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Distribution and Host Preference of Poroid Basidiomycetes in Hungary I. – *Ganoderma*

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Abstract – From the economical point of view, the genus *Ganoderma* is one of the most important groups of Basidiomycetes due to their medicinal effects and also because they cause decay in a very wide range of tree species all over the world. In this study new data of the Hungarian *Ganoderma* species are published and the specimens in accessible Hungarian herbarium collections are processed and revised. The article includes the nomenclatural status, the morphological characters, the host preference, frequencies and the details of the fungarium samples of six *Ganoderma* species (*Ganoderma adspersum*, *G. applanatum*, *G. carnosum*, *G. cupreolaccatum*, *G. lucidum*, *G. resinaceum*) as well. In total 215 *Ganoderma* specimens are examined and 10 hosts of the six native *Ganoderma* species new for Hungary are presented. The Hungarian locality and time of the collection of the only *Ganoderma carnosum* (IZ3122) specimen and two new localities of this rare species is published here for the first time.

***Polyporaceae* / *G. carnosum* / *G. cupreolaccatum* / new host**

Kivonat – Taplógombák előfordulása és gazdanövényköre Magyarországon I. – *Ganoderma*. A taplók közül a *Ganoderma* P. Karst. 1881 gazdasági szempontból az egyik legfontosabb nemzetség, tekintettel növénykórtani jelentőségükre, valamint a gyógyászatban betöltött szerepükre. Jelen munkában feldolgoztuk és revideáltuk a Magyarországi gyűjteményekben elhelyezett hazai fungáriumi mintákat, továbbá újabb, korábban nem publikált adatokat is közlünk. A cikk tartalmazza a hazánkban előforduló hat *Ganoderma* faj (*Ganoderma adspersum*, *G. applanatum*, *G. carnosum*, *G. cupreolaccatum*, *G. lucidum*, *G. resinaceum*) nomenklatúrai helyzetét, az elkülönítő morfológiai bélyegeket, aljzataik gyakorisági megoszlását és a fungáriumi példányok részletes adatait megyék szerint csoportosítva. Összesen 215 *Ganoderma* taxon herbáriumi mintáját vizsgáltuk meg és 10 Magyarországon korábban nem ismert gazdanövényen való előfordulási adatot közlünk. Az eddig egyetlen hazánkból ismert *Ganoderma carnosum* mintának (IZ3122) lelőhelyét és gyűjtésének időpontját, valamint két további hazai minta adatát első alkalommal publikáljuk.

taplók / G. *carnosum* / *G. cupreolaccatum* / új gazdanövény

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1 INTRODUCTION

Ganoderma P. Karst. 1881 is a cosmopolitan, poroid basidiomycete genus, which contains mainly wood decaying fungi of different deciduous trees and conifers (Ryvarden – Gilbertson 1993). From the economical point of view, the genus *Ganoderma* is one of the most important groups of Basidiomycetes due to their medicinal effects (e.g. Papp et al 2012a, Paterson 2006, Trigos – Medellín 2011) and also because they cause decay in a very wide range of tree species all over the world (Flood et al. 2000; Schwarze – Ferner 2003). It is, however, taxonomically „the most difficult genus among polypores" (Ryvarden 1985) and in a state of taxonomical chaos (Ryvarden 1991). Nevertheless the situation is rather confusing even today. Up to now, all over the world, taxonomists have described 326 legitimate *Ganoderma* species and many forms, varieties and subspecies (Robert et al. 2013). Among these only 7 *Ganoderma* species (*G. adspersum*, *G. applanatum*, *G. carnosum*, *G. cupreolaccatum*, *G. lucidum*, *G. resinaceum*, *G. valesiacum*) are accepted in the European polypore monographs (e.g. Bernicchia 2005; Ryvarden – Gilbertson 1993). Moreover there are some species (e.g. *Ganoderma kosteri* Steyaert 1972, *G. puglisii* Steyaert 1972, *G. soniense* Steyaert 1961) which are described from Europe (Steyaert 1961, 1972) and have a modern description and type material, but the taxonomical state of these species is uncertain (Moncalvo – Ryvarden 1997).

The location and host plants of the Hungarian *Ganoderma* species was synthesized firstly by Igmándy (1968, 1970), however not all of his data have been published. The summarized data of the fungarium collection of Zoltán Igmándy was published by Szabó (2012), which mentioned *Ganoderma carnosum* from Hungary for the first time. The Hungarian distribution of *G. cupreolaccatum* (syn. *G. pfeifferi*) was processed by Papp and Siller (2012) and new occurrence data of this rare species have also been reported.

In this study the accessible Hungarian fungarium materials of *Ganoderma* were examined. The localities of the species are presented and the host preference is discussed.

2 MATERIALS AND METHODS

The identification of the Hungarian *Ganoderma* materials was done based on the taxons included in the European polypore monographs (Bernicchia 2005, Ryvarden – Gilberston 1993). In nomenclature, the MycoBank database (Robert et al. 2013) was followed, except for *G. applanatum* (syn. *G. lipsiense*), in which case the sanctioning proposal of Redhead et al. (2006) accepted by the Nomenclature Committee for Fungi (Norvell 2010, 2011) was taken into account. The herbarium of the Hungarian Natural History Museum (BP) and the polypore collection of Zoltán Igmándy (IZ) (which is kept at the Institute of Silviculture and Forest Protection of the University of West-Hungary Sopron) were examined. The new fungarium materials were placed into the first author's collection (PV) and can be accessed at the Botanical Department of the Corvinus University of Budapest (Faculty of Horticultural Science). For the microscopic studies a Zeiss Axio Imager. A2 type light microscope was used.

3 RESULTS

Ganoderma adspersum (Schulzer) Donk, Proceedings van de Koninklijke Nederlandse Akademie van Wetenschappen Section C, 72: 273, 1969

≡ *Polyporus adspersus* Schulzer 1878

= *Polyporus linhartii* Kalchbr. 1884 – *Ganoderma linhartii* (Kalchbr.) Z. Igmándy 1968

= *Ganoderma europaeum* Steyaert 1961

In European monographs, *Ganoderma adspersum* (e.g. Bernicchia 2005, Krieglsteiner 2000, Ryvarden – Gilbertson 1993) was found under the name *G. australe* (Fr.) Pat. 1889 (Bas.: *Polyporus australis* Fr. 1828), which originated from the Pacific Islands. The identity of the two taxa is ambiguous due to the lack of holotype and geographical distribution (Welti – Courtecuisse 2010). Molecular results (Smith – Sivasithamparam 2000) showed that the European taxon (*G. adspersum*) is different from *G. australe* (Australia). This explains why *G. adspersum* (Bas.: *Polyporus adspersus*) should be the appropiate name of the European species, which was described from Croatia and the holotype grew on *Carpinus betulus*. This species is presumably identical with *G. linhartii* (Kalchbr.) Z. Igmándy 1968 and *G. europaeum* Steyaert 1961 (Steyaert 1972).

G. adspersum belongs to the '*G. applanatum – australe* complex' (subgen. *Elfvingia*), it has perennial, sessile and non-laccate basidiocarp. It differs from *G. applanatum* by larger spores [(8–)8,5–10(–12) × (5–)5,5–7,5(–8,5) µm], thicker crust [>0,5(–0,75) mm], homogenous reddish brown context, and tube layer without intervening layers (Leonard 1998, Marriott 1998, Ryvarden – Gilbertson 1993). It mainly grows on living broadleaved trees, and in Hungary it is usually found in parks and urban habitats (Igmándy 1991; Papp 2013). In the Mediterranean region of Europe, it was detected from *Pinus pinea* (De Simone and Annesi 2012). In Hungary, *G. adspersum* was also found on the stem of living coniferous trees in a park in Dénesfa (*Abies* sp., IZ2534) and in the Kámoni Arborétum (*Picea abies*, BP80370).

In this study *Ganoderma adspersum* is presented for the first time from *Juglans nigra* and *Ulmus laevis*. Igmándy (1991) also mentioned *G. adspersum* from *Carpinus betulus*, but the specimen is missing from the collection. In total it can be found on 20 different tree genera, but it mainly grows on *Quercus* species in Hungary. Compared to other domestic *Ganoderma* taxa, it is frequently found on non native trees (e.g. *Gleditschia triacanthos*, *Robinia pseudoacacia*, *Morus alba*) *(Table 1)*.

MATERIAL EXAMINED – Bács-Kiskun county: Lakitelek, *Robinia pseudoacacia*, 14.VI.1981., leg.: F. Varga, det.: Z. Igmándy (IZ2701); *Robinia pseudoacacia*, 15.VI.1981 (BP76355); Kelebia, *Robinia pseudoacacia*, VIII.1974 (BP76075); **Baranya county**: Mekényes, VI.1975, *Quercus cerris*, leg.: A. Tóth, det.: Z. Igmándy (BP76063); **Borsod-Abaúj-Zemplén county**: Makkoshotyka, *Quercus petraea*, VII.1980, leg.: B. Kliegl, det.: Z. Igmándy (BP76358); **Budapest**: Csillaghegy, *Acer saccharinum*, 04.IV.2012. leg. et det.: V. Papp (PV608); Pestlőrinc, *Prunus cerasus*, 03.X.1985, leg.: L. Kárpáti, det.: Z. Igmándy (BP90040/IZ3067); **Csongrád county**: Sándorfalva, *Robinia pseudoacacia*, XI.1974, leg.: A. Kmoskó, det.: Z. Igmándy (BP76065); Ásotthalom, *Quercus robur*, 1978, leg.: Polner F.-né, det.: Z. Igmándy (BP76068); **Fejér county**: Alcsutdoboz, *Gleditschia triacanthos*, 22.X.1967, leg.: V. Csapody, det.: Z. Igmándy (BP76353); **Győr-Moson-Sopron county**: Sopron, *Prunus domestica*, XII.1967, leg.: V. Stubnya, det.: Z. Igmándy (IZ1756); Süttör, *Aesculus hippocastanum*, 25.VI.1971, leg.: V. Stubnya, det.: Z. Igmándy (BP76070/IZ1919); Dénesfa, *Abies* sp., III.1980, leg.: J. Kiss, det.: Z. Igmándy (IZ2534); Sopron, Brennberg, *Prunus domestica*, leg.: L. Kárpáti, det.: Z. Igmándy (BP76354/IZ2537); Kapuvár, Iharos-erdő, *Fraxinus* sp., XI.1980, leg.: S. Nagy, det.: Z. Igmándy (BP76360/IZ2638); Sopron, Botanical Garden, *Prunus* sp., 17.II.1981, leg.: M. Kocsó, det.: Z. Igmándy (BP76357/IZ2665); Lövő, *Gleditschia triacanthos*, 26.III.1960, leg. et det.: Z. Igmándy (BP23746/47675); Bősárkány, *Morus* sp., 26.XI.1966, leg.: Z. Igmándy & F. Varga, det.: Z. Igmándy (BP23691); Kapuvár, *Quercus robur*, 04.V.1978, leg.: Z. Igmándy & L. Kárpáti, det.: Z. Igmándy (BP76060); Fertőd, *Tilia* sp., 21.VI.1981, leg. et det.: Z. Igmándy (BP76359); Sopronhorpács, *Tilia* sp., V.1978, leg. P. Ubrankovics, det.: Z. Igmándy (BP76071); *Gymnocladus dioicus*, 04.XI.1979, leg.: L. Kárpáti, det.: Z. Igmándy (BP76354); Mosonmagyaróvár, *Quercus robur*, 1978, leg.: Palrne D.-né, det.: Z. Igmándy (BP76074/ IZ2459); Sopron, *Robinia pseudoacacia*, 23.IV.1978, leg. et det.: Z. Igmándy (BP76061); Nagylózs, *Populus nigra*, 05.IX.1956, leg. et det.: Z. Igmándy (BP23680); **Hajdú-Bihar county**: Debrecen, Haláp, *Gleditschia triacanthos*, IX.1976, leg.: F. Eszes, det.: Z. Igmándy (BP76066/IZ2252); *Robinia pseudoacacia*, IX.1973, leg.: F. Eszes, det.: Z. Igmándy (BP76076); Nagyerdő, *Gleditschia triacanthos*, 07.IV.2012, leg. et det.: V. Papp (PV609); **Heves county**: Gyöngyössolymos, *Quercus* sp., III.1966, leg.: Nagy, det.: Z. Igmándy (BP20334); **Komárom-Esztergom county**: Tata, Öregtó, *Celtis occidentalis*, 12.VIII.1969, leg. et det.: Z. Igmándy (BP55595); Tata, *Salix* sp., 19.VIII.1969, leg.: Z. Igmándy & F. Varga, det.: Z. Igmándy (BP76073); **Pest county**: Horány, *Juglans nigra*, 18.VI.1978, leg.: M. Babos, det.: Z. Igmándy (BP65369); Ócsa, Ócsai-turjános Forest Reserve, *Fraxinus angustifolia* subsp. *danubialis* leg. et det.: V. Papp (PV497); Vácrátót, Vácrátot Botanical Garden,

hardwood, 13.VIII.2013, leg. et det.: V. Papp (PV941); **Somogy county**: Barcs, Középrigóc, *Betula pendula*, 07.VI.1983, leg.: L. Kárpáti, det.: Z. Igmándy (IZ2957); Balatonendréd, *Quercus* sp., 29.VII.1912, leg.: Mágocsy & S. Dietz, det.: G. Moesz, rev.: Z. Igmándy (BP13663); **Szabolcs-Szatmár-Bereg county**: Vámosatya, indet. hardwood, 19.X.2009, leg. et det.: V. Papp (PV968); **Tolna county**: Pörböly, Szomfova, *Populus alba*, 1956.VI.08. leg. et det.: Z. Igmándy (IZ743); Lengyel, *Ulmus laevis*, 28.VIII.2011, leg. et det.: V. Papp (PV460); Hőgyész, *Fraxinus ornus*, 22.X.1964, leg. et det.: Z. Igmándy (BP76049); Szekszárd, 11.X.1927, leg. et det.: L. Hollós, rev.: Z. Igmándy (BP13630); Pörböly, Gemenci Forest, 08.IV.2013, *Quercus robur*, leg. et det.: V. Papp (PV942); **Vas county**: Szombathely, Kámon, *Picea abies*, 04.IX.1982, leg.: B. Kiss & L. Varga, det.: Z. Igmándy (BP80370); Körmend, *Quercus robur*, X.1982, leg.: J. Raszler, det.: Z. Igmándy (BP80358); Sárvár, *Fraxinus* sp., 20.IX.1977, leg. et det.: Z. Igmándy (BP76072); 12.V.1983, leg. et det.: Z. Igmándy (BP80362); Őriszentpéter, Morus sp., 06.IX.1968, leg. et det.: Z. Igmándy (BP76062); Csapod, *Prunus cerasus*, 14.VII.1980, leg.: S. Faragó, det.: Z. Igmándy (BP76069); Sárvár, *Quercus* sp., 29.VII.1967, leg.: Z. Igmándy & F. Varga, det.: Z. Igmándy (BP47331/47664); Tanakajd, *Quercus* sp. X.1968, leg.: E. Barabits, det.: Z. Igmándy (BP47634); Sitke, Bajti, *Quercus robur*, 14.IX.1964, leg.: Z. Igmándy, H. Pagony, F. Varga, det.: Z. Igmándy (BP23645); **Veszprém county**: Pápa, *Platanus* sp., 09.X.1984, leg.: Z. Igmándy & L. Kárpáti, det.: Z. Igmándy (BP90039/IZ3023); Ugod, Bakony Mts., *Morus* sp. XI.1974, leg.: R. Rózsai, det.: Z. Igmándy (BP76064); **Zala county**: Letenye, *Populus nigra*, VII.1971, leg.: M. Szélessy, det.: Z. Igmándy (BP55601/IZ1971); Eszteregnye, *Quercus petraea*, 26.III.1982, leg.: M. Szélessy, det.: Z. Igmándy (BP90041); Kemendollár, hardwood, 13.II.1982, leg.: M. Szélessy, det.: Z. Igmándy (IZ2814); Pölöske, *Quercus* sp., 06.VII.1965, leg. et det.: Z. Igmándy (BP76050); *Fagus sylvatica*, 11.VII.1965, leg. et det.: Z. Igmándy (BP23665).

Ganoderma applanatum (Pers.) Pat., Bulletin de la Société Mycologique de France, 5: 67, 1889
≡ *Boletus applanatus* Pers. 1799
= *Boletus lipsiensis* Batsch 1786 – *Ganoderma lipsiense* (Batsch) G.F. Atk. 1908

Numerous articles were published to clarify the nomenclatural status of *G. applanatum*, (e.g. Redhead et al. 2006, Niemelä – Miettinen 2008, Demoulin 2010). Eventually the Nomenclature Committee for Fungi sanctioned *Boletus applanatus* Pers. 1799 against *B. lipsiensis* Batsch 1786 (Norvell 2010, 2011).

Main morphological characters of *G. applanatum* are the perennial, applanate basidiocarps with thin, non-laccate crust (<5mm), the whitish streaks and patches in the context and the layer of the trama. Characteristically, drawings can be made on its fresh pore surface with a sharp instrument ("artists' fungus"), since the bruised surface turns brown due to an immediate oxidation (Ryvarden – Gilbertson 1993). Another feature is that the tubes are often attacked by the fungivore insect larvae of *Agathomyia wankowiczii*, which causes distinctive galls to form.

G. applanatum is a common and widespread species in Hungary. It mainly grows on logs and stumps as saprophyte and in contrary of *G. adspersum*, often occures in forest habitats (Igmándy 1991). It is a polyphagous species: in Europe, the substrates are mainly deciduous trees, but sometimes it can be found on conifers as well (*Abies*, *Picea*) (e.g. Ryvarden – Gilbertson 1993, Kotlaba 1984). In Hungary, the most common hosts are *Fagus*, *Salix* and *Populus*, but there are details on several other tree species as well (Table 1.). The first data from *Abies alba* and *Fraxinus ornus* are presented here.

MATERIAL EXAMINED – Bács-Kiskun county: Kecskemét, leg. et det.: L. Hollós (BP13655); **Baranya county**: Béda, *Populus* x *euramericana*, 17.VIII.1968, leg. et det.: Z. Igmándy (BP47456); **Borsod-Abaúj-Zemplén county**: Miskolc-Lillafüred, *Acer* sp., 09.V.1957, leg. et det.: Z. Igmándy (BP76142); **Budapest**: Hármashatárhegy, 04.III.1934, *Quercus* sp., leg.: A. Pénzes, det.: Moesz G. (BP13665); **Csongrád county**: Dóc, 13.X.1985, leg.: unknown, det.: M. Babos & I. Krepuska (BP79529); **Fejér county**: Vértes Mts., 14.IV.1938, leg. et det.: G. Bohus (BP13664); Vértes Mts, Csákberény, Juhdöglő-völgy Forest Reserve, *Fagus sylvatica*, 03.VIII.2011, leg. et det.: V. Papp (PV969); **Győr-Moson-Sopron county**: Sopron, *Alnus glutinosa*, 17.III.1950, leg. et det.: Z. Igmándy (BP34476/IZ120); Sopron, *Tilia* sp., 05.V.1952, leg. et det.: Z. Igmándy (IZ183); Sopron, Felső-Tödl, *Tilia* sp., IV.1954, leg.: I. Deák, det.: Z. Igmándy (BP34479); Sopron, Deák-kút, *Abies alba*, 21.III.2012, leg. et det.: I. Szabó & V. Papp (PV604); Sopron, Deák-kút, *Carpinus betulus*, 27.VIII.1957 (IZ870); Sopron, Ferenc-forrás, *Picea abies*, 22.VII.1978, leg. et det.: Z. Igmándy (IZ2385); Sopron, Füzesárok, *Alnus glutinosa*, 01.IX.1968, leg. et det.: Z. Igmándy (BP47633), 16.IX.1973 (BP76137); Csorna, *Alnus glutinosa*, IV.1979, leg.: T. Pillér, det.: Z. Igmándy (BP76135); Dunasziget, *Ulmus* sp., 08.X.1976, leg.: J.

Nyulasi, det.: Z. Igmándy (BP76365); Sopron, *Tilia* sp., 05.VII.1952, leg. et det.: Z. Igmándy (BP20335/34477); **Hajdú-Bihar county**: Debrecen, Nagyerdő, *Quercus* sp., 23.III.1930, leg. et det.: D. Révy (BP95302); Debrecen, *Quercus robur*, X.1978, leg.: L. Földi, det.: Z. Igmándy (BP76144); **Heves county**: Szilvásvárad, Őserdő Forest Reserve, *Fagus sylvatica*, VIII.1954, leg.: J. Győry, det.: Z. Igmándy (BP34480/IZ501); Szilvásvárad, Őserdő Forest Reserve, *Fagus sylvatica*, 29.IV.2011, leg. et det.: V. Papp (PV307); Szilvásvárad, *Fagus sylvatica*, 15.V.1956, leg. et det.: Z. Igmándy (BP76136); Mátraháza, 08.IX.1940, leg. et det.: G. Moesz (BP13654); Bélapátfalva, *Fagus sylvatica*, 25.VII.1956, leg. et det.: Z. Igmándy (BP34474); Nagyvisnyó, *Fagus sylvatica*, 06.VII.1957, leg. et det.: Z. Igmándy (BP34478); **Jász-Nagykun-Szolnok county**: Tiszapüspöki, *Populus* x *euramericana* cv. *serotina*, VIII.1976, leg.: J. Kómár, det.: Z. Igmándy (BP76141); **Komárom-Esztergom county**: Neszmély, *Salix* sp., 13.X.1955, leg.: L. Haracsi, det.: Z. Igmándy (BP23738/34481); **Nógrád county**: Zagyvaróna, Vecseklői-völgy, *Quercus* sp., 24.VIII.1955, leg. et det.: Z. Igmándy (BP23749/34473); Diósjenő, *Fagus sylvatica*, 01.X.1954, leg.: J. Rumszauer,, det.: Z. Igmándy (IZ517); Nagyoroszi, *Alnus glutinosa*, 27.X.1974, leg.: J. Gyürky, det.: Z. Igmándy (BP76138); Magyarnándor, *Quercus* sp., X.1974, leg.: J. Fidlóczky, det.: Z. Igmándy (BP76140); **Pest county**: Pilisszentkereszt, Szurdok, *Fagus sylvatica*, 30.X.2009, leg. et det.: V. Papp (PV20); Pusztavacs, *Populus* sp., VIII.1955, leg.: M. Balázs, det.: Z. Igmándy (IZ717); Szigetmonostor, *Robinia pseudoacacia*, VI.1972, leg.: Padányi & G. Gulyás, det.: Z. Igmándy (IZ2024); Csővár (Cserhát Mts), unknown, 31.VII.1979, leg. et det.: M. Babos, A. Friesz (BP59038); Nagykőrös, *Robinia pseudoacacia*, VII.1976, leg.: L. Nemes, det.: Z. Igmándy (BP76133); Isaszeg, Szentgyörgypuszta, *Populus* sp., 31.X.1966, leg.: M. Babos, E. Véssey, det.: Z. Igmándy (BP76147); Gödöllő, *Salix* sp., VIII.1964, leg.: E. Véssey, det.: Z. Igmándy (BP76143); Pusztavacs, *Populus* sp., VIII.1955, leg.: M. Balázs, det.: Z. Igmándy (BP34475); **Somogy county**: Segesd, *Quercus* sp., XI.1970, leg.: F. Eszes, det.: Z. Igmándy (BP76139); **Szabolcs-Szatmár-Bereg county**: Nyírtelek, *Quercus robur*, 16.IX.1982, leg.: F. Varga, det.: Z. Igmándy (IZ2857); Baktalórántháza, *Prunus avium*, 03.XI.1975, leg. et det.: Z. Igmándy (BP55669); Nyírbéltek, *Betula pendula*, 03.XI.1975, leg. et det.: Z. Igmándy (BP76134); **Tolna county**: Keselyű, Őcsény, *Populus* sp., 14.IV.1960, leg. et det.: Z. Igmándy (BP34321); Szekszárd, Kis-Bükk erdő, unknown, 18.V.1927, leg. et det.: L. Hollós (BP13628); Szekszárd, Sötét-völgy, unknown, 18.VIII.1927, leg. et det.: L. Hollós (BP13613); Fácánkert, *Robinia pseudoacacia*, 11.X.1928, leg. et det.: L. Hollós (BP13631); Hőgyész, *Fraxinus ornus*, 22.X.1964, leg. et det.: Z. Igmándy (BP20409/20443); **Vas county**: Szalafő, *Quercus* sp., 06.IX.1968, leg. et det.: Z. Igmándy (BP47455); Körmend, Tilalmasi-erdő, *Acer pseudoplatanus*, 26.IV.1958, leg.: Z. Igmándy, H. Pagony, det.: Z. Igmándy (BP76146/IZ992); Sárvár, *Quercus robur*, 06.IX.1979, leg.: Z. Igmándy, Gy. Traser, det.: Z. Igmándy (BP76145); Sitke, *Carpinus betulus*, 11.X.1972, leg. et det.: Z. Igmándy (BP76366); Szalafő, *Quercus robur*, 05.VII.1972, leg. et det.: Z. Igmándy (BP75934); **Veszprém county**: Marcaltő, *Salix* sp., XII.1953, leg.: J. Csötönyi, det.: Z. Igmándy (IZ375); **Zala county**: Sormás, *Alnus glutinosa*, VIII.1972, leg.: M. Szélessy, det.: Z. Igmándy (BP55483); Pölöske, *Quercus rubra*, 19.IX.1978, leg.: M. Szélessy, det.: Z. Igmándy (IZ2398); Letenye, *Fagus sylvatica*, V.1984, leg.: J. Csendes, det.: Z. Igmándy (IZ3006); Vétyem, *Fagus sylvatica*, 06.IX.1981, leg. et det.: Z. Igmándy (BP76363).

Ganoderma carnosum Pat., Bulletin de la Société Mycologique de France, 5: 66, 1889
= *Ganoderma atkinsonii* H. Jahn, Kotl. & Pouzar 1980

G. carnosum (syn. *G. atkinsonii*) belongs to the group of annual and stipitate *Ganoderma* species (*G. lucidum* complex). The main morphological characters are the dark and shiny pileus and in general the larger fruitbody (Jahn et al. 1980), as well as the size of the pores – *G. carnosum* (average: 138.46 μm), *G. lucidum* (average: 238.34 μm) – (Cilerdzic et al. 2011). It is difficult to separate the two species (*G. carnosum* and *G. lucidum*) by anatomical characters, but according to Jahn et al. (1980) *G. carnosum* has wider spores [average wide: (7.3)7.4–7.8(8) μm].

It is a south-central European species, and it grows mainly on *Abies alba*, but rarely occures on other coniferous or decideous tree species (Bernicchia 1995, Jahn et al. 1980). In Hungary, the first data of *G. carnosum* was published by Szabó (2012). Up to now, only twolocalities of this species was known from *Taxus baccata* and stump of unknown coniferous tree (cf. *Abies alba*) in Hungary *(Table 1, Figure 1).*

MATERIAL EXAMINED – Csongrád county: Szeged, *Taxus baccata*, III.1984, leg.: Gy. Patkó, det./rev.: I. Szabó & V. Papp (IZ2991); Szeged, Museum garden, *Taxus baccata*, 05.XII.1986, leg. F. Eszes, det. Z. Igmándy (IZ3122); **Győr-Moson-Sopron county**: Sopron, Kecske-patak, cf. *Abies alba*, 14.IX.2008, leg.: B. Dima & L. Albert, det.: B. Dima & V. Papp (PV970).

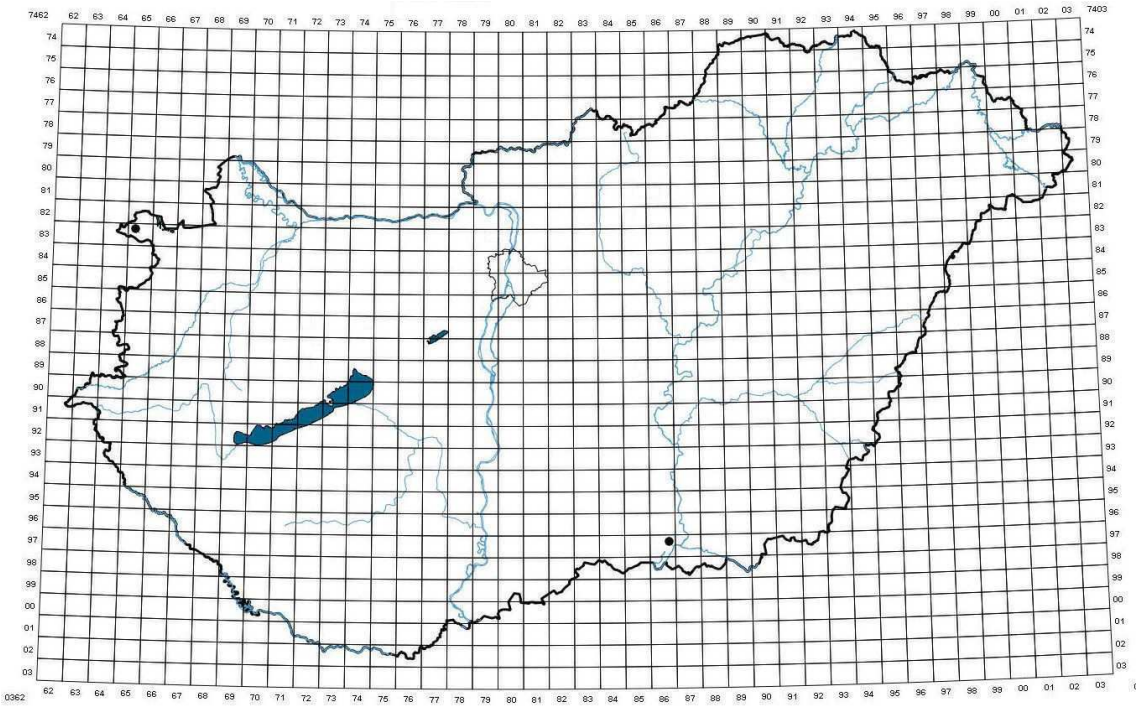

Figure 1. Localities of Ganoderma carnosum in Hungary

Ganoderma cupreolaccatum (Kalchbr.) Z. Igmándy, Acta Phytopathologica Academiae Scientiarum Hungaricae, 3: 234, 1968

≡ *Polyporus cupreolaccatus* Kalchbr. 1885

= *Polyporus laccatus* Kalchbr. 1885

= *Ganoderma pfeifferi* Bres. 1889

G. cupreolaccatum (Bas. *Polyporus cupreolaccatus* Kalchbr. 1885) is presumably identical with *G. pfeifferi* Bres. 1889, which was described from *Abies* (Patouillard 1889), however this taxon is a characteristic species of natural European beech forests (Christensen et al. 2004) and mainly grows on the base of living *Fagus sylvatica* (Ryvarden – Gilbertson 1993). In Europe, it is rarely found on other hardwood species, like *Ulmus laevis, Acer saccharinum* (Szczepkowski – Piętka 2003) or *Aesculus*, *Fraxinus*, *Prunus* and *Quercus* species (Petersen 1987, Ryvarden – Gilbertson (1993).

G. cupreolaccatum (Kalchbr.) Z. Igmándy (syn. *G. pfeifferi* Bres.) has perennial basidiocarp, nevertheless molecular works (e.g. Moncalvo et al. 1995) was shown that it belongs to the annual and laccate '*G. resinaceum*' complex. The old basidiocarps were possibly mistaken for *G. applanatum* (Niemelä – Miettinen 2008). Main characteristics of this species are the laccate pileus, dark brown context and the size of the spores (9–11,5 × 6–9 µm).

In Hungary *G. cupreolaccatum* typically grows on the base of old living *Fagus sylvatica* (e.g. Igmándy 1968, Papp – Siller 2012), that explains why most of the data of this species originate from beech forest reserves. It is also rarely found on other hardwood species – *Acer* (BP20323), *Quercus* (IZ639) – in Hungary. Moesz (1942) reffering to the collection of Schilberszky (Nagytétény, Budapest) published a data of *Ganoderma laccatum* (Kalchbr.) Bourdot & Galzin (synonyms given by the author: *G. pfeifferi* Bres. and *Placodes resinosus* (Schrad.) Quél.), which grew on *Prunus persica*. Since *Prunus* is a particular host for this species, the reconsideration of the data is needed, but the specimen is not found. Igmándy (1970) previously mentioned *Ganoderma cupreolaccatum* only from two localities (Erdősmecske, Pusztavám). Pál-Fám and Lukács (2002) published this species on living *Fagus* in Kőszegi-forrás Forest Reserve (Mecsek Mts). Siller also found it on *Fagus sylvatica*

in Őserdő Forest Reserve (Siller 2004) and in Tátika Forest Reserve (Papp – Siller 2012). Previously the first author reported this species from Dobogókő, Pilisszentlélek (Visegrád Mts) and Juhdöglő-völgy Forest Reserve (Vértes Mts) (Papp – Siller 2012). In this study three new localities are published (Galyatető, Nagykanizsa, Zagyvaróna) *(Table 1, Figure 2)*.

MATERIAL EXAMINED – Baranya county: Erdősmecske, VIII.1965, leg.: Vaday, det.: Z. Igmándy (BP20323); **Fejér county**: Pusztavám, *Acer* sp., 13.X.1955, leg.: L. Haracsi, det.: Z. Igmándy (BP20313); Csákberény, Juhdöglő-völgy Forest Reserve, *Fagus sylvatica*, 15.X.2010, leg. et det.: V. Papp (PV971); *Fagus sylvatica*, 04.III.2011, leg. et det.: V. Papp (PV972); **Heves county**: Mátra Mts, Galyatető, *Fagus sylvatica*, 22.IX.2013, leg. et det.: V. Papp (PV967); **Nógrád county**: Zagyvaróna, Vecseklő-völgy, *Quercus* sp., 24.VII.1955, leg.: Z. Igmándy, det./rev.: V. Papp (IZ639); **Pest county**: Visegrádi Mts, Pilisszentlélek, *Fagus sylvatica*, 27.III.2010, leg. et det.: V. Papp (PV45); Visegrádi Mts, Dobogókő, *Fagus sylvatica*, 24.IV.2011, leg. et det.: V. Papp (PV287); Visegrádi Mts, Dobogókő, *Fagus sylvatica*, 11.VII.2012, leg. et det.: V. Papp (PV643); Börzsöny Mts, Nagy-Hideg-hegy, *Fagus sylvatica*, 12.III.1972, leg.: A. Dobos, det.: Z. Igmándy (BP76034); **Zala county**: Vétyem, *Fagus sylvatica*, 18.VI.1981, leg.: Z. Igmándy & Gy. Traser, det.: Z. Igmándy (BP76364/90042); Vétyem, *Fagus sylvatica*, III.1984, leg.: G. J. Kovácsné, det.: Z. Igmándy (IZ2994); Nagykanizsa, *Fagus sylvatica*, 03.VIII.1982, leg.: M. Szélessy, det.: Z. Igmándy (BP80368/IZ2844).

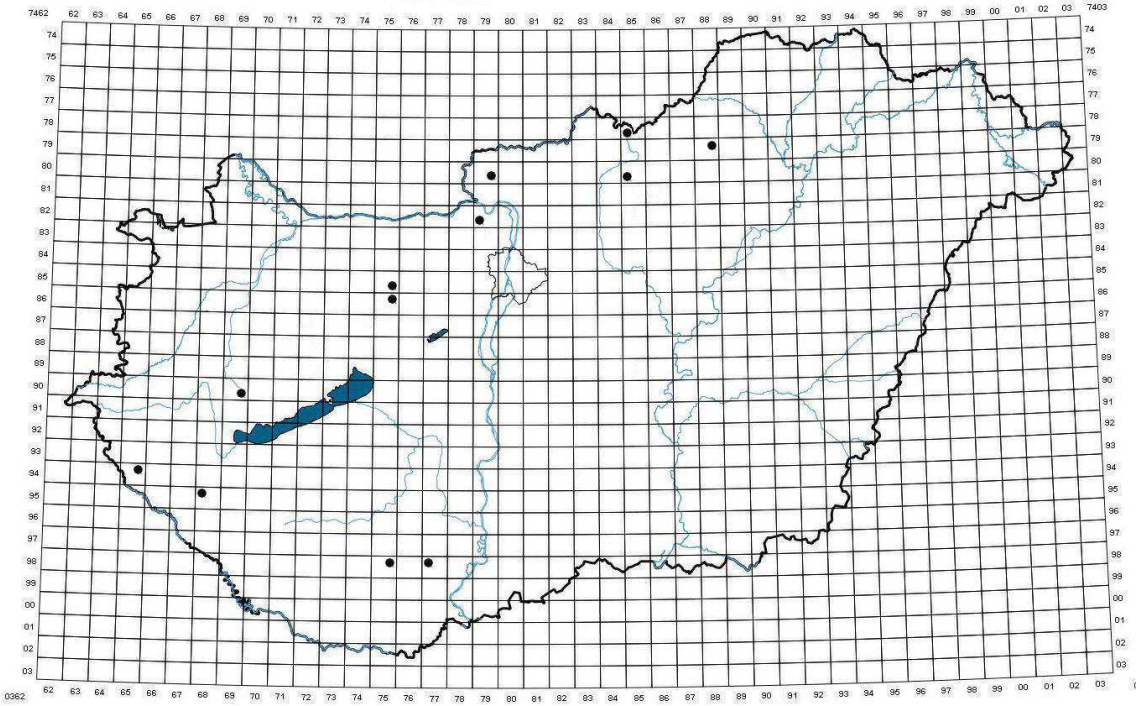

Figure 2. Localities of Ganoderma cupreolaccatum in Hungary

Ganoderma lucidum (Curtis) P. Karst., Revue Mycologique Toulouse, 3 (9): 17, 1881
≡ *Boletus lucidus* Curtis 1781 – *Polyporus lucidus* (Curtis) Fr. 1821
= *Boletus flabelliformis* Leyss. 1761

Ganoderma lucidum is the type species of the genus *Ganoderma* (Karsten 1881), nevertheless taxonomically it is quite problematic (Moncalvo et al. 1995). The morphologically similar species are often identified mistakenly as '*G. lucidum*' all around the world. According to Seo and Kirk (2000) '*G. lucidum*' is the most often incorrectly used name within the genus *Ganoderma* besides *G. applanatum*. For this reason it is difficult to define the real *G. lucidum* s. str. (Park et al. 2012, Szedlay 2002, Wasser 2005). Recent molecular studies showed that certain Chinese taxons, which previously have been identified as *G. lucidum*, are different from the European specimens (*G. lucidum* s. str.) (e.g. Cao et al. 2012, Wang et al. 2009, Wang et al. 2012).

The morphological characters of *G. lucidum* that separates it from other European annual and stipitate *Ganoderma* species (*G. carnosum*, *G. valesiacum*) are the colour of the basidiocarp and context, the size of pores and the host preference (Bernicchia 2005, Ryvarden – Gilbertson 1993). *G. resinaceum* may have short expanding stipe, but it has a robust basidiocarp and usually grows on base of living trees (Igmándy 1991). In the context of this species a wide darker zone can be found, which is absent in *G. lucidum* (Petersen 1987).

The holotype was described from *Corylus avellana* (Moncalvo – Ryvarden 1997), however in Hungary it mainly grows on *Quercus*, *Carpinus* and *Salix* (Igmándy 1991), but it is also known from *Acer* and *Platanus* (Szabó 2012). Igmándy identified it as *G. lucidum* on *Taxus baccata* (Szabó 2012), but following the revision of the speciment, it is prooved to be identical with *G. carnosum*. Previously, *G. lucidum* has not been found in Hungary on *Fagus sylvatica* (PV789) and *Robinia pseudoacacia* (PV461).

MATERIAL EXAMINED – Bács-Kiskun county: Baja, unknown, 18.X.1968, leg.: V. Stubnya, det.: Z. Igmándy (BP76190); Hajós, *Salix* sp., 13.VI.1980, leg.: A. Szalczer, det.: Z. Igmándy (BP76190); **Baranya county**: Marócsa, *Carpinus betulus*, 04.V.1978, leg.: F. Varga, det.: Z. Igmándy (BP76201); **Budapest**: Budai-hegyek, unknown, VI.1957, leg.: I. Szőke, det.: Z. Igmándy (BP76195/IZ881); Vadaskert, *Quercus* sp., 12.X.1934, leg. et det.: A. Pénzes (BP67844), 01.III.1941, leg.: Kőfaragó, V. Gyelnik, det.: G. Bohus (BP28271); Budakeszi, unknown, 29.VIII.1979, leg. et det.: M. Babos (BP65358), 14.III.1982, leg.: O. Dálnoki, det.: G. Bohus (BP78772); Jánoshegy, unknown, 13.VI.1926, leg.: J. Zöldy, det.: J. Tuzson (BP66610), 05.VII.1953, leg. et det.: G. Ubrizsy (BP58939); Hüvösvölgy, *Quercus* sp., 28.VII.1951, leg. et det.: G. Ubrizsy (BP58938); Kamaraerdő, unknown, 30.VI.1985, leg. et det.: M. Rajczy (BP78634); **Fejér county**: Alcsútdoboz, hardwood, 01.V.2013, leg. et det.: V. Papp (PV940); Csákberény, Juhdöglő-völgy Forest Reserve, *Fagus sylvatica*, 10.X.2012, leg. et det.: V. Papp (PV789); **Győr-Moson-Sopron county**: Sopron, unknown, 15.X.1951, leg.: Ö. Apt, det.: Z. Igmándy (IZ55); Sopron, Iker-árok, *Carpinus betulus*, IX.1952, leg.: I. Szodfried, det.: Z. Igmándy (IZ223); Sopron, Fáber-rét, *Carpinus betulus*, 30.VII.1953, leg. et det.: Z. Igmándy (IZ312); Sopron, Váris, *Quercus cerris*, 17.VII.1955, leg. et det.: Z. Igmándy (IZ582); Sopron, Várhely, unknown, 03.VIII.1956, leg.: L. Haracsi, Z. Igmándy, det.: Z. Igmándy (BP76198); Sopron, Vas-hegy, *Carpinus betulus*, IX.1958, leg.: H. Pagony, det.: Z. Igmándy (IZ1103); Sopron, unknown, XII.1965, leg.: Gy. Holdampf, det.: Z. Igmándy (BP76191); Csáfordjánosfa, *Quercus robur*, 27.IX.1981, leg. et det.: Z. Igmándy (BP76368); Sopron, Hotel Lővér, unknown, 21.VII.1985, leg. et det.: B. Lowy (BP78635); **Hajdú-Bihar county**: Debrecen, Nagyerdő, *Quercus* sp., 06.VIII.1957, leg. et det.: Z. Igmándy (BP76200); Debrecen, Haláp, unknown, IX.1973, leg.: F. Eszes, det.: Z. Igmándy (BP76197); **Heves county**: Felsőtárkány, Török-út (Bükk Mts), *Quercus* sp., 01.IX.2005, leg. et det.: T. Sántha (BP99420); Gyöngyösoroszi (Mátra Mts), *Quercus* sp., 16.VIII.2013, leg. et det.: V. Papp (PV939); Síkfőkút, unknown, 12.VI.1974, leg. et det.: M. Babos (BP80465); Kerecsend, unknown, 17.VI.1956, leg.: B. Zólyomi, det.: G. Bohus (BP28274); Síkfőkút, unknown, 27.VIII.1977, leg. et det.: M. Babos (BP80483); **Nógrád county**: Mátraverebély, Szentkút (Mátra Mts), unknown, 10.VIII.1938, leg. et det.: G. Moesz (BP14029); **Pest county**: Nagybörzsöny (Börzsöny Mts), *Quercus* sp., 05.VII.2013, leg.: J. Nagy, det.: V. Papp (PV973); Dobogókő (Visegrád Mts), *Quercus petraea*, 22.IV.2012, leg. et det.: V. Papp (PV615), *Quercus petraea*, 21.VIII.2012, leg. et det.: V. Papp (PV746); Horány, Szigetmonostor, unknown, 11.VII.1982, leg. et det.: M. Babos (BP79139); Vácrátót, Botanical Garden, unknown, 30.XI.1983, leg.: unknown, det.: M. Babos (BP78631); Bag, unknown, 03.X.1955, leg.: B. Zólyomi, det.: G. Bohus (BP28275); Kőhegy (Pilis Mts), unknown, 18.VII.1965, leg.: L. Vajda, det.: M. Babos (BP); Leányfalu, unknown, 09.VII.1979, leg. et det.: M. Babos, G. Bohus, Vidovszky et al. (BP59035); **Somogy county**: Somogyszob, Kaszópuszta, *Acer negundo*, 12.VII.1966, leg. et det.: Z. Igmándy (BP76188); Balatonboglár, *Platanus acerifolia*, 01.VIII.1957, leg. et det.: Z. Igmándy (BP76193); **Tolna county**: Lengyel, Annafürdő, *Robinia pseudoacacia*, 28.VIII.2011, leg. et det.: V. Papp (PV461); Őcsény, Borrévi-erdő, *Salix* sp., 03.IX.1954, leg. et det.: Z. Igmándy (BP34478/IZ461); Pörböly, *Salix alba*, 08.VI.1956, leg. et det.: Z. Igmándy (IZ744); Szekszárd, *Salix* sp., 23.VII.1912, leg. et det.: L. Hollós (BP14023); Szekszárd, Kis-Bükk forest, *Quercus* sp., 23.III.1927, leg. et det.: L. Hollós (BP14025); **Vas county**: Sárvár, hardwood, 06.IX.1979, leg.: Z. Igmándy, Gy. Traser, det.: Z. Igmády (BP76199); Sárvár, *Carpinus betulus*, 20.VIII.1980, leg. et det.: Z. Igmándy (BP76196); Sitke, *Carpinus betulus*, 08.XI.1968, leg. et det.: Z. Igmándy (BP76194); **Zala county**: Sormás, *Quercus* sp., VII.1972, leg.: M. Szélessy, det.: Z. Igmándy (BP76192); Eszteregnye, unknown, VII.1972, leg.: M. Szélessy, det.: Z. Igmándy (BP76369); Pacsa, unknown, 16.VII.1984, leg.: Gy. Bartos, det.: M. Babos (BP78632); Balatongyörök, Gargavölgy, unknown, 15.IX.1927, leg. et det.: G. Moesz (BP14030); **unknown**: S.Kápolna, unknown, VIII.1893, leg. et det.: J. Márton (BP14021); Lepence, unknown, 27.IX.1980, leg. et det.: M. Babos, L. Albert (BP65358); Hortobágy, Ohati-erdő, unknown, 26.VI.1974, leg.: K. Verseghy, S. Orbán, det.: M. Babos (BP51563), 14.XI.1975, leg.: Zs. Komáromi, S. Orbán, det.: M. Babos (BP51550).

Ganoderma resinaceum Boud., Bulletin de la Société Mycologique de France, 5: 72, 1889

G. resinaceum has a robust annual basidiocarp (Igmándy 1991, Mattock 2001, Mohanty et al. 2011), but some authors state that it is perennial (Bernicchia 2005, Ryvarden – Gilbertson 1993). Its microscopic features are very similar to those of *G. lucidum*, but it is different for the lack of the stipe, the size of the pileus and its facultative necrotrophic characters (Igmándy 1991).

In Hungary *G. resinaceum* usually grows at the base of living *Quercus* trees (e.g. Igmándy 1981, Trecker – Szabó 2002), but it occures on other decidous trees (*Platanus acerifolia*, *Pyrus communis*, *Robinia pseudoacacia*, *Salix* spp.) as well (Igmándy 1981, Papp et al. 2012b, Szabó 2012). Previously, it has not been found in Hungary on *Acer saccharinum* (PV480) and *Aesculus hippocastanum* (PV976). Igmándy (1991) mentioned this species from *Mahonia aquifolium* (BP47614/IZ1801), but after examining the speciment, it can be stated that is not identical with *G. resinaceum* and is likely to be different from the accepted European *Ganoderma* species. To determine the speciment, further studies are required.

MATERIAL EXAMINED – Budapest: XI. ker., Lágymányosi str., *Acer saccharinum*, 13.X.2011, leg. et det.: V. Papp (PV480); II.ker., Határ str., *Quercus robur*, 12.VII.2013, leg. : B. Dima, det.: B. Dima & V. Papp (PV974); Wekerle, *Platanus acerifolia*, 19.IX.2012, leg. et det.: V. Papp (PV975); **Győr-Moson-Sopron county**: Sopron, Váris, *Quercus* sp., V.1950, leg. et det.: Z. Igmándy (BP34485/IZ134); Sopron, *Pyrus* sp., XII.1954, leg.: J. Győry, det.: Z. Igmándy (BP34488/IZ527); Sopron, Béka-tó, *Quercus* sp., 23.IX.1956, leg. et det.: Z. Igmándy (BP34482), 07.IX.1969, leg. et det.: Z. Igmándy (BP55488/IZ1840); Sopron, Szárhalmi-erdő, *Quercus petraea*, 24.III.1986, leg.: F. Varga, det.: Z. Igmándy (BP90043/IZ3084); Sopron, Dalos-hegy, *Quercus* sp., 20.X.1963, leg.: A. Szappanos, det.: Z. Igmándy (BP13987); Sopron, Fáber-rét, *Quercus cerris*, 21.IV.1959, leg. et det.: Z. Igmándy (BP34426/47670), 13.XI.1963, leg.: Z. Igmándy, F. Varga, det.: Z. Igmándy (BP47632), 21.IX.1965, leg. et det.: Z. Igmándy (BP47625); Sopron, Deák-tér, *Aesculus hippocastanum*, 09.X.2013, leg.: I. Szabó, det.: I. Szabó & V. Papp (PV976); **Tolna county**: Pörböly, *Robinia pseudoacacia*, 10.VII.1956, leg.: H. Pagony, det.: Z. Igmándy (BP34484/IZ762), Pörböly, Szomfova, *Salix* sp., 08.VI.1956, leg.: H. Pagony, det.: Z. Igmándy (BP34483); Lengyel, Annafürdő, *Quercus cerris*, 08.IX.2013, leg. et det.: V. Papp (PV962); **Vas county**: Őriszentpéter, *Quercus* sp., 15.III.1966, leg.: Z. Igmándy, F. Varga, det.: Z. Igmándy (BP47519); **Veszprém county**: Balatonalmádi, *Salix* sp., 26.VII.2011, leg. et det.: V. Papp (PV555); Szigliget, *Salix alba*, 22.VIII.2013, leg. et det.: V. Papp (PV938); **Zala county**: Keszthely, *Salix alba*, 15.II.1953, leg.: I. Koronky, det.: Z. Igmándy (BP20299/34489/IZ387); Keszthely, *Salix* sp., 25.VII.1967, leg. et det.: Z. Igmándy (BP47335/IZ1717); **unknown**: Bejegyertyános, Rózsáskert, *Quercus robur*, 29.VIII.1956, leg. et det.: Z. Igmándy (BP34486).

4 CONCLUSIONS

Up to now, six species of *Ganoderma* are known in Hungary. *Ganoderma valesiacum* Boud. 1894 is a Central European species occurring predominantly in montane to subalpine regions, in the natural stands of *Larix* (Ryvarden – Gilbertson 1993). In Hungary, the host of this species is not native, only some planted stands are known. Therefore the occurence of *G. valesiacum* in Hungary is not to be excluded, but is unlikely.

In the proposed red list of the Hungarian macrofungi (Rimóczi et al. 1999) only two *Ganoderma* species (*G. adspersum*, *G. resinaceum*) are mentioned, which mostly occure in urban habitats in Hungary (Igmándy 1991, Papp 2013). Due to the data of the specimens it can be stated that these species are not ’vulnerable’ in Hungary. Based on their data *G. carnosum* and *G. cupreolaccatum*, which are clearly rarer, are not included on the list. In Hungary only a few *Abies* stands can be found, which is the main host of *G. carnosum*. Therefore it is probably the rarest species of the genus in Hungary. *Ganoderma cupreolaccatum* has perennial basidiocarp, nevertheless not too much occurrences are known. Due to this reason and its habitat preference *G. cupreolaccatum* has recently been declared protected in Hungary [83/2013. (IX. 25.) VM edict].

Acknowledgements: This work is dedicated to the memory of Prof. Zoltán Igmándy (1925-2000), who was the most prominent Hungarian researcher of poroid wood-inhabiting basidiomycetes. His research activity initiated the modern investigation of polypores in Hungary. We are grateful to Csaba Németh for his help in the preparation of the distribution maps. Bálint Dima is thanked for providing *Ganoderma carnosum* specimens from Sopron.

Table 1. Host preference of the Hungarian Ganoderma species based on the examined fungarium materials

	G. adspersum	***G. applanatum***	***G. cupreolaccatum***	***G. carnosum***	***G. lucidum***	***G. resinaceum***
Abies*	1	1		1		
Acer	1	2	1		1	1
Aesculus*	1					1
Alnus		6				
Betula	1	1				
Carpinus		2			6	
Celtis*	1					
Fagus	1	10	9		1	
Fraxinus	5	1				
Gleditschia*	4					
Gymnocladus*	1					
Juglans	1					
Morus*	3					
Picea	1	1				
Platanus*	1				1	1
Populus	3	6				
Prunus	5	1				
Pyrus						1
Quercus	14	12	1		15	11
Robinia*	6	3			1	1
Salix	1	3			4	5
Taxus				2		
Tilia	2	3				
Ulmus	1	1				
unknown	4	7	1		32	
∑	**58**	**60**	**12**	**3**	**61**	**21**

(*) not native in Hungary. The table shows the numbers of the examined specimens. The shades of the boxes indicate the frequency of *Ganoderma* species on different host genera.

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