyphidia 20–35 × 1–2 μm, richly branched, at first hyaline, then yellowish to grey-brown. Basidia (holobasidia) 30–60 × 4–5 μm, with clamps and 4 sterigmata. Basidiospores 6.0–8.4 × 3.0–4.2 μm, ovate or ellipsoid, thin-walled, smooth, at first hyaline or yellowish, then brown, non-amyloid (Fig. 1).

Distribution, habitat and ecology in Poland – *P. strigosozonata* is known from only three localities including the one newly discovered.

Known localities

1. The Niziny Środkowopolskie lowlands, near the border with the Polesie region, the Równina Łukowska plain, near the border with Zaklęsłość Łomaska hollow, near Międzyrzec Podlaski, ca 25 km. SW of Biała Podlaska, ca. 130 km SE of Warsaw, on trunks of *Salix caprea*, *leg*. *Bogumir Eichler* from Międzyrzec Podlaski (Bresadola 1903: 90).

2. The Wysoczyzny Podlasko-Białoruskie high plains, the Równina Bielska plain, the Puszcza Białowieska primeval forest, Białowieża National Park, ca 20 km SE of Hajnówka, ca. 65 km SE of Białystok, ca 200 km NE of Warsaw, *leg. S. Domański*, who stated that in this park *P. strigosozonata* is "not rare" or "rather common" (Domański 1991a: 19 & 116). In HMIPC, herbarium of fungi of the Academy of Agriculture, Department of Forest Pathology, Cracow (Mirek *et al*. 1997), specimens from Białowieża National Park absent.

New locality

3. Pojezierza Wschodniobałtyckie lakeland, Równina Augustowska plain, Puszcza Augustowska primeval forest, Starożyn reserve, ca 6 km W of Gruszki village, ca 25 km NE of Augustów, ca. 85 km N of Białystok, ca 240 km NE of Warsaw, in deciduous (*Tilio-Carpinetum*) and mixed forests, on fallen dead trunks and fallen dead branches and twigs of *Populus tremula*, 17 Sept. 1974, *leg*. *and det.*

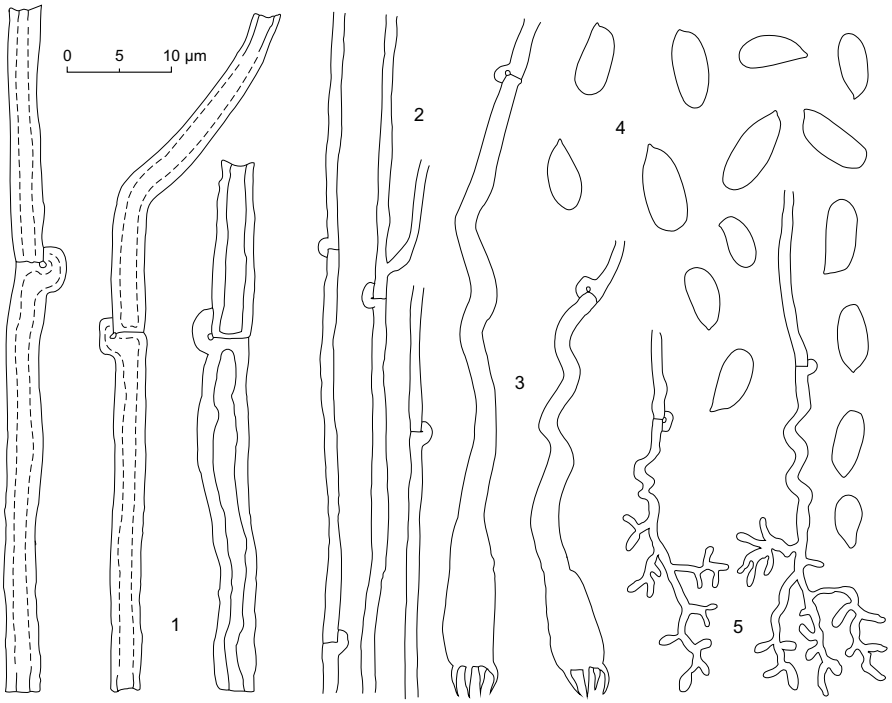

Fig. 1. *Punctularia strigosozonata* (Schw.) Talbot. 1 – basal hyphae; 2 – hymenial hyphae; 3 – basidia; 4 – basidiospores; 5 – dendrohyphidia (drawn from KRAM F-32940).

W. Wojewoda (KRAM F-30412, 30413, 32940); *leg. V. Holubová, det. Z. Pouzar*, HMIPC, "ex Herbario Mycologico Musei Nationalis Prague", without number.

Threat – *P. strigosozonata* is very rare in Poland (probably common locally in the Białowieża National Park only) and threatened. This species appears on the "red list" of Polish threatened macrofungi, where it is placed in the "V" (vulnerable) category (Wojewoda & Ławrynowicz 1992). It is also threatened in Finland (Anon. 1995).

Punctularia strigosozonata in North Korea

Features of examined material – As in Polish material.

Distribution, habitat and ecology – *P. strigosozonata* has been published from NW North Korea as *Phlebia strigosozonata* (Schw.) Lloyd. (Anon. 1983: 104). During 1983–1986, 5 localities of this fungus were recorded (Wojewoda *et al*. 1993).

New localities

1. **RYANGGANG PROVINCE**, near border with China, Paekdu-san Mts, basalt hill near Taehongdan village, ca 70 km NE of Hyesan city, ca 1500 m a.s.l., in taiga, in mixed forest with *Betula, Larix,*

Populus and *Quercus*, on lying trunk of deciduous tree, 29 Sept. 1984, *leg. and det. W. Wojewoda*, (KRAM F-30409).

2. **CHAGANG PROVINCE**, Myohyang-san Mts, Kuchung falls in Manpok valley, ca 10 km E of Hyangsan city, ca 700 m a.s.l., in deciduous forest, on decayed stump of deciduous tree, 8 Aug. 1983, *leg. and det. W. Wojewoda* (KRAM F-30411, 30414).

3. **PYONGYANG CITY**, ca 100 m a.s.l., Central Botanical Garden, on stump of deciduous tree, 26 Sept., 1984, *leg. and det. W. Wojewoda* (KRAM F-30408).

4. **SOUTH HWANHAE PROVINCE**, Suiang-san Mts, ca 5 km N of Haeju city, ca 500 m a.s.l., in mixed forest, on fallen dead trunk of deciduous tree, 6 July 1986, *leg. and det. W. Wojewoda* (KRAM F-30407).

5. **KANGWON PROVINCE**, Kumgang-san Mts, Myonggyongdae valley, near Onjong-ri village, ca 90 km SE of Wonsan city, ca 600 m a.s.l., in deciduous forest, on fallen dead trunk of *Fraxinus rhynchophylla*, 17 Aug. 1983, *leg. and det. W. Wojewoda* (KRAM F-30410).

Threat – In North Korea this species probably is not rare and not threatened.

OTHER SPECIMENS EXAMINED – ESTONIA. *Phaeophlebia strigosozonata* (Schw.) W. B. Cooke. "Rarissime ad caudices dejectos *Populi tremulae* et *Alni incanae* crescit. Ad ramos caudicis dejectae *Populi tremulae* in piceeto myrtilloso. Distr. Väike-Maarja, Kuusikumäe, 5 Oct.1956, *leg. E. Parmasto*," Mycotheca Estonica, Fasc. I (1957).

CANADA. *Phlebia strigoso-zonata* (Schw.) Lloyd, "New Durham, Ont., ad lignum *Populi tremuloidis*, 21 Sept.1931, *leg. R. F. Cain, det. H. S. J.*" Specimens from Estonia and Canada now are preserved in HMIPC (without numbers).

Acknowledgements. I thank Professor S. Kowalski, curator of HMIPC, for the loan of specimens of *Punctularia strigosozonata*, and the anonymous reviewer for critical remarks.

REFERENCES

ANONYMOUS 1983. ["Index of Korean Cryptogamic Plants"]. 318 pp. Pyongyang (in Korean).

ANONYMOUS 1995. Red Lists of Macrofungi in the Baltic and Nordic region. Expert Seminar on threatened species in the Baltic region – Cryptogams, Invertebrates, Fish – Latvia, December 4–8 1995, Riga, pp. 1–58. Working paper/draft, Nov. 27, 1995.

BOIDIN J., MUGNIER J. & CANALES R. 1998. Taxonomie moleculaire des Aphyllophorales. – Mycotaxon **66**: 445–491.

BRESADOLA J. 1903. Fungi polonici a cl. viro B. Eichler lecti. – Ann. Mycol. **1**(1): 65–131.

CHAMURIS G. P. 1988. The non-stipitate stereoid fungi in the northeastern United States and adjacent Canada. – Mycol. Mem. **14**: 1–247.

COOKE W. B. 1956. The genus *Phlebia*. – Mycologia **48**: 386–405.

CUNNINGHAM G. H. 1963. The Thelephoraceae of Australia and New Zealand. – New Zealand Dept. Sci. Industr. Res. Inform. Ser. **145**: 1–359.

DAVYDKINA T. D. 1980. Stereumovye griby sovetskovo Soyuza ["Stereoid fungi of SSSR"]. 143 pp. Nauka, Leningrad (in Russian).

DOMAŃSKI S. 1978. Basidiomycetes (Podstawczaki), Aphyllophorales (Bezblaszkowe), Thelephorales (Chropiatkowate). **3**. Amylariaceae, Aphelariaceae, Cantharellaceae, Physalacriaceae, Punctularia-

ceae, Sparassidaceae, Thelephoraceae. – In: S. DOMAŃSKI (ed.), Mała flora grzybów ["Field flora of fungi"]. **1**. 351 pp. Państwowe Wydawnictwo Naukowe, Warszawa – Kraków (in Polish).

DOMAŃSKI S. 1991a. Basidiomycetes (Podstawczaki), Aphyllophorales (Bezblaszkowce), Stephanosporales (Stefanosporowce). **6**. Corticiaceae: *Kavinia – Rogersella*, Stephanosporaceae: *Lindtneria*. – In: S. DOMAŃSKI (ed.), Mała Flora ["Field flora of fungi"]. **1**. 272 pp. Państwowe Wydawnictwo Naukowe, Warszawa – Kraków (in Polish).

DOMŃSKI S. 1991b. Podstawczaki (Basidiomycota), Bezblaszkowce (Aphyllophorales), Skórnikowate (Stereaceae), Pucharkowate (Podoscyphaceae). – In: J. KOCHMAN & A. SKIRGIEŁŁO (eds), Flora Polska. Rośliny Zarodnikowe Polski i ziem ościennych ["Flora of Poland. Cryptogamous plants of Poland and adjacent territories"]. Grzyby (Mycota). ["Fungi (Mycota)"]. **21**. 133 pp. Państwowe Wydawnictwo Naukowe, Warszawa – Kraków (in Polish with English summary).

DONK M. A. 1964. A Conspectus of the families of Aphyllophorales. – Persoonia **3**(2): 199–324.

ERIKSSON J., HJORTSTAM K. & RYVARDEN L. 1981. The Corticiaceae of North Europe. **6.** *Phlebia-Sarcodontia*, pp. 1051–1276. Fungiflora, Oslo.

GINNS J. & LEFEBVRE M. N. L. 1993. Lignicolous corticioid fungi (Basidiomycota) of North America. Systematics, distribution, and ecology. – Mycol. Mem. **19**: 1–247.

HAWKSWORTH D. L., KIRK P. M., SUTTON B. C. & PEGLER D. N. 1995. Ainsworth & Bisby's Dictionary of the Fungi. Ed. 8. 616 pp. IMI, University Press, Cambridge.

HJORTSTAM, K. 1995. Two new genera and some new combinations of corticioid fungi (Basidiomycotina, Aphyllophorales) from tropical and subtropical areas. – Mycotaxon **54**: 183–193.

IMAZEKI R. & HONGO T. 1975. Coloured illustrations of fungi of Japan. **2**. 238 pp. Hoikusha Publ. Co. Ltd., Osaka.

JÄRVA L. & PARMASTO E. 1980. List of Estonian fungi. 331 pp. Institute of Zoology and Botany, Academia of Sciences of Estonian S.S.R., Tartu.

JÜLICH W. 1981. Higher taxa of Basidiomycetes. – Bibl. Mycol. **85**: 1–485.

JÜLICH W. 1984. Die Nichtblätterpilze, Gallertpilze und Bauchpilze. – In: H. GAMS (ed.), Kleine Kryptogamenflora **2b**(1). Basidiomyceten. **1**. Ed. 1. 626 pp. G. Fischer, Stuttgart – New York.

JÜLICH W. & STALPERS J. A. 1980. The resupinate non-poroid Aphyllophorales of the temperate northern hemisphere. – Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Ser. 2 **74**: 1–335.

LISY J. M., CLARDY J., ANCHEL M., WEINREB S. M. 1975. X-ray structures of phlebiakauranol and phlebianorkauranol, highly oxygenated antibacterial metabolites of *Phlebia strigoso-zonata*. – J. Chem. Soc. Chem. Comm. (1975): 406–407.

MAEKAWA, N. & ZANG, M. 1995. Corticiaceous Fungi (Aphyllophorales, Basidiomycotina) Collected in Yunnan, China. – Bull. Natn. Sci. Mus., Tokyo, Ser. B **21**(2): 87–94.

MARTIN K. J. & GILBERTSON R. L. 1980. Synopsis of wood-rotting fungi on spruce in North America III. – Mycotaxon **10**: 479–501.

MICHAEL E., HENNIG B. & KREISEL H. 1988. Handbuch für Pilzfreunde. 2 Aufl. **6**. Die Gattungen der Großpilze Europas. Bestimmungschlüssel und Gesamtregister der Bände I bis V. 310 pp. VEB G. Fischer Verlag, Jena.

MIREK Z., MUSIAŁ L. & WÓJCICKI J. J. 1997. Polish herbaria. – Polish Bot. Stud. Guideb. Ser. **18**: 1–116.

PARMASTO E. 1968. Conspectus systematis Corticiacearum. 261 pp. Inst. Zool. Bot. Acad. Sci. RPSS Estonicae, Tartu.

PARMASTO E. 1986. On the origin of the Hymenomycetes (What are corticioid fungi?). – Windhalia **16**: 3–19.

SEMERDŽIEVA M. & VESELSKÝ J. 1986. Léčivé houby dříve a nyní ["Medicinal fungi formerly and today"]. 177 pp. Academia, Praha (in Czech).

TALBOT P. H. B. 1958. Studies of some South African resupinate Hymenomycetes. Part II. – Bothalia **7**(1): 131–187.

TELLERÍA M. T. 1997. An annotated list of the Aphyllophorales of the Balearic Islands. – Mycotaxon **65**: 353–377.

WOJEWODA W. & ŁAWRYNOWICZ M. 1992. Red list of threatened macrofungi in Poland. – In: K. ZARZYCKI, W. WOJEWODA & Z. HEINRICH (eds), List of threatened plants in Poland. Ed. 2, pp. 27–56. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

WOJEWODA W., HEINRICH Z. & KOMOROWSKA H. 1993. Macromycetes Korei Północnej ["Macrofungi of North Korea"]. – In: J. B. FALIŃSKI & Z. MIREK (eds), Polskie badania geobotaniczne poza granicami kraju ["Polish geobotanical investigations abroad"]. – Wiad. Bot. **37**(3–4): 125–128 (in Polish with English summary).