Agrocybe praemagna: a new alpine species from Colorado, Idaho and Wyoming, Rocky Mountains, USA

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Abstract

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Agrocybe praemagna is described as a new species occurring in open alpine (occasionally also subalpine) habitats of the Rocky Mts., USA. Based upon relevant literature records a summary of *Agrocybe* species reported from alpine and arctic localities is presented.

Keywords: *Agrocybe praemagna* spec. nov., Basidiomycota, Agaricales, arctic-alpine habitat, Rocky Mts., USA.

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Introduction

In the last few years we observed close to or above timber line at several alpine localities of the Rocky Mts. (Colorado, Idaho, Wyoming) the rather large basidiomes of a conspicuous *Agrocybe* growing in open tundra-like vegetation. Apart from the robust basidiomes, this new species, *Agrocybe praemagna*, is characterized by the complete absence of veil remnants (cortina, ring) both on stipe and surface of the pileus, the comparatively large basidiospores, the unusual shape of the cheilocystidia, the presence of pileocystidia and the occurrence in inhospitable habitats in the upper subalpine and alpine zone of the Central Rocky Mts., USA.

Description of the new taxon

Agrocybe praemagna M.M. Moser & E. Horak, spec. nov. (Figs. 1-3)

Pileus 50-100 (-150) mm latus, convexus, pulvinatus vel obtuse umbonato-campanulatus, primo ad marginem estriatum incurvatus, albidulus, eburneus vel argillaceus, opacus, siccus, glaber minute furfuraceus, velum nullum. Lamellae 80-100, usque ad 15 lamellulae, densae, emarginatae, latae, pallidae dein pallide armeniaco-alutaceae vel griseo-brunneae. Stipes 50-10(-140) x 10-15(-25) mm, cylindricus, attenuatus apicem versus, albidulus vel pallide ochraceus, brunnescens ad basim, minute furfuraceus sed innate fibrillosus basim versus, saepe striato-sulcatus ad apicem, siccus, solitarius, solidus. Cortina et annulus desunt. Caro albidulus, immutabilis. Sapor odorque subfarinosi. Basidiosporae in cumulo fuscae, 13-18.5 x 7-9.5 µm, ellipsoideae, poro germinativo instructae, brunneae, leves. Basidia 36-40 x 10-11 µm, 4-spora, fibulata. Cheilocystidia 30-55 x 12-16 µm, obtuse fusoideo-ventricosa vel subutriformia, pigmento brunneo impleta, incrustatione subcrystallina vel amorpha ad apicem obtecta, hyalina, tenuitunicata. Pleurocystidia 38-42 x 12-16 µm, clavata vel vesiculoso-pedunculata, hyalina, tenuitunicata, levia. Pileipellis ex cellulis cylindrico-clavatis et fusoideis (pileocystidia) cel-

Fig. 1. *Agrocybe praemagna* (holotype).

lulodermium formantibus, 12-40 x 4-10 µm latis, hyalinis, haud gelatinosis, fibulatis. Ad terram nudam apricamque inter detritum plantarum, in pratis alpinis rare subalpinis. America borealis, Wyoming: Shoshone National Forest, E-side of Two Ocean Mountain, 7. Aug. 1997, leg. Moser 97-134 (Holotypus, IB).

Pileus 50-100 mm diam., occasionally reaching up to 150 mm, broadly convex to pulvinate or obtusely umbonate-campanulate, margin at first incurved becoming straight in age, with pale colors ranging from dingy whitish to ivory or alutaceous, sometimes with pale brownish spots and areas near the always non-striate margin, opaque when wet, dry, smooth at first, becoming minutely furfuraceous or suede-like with age, veil remnants at non-striate margin absent. – Lamellae up to 80-100 reaching stipe, up to 15 lamellulae, crowded, widely emarginate and decurrent with short tooth, up to 8(-10) mm wide, at first pallid, then pale apricot-alutaceous, finally turning (grey-)beige or grey-brown with age, even edges concolorous. – Stipe 50-100(-140) x 10-15(-25) mm, base slightly enlarged, dingy whitish to pale ochraceous, base becoming brownish with age, finely furfuraceous, apex often striate-furrowed, downwards innate-fibrillose, dry, solid, solitary. Sclerotium absent. – Veil remnants (cortina or annulus) absent, also in button-stage of young specimens). – Context whitish, in pileus up to 10 mm thick above lamellae. – Taste mild, slightly farinaceous. – Odor not distinctive or weakly farinaceous. – Chemical reactions on pileus: KOH negative.

Spore print dark brown, nearly blackish brown. – Basidiospores 13-18.5 x 7-9.5 µm, ellipsoid, with large eccentric apiculus, germ pore distinctive, 1-3 µm wide, brown walls thick (up to 1 µm diam.), smooth. – Basidia 36-40 x 10-11 µm, 4-spored, clavate. – Cheilocystidia 30-55 x 12-16 µm, variable in shape ranging from bottle-shaped to fusoid-subulate (and then often constricted towards apex) or nearly utriform, often with (yellow-)brown content and sometimes amorphous to subcrystalline incrustatation at apex, hyaline, thin-walled. – Pleurocystidia 38-42 x 12-16 µm, clavate to vesiculose-pedunculate, scattered, hyaline, thin-walled, smooth. – Pileipellis a celluloderm composed both of clavate cells intermixed with distinctly larger, fusoid, pileocystidia-like cells, 12-40 x 4-10 µm, hyaline, non-gelatinous walls thin, smooth, pigment

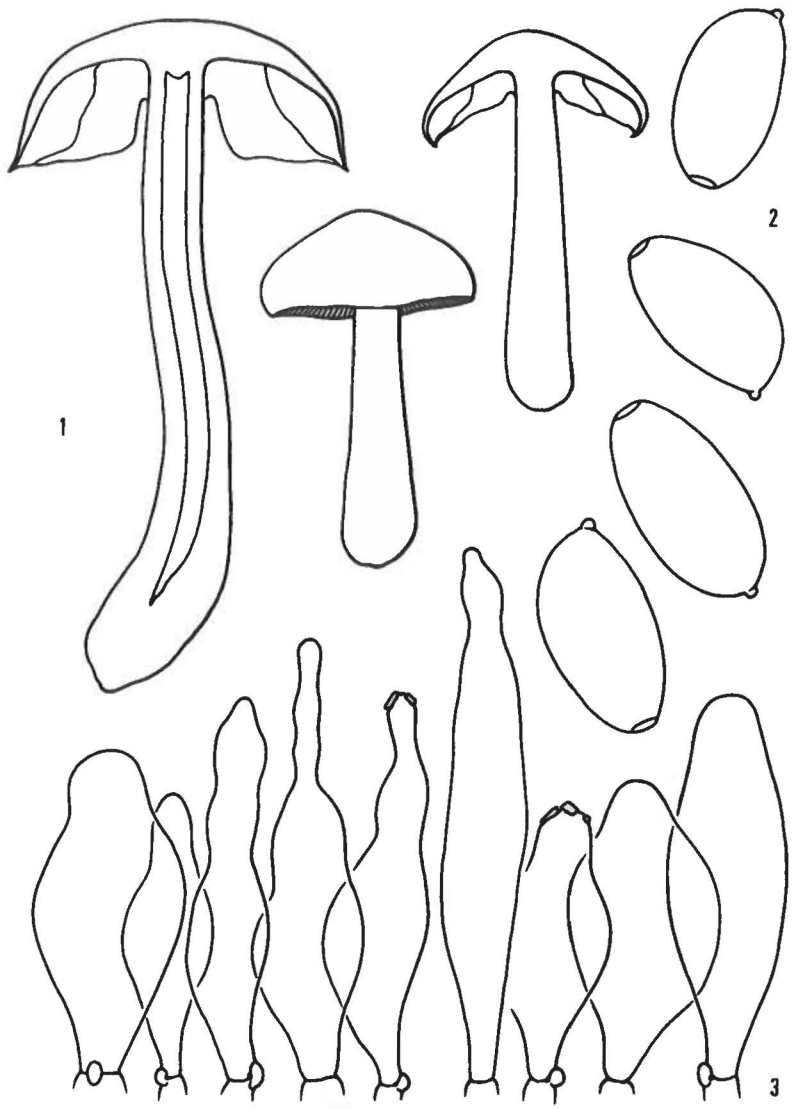

Fig. 2. *Agrocybe praemagna* (ZT 7487). 1. Basidiomes (nat. size). 2. Basidiospores (x 2000). 3. Cheilocystidia (x 1000). Bar = 20 mm (1), 10 µm (2), 20 µm (3).

absent. Hyphae of subcutis composed of irregularly entangled cylindrical hyphae, 6-10 µm diam. – Oleiferous hyphae present. – Clamp connections present.

Habitat: On soil in open habitats close to and above timberline, in mountain meadows and sagebrush heath, close to and above timber line. Not coprophilous.

Material examined: USA: Wyoming, Shoshone National Forest, E-side of Two Ocean Mtn., in alpine meadow, about 2950 m alt., 7. Aug. 1997, leg. Moser 97-134 (Holotype, IB).

Additional collections of *A. praemagna* from the Rocky Mts. (USA):

Wyoming: Teton National Forest, trail to Union Peak, among sagebrush, above 3000 m alt., 23. Aug. 1991, leg. Moser, 91-301 (IB). Colorado: Sanatch Range, Independence Pass, on S-exposed slopes N of Pass, 3700 m alt., on acid soil in alpine meadow, 13. Aug. 1999, leg. Horak 7487 (ZT). Idaho: Grand Teton Mts., Teton Co., N of Driggs, on loess-like soil near *Populus tremelloides*, about 2000 m alt., leg. Cripps (CLC 079) in Horak ZT 8810.

Discussion

Following the taxonomic concepts as proposed by Watling (1982), Singer (1986) and Horak (2005), *Agrocybe praemagna* belongs to sect. *Pediadeae* which encompasses species whose basidiomes are characterized by the lack of persisting veil remnants, presence of pleurocystidia and comparatively large basidio-

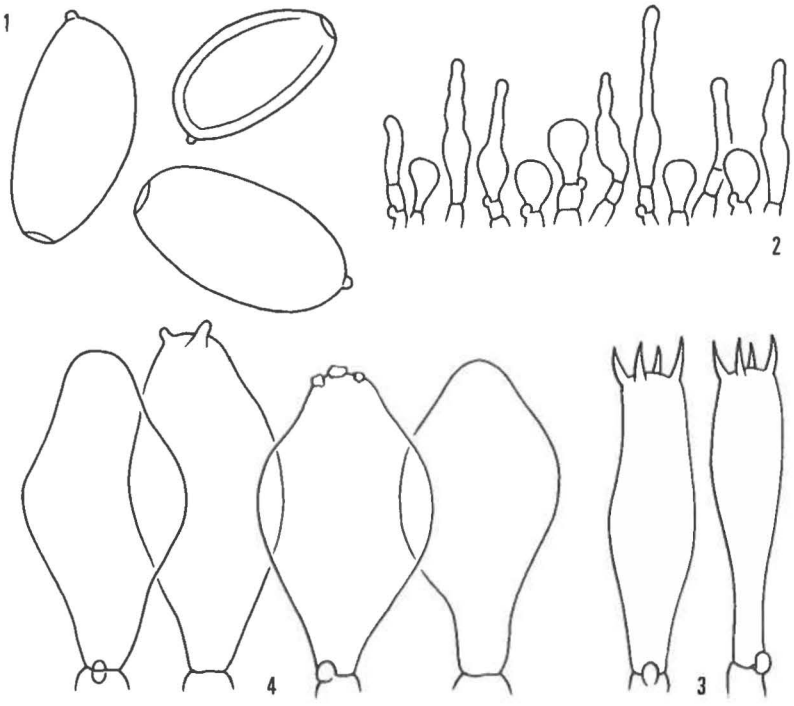

Fig. 3. *Agrocybe praemagna*. 1. Basidiospores (holotype, x 2000). 2. Pileipellis (x 500, vertical section, ZT 7487). 3. Basidia (x 1000, ZT 7487). 4. Pleurocystidia (x 1000, ZT 7487). Bar = 10 µm (1), 40 µm (2), 20 µm (3, 4).

spores exceeding 12.5 µm in length. The presence of distinctive fusoid and pileocystidia-like cells in the pileipellis indicate, however, that taxonomically *A. praemagna* is also leaning towards species accomodated in sect. *Microsporae*.

The present new species is distinctly characterized by the remarkably large basidiospores, the complete absence of veil remnants (even in button stage), the lack of a sclerotium at the base of the stipe and the typical habitat in open, wind-exposed and rather dry localities in the (subalpine to) alpine zone beyond timberline. The four recorded collections of *Agrocybe praemagna* were exclusively found on (often bare) soil among rotting plant debris of the surrounding vegetation. Thus it can be concluded that within the genus *Agrocybe* this species ecologically belongs to the group of the non-coprophilous representatives.

In several alpine localities of Wyoming, basidiomes of the present species have repeatedly been observed, but unfortunately no specimens were preserved. Accordingly, it is expected that this conspicuous agaric is widely distributed in the Rocky Mts.

One possible reason why *Agrocybe praemagna* was not discovered yet in North America (Murrill 1917, Flynn and Miller 1990) is the fact that the basidiomes of this species can readily be confused with those of the widely distributed *A. praecox* (Pers.: Fr.) Fayod or *A. dura* (Bolton: Fr.) Singer. As a matter of fact at Independence Pass (in about 3700 m) *A. praemagna* was observed together with *A. praecox* at the same locality (Table 1).

The large basidiospores of *Agrocybe praemagna* are a principal microscopic character to separate this species from related taxa whose basidiospores also exceed 10 µm in length. In the course of our studies we discovered also one population (IB 91-301) with basidiospores slightly smaller than measured in the type material viz. 12.5-16 x 7-8.5 µm. This data, however, still fall inside the range of spore size variation and accordingly this collection is considered a mere local ecotype of *A. praemagna*.

Further significant microscopic features of *A. praemagna* are the distinctive thin-walled cheilocystidia with (yellow-)brown plasmatic pigment and amorphous to subcrystalline incrustation at the apex, and the hymeniform pileipellis composed of both clavate and fusoid cells.

In the course of evaluating the taxonomic position of *Agrocybe praemagna* (Watling and Gregory 1981, Watling 1982), we found that Flynn and Miller (1990, and pers. comm.) refer to a species of *Agrocybe* (*A. montana*, nom. prov.), originally collected in sub-

Table 1. List of *Agrocybe* species reported from arctic-alpine, tundra or paramo habitats (including additional unpublished records from the Rocky Mountains).

A. arenaria	Russia: Pamir, 2800 m alt. (Kalamees 1989)
A. erebia	Russia: Siberia: tundra, sea level (Lebedeva 1927)
A. muscigena	France: Savoyan Alps, 2320 m alt. (Remy 1964)
A. paludosa	Russia: Taimyr: tundra, sea level (Tomilin 1971, Vasilkov 1971); Khibini Mts. (Mikhailovsky 1975) Scotland (Watling 1987) Switzerland: Grisons, 2400 m alt. (Senn-Irlet 1992)
A. pediades	Greenland: tundra, sea level (Rostrup 1891) Switzerland: Wallis (Boudier and Fischer 1895)
A. praecox	Canada: Axel Heiberg Is., tundra, sea level (Parmalee 1963) Faeroer: pastures (Møller 1945) Russia: Taimyr, tundra, sea level (Stepanova and Tomilin 1973); Khibini Mts. (Mikhailovsky 1975) Svalbard: tundra, sea level (Ohenoja 1971, Gulden 1996)
New, unpublished records: USA:	Colorado: Independence Pass N: tundra with dwarf and shrubby willows, 3700 m alt., 11 Aug. 1999, Horak 8119 (ZT). – Same locality: tundra with dwarf and shrubby willows, 3700 m alt., 13 Aug. 1999, Cripps 1366 (MONT). USA: Montana: Beartooth Mts., Plateau N, tundra with dwarf and shrubby willows, 3280 m alt., 22 Jul. 1999, Cripps 1289 (MONT).
A. praecox var. *cutifracta*	Venezuela: Andes, Páramo, 3560 m alt. (Dennis 1960)
A. semiorbicularis	Greenland: Kingitok, tundra, 550 m (Rostrup 1891) Jan Mayen: tundra, sea level (Hagen 1950)
A. semiorbicularis var. *caerulescens*	Faeroer: pastures, sea level (Møller 1945)
A. sphaleromorpha	Russia: Caucasus, 2750 m alt. (Onipchenko and Kaverina 1989)

alpine habitats in Canada (Alberta) and the USA (Montana, Oregon, California), which also has relatively large basidiomes. However, by comparison this yet undescribed *Agrocybe* is characterized by distinctly smaller basidiospores measuring only 8-12 x 5.6-6(-8) µm. In addition, this taxon differs from *A. praemagna* by the color of the basidiomes, distinctive veil remnants and its occurrence in subalpine conifer forests. In order to ascertain that these two sympatric taxa are actually not conspecific, related at subspecific level (ecotype) or intergrading, somatic compatibility tests in the laboratory of Prof. O.K. Miller (Blacksburg, USA) have been carried out. As expected from morphotaxonomic evidence, it eventually turned out that the mycelia are incompatible and accordingly two distinctive species are involved.

World-wide, references of *Agrocybe* occurring in arctic-alpine, subantarctic (Horak 1982), tundra or páramo habitats are relatively scarce and often concern only fimicolous or paludicolous species which, however, are characterized by a rather wide ecological range. The ten taxa of *Agrocybe* found in the pertinent literature are enumerated in Table 1.

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References

Boudier, E. and Fischer, E. 1895. Rapport sur les espèces de champignons trouvées pendant l'assemblée à Genève et les excursions faites en Valais par les Sociétés de Botanique de France et de Suisse du 5 au 15 août 1894. – *Bulletin de la Societe Botanique de France* 41: 237-249.

Dennis, R. W. G. 1960. Fungi Venezuelani. IV. – *Kew Bulletin* 15: 67-156.

Flynn, T. and Miller, O. K. 1990. Biosystematics of *Agrocybe molesta* and sibling species allied to *Agrocybe praecox* in North America and Europe. – *Mycological Research* 94: 1103-1110.

Gulden, G. 1996. *Contributions to an agaric flora of Svalbard*. – Int. Report, Bot. Museum Oslo, 1-200.

Hagen, A. 1950. Notes on Arctic fungi. 1. Fungi from Jan Mayen. – Norsk Polarinstitutts Skrifter, Oslo, 93: 1-11.

Horak, E. 1982. Agaricales in Antarctica and Subantarctica: distribution, ecology and taxonomy. – In: G.A. Laursen and J.F. Ammirati (eds) *Arctic and Alpine Mycology* 1: 82-122.

Horak, E. 2005. *Röhrlinge und Blätterpilze in Europa*. – Elsevier GmbH, München: 555 pp.

Kalamees, K. 1989. On the Agaricales flora of the Zaamin National Park. 2. *Folia Cryptogamica Estonica* 27: 1-24.

Lebedeva, L. 1927. Champignons de la côte arctique de la Sibérie. – Travaux Comm. Etude Rep. Aut. Sov. Soc. Iakoute 12: 1-23.

Mikhailovski, L. V. 1975. Macromycetes of heathery tundra in the valley of the lakes Great and Small Vuyavrs in the Khibini Mts. – *Mikologija i Fitopatologija* 9: 293-298.

Møller, F. H. 1945. *Fungi of the Faeröes. 1. Basidiomycetes*. – Copenhagen: 295 pp.

Murrill, W. A. 1917. *Naucoria*. – *North American Flora* 10: 170-186.

Nezdoiminogo, E. L. 1994. Dark-spored agarics in Russian Arctic. – *Mikologija i Fitopatologija* 28: 8-15.

Ohenoja, E. 1971. *The larger fungi of Svalbard and their ecology*. – Report Kevo Subarctic Research Station 8: 122-147.

Onipchenko, F. V. G. and Kaverina, E. N. 1989. Makromyceten der Hochgebirgsregionen des Naturschutzparkes von Teberda (NW-Kaukasus). *Wasserpflanzen, Flechten, Pilze und Moose in Naturschutzparken der RSFSR, ZNIL*, 28-34.

Parmelee, J. A. 1963. Mycological studies. – In: Axel Heiberg Island research report, preliminary report 1961-1962, McGill University, Montreal: 173-181.

Remy, L. 1964. Contribution à l'étude de la flore mycologique briançonnaise. – *Bulletin de la Societe Mycologique de France* 80: 459-585.

Rostrup, E. 1891. Tillaeg til Grønlands svampe (1888). – *Meddelelser om Grønland* 3: 591-643.

Senn-Irlet, B. 1992. Botanischer Reichtum am Weg von Davos über die Bergüner Furgga zum Albula. 6. Makromyzeten (Basidiomycota, Agaricales, Aphyllophorales). – *Botanica Helvetica* 102: 49-59.

Singer, R. 1986. *The Agaricales in modern taxonomy*. – Koeltz Scientific Books, Koenigstein: 981 pp.

Stepanova I. V. and Tomilin, B. A. 1973. Fungi occurring in common plant communities of Taimyr tundra. – *Mykologija i Fitopatologija* 7 (1): 12-17.

Tomilin, B. A. 1971. Some data on the geographical distribution and ecology of the fungi in the region of the Taimyr Station. – In: Biogeocenoses of Taimyr Tundra and their productivity, Academiae Scientiarum USSR: 130-137.

Vasilkov, B. P. 1971. Macromycetes in the region of the Taimyr Station. – In: Wielgolaski, F.E. and Th. Throsswall (eds): Proc. IV. Internat. Meet. on the biological productivity of Tundra (Biocenoses of Taimyr Tundra and their productivity), Acad. Sci. USSR, Leningrad: 145-150.

Watling, R. 1982. *Agrocybe, Bolbitius* and *Conocybe*. – British Fungus Flora 3: 1-139. Royal Botanic Garden Edinburgh.

Watling, R. 1987. Larger arctic-alpine fungi in Scotland. – In: G. A. Laursen, J. F. Ammirati and S. A. Redhead (eds), *Arctic and Alpine Mycology* 2: 17-45.

Watling, R. and Gregory, N. M. 1981: Census catalogue of world members of the Bolbitiaceae. *Bibliotheca Mycologica* 82: 224 p.