

Contribution to the knowledge of agarics diversity in the Western Caucasus

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Abstract. Data on 30 species of agaricoid basidiomycetes searched out for the first time in the Western Caucasus are given. As a result, the species diversity of studied region is estimated at 867 agarics taxa.

Key words: agaricoid basidiomycetes, fungal diversity, new findings, Western Caucasus

Introduction

The study of agaricoid basidiomycetes of the Western Caucasus was started in the beginning of 20th century and was not completed until the present. Available information is scattered in several papers (Woronov 1915; Singer 1931, 1933; Vassiljeva 1939; Nakhutsrishvili 1975, 1986; Kovalenko 1979, 1980a, b; Vaasma *et al.* 1986; Onipchenko & Kaverina 1989; Lebedeva 1994; Morozova 1997; Kalamees & Botashev 2000; Sopina 2000, 2001a, b, 2004a, b). In total they list 837 species with the exception of some ambiguous taxa (which cannot be interpreted because of the lack of voucher specimens). However this number is probably not completely adequate. The Western Caucasus is characterized by one of the most rich flora and fauna on the same latitude. Therefore there are some reasons to expect the existence here of one of the most rich fungal biodiversity and particularly diversity of agaricoid basidiomycetes. In addition, the territory of the Western Caucasus is investigated unequally. The northern macroslope of the Great Caucasus (principally in the Caucasian and Teberda State Biosphere Reserves in Russia) is fairly well explored, whereas the Black Sea coast has been poorly studied. The present article is a contribution to the study of species diversity and distribution of agarics in the Western Caucasus. Data on 30 species searched out in this region for the first time are given.

Investigated area

The Western Caucasus is the western part of the Great Caucasus mountain region. It stretches from low mountains in the vicinity of Anapa city to meridian of the Elbrus mountain and the Kodor ridge. The eastern boundary passes through upper reaches of the Kuban' and watershed of the Kuban' and Terek rivers (Fig. 1). The NW part of the Western Caucasus has a low-mountain relief whereas the E part belongs to highlands. The highest peak is Dombai-Ulgen (alt. 4046 m). The bedrock of the Western Caucasus is formed by different volcanic and sedimentary rocks (granites, porphyrites, argillaceous slates, limestones, etc.). There are karst landscapes in several places. Predominant soil types are brown mountain-forest and mountain-meadow soils as well as formed on limestone rendzinas (Gvozdetsky 1954). The studied region is rich in rivers and water sources.

The Western Caucasus is situated in the temperate climatic belt at a border with the subtropical belt. Its climate changes from moderate arid with submediterranean features in the NW part of the Black sea coast to mild, humid (800–2500 mm precipitations per year) in Abkhazia and some parts of the northern macroslope of the Great Caucasus (upper reaches of Belaya). There is a winter maximum of precipitations approx. overall in the Western Caucasus. The av. annual temperature at the bottom of the forest belt varies from +9.8°C in NW

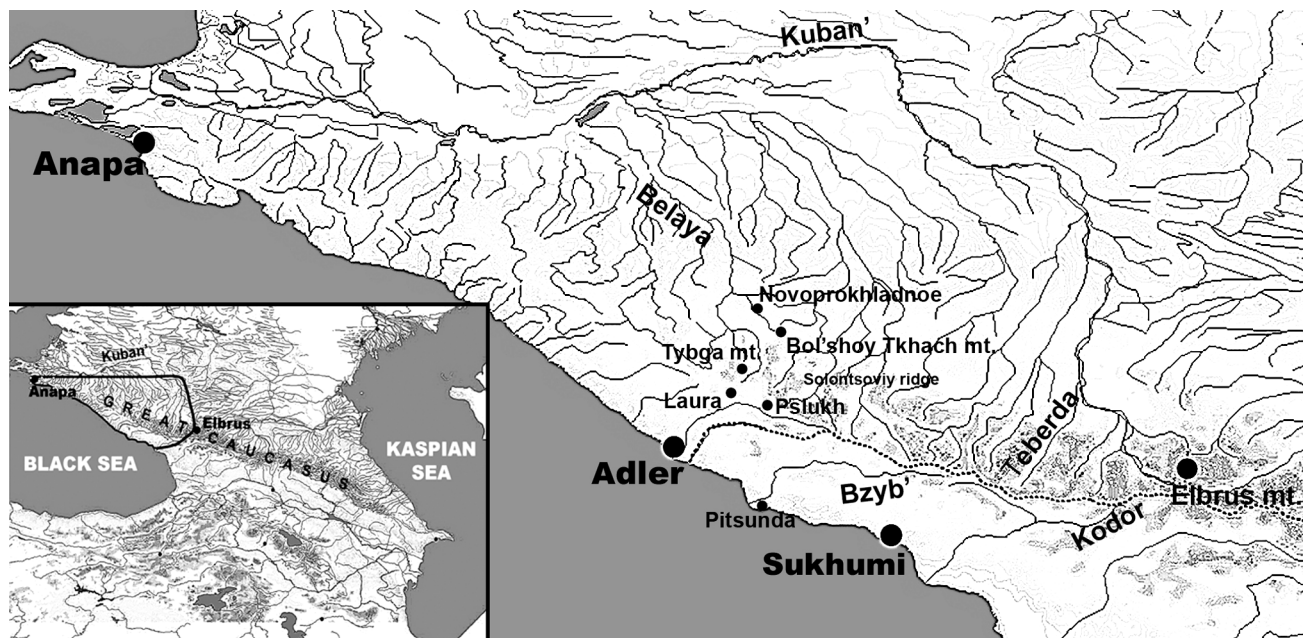


Fig. 1. Study area

end to +14°C in SE part (Zimina & Zlotin 1990). The av. annual temperature decreases with increase of altitude (up to 0 ...–4°C at the upper limit of forest belt).

The distribution of different ecosystems corresponds with the original type of altitudinal zonation (Shiffers 1953). The forest belt stretches from the Black sea coast level up to alt. 2000–2100 m (but it may be decreased up to 1750–1800 m due to human activity). The tree species diversity of the forests is high. Relict and Caucasian endemic beech (*Fagus orientalis* Lipsky) and fir (*Abies nordmanniana* (Stev.) Spach) as well as oaks (*Quercus hartwissiana* Stev., *Q. petraea* L. ex Liebl., *Q. pubescens* Willd.), hornbeam (*Carpinus betulus* L., *C. orientalis* Mill.), spruce (*Picea orientalis* (L.) Link) are the most widespread tree species. They form overwhelming majority of Caucasian forests. But there are also small groves with pistachio tree (*Pistacia mutica* F. et M.), pine (*Pinus pityusa* Stev.), yew (*Taxus baccata* L.), box (*Buxus colchica* Pojark.) and others on the Black sea shore. Due to their structure the majority of Caucasian forest types belongs to the Western Europe communities of classis *Quercus–Fagetea* Br.-Bl. et Vlioger, 1937. However they form a wide range of original associations saturated often with relict Kolhida or xerophytic Mediterranean floristic elements (Zimina & Zlotin 1990). The ecotone between forest and subalpine meadow belts is composed by elfin woodlands of birch (*Betula litwinowii* Doluch.) and beech as well as shrubs of *Rhododendron caucasicum* Pall. and *R. luteum* Sweet. Open woodlands of *Pinus kochiana* Klotzsch ex C. Koch are formed often on rocks and screes. Above this the spacious zone of mesophytic subalpine meadows is occurred. They belong to several high-grass and middle-grass associations (mainly *Betonici macranthae* – *Calamagrostietum arundinaceae* Onipchenko 2001 and *Cephalario giganteae* – *Ligusticetum alani* Onipchenko 2002). Alpine low-grass meadows and

wastes (e.g. *Pediculari chroorrhynchae* – *Eritrichitum caucasicum* Minaeva 1987; *Campanulo ciliatae* – *Chamaesciadietum acaulis* Onipchenko 2002 etc.) are located above alt. 2000–2500 m (Onipchenko 2002). The native vegetation communities are best preserved in the Caucasian and Teberda Reserves as well as several National or Nature Parks (Sochinskiy, Bol'shoy Tkhach, etc.) but the coastal part of the Western Caucasus is now very disturbed by human activity.

Materials and methods

Fungi were collected by the author for several seasons (2001–2007 years) during late summer and first half of autumn. In this period natural and semi-natural broad-leaved forests (*Quercus petraea*, *Fagus orientalis*, *Carpinus betulus*, *Castanea sativa* Mill., and *Acer* spp.), mixed forests (mainly *Fagus orientalis* – *Abies nordmanniana*), subalpine and alpine meadows and as well as a grove of *Pinus pityusa* and *Buxus colchica* along the Black sea shore were investigated. Collected specimens are kept in the Herbarium Mycologicum of V.L. Komarov Botanical Institute, Saint Petersburg, Russia (LE). Their accession numbers are cited in brackets at the end of each record. Families and genera of fungi are given according to the arrangement of Kirk *et al.* (2001) with two exceptions: the family *Hygrophoraceae* Lotsy and genus *Melanotus* Pat. are accepted here. All specimens were determined by the author with the exception of LE 265082 (*Entoloma polioopus* var. *discolor*) determined by Dr. O.V. Morozova.

Marks and abbreviations used: Syn. – synonym; terr. – territory (large administrative unit in Russia); vic. – vicinities; NF – Northern Forestry of the Caucasian Reserve; SF – Southern Forestry of the Caucasian Reserve.

List of collected fungi

Agaricales

Agaricaceae

Leucoagaricus sublittoralis (Kühner ex Hora) Singer, Nova Hedwigia **29**: 163, 1969.

Abkhazia: the Black sea coast towards NW from Pitsunda city, a grove of *Pinus pityusa* and *Buxus colchica* on dunes along seashore, on litter, 30 Sept 2007 (LE 265173).

Bolbitiaceae

Conocybe juniana (Velen.) Hauskn. et Svrček, in Hausknecht, Öst. Z. Pilzk. **8**: 46, 1999.

Russia: Adygeya, Maikop distr., vic. Novoprokhladnoe village, subalpine high-grass meadow, on grass remains, 8 Aug 2004 (LE 265062). Caucasian Reserve, SF, Laura reserve station, on soil, 12 Aug 2006 (LE 265104).

Coprinaceae

Psathyrella prona (Fr.) Gillet, Hyménomycètes: 618, 1878.

Russia: Krasnodar terr., Adler distr., Sochinskiy National Park, vic. Pslukh reserve station, on soil among ferns, 31 Aug 2006 (LE 265234).

Cortinariaceae

Cortinarius barbaricus (Brandrud) Frøslev *et al.*, in Frøslev *et al.*, Mycotaxon **97**: 375, 2006.

Abkhazia: the Black sea coast towards NW from Pitsunda city, a grove of *Pinus pityusa* and *Buxus colchica* on dunes along seashore, under pines, 30 Sept 2007 (LE 265175).

Note: This species is reported to be found usually with *Picea* spp. on calcareous soil. The spore dimensions seems to be one of the main morphological features permitted to distinguish this species from close *Cortinarius barbarorum* Bidaud, Moëne-Loc. et Reumaux. The later has spore (9.5–) 10–11.5 (–12) × 6–7.5 µm whereas *C. barbaricus* is characterized by slightly large size (11.5–) 12–13 (–13.5) × 7–8.5 µm. Studied specimens have 11.2–12.7 × 6.2–7.5 µm amigdaloid-citriiform spores. The macromorphological features are following: cap evenly yellowish-ochraceous, only slightly radial streaked, slightly sticky, matt when dried, with brownish veil patches resembling *Amanita*. Pileipellis strongly pink-red with KOH even in herbarium. Gills violaceous at first, then brown with violaceous tint. Stem with well-defined bulb, pale-violaceous in upper part, pale yellowish-ochraceous below. Bulb without yellow mycelial strands, strongly pink-red with KOH. Flesh whitish with violaceous tint at the periphery of stem. Without a special smell.

Cortinarius caninus (Fr. : Fr.) Fr., Epicr.: 285, 1838.

Russia: Caucasian Reserve, NF, NW slope of the Solontsoviy ridge near the Port-Arthur ridge, alpine meadow with *Salix* sp., under willow, 21 Aug 2005 (LE 265110).

Note: Common in different subalpine and alpine meadows and wastes with *Salix* spp.

Cortinarius cinnamomeoluteus P.D. Orton, Trans. Brit. Mycol. Soc. **43**: 217, 1960.

Russia: Caucasian Reserve, NF, NW slope of the Solontsoviy ridge near the Port-Arthur ridge, alpine waste with *Salix* sp., under willow, 22 Aug 2005 (LE 265048).

Note: Common in different subalpine and alpine meadows and wastes with *Salix* spp.

Galerina pumila (Pers. : Fr.) M. Lange, Persoonia **2**(1): 41, 1961

Russia: Caucasian Reserve, NF, NW slope of the Solontsoviy ridge near the Port-Arthur ridge, subalpine middle-grass meadow, in moss cushion, 21 Aug 2005 (LE 265037).

Entolomataceae

Entoloma caeruleum (P.D. Orton) Noordel., Persoonia **11**(4): 470, 1982.

Russia: Adygeya, Maikop distr., Bol'shoy Tkhach Nature Park, NE slope of the Bol'shoy Tkhach mountain, subalpine middle-grass meadow, on soil, 12 Aug 2004 (LE 265042).

Entoloma pleopodium (Bull. : Fr.) Noordel., Persoonia **12**(4): 459, 1985.

Syn. *Entoloma icterinum* (Fr. : Fr.) M.M. Moser, Kleine Kryptogamenflora, 2b/2: 205, 1978.

Russia: Caucasian Reserve, SF, vic. Pslukh reserve station, floodplain of the Pslukh river, broad-leaved forest with *Alnus glutinosa* (L.) Gaertn., on soil, 2 Sept 2006 (LE 265081).

Entoloma poliopus (Romagn.) Noordel. var. *discolor* Noordel., Persoonia **12**(4): 460, 1985.

Russia: Caucasian Reserve, NF, NW slope of the Solontsoviy ridge near the Port-Arthur ridge, subalpine middle-grass meadow, on soil, 21 Aug 2005 (LE 265082). Det. O.V. Morozova.

Entoloma pseudocoelestinum Arnolds, Bibl. Mycol. **90**: 341, 1982.

Russia: Caucasian Reserve, NF, SE end of the Solontsoviy ridge, cold *Geranium* – *Hedysarum* subalpine meadow, on soil, 24 Aug 2005 (LE 265074).

Hygrophoraceae

Gliophorus subminutulus (Murrill) Kovalenko, Mikol. Fito-patol. **22**(3): 209, 1988.

Russia: Caucasian Reserve, NF, E end of the Solontsoviy ridge, subalpine middle-grass meadow, in moss under willow, 22 Aug 2005 (LE 265035).

Hygrocybe reidii Kühner, Bull. trimest. Soc. Mycol. Fr. **92**(4): 463, 1976.

Russia: Caucasian Reserve, NF, SE end of the Solontsoviy ridge, subalpine middle-grass meadow, on soil among *Alchemilla* spp., *Swertia iberica* Fischer ex C.A. Meyer, *Cirsium* spp., 24 Aug 2008 (LE 265034).

Marasmiaceae

Marasmius wettsteinii Sacc. et P. Syd., Syll. fung. 14(1): 117, 1899.

Russia: Caucasian Reserve, SF, vic. Pslukh reserve station, floodplain of the Pslukh river, broad-leaved forest with *Alnus glutinosa*, on small twigs, 2 Sept 2006 (LE 254076).

Omphalotus olearius (DC. : Fr.) Singer, Pap. Mich. Acad. Sci. 32: 133, 1946.

Abkhazia: Pitsunda distr., vic. Ptitsefabrika village near outfall of the Bzyb', oak forest with beech, hornbeam, and maple, on buried wood (oak?), 2 Oct 2007 (LE 265256).

Pluteaceae

Limacella illinita (Fr. : Fr.) Murrill, North Amer. Fl. 10: 40, 1914.

Russia: Caucasian Reserve, NF, NW slope of the Solontsoviy ridge near the peak (alt. ca 2300 m), low-grass alpine meadow, among green mosses, 22 Aug 2005 (LE 265056).

Abkhazia: the Black sea coast towards NW from Pitsunda city, a grove of *Pinus pityusa* and *Buxus colchica* on dunes along seashore, on litter under pines, 30 Sept 2007 (LE 265258).

Limacella aff. *vinosorubescens* Furrer-Ziogas, Schweiz. Z. Pilzk. 47: 214, 1969.

Abkhazia: Pitsunda distr., vic. Ptitsefabrika village near outfall of Bzyb', oak forest with beech, hornbeam, and maple, 2 Oct 2007 (LE 265264).

Note: The description of studied specimens is followed: Cap dry, matt, tomentose or slightly innately fibrillose-squamulose, conspicuously cracked (may be because dry season?), pinkish brick or pinkish brown, rather bright. Gills adnexed, pale beige. Stem whitish at the top, with fibrillose ring zone of pinkish brown fibrils. Flesh whitish. Smell not recorded. Spores globose to subglobose, 3.6–4.2 × 3.6–3.9 µm, smooth or slightly verruculose (immersion!), some with dextrinoid reaction. Pileipellis is an ixotrichoderm, terminal elements mainly conical, 39–45 × 6 × 3.5 µm, with intra- and extracellular brownish pigments. The habitus and structure of pileipellis of this specimens appear to be similar with *L. vinosorubescens* (ss. Neville & Poumarat 2004) but gills and flesh are not reddened and gills are adnexed. From *Limacella delicata* (Fr.) Konrad et Maubl. it differs in more robust habitus, brighter colour and cracked cap as well as in more conical terminal elements of pileipellis.

Strophariaceae

Melanotus phillipsii (Berk. et Broome) Singer, Beih. Sydowia 7: 84, 1973.

Russia: Caucasian Reserve, NF, NE branch of the Tybga mountain (alt. ca 2210 m) near Turoviy reserve station, subalpine high-grass meadow, on stem of large cereal (like *Calamagrostis arundinacea* (L.) Roth.), 9 Aug 2005 (LE 265039). Caucasian Reserve, NF, SE end of the Solontsoviy

ridge, subalpine middle-grass meadow, on stem of *Aconitum* sp., 24 Aug 2005 (LE 265038).

Psilocybe subviscida (Peck) Kauffm. var. *velata* Noordel. et Verduin, in Noordeloos, Persoonia 17(2): 256, 1999.

Russia: Adygeya, Maikop distr., vic. Novoprokhladnoe, upper reaches of the Sakhrai, high-grass subalpine meadow, on fallen leaves of grass, 8 Aug 2004 (LE 265103). Caucasian Reserve, NF, NE branch of the Tybga mountain (alt. ca 2230 m) near Turoviy reserve station, subalpine middle-grass meadow, on fallen stems and leaves of *Calamagrostis arundinacea*, 9 Aug 2005 (LE 265127). Caucasian Reserve, NF, the Port-Athur ridge, elfin woodland of birch, on fallen stems and leaves of *Calamagrostis arundinacea*, 20 Aug 2005 (LE 265105).

Note: Widespread species in subalpine belt.

Tricholomataceae

Calyptella capula (Holmsk. : Fr.) Quél., Fl. Mycol. France: 25, 1888.

Russia: Caucasian Reserve, SF, vic. Pslukh reserve station, floodlands of the Pslukh river, broad-leaved forest, on stem of *Petasites albus* Gaertner, 2 Sept 2006 (LE 265249).

Note: Probably widespread but overlooked species.

Clitocybe phaeophthalma (Pers.) Kuyper, Persoonia 11(3): 386, 1981.

Russia: Krasnodar terr., Adler distr., Sochinskiy National Park, fir-beech forest with undergrowth of Kolkhida floristic elements, on coniferous litter, 25 Aug 2006 (LE 265143).

Delicatula integrella (Pers. : Fr.) Pat., Essai Taxon.: 157, 1900.

Russia: Caucasian Reserve, SF, vic. Laura reserve station, broad-leaved forest, on rotten log of broad-leaved tree, 13 Aug 2006 (LE 265248).

Hemimycena crispata (Kühner) Singer, Ann. Mycol. 41(1/3): 121, 1943.

Russia: Adygeya, Maikop distr., vic. Novoprokhladnoe, upper reaches of the Sakhrai, high-grass subalpine meadow, on fallen leaves of grass, 8 Aug 2004 (LE 265189).

Hemimycena cucullata (Pers. : Fr.) Singer, Persoonia 2: 20, 1961.

Abkhazia: Black sea coast towards NW from Pitsunda city, a grove of *Pinus pityusa* and *Buxus colchica* on dunes along seashore, on litter under pines, 30 Sept 2007 (LE 265223).

Note: Probably widespread but overlooked species.

Melanoleuca subbrevipes Métrod, Rev. Mycol. 7(2–4): 90, 1942.

Russia: Adygeya, Maikop distr., Bol'shoy Tkhach Nature Park, NE slope of the Bol'shoy Tkhach mountain (alt. ca 2200 m), subalpine middle-grass meadow, on soil, 12 Aug 2004 (LE 265197).

Mycena capillaris (Schum. : Fr.) P. Kummer, Führ. Pilzk.: 108, 1871.

Russia: Adygeya, Maikop distr., Bol'shoy Tkhach Nature Park, SW slope of the Bol'shoy Tkhach mountain (alt. ca 2000 m), subalpine middle-grass meadow, on rotten stem of *Aconitum* sp., 13 Aug 2004 (LE 265058).

Boletales

Boletaceae

Boletus parasiticus Bull. : Fr., Syst. Mycol. 1: 389, 1821.

Syn. *Xerocomus parasiticus* (Bull. : Fr.) Quél., Fl. Mycol. France: 418, 1888.

Russia: Caucasian Reserve, SF, vic. Laura reserve station, broad-leaved forest, on fruit bodies of *Scleroderma* sp., 12 Aug 2006 (LE 265261).

Phylloporus pelletieri (Lév.) Quél., Fl. Mycol. France: 409, 1888.

Russia: Caucasian Reserve, SF, Laura reserve station, in garden, under hazel and pear tree, 12 Aug 2006 (LE 265259).

Gyroporaceae

Gyroporus ammophilus (M.L. Castro et L. Freire) M.L. Castro et L. Freire, Persoonia 16(1): 123, 1995.

Syn. *Gyroporus castaneus* var. *ammophilus* M.L. Castro et L. Freire, Ann. Jard. Bot. Madrid 45(2): 549, 1989.

Abkhazia: the Black sea coast towards NW from Pitsunda city, a grove of *Pinus pityusa* and *Buxus colchica* on dunes along seashore, under pines, 30 Sept 2007 (LE 265253).

Note: Rare species with Mediterranean distribution. The locality cited above corresponds probably with the north limit of this species' area. The description of studied specimens is following: Cap matt, tomentose, with cracked surface (flesh in cracks is whitish), pinkish-brown or pinkish-yellowish. Pileipellis of dried herbarium specimens distinctly turns reddish-brown with ammonium. Tubes short, with fine pinkish-cream or orange-cream pores, not blueing when crush or slightly browning. Stem tomentose, concolorous with the cap. Flesh firm, whitish, smell slightly sharp. Spores pale ochraceous in KOH 5 %, cylindrical or even slightly phaseoliform, $8.8\text{--}12.2 \times 4.2\text{--}5.7 \mu\text{m}$ ($Q = 1.9\text{--}2.3$, $Q_{av} = 2.2$).

Russulales

Russulaceae

Russula roseipes Secr. ex Bres., Fung. trident. 1: 37, 1881.

Russia: Caucasian Reserve, NF, vic. Guzeripl' reserve station, beech-fir forest, under old beech, 11 Sept 2003 (LE 265267).

Note: This species is known to form mycorrhiza with coniferous trees. Probably it has a mycorrhiza with fir although its fruit bodies were found under beech.

Conclusion

In the course of this investigation 30 new species have been recorded for the Western Caucasus. Although some of these species are not rare they all contribute to increasing our knowledge of the diversity of agaricoid basidiomycetes in the Western Caucasus and serve to bring the total number to 867 species.

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